BCA (DES)305- 3rd YEAR

ILLUSION-02

Block 1

BCA(DES)-305
ILLUSION-02

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ROLE OF SELF INSTRUCTIONAL MATERIAL INDISTANCELEARNING

The need to plan effective instruction is imperative for a

Successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual

Involvement and contain all the necessary learning instructional activities ties that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect,

Students 'assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make

use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge isbuilt.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices pros vided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive

Communication clues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to r e d u c e

This. Divide and to bring this Self Instructional Material as the b e s t

teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts.

Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline.

These could be in the form of students 'assignments, a research project

or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you

Expect.

All the best for your studies from our team!

All the best for your studies from our team!

Unit 1 Skeletons and Rigging

	Time Required to Complete the unit

The time required to study thus Unit is broken as follows

. 1st Reading: It will need 2 Hrs for reading a unit

. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit

. Self Assessment: It will need 3 Hrs for reading and understanding a unit

. Revision and Further Reading: It is continuous process

1.1 Introduction

Skeletons
Skeletons are hierarchical, articulated structures that let you pose and animate bound models. A skeleton provides a deformable model with the same underlying structure as the human skeleton gives the human body. Just like in the human body, the location of joints and the number of joints you add to a skeleton determine how the skeleton's bound model or 'body' moves.

Skeleton components

A skeleton is composed of a series of joints and bones that form joint chains.

1.1.1 Joints and bones

Joints are the building blocks of skeletons and their points of articulation. Joints have no shape and therefore can not be rendered. Each joint can have one or more bone attached to it, and more than one child joint. Joints let you transform a skeleton when posing and animating a bound model. In simple words it represents the rotational pivot points.
Bones do not have nodes, and they do not have a physical or calculable presence in your scene. Bones are only visual cues that illustrate the relationships between joints. In simple words it represents how joints are connected.

1.1.2 Anatomical joint types

Various joint attributes determine how joints behave. By adjusting the attributes of a joint, you can limit how far a joint can rotate or restrict what planes it can rotate about.
1. **Ball joint**: A ball joint is a joint that can rotate about all three of its local axes. For example, the human shoulder is a ball joint.
2. **Universal joint**: A universal joint is a joint that can rotate about only two of its local axes. The human wrist is an example of a universal joint.
3. **Hinge joint**: A hinge joint is a joint that can rotate about only one of its local axes. For example, the human knee is a hinge joint.

Joint chains
A joint chain is any group of joints and their bones connected in a series. Joints are connected linearly, and their paths are drawn on screen by the bones. A joint chain begins at the highest joint in the chain's hierarchy, and its bones are drawn pointing down the chain.

1.1.3 Skeleton hierarchy

A skeleton hierarchy is composed of a series of joints and joints chains with hierarchical relationships. Each joint in a skeleton hierarchy is a child joint and a parent joint. The root joint is the highest joint in a skeleton's hierarchy. A skeleton can have only one root joint. You can move and orient the entire skeleton in world space by translating and rotating the root joint.

1.1.4 Skeleton >

Joint Tool
Join tool creates joints and joint chains. The options in the option box are:

Joint Settings:
1. **Degrees of Freedom**: This option specifies which of the joint's local axes; the joint can rotate about during inverse kinematics posing.
2. **Orientation**: This setting sets the orientation of the local axes for all the joints you create with the Joint Tool. All the selections specify that the joint's local axis be oriented so that the first axis points into the joint's bone, the second axis points at right angles to the first and third axes, and the third axis points sideways from the joint and its bone.
3. **Second Axis World Orientation**: This setting sets the world axis orientation for the second rotation axes of all the joints you create with the Joint Tool.
4. **Scale Compensate**: When this option is on, the joints you create are not scaled automatically when you scale joints above them in the skeleton's hierarchy.
5. **Auto Joint Limits**: When this option is on, Maya automatically limits the extent a joint can rotate about its axes according to the angles at which you build the skeleton's joints.
6. **Create IK Handle**: When this option is on, an IK handle is automatically created for any joint chain you draw and the IK Handle Options section of the Joint Tool settings is available. The IK handle that is automatically created will run from the joint chain's start joint to its end joint.
7. **IK Handle Options**: This option specifies the creation options for the IK handle that is automatically created when Create Ik Handle is on.
8. **Bone Radius Settings**: When you create joints, the radii of your joints are determined by the length of their bones.
a. **Short Bone Length**: This setting sets the bone length at which a bone is classified as short.
b. **Short Bone Radius**: This setting sets the bone radius of short bones.
c. **Long Bone Length**: This setting sets the bone length at which a bone is classified as long.
d. **Long Bone Radius**: This setting sets the bone radius of long bones.

Insert Joint Tool
Insert Joint Tool lets you add an additional joint to an existing joint chain.

Reroot Skeleton
Reroot Skeleton designates the current joint as the parent or root of its hierarchy.

Remove Joint
Remove Joint option deletes the current joint and unites the remaining joints and bones into a single joint chain.

Disconnect Joint
Disconnect Joint option breaks the skeleton at the current joint, separating the

skeleton into two joint chains

Connect Joint
Connect Joint option connects the selected joints. The options available are:
1. **Connect Joint**: This option connects the selected joints and moves the joint chain of the first joint to the position of the second joint.

2. **Parent Joint**: This option connects the selected joints by inserting a new bone between them.

Mirror Joint
This option duplicates the current parent's joint chain across the specified plane, as well as changes the orientation of the resulting duplicate joints. The available options are:
1. **Mirror Across**: This option mirrors the joint across the plane you specify.
2. **Mirror Function**: There are two options:
a. **Behavior**: When this option is on, the mirrored joints have the opposite orientation as the original, and the local rotation axis of each joint points in the opposite direction of their counterparts.
b. **Orientation**: When this option is on, the mirrored joints have the same orientation as the original joints. With this setting, you can copy animation from one limb to another and get identical behavior.
c. **Replacement names for duplicated joints**: This option lets you specify the name identifier of the joints in the mirrored joint chain and lets you specify the names with which to replace the mirrored joint.

Orient Joint
This option sets the orientation of the selected joint. The options available are:
1. **Orientation**: This option specifies the orientation of a joint's local axis.
2. **Second Axis World Orientation**: This setting sets the world axis orientation for the second rotation axes of all the joints you create with the Joint Tool.
3. **Hierarchy (Orient child joints)**: When this option is on, the settings for Orient Joint will affect all the joints below the current joint in the skeleton's hierarchy.
4. **Scale (Reorient the local scale axes)**: When this option is on, the local scale axes of the current joint are also reoriented.

Set Preferred Angle
Set Preferred Angle lets you specify whether to set the preferred angle for the current joint or for all the joints from the current joint to its chain's end joint. The options available are:
1. **Selected Joint**: This option sets the current angle of the selected joint as its preferred angle.
2. **Recursive**: This option sets the current angles of all the joints from the selected joint to the joint at the end of the chain as their preferred angles.

Assume Preferred Angle
This option returns the current skeleton's joints to the angles they possessed when their preferred angles were initially set. Lets you specify whether to reset the current joint's angle to its preferred angle or to reset all the joints from the current joint to its chain's end joint to their preferred angles. The available options are:
1. **Selected Joint**: This option resets the current angle of the selected joint to its preferred angle.

Recursive: This option resets the current angles of all the joints from the selected joint to the joint at the end of the chain to their preferred angles.

1.2 IK Handles And Solvers

1.2.1 Kinematics
Kinematics is the branch of classical mechanics concerned with describing the motions of objects without considering the factors that cause or affect the motion.

1.2.2 Forward kinematics (FK)
With forward kinematics (FK), you rotate or move individual joints to pose and animate your joint chains. Moving a joint affect's that joint and any joints below it in the hierarchy. Forward kinematics is ideal for creating non-directed motion such as the rotations of a shoulder joint, and should not be used to animate a large, complicated skeleton. Also, forward kinematics is difficult to use for specifying goal-directed motion.

1.2.3 Inverse kinematics (IK)
With inverse kinematics (IK), you move an IK handle to pose an entire joint chain. An IK handle is an object you can select and move that affects the joints it is assigned to. A joint chain that has an IK handle is called an IK chain. When you pose and animate a joint chain with an IK handle, the IK solver automatically rotates all the joints in the IK chain. The IK solver is what Maya uses to calculate the rotations of all the joints in the IK chain when you position the IK handle. Inverse kinematics is more intuitive for goal-directed motion than forward kinematics because you can focus on the goal you want a joint chain to reach without worrying about how each joint in the chain should rotate.

Full body IK (FBIK)
You can quickly and easily create natural looking poses and animation for your biped and quadruped characters with the new full body IK.

IK handles
In an IK chain, the joint where the IK handle begins is called the start joint and the joint where the IK handle ends is called the end joint. The end of the IK handle, which is located at the last joint of the IK chain by default, is called the end effecter. When you move the IK handle, the IK solver uses the end effecter's

position and orientation in its calculations to rotate the joints in the IK chain accordingly.

IK/FK blending
You can pose and animate the joints of a joint chain using both FK and IK. This is called animation blending. Ik Blend lets you switch between posing and animating with pure FK or pure IK, as well as control the blend between the two kinds of animation.

1.2.4 IK Solvers

IK solvers are the mathematical algorithms behind the IK handles. IK solvers calculate the rotations of all the joints in a joint chain controlled by an IK handle. The effect an IK handle has on a joint chain depends on the type of IK solver used by the IK handle. IK solvers available in Maya are:
1. Single Chain IK solver (ikSCsolver)
2. Rotate Plane IK solver (ikRPsolver)
3. Spline IK solver (ikSplineSolver)
4. Human IK solver (hikSolver)
5. 2 Bone IK solver (ik2Bsolver)
6. Multi-Chain IK solver (ikMCsolver)
7. Spring IK solver (ikSpringSolver)

1.2.5 Pole vector

The pole vector is a manipulator that lets you change the orientation of the IK chain. The pole vector also lets you control flipping.

IK Handle Tool
IK Handle Tool is used to create IK handles for the joint chains. The options available in the option box are:
1. **Current Solver**: This drop-down menu specifies the type of IK solver IK handle will have.
2. **Autopriority**: When this option is on, software sets the IK handle's Priority automatically upon creation.
3. **Solver Enable**: When this option is on, the IK solver will be active upon creation.
4. **Snap Enable**: When this option is on, IK handle will snap back to the IK handle's end joint's position.
5. **Sticky**: When this option is on, the IK handle will stick to its current position and orientation when you pose the skeleton using other IK handles or when translating, rotating, or scaling individual joints.

Enable IK Handle Snap
This option causes the IK handle to snap back to its end joint's position.

Enable IK/FK Control
When Enable IK/FK Control is on, you can rotate the joints in an IK chain whether or not the IK handle has keys.

Enable Selected IK Handles

This option turns the editability of the selected IK handles on, and sets their Ik Blend values to 1.000.

Disable Selected IK Handles
This option turns the editability of the selected Ik handles off, and sets their IK Blend values to 0.000.

1.2.6 Constraints >

Pole vector constraint: pole vector constraint is a constraint that causes the end of a pole vector to move to and follow the position of an object, or the average position of several objects.

To create Pole Vector Constraint :
Select Constrain > Pole Vector
First set creation options and create a pole vector constraint, or you can immediately create a constraint with the current creation options also.

To delete Pole Vector Constraint:
Delete the pole vector constraint node.

To set pole vector constraint options:
Select Constrain > Pole Vector >
The Pole Vector Constraint Options window is displayed.
So, now you can set the options.

To edit pole vector constraint attributes:
Select the pole vector constraint node.
Open the Attribute Editor by selecting Window > Attribute Editor

1.2.7 Spline IK: This is used to control a chain of linked objects or bones of a character as a connected chain like the bones of a tail or spine, so the bones will be able to move like the same when we move them.
In Maya a NURBS curve is used to control an IK Spline handle, so when the NUBRS curve is moved or animated the bones will be having the same animation.
You can convert any NURBS CV in to Spline IK joint chain by using Edit Curves > Curve Editing Tool

1.2.8 Skeleton >

IK Spline Handle Tool
IK Spline Handle Tool is used to create Ik spline handle for the joint chains. The options available in the option box are:
1. **Root on Curve**: When this option is on, the start joint of the IK spline handle is constrained the curve. You can drag an offset manipulator to

slide the start joint along the curve.
2. **Auto Create Root Axis**: When this option is on, a parent transform node above the start joint in the scene hierarchy is created with the spline IK handle.
3. **Auto Parent Curve**: If you create a handle that starts at a joint in the chain lower than the root joint of your skeleton, turn this option on to ensure that the joint chain moves with the transformations of its parent joint.
4. **Snap Curve to Root**: When this option is on, the start of the curve snaps to the position of the start joint. The joints in the chain rotate to adapt to the shape of the curve.
5. **Auto Create Curve**: When this option is on, Maya creates a NURBS curve when you create the spline IK handle. The curve that is created follows the path of the joint chain.
6. **Auto Simplify Curve**: When this option is on, Maya automatically creates a NURBS curve with the specified Number of Spans. The number of spans corresponds to the number of CVs in the curve.
7. **Number of Spans**: Number of Spans specifies the number of CVs for the curve that Maya automatically creates when you create the spline IK handle.
8. **Root Twist Mode**: When this option is on, manipulating the twist manipulator at the end joint will twist the start joint slightly with the other joints.

1.3 Assignment

1. Build Skeleton and FK Walk Cycle

2. IK Walk Cycle

UNIT 2 Facial Expressions

Time Required to Complete the unit

The time required to study thus Unit is broken as follows

. 1st Reading: It will need 2 Hrs for reading a unit

. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit

. Self Assessment: It will need 3 Hrs for reading and understanding a unit

. Assignment: It will need 4 Hrs for completing an assignment

. Revision and Further Reading: It is continuous process

2.1 Blend Shapes

2.1.1 Create Blend Shape

Blend shape deformers let you to deform a surface into the shapes of other surfaces. You can blend shapes with the same or a number of vertices (or CVs). Objects whose shapes you want to use to deform the shape of another object are called target objects, and the object being deformed is called the base object.
The options available in the option box are:
1. **BlendShape Node**: This option specifies the name of the blend shape deformer.
2. **Envelope**: This option specifies the deformation scale factor.
3. **Origin**: This option specifies whether the blend shape will be relative to the base object shape's position, rotation, and scale or to the world.
4. **Target Shape Options**:
a. **In-Between**: This option specifies whether the blending will be in series or in parallel. Shape transitions will occur in the order in which you selected the target shape(s). The effect will be that the blend shape will be able to change from the first target object shape, to the second, and so on, back and forth through the series of target object shapes chained together as "in-between" shapes.
b. **Check Topology**: This option specifies whether to check if the base shape and the target shape(s) have the same topology.
c. **Delete Targets**: This option specifies whether to delete the target shape(s) after creation.

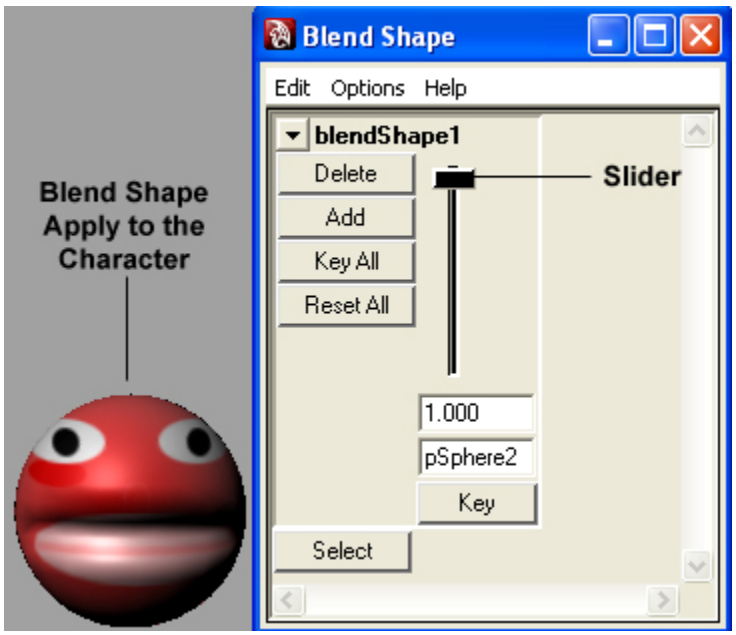
2.1.2 Edit Blend Shape

1. **Add**: This option adds the selected object to the blend deformer.
2. **Remove**: This option removes the selected object from the blend deformer.
3. **Swap**: Swap option interchanges the blend targets; this is useful in case if you blend with in-between option.
4. **Bake Topology to targets**: With Bake Topology to targets, you can regenerate or update your blend shape deformations so that any topological changes made to your blend shape base shapes are also applied to their target shapes.

Blend Shape Editor

Blend shape editor provides you with the options to control the blend deformer. In this editor you will be provided with the target weight sliders, target names and buttons to key the blend deformer.
The options available are:

1. **Target weight sliders**: Each slider provides a way for you to set the target weight quickly. You can change the orientation of the sliders from the options menu.
2. **Target weight boxes**: Each box displays the current weight for each target.
3. **Target names**: By default, the target name is the name of a target object. Entering a new target name does not change the name of the target object.
4. **New button**: Click **New** to create a new blend shape deformer.
5. **Add button**: It bakes the selected base shape and add it as a target.
6. **Key All button**: Key all weights at their current values.
7. **Reset All button**: Set all weight values to zero.
8. **Select button**: Select the blend shape deformer node.
9. **Key buttons**: Key the current value.



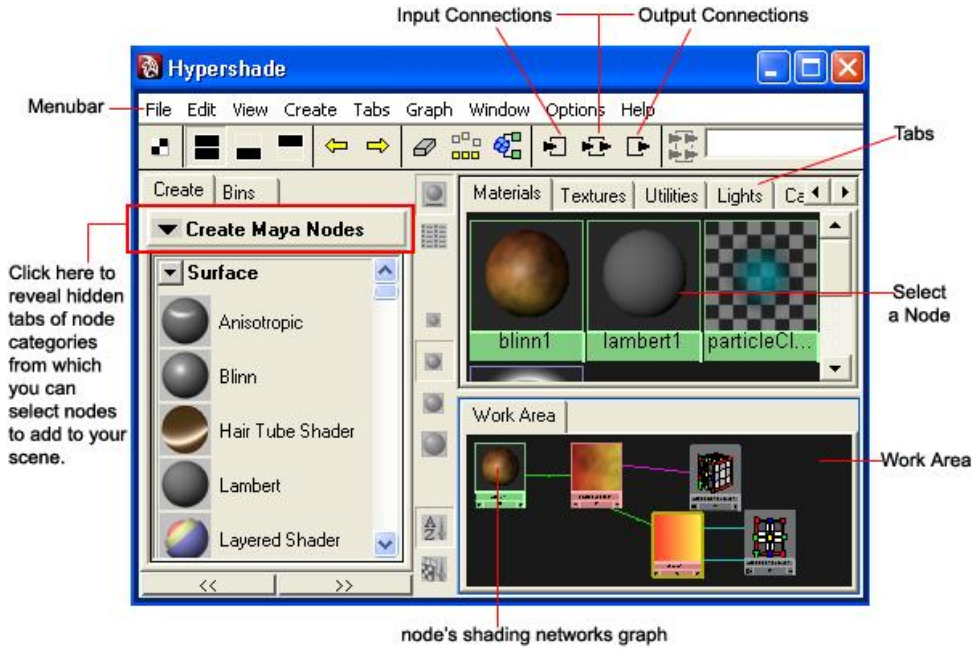
1.2 Texturing

1.3 Shaders, Materials and Mapping

2.3.1 Hypershade

Hypershade is a window in which you can create, edit and connect the rendering nodes such as materials, shaders, rendering utilities, lights, etc. Hypershade is the best way to map relationships and edit shading networks. In a way, you are a programmer because you are connecting coded elements to produce an algorithm to describe a material to render. The result is a Shader that has certain visual properties that are then applied to a surface. Hypershade simply graphs the elements that comprise your Shader.

2.3.2 Interface

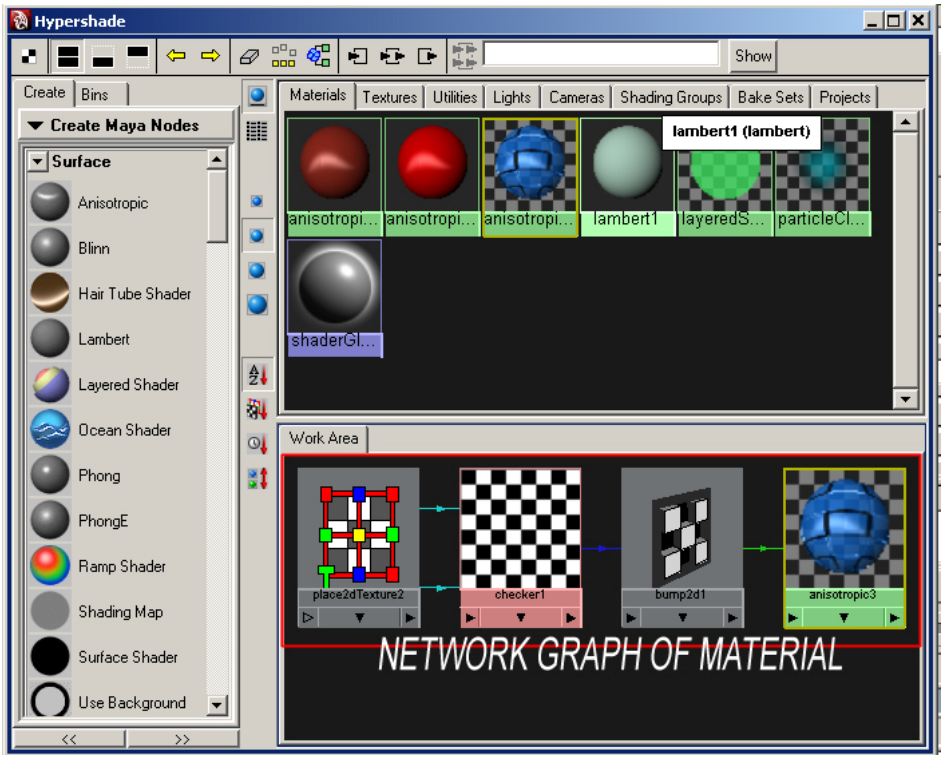


When you open Hypershade, you are presented with three areas. The first is Create Nodes, on the left. The second is the top tabs, where materials, textures, and other related materials are located. The bottom tab contains a work area as well as tabs such as the Shader Library; this is where most of the mapping of relationships occurs.
Hypershade window has its own menu bar.
1. File menu contains command for importing and exporting the materials.
2. Edit menu contains command for deleting, selecting, converting and rendering texture range.
3. Create menu contains command for creating render nodes.
4. Tabs menu contains commands for creating, renaming and deleting tabs.

Texture Libraries
You can also create texture libraries for reusable textures. This is done by following these steps:
1. Create a Library project by going to File > Project > New. Set the Use Defaults button on.
2. Make a tab in your Hyhpershade window by selecting Tabs, Create New.
3. Type Library in the New Tab Name text box.
4. Set the Initial Placement to Bottom, and set Tab Type to Disk.
5. Click the Root Directory folder icon to browse to the Library project.
6. Click creates to see the new tab in the lower Hypershade panel.

2.3.3 Understanding the Network Graph of Material

In the Hypershade pellette right click on any of the assigned material and select Network graph. Down there you can get the Network graph of the material.



2.3.4 Raytracing

Raytracing is a rendering technique used to create photorealistic reflections and refractions on reflective surfaces, and to produce shadows. Raytracing is a highquality alternative to reflection mapping, although it requires more computation time. Raytracing accurately renders the properties like:

1. Direct Illumination
2. Shadows
3. Specular Reflections
4. Transparency Effects

The raytracing algorithm calculates the color for each pixel by emitting rays from the camera into the scene. When a ray hits an object, its color is evaluated and then a secondary ray is projected (bounced) if the object is reflective or refractive. Maya calculates raytracing only when it is turned on in the raytracing quality section in render options.

2.3.5 Hypershade Nodes

Nodes in the Hypershade window are divided into following categories:

1. **Material Nodes**: The Material node is further categorized into following:
a. **Surface Material Nodes**
b. **Displacement Nodes**
c. **Volumetric Nodes**
2. **Texture Nodes**: The texture node is further categorized into following:
a. **2D Texture Nodes**
b. **3D Texture Nodes**
c. **Environment Nodes**
d. **Other Textures Nodes**

3. **Image Planes Nodes:**
4. **Render Utilities Nodes:** The Render Utilities node is further categorized into following:
a. **General Utilities Nodes**
b. **Color Utilities Nodes**
c. **Switch Utilities Nodes**
d. **Particle Utilities Nodes**
5. **Lights Nodes**
6. **Glow Nodes**

Common Surface Attributes
The following attributes are common to most surface materials.
1. **Color**: The default material color.
2. **Transparency**: A material's color and level of transparency. For example, if the Transparency Value is 0 (black), the surface is totally opaque; if the Transparency value is 1 (white), the surface is totally transparent.
3. **Ambient Color**: If the Ambient Color becomes lighter, it affects the material's Color by lightening it and blending the two colors. If there are ambient lights in the scene, the color and brightness of those lights is used to control how much the ambient color contributes to the final color of the material.
4. **Incandescence**: The color and brightness of light that a material appears to be emitting.
5. **Bump Mapping**: Makes the surface appear rough or bumpy by altering surface normals (during rendering) according to the intensity of the pixels in the bump map texture. A bump map does not actually alter the surface. A silhouette of the surface appears smooth.
6. **Diffuse:** Gives the material the ability to reflect light in all directions. The Diffuse value acts like a scaling factor applied to the Color setting—the higher the Diffuse value, the closer the actual surface color is to the Color setting.
7. **Translucence**: Gives the material the ability to transmit and diffuse light. Light falling on a translucent surface is first absorbed beneath the surface, and then diffused in all directions.
8. **Translucence Focus**: The Translucence Focus value controls how much translucent light is scattered depending on the direction of the light.
9. **Specular Color**: The color of shiny highlights on the surface. A black Specular Color produces no surface highlights.
10. **Reflectivity**: Gives the surface the ability to reflect its surroundings or the Reflected Color
11. **Reflected Color**: Represents the color of light reflected from the material.
12. **Special Effects**: These attributes control the appearance of glows produced from light reflecting off surfaces, or from surface incandescence. Special Effects attributes are available for Anisotropic, Blinn, Lambert, Phong, and PhongE material types.
13. **Matte Opacity**: **Y**ou can control the mask value for individual objects. Matt Opacity attributes are available for Anisotropic, Blinn, Lambert, Layered Shader, Phong, PhongE, Shading Map and Use Background material types.
14. **Raytrace Options**: The Raytrace Options attributes control the

appearance of a surface during raytracing only. Raytrace Options attributes are available for Anisotropic, Blinn, Lambert, Phong, and PhongE material types.

2.3.6 IPR Renders

IPR stands for Interactive Photo Realistic rendering. It's a tool designed to allow you to make interactive adjustments to the final rendered image, and which greatly enhances rendering productivity. IPR lets you preview and adjust lights, shaders, textures, and 2D motion blur quickly and efficiently. IPR is ideal for visualizing your scene as you work because it almost immediately shows the changes you make. IPR doesn't support all software renderable features like raytracing.

To render a single frame choose Render **>** Render Current Frame.

2.3.7 Material

Material is an picture of the objects look like when it is rendered. It is also known as shader.

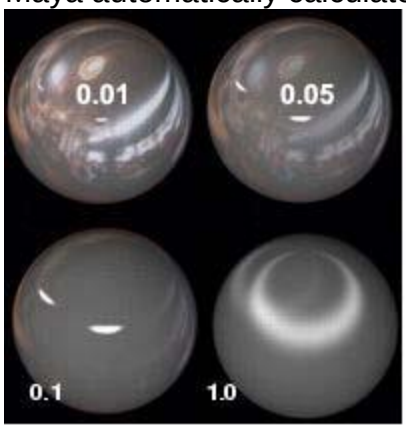
Anisotropic

An anisotropic material reflects specular light differently in different directions. If you spin an anisotropic sphere, its specular highlight changes, depending on the direction of the grooves. The options specific to this shaders are:

1. **Angle**: Angle determines the orientation of the grooves.
2. **Spread X/Spread Y**: Spread determines how much the grooves spread

out in the X and Y directions. The X direction is the U direction rotated counter-clock-wise by the specified Angle degrees. The Y direction is perpendicular to the X direction in UV space.

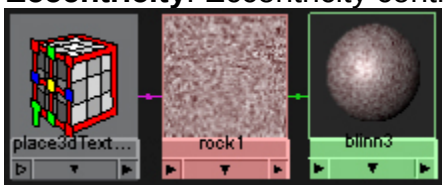
3. **Roughness**: Roughness determines the overall roughness of the surface.
4. **Fresnel Index**: A fresnel is a flat lens consisting of a number of concentric rings that reduces spherical abnormalities. The Fresnel Index value computes the fresnel factor that connects the reflected light wave to the incoming light wave.
5. **Anisotropic Reflectivity**: If Anisotropic Reflectivity is on, Maya automatically calculates Reflectivity as a fraction of Roughness.



Blinn

An isotropic material (such as Phong or Blinn) reflects specular light identically in all directions. If you spin an isotropic sphere, its specular highlight remains still. Blinn is a material that is particularly effective at simulating metallic surfaces (for example, brass or aluminium) which typically have soft specular highlights. The options specific to this shaders are:

1. **Eccentricity**: Eccentricity controls the size



of shiny highlights on the surface.

2. **Specular Roll Off**: Specular Roll Off gives the surface the ability to reflect its surroundings (the environment, other surfaces) or the Reflected Color, when viewed at oblique angles.

Lambert

Lambert is a material that represents matte surfaces (unpolished surfaces) with no specular highlights. The default shading group uses a special Lambert surface material. Do not modify it; instead, create and apply a new Lambert material. There are no specific options for Lambert.

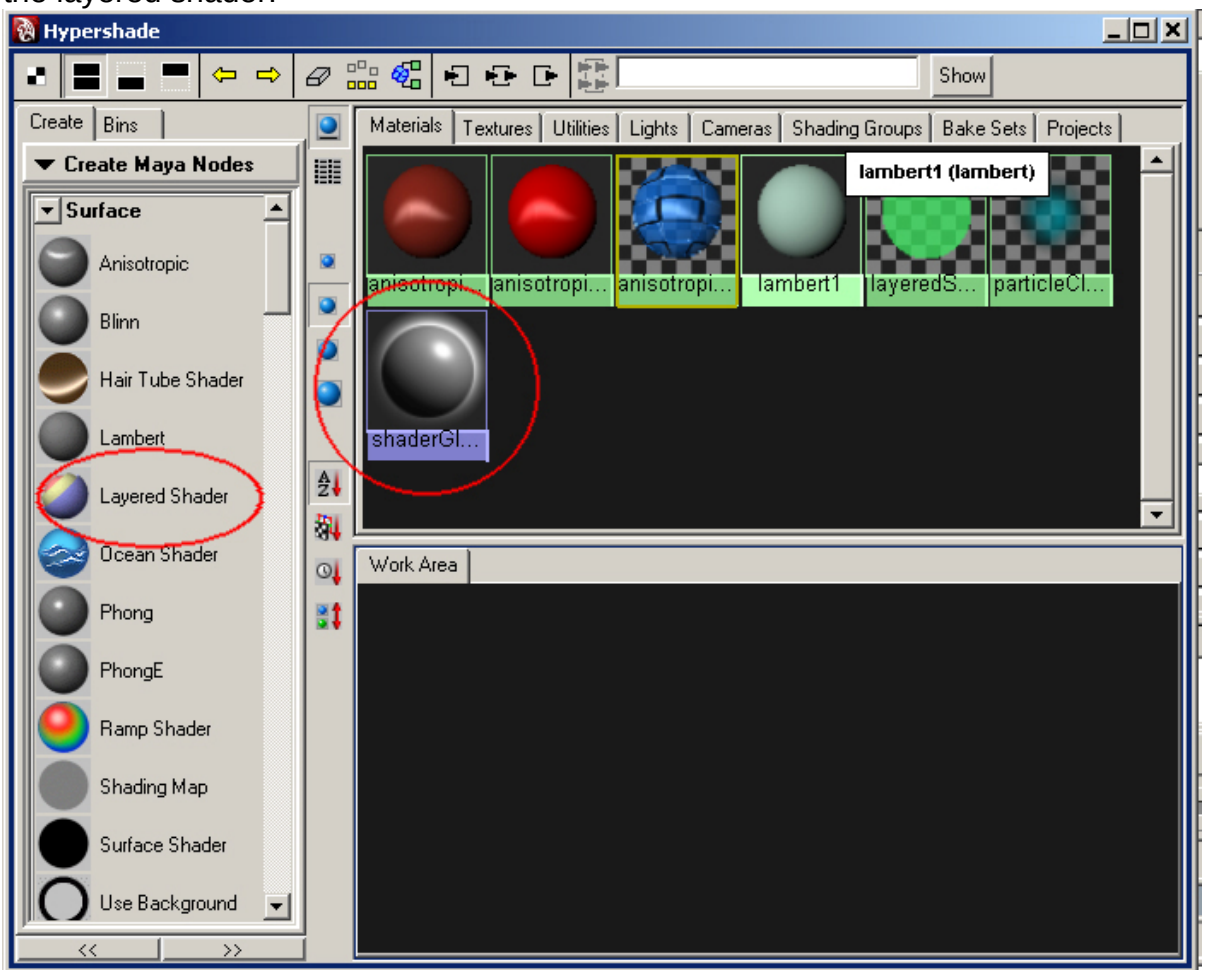
Layered shaders

You can layer shaders when you want to use more than one material for an object. Layered shaders let you create the appearance of variations in the material qualities of the surface by combining two or more material nodes that each has their own qualities. The options specific to this shaders are:

1. **Transparency**: Transparency sets the material's transparency. By default the material is semi-transparent.
2. **Compositing Flag**: This option is used to composites the layers in either Layered Shader node or Layered Texture node. Each mode calculates the transparency flag differently.

a. **Layered Shader**: The color and transparency are processed and passed together to the Layered Shader.

b. **Layered Texture**: Color and transparency are passed separately to the layered shader.



Phong

Phong is a material that represents glassy or glossy surfaces with a hard specular highlight. The options specific to this shaders are:

1. **Cosine Power**: Cosine power controls the size of shiny highlights on the surface.

Phong E

PhongE is a material that is a simpler version of the Phong material. The specular highlights on Phong E surfaces are softer than those on Phong surfaces, and Phong E surfaces render faster. The options specific to this shaders are:

1. **Roughness**: Roughness controls the specularity focus.
2. **Highlight Size**: Highlight Size controls the amount of specular highlight.
3. **Whiteness**: Whiteness controls the specular highlight color. The default is white, but you can choose any color. You can also map a texture to this value.

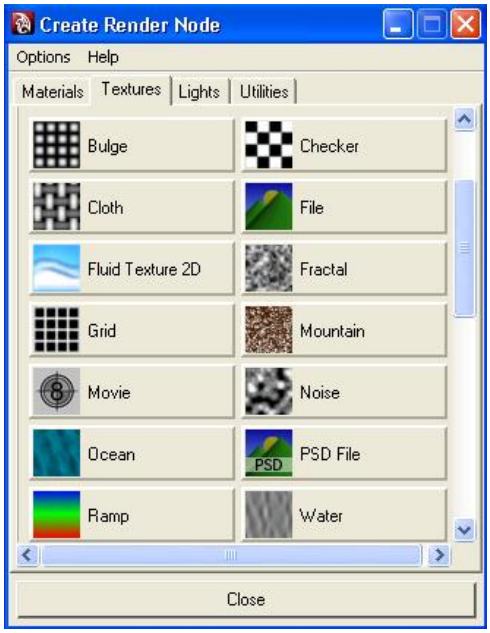
Ramp Shader

The Ramp Shader is a material that you can use for extra control over the way color changes with light and the view angle. You can simulate a variety of exotic materials and tweak traditional shading in subtle ways.

All the color-related attributes in the Ramp Shader are controlled by ramps (gradients). Graphs let you avoid complex shading networks by making certain looks, like toon shading, easier to achieve.

You can set the many attributes of the Ramp Shader to control the appearance of objects. Each color entry in a ramp has a circular color handle above the ramp, and a square color icon below the ramp. The active color has a white border around its color handle and icon.

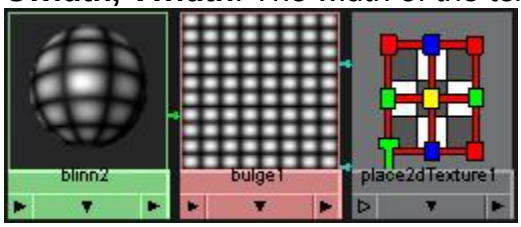
Textures 2D



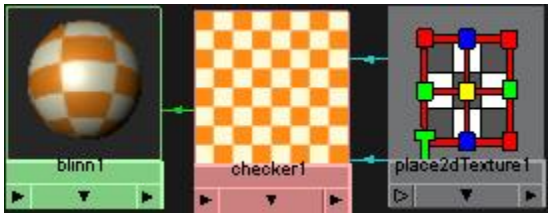
Bulge

Bulge procedurally creates a grid of white squares that fade to gray toward the edges. Use as a bump or displacement map to create surface bulges, as a transparency map or specular map to simulate real-world objects, such as windows that are dirty around the edges, or as
a color map to simulate tiles. The options are:

Uwidth, Vwidth: The width of the texture squares in U and V directions.



Checker



Checker procedurally creates a checkerboard pattern. The options available are:

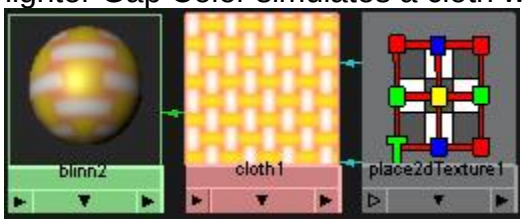
1. **Color 1 & 2**: The two colors for the
patterns.
2. **Contrast**: The color contrast
between the two colors.

Cloth

Cloth simulates fabric or other woven materials. The options available are:

1. **Gap Color**: The color of the area between the warp (U direction) and weft (V direction) threads. The colors blend into the Gap Color at their edges. A

lighter Gap Color simulates a cloth with softer, more translucent threads.

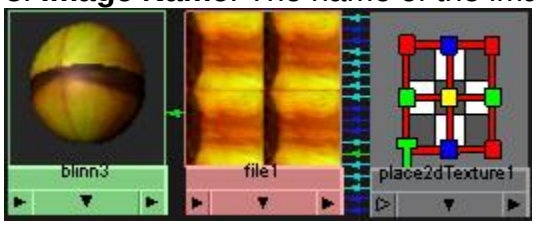


2. **U Color, V Color**: U and V thread colors.
3. **U Width, V Width**: U and V thread widths.
4. **U Wave, V Wave**: The waviness of U and V threads. Use to create special wave effects.

5. **Randomness**: Smears the texture randomly in U and V directions. Adjust the Randomness value to create natural-looking cloth with irregular threads, or to prevent aliasing and moiré patterns on very fine cloth textures.
6. **Width Spread**: Width spread randomizes the width of each thread along its length by subtracting a random amount from the U Width and V Width values.
7. **Bright Spread**: Bright Spread randomizes the brightness of each thread along its length by subtracting a random amount from U Color and V Color.

File

File lets you use an image file as a 2D texture. The options available are:
1. **Filter Type**: The sampling technique applied to the image file during rendering. The Quadratic, Quartic, and Gaussian filters only work when the File texture is mapped directly to a shading group.
2. **Pre-Filter**: The Pre-Filter and Pre-Filter Radius attributes are used to correct file textures that are aliased or contain noise in unwanted areas. This can be very useful in displacement mapping.
3. **Image Name**: The name of the image file or movie file used by the File texture.



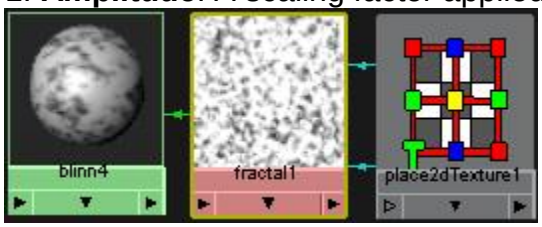
4. **Reload**: Use this to force a refresh of the texture.
5. **Edit**: Launches an external application from Maya so that you can edit your textures.
6. **View**: Launches an external application from Maya so that you can view your textures.
7. **Use BOT**: Use block ordered textures.
8. **Disable File Load**: If set, then the texture is not loaded. Instead a grey color is output in place of the image.
9. **Use Image Sequence/Image Number/Frame Offset**: To use a sequence of image files as an animated texture when rendering, turn on Use Image Sequence.

Fractal

Fractal represents a random function with a particular frequency distribution. You

can use the Fractal texture as a bump or displacement map to simulate rock or mountains, or as a transparency map to
simulate clouds or flames. The available
options are:

1. **Amplitude**: A scaling factor applied to all values in the texture.

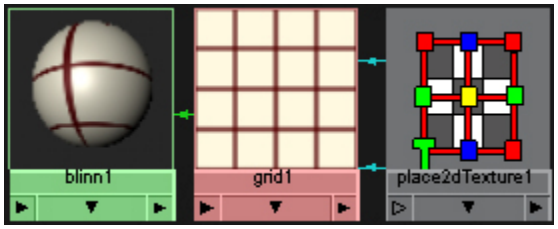


2. **Threshold**: An offset factor applied to all values in the texture.
3. **Ratio**: Ratio controls the frequency of the fractal pattern.
4. **Frequency Ratio**: This option determines the relative spacial scale of the noise frequencies. If this ratio is not a whole integer then the fractal does not repeat at the integer uv boundaries. A cylinder with default placement would then display a seam.
5. **Level Min, Level Max**: The minimum and maximum number of iterations used to calculate the fractal pattern. These values control the granularity of the fractal pattern.
6. **Inflection**: This applies a kink in the noise function. This is useful for creating puffy or bumpy effects.
7. **Animated**: Animate the fractal pattern by setting Animated on and keyframing the Time value. The Fractal texture takes longer to calculate when Animated is on.
8. **Time**: Change the Time value to adjust an animated fractal pattern.
9. **Time Ratio**: This option determines the relative time scale of the noise frequencies.

Grid

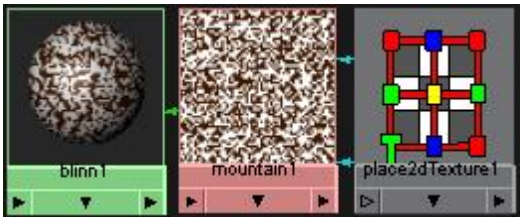
Grid represents a scalar grid pattern. The options available are:

1. **Line Color**: Color of the grid lines.
2. **Filler Color**: Color of the spaces between the grid lines.
3. **U Width, V Width**: Width of the grid lines in U and V directions.
4. **Contrast**: Contrast between the Line Color and the Filler Color.



Mountain

Mountain simulates rocky terrain using a 2D fractal pattern. The options available are:

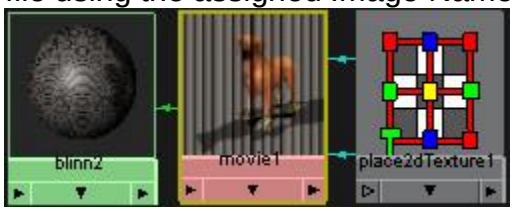


]

1. **Snow Color, Rock Color**: Color of the snow and rock.
2. **Amplitude**: Scaling factor applied
to all values in the texture.
3. **Snow Roughness**: Roughness of the snow.
4. **Rock Roughness**: Roughness of the rock.
5. **Boundary**: Raggedness of the rock/snow boundary.
6. **Snow Altitude**: The level (altitude) of the transition between rock and snow.
7. **Snow Dropoff**: The suddenness with which snow no longer sticks to the mountain.
8. **Snow Slope**: The maximum angle (expressed as a decimal value) over which snow does not stick to the mountain.
9. **Depth Max**: The maximum number of iterations used to calculate the fractal pattern, which controls the granularity of the fractal pattern.

Movie

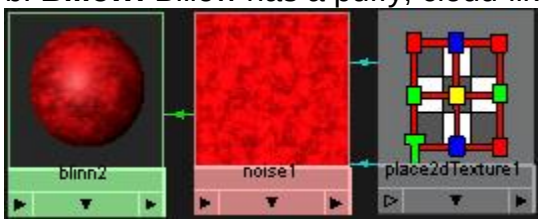
The Movie texture shares the same attributes as the File texture. The difference is that the Movie texture assumes all frames are stored in a single concatenated file using the assigned Image Name instead of separate files.



Noise

Noise can be used to create many different types of effects. The options available are:
Threshold: The number added to the whole fractal effect, making it uniformly brighter. If the Volume Noise is used as a bump map, it appears as plateau regions. The options available are:
1. **Amplitude**: Scaling factor applied to all the values in the texture, centered on the texture's average value. When you increase Amplitude, the light areas get lighter and the dark areas get darker. If Noise is used as a bump map, increasing Amplitude results in higher bumps and deeper valleys.
2. **Ratio**: Ratio controls the fractal noise frequency. Increase this value to increase the fineness of the fractal detail.
3. **Frequency Ratio**: This option determines the relative scale of the noise frequencies.
4. **Depth Max**: This option controls how much calculation is done by the Noise texture. Use Depth Max to control the maximum amount of calculation for the texture.
5. **Inflection**: Inflection applies a kink in the noise function. It is useful for creating puffy or bumpy effects.
6. **Time**: Time is used to animate the Noise texture. You can keyframe the Time attribute to control the rate and amount of change of the texture.
7. **Frequency**: Frequency determines the fundamental frequency for the noise. As this value increases the noise becomes more detailed. It has the inverse effect of the scale parameter.

8. **Implode**: This warps the noise function in a concentric fashion about a point defined by the Implode Center.
9. **Implode Center**: This option defines the center UV point about which the implode effect is defined.
10. **Noise Type**: This option determines which noise to use during the fractal iteration.
a. **Perlin Noise**: The standard 3D noise used in the solidFractal texture.
b. **Billow:** Billow has a puffy, cloud-like effect.



c. **Wave**: A sum of 3D waves in space.
d. **Wispy**: A Perlin noise that is uses a second noise as a smear map; this makes the noise stretch out in places, looking wispy.
e. **SpaceTime**: A 4-dimensional version of the Perlin noise, where time is the 4th dimension.
11. **Density**: Density controls how many cells are imbedded in the medium used by the Billow noise type.
12. **Spottyness**: Spottyness controls the density randomization of individual cells used by the Billow noise type.
13. **Size Rand**: This option controls the randomization of the size of the individual blobs used by the Billow noise type.
14. **Randomness**: Randomness controls how the cells for the Billow noise type are arranged relative to one another.
15. **Falloff**: Falloff controls the way intensity falls off for individual blobs for the Billow noise type.
a. **Linear**: A uniform falloff from the center to a value of zero at the edges of the blobs.
b. **Smooth**: More natural looking, using a gaussian falloff.
c. **Fast**: Fast focuses the intensity more towards the center of the blobs.
d. **Bubble**: Uses a reverse falloff, fading to zero at the blob center.
16. **Num Waves**: This option determines how many waves to generate for the Wave noise type.

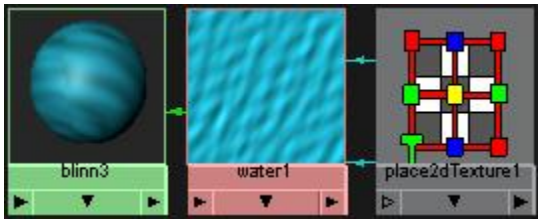
Ramp

Ramp creates a gradation through a series of colors. The options available are:
Type: The direction of the color ramp.
1. **Interpolation**: Interpolation controls the way colors blend in the ramp.

2. **Ramp**: Each color component in the ramp has a circular color handle on the left side, and a square color icon on the right side.

3. **Selected Color**: The active color component. The active color has a white border around its color handle and icon.
4. **Selected Position**: Position of the active color component in the ramp.
5. **U Wave, V Wave**: These options control the amplitude of a sine wave offset of the texture in the U and V directions. Increasing the U Wave or V Wave increases the display of the texture's waviness.
6. **Noise**: Offset amount in the U and V directions by 2D noise.
7. **Noise Freq**: This option controls the noise granularity.
8. **HSV Color Noise**: This option randomizes a Ramp texture's color using three separate 2D noises which affect the color's Hue, Saturation, and Value.
9. **Hue Noise:** Offsets the color hue. Use to mark the color with specks of different colors.
10. **Sat Noise**: Offsets the color saturation. Use to create a weathered look.
11. **Val Noise**: Offsets the color value.
12. **Hue Noise Freq, Sat Noise Freq, Val Noise Freq**: These options control the granularity for hue, saturation, and value noise.

Water



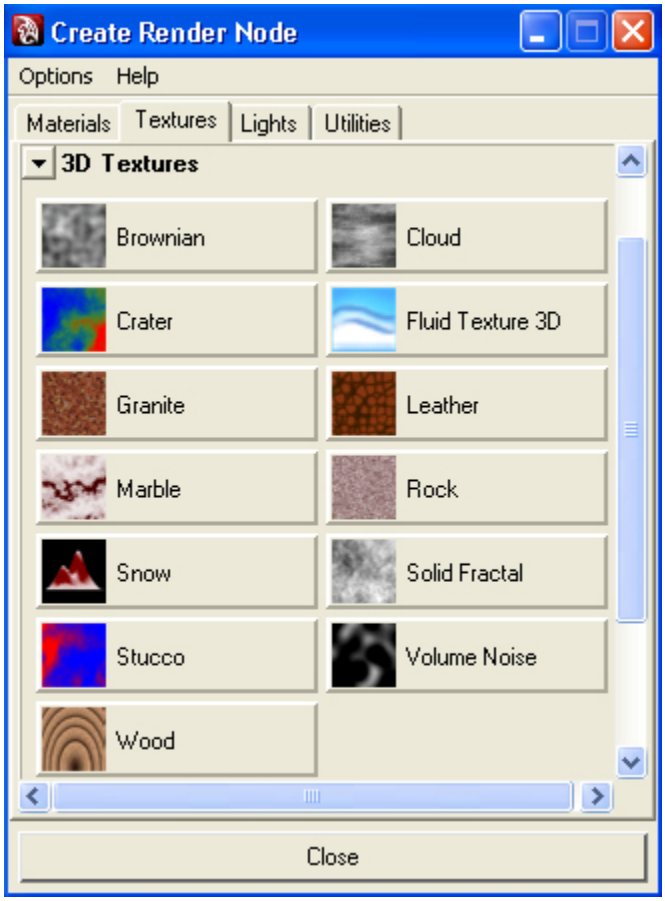
Water simulates linear water waves, concentric water ripples, or a combination of waves and ripples. Use as a bump or displacement map to simulate water, or as a color map to simulate light reflections or refractions from a water surface. The options available are:
1. **Number Of Waves**: The number of linear waves in the texture.
2. **Wave Time**: This option controls the appearance of the waves over time. To simulate moving waves, animate the Wave Time value.
3. **Wave Velocity**: This option controls the wave speed.
4. **Wave Amplitude**: Wave Velocity scales the wave height.
5. **Fast**: An optimization for the Water texture.
6. **Wave Frequency**: This option controls the distance between primary waves.
7. **Sub Wave Frequency**: This option controls the distance between secondary waves that ride on top of primary waves.
8. **Smoothness**: Smoothness controls the intensity of secondary waves.
9. **Wind UV**: The strength of wind in the U and V directions.

Concentric Ripple Attributes: These options control the appearance of concentric water ripples. The Concentric Ripple attributes do not affect the linear wave component of the texture.
1. **Ripple Time**: Ripple time controls the appearance of ripples over time.
2. **Ripple Frequency**: Ripple Frequency controls the distance between individual ripples.
3. **Ripple Amplitude**: This Scales the height of the ripples.
4. **Drop Size**: The mass of the droplet that starts the water ripples.
5. **Ripple Origin**: The location of the center of the ripples along U and V

directions.
6. **Group Velocity**: The speed of the primary ripple.
7. **Phase Velocity**: The speed of sub-ripples.
8. **Spread Start**: Degree of effect a droplet has on a still water surface at time 0. A concentric ripple starts as a point of disturbance in space when the Ripple Time value is 0. The size of the disturbance at time 0 is determined by the Spread Start value.
9. **Spread Rate**: Rate at which the primary ripple breaks into sub-ripples.
10. **Reflection Box**: This option activates an imaginary reflective bounding box ripples can reflect off.
11. **Box Min, Box Max**: These options define the bounding box in the U and V directions. If Reflection Box is off, these attributes have no effect.

3D Textures

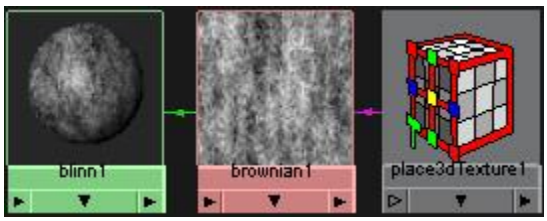
3D textures allow objects to appear as if carved out of materials such as marble, rock, or wood.



Brownian

Brownian resembles thickly painted metal. The options available are

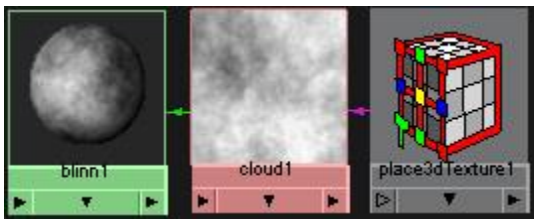
1. **Lacunarity**: Lacunarity defines the gap between the frequencies you add to form the texture.



2. **Increment**: Increment determines the ratio for the fractal noise.
3. **Octaves**: Octaves sets the upper limit for noise frequencies.
4. **Weight3d**: This option determines how wavy the image appears when projected by controlling the scale of the frequency of any fractal used in the procedure.

Cloud

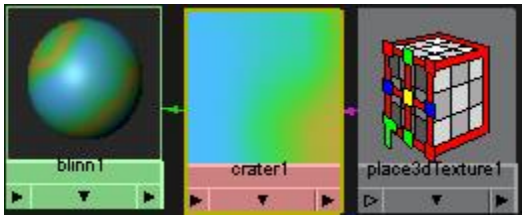
Cloud simulates the clouds. You should use cloud texture only on spheres. The area surrounding the cloud is always transparent. You can combine two or more spheres to create complex cloud arrangements. The options available are:



1. **Color1, Color2**: The two colors blended together to form the cloud.
2. **Contrast**: The contrast between Color1 and Color2.
3. **Amplitude**: Amplitude controls the strength of the fractal noise used to generate the Cloud texture.
4. **Depth**: Depth controls the granularity of the texture.
5. **Ripples**: Ripples determines the texture's waviness in the X, Y, and Z directions.
6. **Soft Edges**: This option simulates natural looking clouds. Gradually increases the transparency of the texture as the surface it is mapped to turns away from the camera.
7. **Edge Thresh, Center Thresh**: If Center Thresh is low and Edge Thresh is high, the texture resembles a dense cotton-ball. If Center Thresh is high and Edge Thresh is low, the texture resembles a wispy cloud.
8. **Transp Range**: The range over which the texture becomes transparent. The value controls the sharpness/softness of the cloud's edges.
9. **Ratio**: Ratio controls the frequency of the fractal noise used to generate the Cloud texture.

Crater

Crater creates the appearance of both plateaus and craters by mixing normal disturbance and 3D disturbance, such as color or transparency. The options available are:

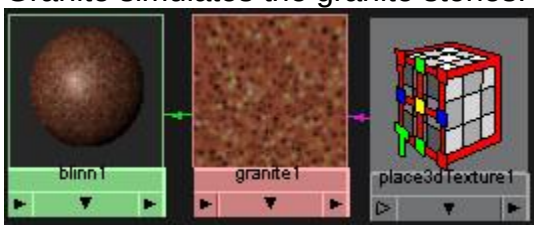


1. **Shaker**: Increase this value to add more detail to the default Shaker texture.
2. **Channel1, Channel2, Channel3**: The three channels through which

information such as color values passes.
3. **Melt**: Melt controls the edge softness between the colors in the texture. Increase this value to display the borders between the colors smoother and wider.
4. **Balance**: Balance controls the ratio of the three shaken colors.
5. **Frequency**: This option controls the frequency of how many times the texture colors are shaken.
6. **Norm Depth**: This option controls the depth of the craters when the texture is used as a bump map. Increasing Norm Depth deepens the craters.
7. **Norm Melt**: This option controls the softness of the crater edges when this texture is used as a bump map. You can animate this to make the cratered surface look like it is melting.
8. **Norm Balance**: This option controls the ratio between the low and high normal's disturbance when this texture is used as a bump map.
9. **Norm Frequency**: Norm Frequency controls the amount of rough detail when this texture is used as a bump map.

Granite

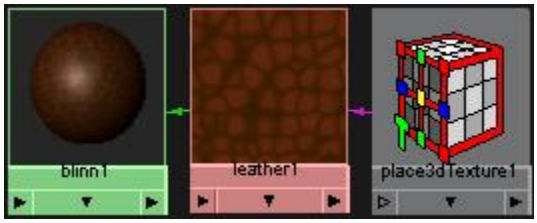
Granite simulates the granite stones. The options available are:



1. **Color1, Color2, Color3, Filler Color**: The color of the three different types of cells and the color surrounding the cells.
2. **Cell Size**: Cell size represents the individual cell size. This value scales the entire texture.
3. **Density**: Density controls the cell spacing.
4. **Mix Ratio**: This option determines which color is dominant.
5. **Spottyness**: Spottyness randomizes the cell color intensity.
6. **Randomness**: This option randomizes the cell position.
7. **Threshold**: Threshold controls how cell colors and filler color mix into each other.
8. **Creases**: Creases creates boundaries between cells.

Leather

Leather simulates materials such as snake or alligator skin, Styrofoam, or concrete. Major options of leather are similar to the granite except that there is one cell color instead of three:



1. **Cell Color, Crease Color**: The

color of individual cells and the
color surrounding the cells.

Marble
Marble simulates marble stone. The options available are:
1. **Filler Color, Vein Color**: The color of the filler material and the vein material.
2. **Vein Width**: The thickness or width of the veins.

3. **Diffusion**: Diffusion controls the amount of Vein Color that blends into the Filler Color.

4. **Contrast**: The contrast between the Vein Color and Filler Color.

5. **Amplitude**: A scaling fact applied to all values in the fractal noise about the average value.

6. **Ratio**: Ratio controls the fractal
noise frequency.
7. **Ripples**: Ripples determines the texture's waviness in the X, Y, and Z directions.
8. **Depth**: The minimum and maximum number of iterations used to calculate the texture pattern. Depth controls the texture's granularity.

Rock
Rock simulates rock using a random 3D distribution of two different grain material types. The options available are:
1. **Color1, Color2**: The color of the two grains in the texture.
2. **Grain Size**: Grain size specifies the grain size and scales the entire texture.
3. **Diffusion**: Diffusion controls the amount Color1 blends into Color2.
4. **Mix Ratio**: Mix ratio determines the dominant color.

Snow
Snow simulates snow on a surface. The available options are:
1. **Snow Color**: The color of the snow on the top of the surface.
2. **Surface Color**: The color of the surface on which the snow lies.
3. **Threshold**: Threshold determines the maximum slope that holds snow.
4. **Depth Decay**: The rate at which the snow color blends into the surface color.
5. **Thickness**: The apparent depth of the snow. Thickness controls the opacity of the snow.

Solid Fractal
Solid Fractal represents a 3D random function with a particular frequency distribution. The available options are:
1. **Threshold**: This is an offset factor applied to all values in the texture.

2. **Amplitude**: Amplitude is the scaling factor applied to all values in the texture.
3. **Ratio**: Ratio controls the frequency of the fractal noise.
4. **Frequency Ratio**: This option determines the relative spacial scale of noise frequencies. If not a whole number, the fractal does not repeat at the UV boundaries.
5. **Ripples**: Ripples determines the texture's waviness in the X, Y, and Z directions.
6. **Depth**: The minimum and maximum number of iterations used to calculate the texture pattern. This parameter controls how fine grained the texture is.
7. **Bias**: Values greater than zero result in a more contrasting fractal while values less than zero make it more flat and spiky.
8. **Inflection**: This applies a kink in the noise function. This can be useful when creating puffy or bumpy effects.
9. **Animated**: Turn on to animate the texture and access the Time and Time Ratio attributes.
10. **Time**: Time determines the relative time scale of noise frequencies.
11. **Time Ratio**: Default is equal to the Frequency Ratio setting, which means higher frequency noises move faster in direct proportion to the frequency.

Stucco

Stucco randomly disturbs the material by mixing two input attributes, Channel1 and Channel2, to create an effect resembling stains or clouds. Stucco includes Normal Options attributes you can use to control the effect. The options available are:

1. **Shaker**: Increase this value to add more detail to the default Shaker attribute setting. If used as a bump map, increase the value to increase the number of craters and valleys.
2. **Channel1, Channel2**: The two channels through which information such as color values passes. You can also supply information to the channels using a three-channel (RGB) mapping.
3. **Normal Depth**: This option controls the depth of the craters when the texture is used as a bump map. Increasing Normal Depth deepens the craters.
4. **Normal Melt**: This option controls the softness of the crater edges when this texture is used as a bump map. Increasing Normal Melt softens the edges. Animate this texture to simulate a melting cratered surface.

Wood

Wood simulates wood by projecting a 2D pattern. This pattern consists of concentric ring layers defined by veins and filler. When you map the Wood texture to a surface, the surface seems to be carved out of wood. When you map it to several surfaces, they seem to be carved from a single block of wood. The options available are:

1. **Filler Color**: The color of the space between veins. The vein color diffuses into the filler color.
2. **Vein Color**: The vein color of the wood. The vein color diffuses into the filler color.
3. **Vein Spread**: The amount of vein color that diffuses into the filler color.
4. **Layer Size**: The average thickness of each layer or ring.
5. **Randomness**: Randomizes the thickness of individual layers or rings.

6. **Age**: The age of the wood (in years). This value determines the total number of layers or rings in the texture, and influences the relative thickness of central and outer layers.
7. **Grain Color**: The color of the random grain in the wood.
8. **Grain Contrast**: Grain contrast controls the amount of Grain Color that diffuses into the surrounding wood color.
9. **Grain Spacing**: The average distance between grain spots.
10. **Center**: The location of the center of the texture's concentric rings in the U and V directions.
11. **Amplitude X, Amplitude Y**: An average scaling factor applied to all values in the fractal noise in the texture's X and Y directions.
12. **Ratio**: Ratio controls the fractal noise frequency.
13. **Ripples**: Ripples determines the texture's waviness in the X, Y, and Z directions.
14. **Depth**: The minimum and maximum number of iterations used to calculate the texture pattern. This parameter controls how fine grained the texture is.

Environment Textures

Maya provides environment textures for use as backgrounds for your scene.

Common Environment texture attributes

Color Remap

Color Remap applies a color map to the texture. It is the only common Effects Environment texture attribute. The U value of the Color Remap texture is mapped to the original texture's hue, and the V value is mapped to the original texture's intensity (the value defined by [R+G+B]/3).

Env Ball

Env Ball uses an image of a highly reflective chrome ball in an environment to recreate
that environment. An Env Ball texture background renders faster than a procedural texture background or a background modeled with surfaces. You can therefore replace a complex background with an Env Ball texture to reduce rendering times. The options available are:

1. **Image**: The texture used by the Env Ball texture. To use a single image of a highly reflective chrome ball in an environment, map a File texture to the Env Ball texture's Image attribute, and then specify an image file for the File texture's Image Name attribute.
2. **Inclination**: The rotation of the ball image about the vertical axis.
3. **Elevation**: The rotation of the ball image about the horizontal axis.
4. **Eyespace**: Eyespace causes the position of the Env Ball texture's Image file to be defined relative to the window, not the camera view.
5. **Reflect**: Reflect causes the Image file to be reflection mapped onto the background.
6. **Projection Geometry**: The Projection Geometry attributes controls the appearance of reflections from an Env Ball texture. They define the location of the sky and, or room walls of the original environment so that Maya can calculate reflections on surfaces in the re-created environment.

a. **Sky Radius**: The radius of the sky of the original environment.
b. **Bottom, Top, Left, Right, Front, Back**: The distance between the reflective ball and each wall of the original environment.

Env **Chrome**

Env Chrome simulates a showroom environment. The texture consists of a plane and a sky plane, and provides a simple but effective environment to simulate reflections off chrome surfaces. The Environment Chrome Attributes control the size and placement of the simulated fluorescent lights in an Env Chrome texture. The options available are:

1. **Light Width, Light Depth**: The width and depth of each light. These parameters also determine spacing between lights.
2. **Light Width Gain, Light Width Offset**: The number of lights per unit length.
3. **Light Depth Gain, Light Depth Offset**: This option defines the light displacement.
4. **Sky Color**: The color of the sky at the horizon. Overall sky color is linearly interpolated between Sky Color and Zenith Color.
5. **Zenith Color**: The color of the sky at the zenith. Overall sky color is linearly interpolated between Sky Color and Zenith Color.
6. **Light Color**: The color of the simulated fluorescent lights. These “lights” produce reflections in surfaces, but they do not actually illuminate surfaces.
7. **Floor Color, Horizon Color, Grid Color**: The color of the floor, the floor’s horizon and the floor’s grid.
8. **Real Floor**: If Real Floor is off, the environment’s floor is located at infinity, so reflections on moving objects and, or reflections viewed from a moving camera are incorrect. If Real Floor is on, the floor is located relative to the grid plane, so reflections on moving objects and, or reflections viewed from a moving camera are correct.
9. **Floor Altitude**: The height of the floor relative to the grid plane. Floor Altitude has no effect if Real Floor is off.
10. **Grid Width, Grid Depth**: The width and depth of the grid lines. These attributes also determine the spacing between grid lines.
11. **Grid Width Gain, Grid Depth Gain**: The number of grid cells per unit length.
12. **Grid Width Offset, Grid Depth Offset**: This option defines the grid displacement.

Env Cube

Env Cude simulates an environment by mapping six image files onto the inner surfaces of a large cube. Use Env Cube to make reflections on a moving surface during an animation if you do not have time to raytrace because it treats the texture placement box as the geometry of the environment. This means changes in the relative size and position of camera, surface, and environment are respected. The options available are:

1. **Infinite Size**: When on, the images in the cube are reflected as though the sides of the cube were infinitely far away. If you are using images with distance, such as the horizon or a starfield, turn on Infinite Size. If the images are of the interior of a room, or nearby objects, leave Infinite Size off.
2. **Right, Left, Top, Bottom, Front, Back**: The image files mapped to the right, left, top, bottom, front, and back inner surfaces of an infinite cube.

Env Sky

Env Sky simulates a planetary environment viewed from the surface of a planet. The options available are:

1. **Total Brightness**: The overall brightness of the environment.
2. **Sun Brightness**: The color and brightness of the sun.
3. **Halo Brightness**: The color and brightness of the halo around the sun.
4. **Interactively adjusting Sun attributes**: The following attributes relate directly to the Sky's texture placement object. You can use the Maya transform tools, such as Scale and Rotate to place the manipulator, or use the Show Manipulator tool. As you change the settings for Elevation, Azimuth, and Size attributes.
5. **Elevation**: The angle of elevation of the sun relative to the floor.
6. **Azimuth**: The angle of the sun in the sky about a vertical vector.
7. **Size**: The size of the sun.
8. **Blur**: The size of the halo around the sun.
9. **Sky Brightness**: A scaling factor applied to the sky color.
10. **Air Density**: The density of the air in the atmosphere. The denser the air, the more light is scattered. Air density represents low and high altitudes.
11. **Dust Density**: The density of dust in the atmosphere.
12. **Sky Thickness**: The thickness of the atmosphere.
13. **Sky Radius**: The outer radius of the sky as a multiple of Sky Thickness. Sky Thickness and Sky Radius values determine the planet radius, and planet radius influences the appearance of sunsets.
14. **Has Floor**: Turns the floor on or off. If Has Floor is off, the environment below the horizon is a mirror image of the environment above the horizon.
15. **Floor Color**: The color of the floor.
16. **Floor Altitude**: The height of the floor relative to the grid plane.
17. **Use Texture**: This option controls whether or not Env Sky pays attention to the Cloud Texture attribute.
18. **Cloud Texture**: The texture that determines cloud distribution in the sky.
19. **Cloud Brightness**: The brightness and color of cloud illumination from ambient scattered light in the atmosphere.
20. **Sunset Brightness**: The brightness and color of cloud illumination when the sun is below the horizon and the clouds are front lit.
21. **Density**: The density of individual clouds.
22. **Threshold**: A threshold value for the Cloud texture that controls how much of the sky is covered with cloud.
23. **Power**: The clouds are scaled and positioned by adjusting the Power value.
24. **Altitude**: The height of the clouds. It determines how much the atmosphere obscures the clouds near the horizon.
25. **Halo Size**: The size of cloud illumination from direct back lighting by the sun.

Calculation Quality

The Calculation Quality attributes control the rendering speed of an Env Sky texture. The calculations required for curved atmospheres reduce speed. The Calculation Quality attributes do not greatly affect the appearance of the sky, but do affect the speed at which the calculations are computed.

26. **Sky Samples**: The number of samples used above the cloud layer.
27. **Floor Samples**: The number of samples used by the atmosphere between the eye and the horizon.
28. **Cloud Samples**: The number of samples used below the cloud layer.

Env Sphere

Env Sphere simulates an environment by mapping a texture or image file directly onto the inner surface of an infinite sphere. The options available are:
1. **Image**: The texture mapped to the inner surface of an infinite sphere.
2. **Shear U**: Shears the Image texture in the U direction.
3. **Shear V**: Shears the Image texture in the V direction.
4. **Flip**: Flip reverses the U and V orientation of the Image texture.

Utilities

Bump 2d & 3d

Bump 2d/3d converts a 2D/3D texture to bump map. The options available are:
1. **Bump Value**: The source 2D/3D texture used for the bump map. You can connect the output of any shading network to Bump Value to use as the source of the bumps.
2. **Bump Depth**: Bump Depth controls how high the bumps display on the surface. Increase Bump Depth to make the surface bumpier.
3. **Bump Filter**: Bump filter affects the filtering level performed on a texture used as a bump map.
4. **Bump Filter Offset**: This option affects the amount of filtering performed on a texture.
5. **Adjust Edges**: Artifacts may display on texture boundaries when you map textures with the place2dtexture's Wrap U and Wrap V attributes turned off, using Adjust Edges removes these artifacts.

Condition

The condition utility in shader networks is capable of acting one way in one set of circumstances and another way in a different set of circumstances. Condition produces a color value depending on the conditions you set. It requires one logical operator and two choice values. It is similar to "IF" statement. The available options are:
1. **First Term**: First term represents the first term of the condition.
2. **Second Term**: Second term represents the second term of the condition.
3. **Operation**: options option displays a drop-down list from which you can select an operator. The operators include: Equal, Not Equal, Greater Than, Greater or Equal, Less Than, Less or Equal.
4. **Color If True**: The color or texture that is output when the condition is true.
5. **Color If False**: The color or texture that is output when the condition is false.

2d Placement

2D placement defines a texture frame—a rectangular area on a surface in which the texture appears. You can control the position, size, and rotation of this frame on the surface. You can also control how the texture is tiled within the frame. The available options are:
1. **Interactive Placement**: This option displays the texture placement manipulator.
2. **Coverage**: Coverage specifies what ratio of the surface the texture map cover
3. **Translate Frame**: The Translate attributes position the texture map on the surface and move the coverage area across the surface.
4. **Rotate Frame**: Rotates the texture map on the surface.
5. **Mirror U, V**: Only works when U Repeat or V Repeat attributes are greater than 1. Mirror in the U and V direction separately.

6. **Stagger**: Maya offsets repeats of maps making alternate rows of repeats offset exactly by half.
7. **Wrap U, Wrap V**: Wrap U and Wrap V attributes control whether a map is repeated in U or V directions, or both U and V.
8. **Repeat UV**: This option specifies how many copies of the texture map are mapped within the coverage area along either the U or V directions.
9. **Offset**: Offsets the pattern of the texture map.
10. **Rotate UV**: You can not rotate surface placement with the interactive placement tool. So, you can use rotate UV to rotate.
11. **Noise UV**: 2D noise for U and V. Displaces the colors of the texture map.
12. **Fast**: Turn fast on to slightly improve rendering speed.

3D Placement

A 3D placement node defines a 3D texture or Environment texture's positioning and orientation in world space. 3D placement nodes make it easier to texture multiple surfaces as if they were one. Maya provides two methods to place 3D textures on NURBS surfaces—Interactive Placement or Fit to group bbox (Bounding Box). Select the method most suitable for your needs. When you create a 3D texture or project a texture onto an object, a cube-shaped icon appears in the scene that corresponds to the size, scale, and location of the texture on the surface. Especially for animated or deforming objects, you must maintain the correct positioning of the texture on the object. Options are same for 2D and 3D texture placement utilities.

Projection

Projection turns any 2d texture into a 3d texture you can place on the surface using one of the available projection types. Use to adjust the texture placement on the surface. The options are:

1. **Interactive Placement**: This option displays the Projection manipulators in the scene view.
2. **Fit To BBox**: The texture map coincides with the bounding box of the mapped object or set.
3. **Proj Type**: Select a projection type from the drop-down list to display seven projection manipulators.

a. **Off**: Uses no projection type.
b. **Planar**: Default Proj Type. Places the texture on a planar surface and projects it onto the object.
c. **Spherical:** Places the texture inside a sphere and projects it onto the object.
d. **Cylindrical**: Places the texture inside a cylinder and projects it onto the object.
e. **Ball**: Places the texture inside a ball and projects it onto the object.
f. **Cubic**: Defines the projection surface as a box. Maya places images on each plane and projects them onto the object.
g. **Triplanar**: Extrudes the texture along the axis defined by the maximum direction of the surface normal. The texture is projected much like fabric pulled around an arc.
h. **Concentric**: Projects a vertical slice of the texture from the inside to the outside edge of the voxel. The vertical slice used is randomly chosen for each voxel. A voxel is a 3D version of a rectangle—a voxel grid is a series of 3D cubes that line up to form a bigger cube.
i. **Perspective**: Integrates 3D elements with a background image or a

live action sequence.
4. **Image**: The 2D texture to be used as a map.
5. **U angle**: This option changes the U angle (For spherical and cylindrical mapping only).
6. **V angle**: This option changes the V angle (For spherical mapping only).
7. **Link To Camera**: The drop-down list contains a list of the perspective cameras in the scene.
8. **Fit Type**: This option Controls how the texture fits to the camera when Proj Type is Perspective. Select from the following:
a. **None**: The image is not squeezed or stretched to fit.
b. **Match Camera Film Gate**: It squeezes the image to fit the film gate.
c. **Match Camera Resolution**: If you use this to match a backdrop, match these settings to the settings in the Image Plane.
9. **Fit Fill**: Only available if Proj Type is Perspective and Fit Type is None.

Reverse

Reverse reverses effect of the connected node. If the nodes' output value is white, it will reverse it into black and so.

Sampler Info

Sampler Info provides you with information about each point on a surface as it is being sampled, or calculated, for rendering purposes. Sampler Info can give you information about a point's position in space, its orientation and tangency, and its location relative to the camera. Many of the attributes for this node provide values in camera coordinate space, the local object space of the camera. The options available are:
1. **Point World**: This option provides the position currently being sampled relative to the X, Y, and Z-axis of the world.
2. **Point Obj**: This option provides the position currently being sampled relative to the X, Y, and Z-axis of the object.
3. **Point Camera**: This option provides the point of the object being shaded.
4. **Normal Camera**: This option provides the orientation of a face relative to the camera.
5. **Uv Coord**: This option provides the UV coordinates of a point to be shaded. The convention is that UV coordinates are measured from (0, 0) to (1, 1).
6. **Ray Direction**: This indicates the direction in which the current point is seen from the camera. Use this attribute in materials for objects to provide the direction towards the camera for every pixel in the object.
7. **Tangent UCamera, Tangent VCamera**: This option sets the surface tangents in camera space.
8. **Pixel Center**: This option provides Pixel Center X and Pixel Center Y. The result depends on the image, not on the geometry.
9. **Facing Ratio**: This option produces a value that varies between 0 and 1 depending on the angle between the surface normal and view direction.
10. **Flipped Normal**: The flipped normal attribute indicates if the surface normal is flipped which also tells you which side of the surface Maya is shading.

Stencil

Stencil maps any image input onto an object. You can mask the input image to control how it covers a surface, to overlay different textures and control what

parts of the texture are visible, or to label map a surface. The options available are:

1. **Image**: The texture that is used as a stencil.
2. **Edge Blend**: Edge Blend controls the sharpness of the texture edges. The default Stencil's color is the color of the edge blend. Increase this value to blend edges softly.
3. **Mask**: Mask represents the Stencil's transparency. Use to control the overall transparency of the entire texture.
4. **Key Masking**: This option enables or disables Chroma Key masking.
5. **Positive Key**: Inverts the chroma key mask.
6. **Color Key**: The color to be masked in the texture.
7. **Threshold**: This option controls the point at which the color state changes.

Blend Colors

Blend colors utility blends two input values using a mixer. You use a mask to determine where to put two materials placed on an object. The options available are:

1. **Blender**: Blender controls how much of each of the input colors mixes into the final Output.
2. **Color1/Color2**: Color1 and Color2 are the first and second input colors.

Switch Utilities

Switch utilities let you apply textures to different patches that make up one object. Several objects can share shading characteristics and you can define unique characteristics on an object-by-object basis using Maya's Switch utilities.

Single Switch

Single switch connects only to a single value node, nodes which are controlled by a single value like Bump, Reflectivity etc. The options available are:

1. **Add Surfaces**: This button adds all the shapes on which that material is applied in inshape column.
2. **inShape**: This column contains the name of the shape you want to connect to the Single Shading Switch utility. You can add as many objects as you want to this column.
3. **inSingle**: This column contains the texture, file, or placement node that you want to map to the object.
4. **Remove Item**: This button removes the currently selected row in the Switch table.
5. **Map Item**: You can use the Map Item button to select a texture, file, or placement node to map it to the object.

Double Switch

Double switch connects to a double value node, nodes which are controlled by a two value like Repeat UV, Offset, and Rotate UV etc in 2D placement. The options are similar to that of Single Switch.

Triple Switch

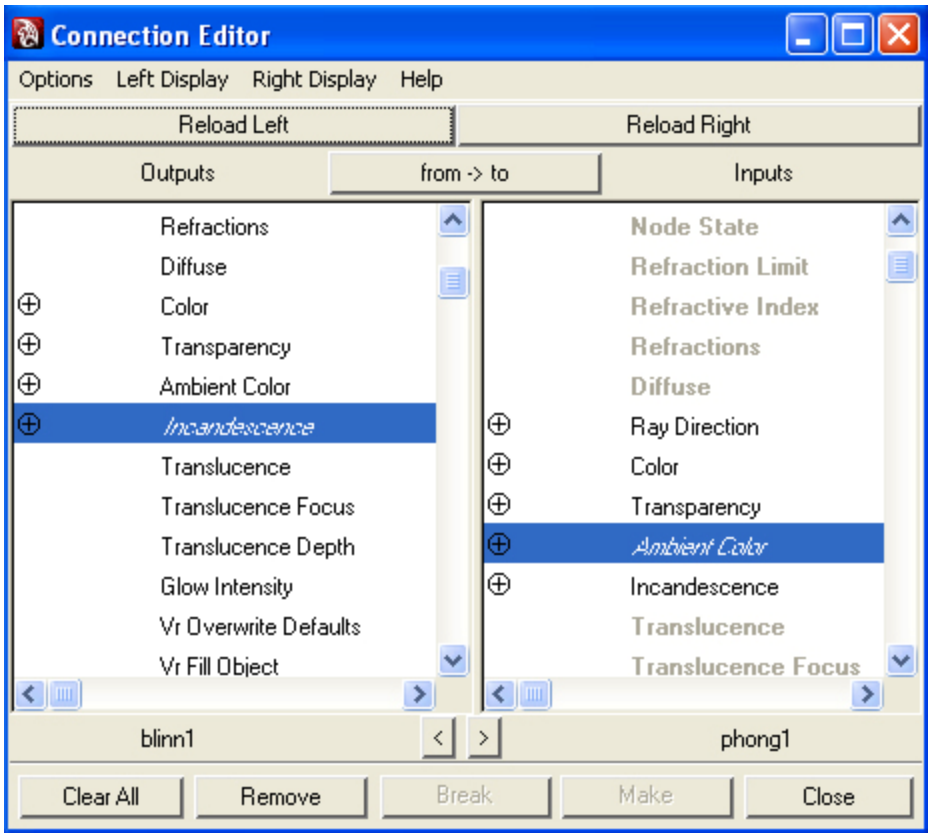
Triple switch connects to a triple value node, nodes which are controlled by a three value like all color nodes, nodes in 3D placement etc. The options are similar to that of Single Switch.

Quad Switch

Quad switch connects to a triple value node and single value node or a quad node. The options are similar to that of Single Switch.

Connection Editor

This editor is useful for fine-tuning a shading network. Use it to make non-default connections, to traverse nodes to view their inputs or outputs, or to make connections going in either direction of the network. Connection Editor is also known as parameter wiring in other software like 3DS Max. The Connection Editor, however, is the best tool for fine-tuning a shading network and for making non-default connections. The Connection Editor shows node network information in a side-by-side layout so that you can view two connected nodes in a node network. You can quickly and easily traverse from node to node and show a node's outputs or inputs. Connected attributes in the Connection Editor appear in italics, while non-keyable attributes appear dimmed. Some dimmed attributes indicate a nested list of attributes.



Texture-mapping NURBS surfaces: This is a Projection map kind of option. This option is available in the utilities panel.

Here you can create a projector kind of effect like a light with a map falls on the object. It is very useful in creating 3D effects on any object just by applying the same in the projector map in the lights. Here are the options you find in it.

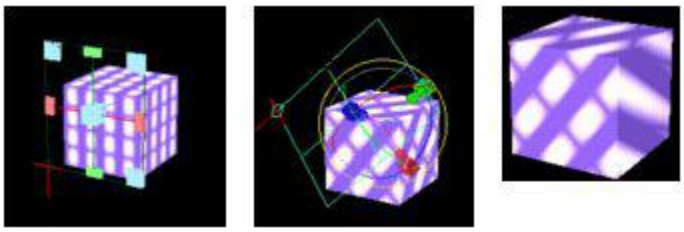
1. Interactive Placement: It displays the Projection manipulators in the scene view.

2. **Fit To Bbox**: It makes the map fit to the bounding box of the object.

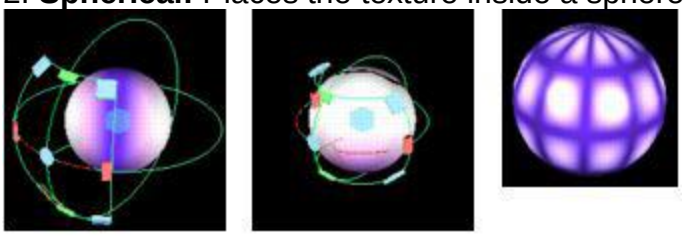
You can select a projection type from the drop-down list to display seven projection manipulators.

Here the Projector Types are:

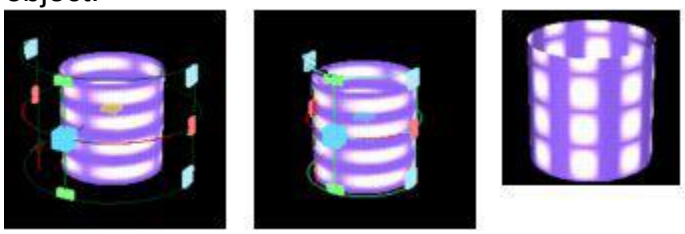
1. **Planar:** Default Proj Type. Places the texture on a planar surface and projects it onto the object.



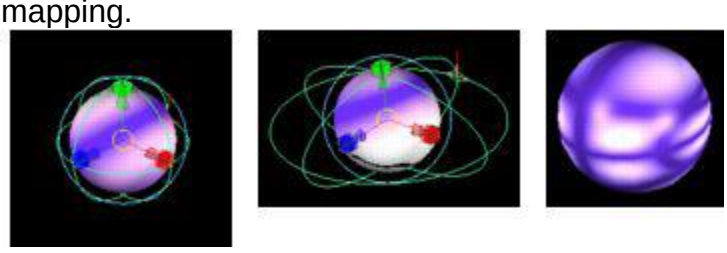
2. **Spherical:** Places the texture inside a sphere and projects it onto the object.



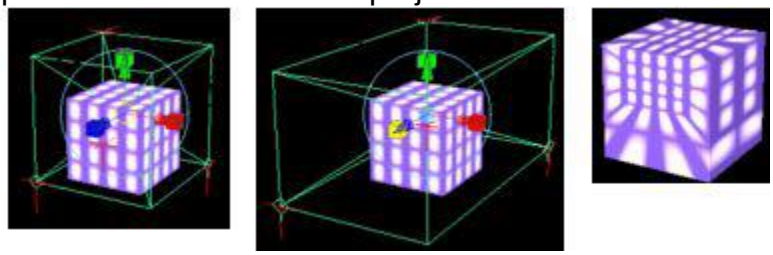
3. **Cylindrical:** Places the texture inside a cylinder and projects it onto the object.



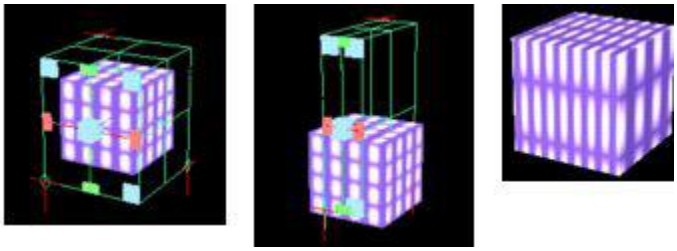
4. **Ball:** Places the texture inside a ball and projects it onto the object. For example, Maya projects the texture as if a candy wrapper is pulled around a lollipop. There is one pinch point to the mapping at the -z-pole, as opposed to the two pinch points at the +y and -y poles in spherical and cylindrical mapping.



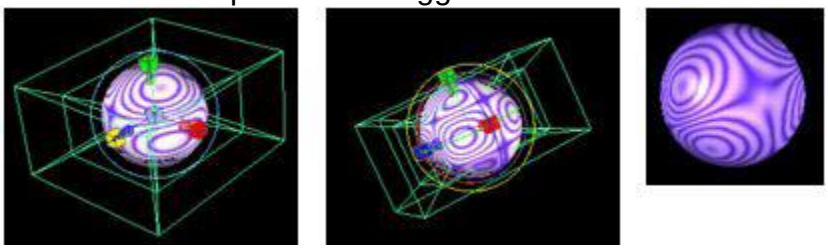
5. **Cubic:** Defines the projection surface as a box. Maya places images on each plane and projects them onto the object.



6. **Triplanar:** Extrudes the texture along the axis defined by the maximum direction of the surface normal. The texture is projected much like fabric pulled around an arc.



7. **Concentric:** Projects a vertical slice of the texture from the inside to the outside edge of the voxel. The vertical slice used is randomly chosen for each voxel. A voxel is a 3D version of a rectangle—a voxel grid is a series of 3D cubes that line up to form a bigger cube.



8. **Perspective:** Integrates 3D elements with a background image or a live action sequence.

Combining materials: You can combine the materials by using the Hypershade option given in Utilities > Hypershade or Hypershade from the render menu. Here the options are given to combine two, three, four materials together and use them.

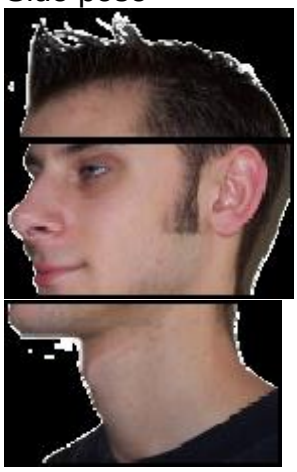
Texturing polygons: You can apply textures on the polygons by right click on the object in the view port and assign the material. Here you can use the bump, specular etc materials and modify them.

Photoshop

Here we will see how to make different kind of materials in Photoshop for use in MAYA materials, like face maps, unwrap maps for objects, hands of the character. This is very useful for gaming for decreasing the file size.
Down is given a method of making a map for a face which is unwrapped.
Here you need one person's photograph from front side, left or right side and a perspective side but the proportion of all must be same as we are going to merge them. You can collect more photographs from more sides for the better result.
You can have photographs like the followings:

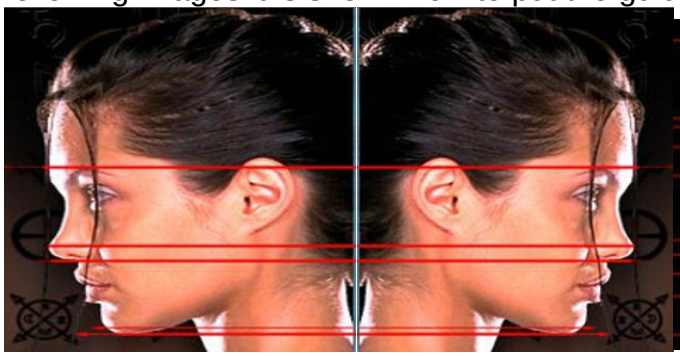
Front photograph

Side pose

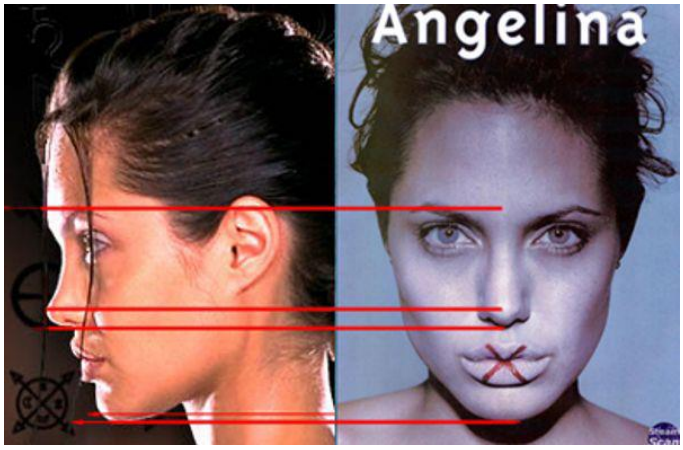


Perspective pose

Take a new file. Arrange all the front, side and perspective photographs in three different layers and put guidelines to arrange them in proportion. Here in the following images it is shown how to put the guidelines for a better proportion.



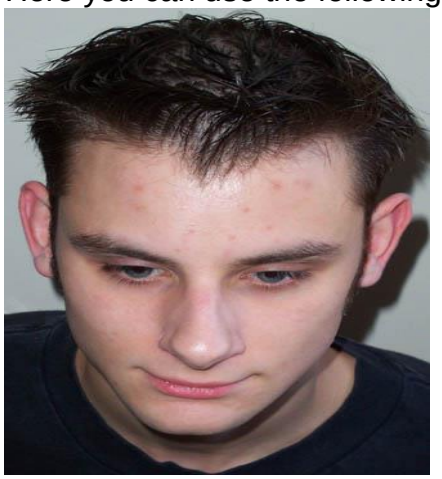
Then arrange the images as the following one by one and set them in proportion by using the guidelines. Like in the following picture:



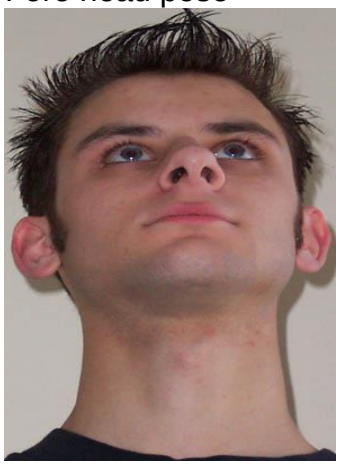
After setting all the front, side and perspective view start merging the layers. First delete the unwanted areas from the layers and try to merge the face's front, side and perspective views.
Now, You can start merging the views by using the stamp tool, selection tool etc. It is depended with which tool you are comfortable to work. While merging the face images take care of the proportions and shades of the face from all the sides.

Photoshop

Now, After mergin the pictures of all the sides like front, side and perspective you will have to make the part of fore head and neck also.
Here you can use the following images or poses.



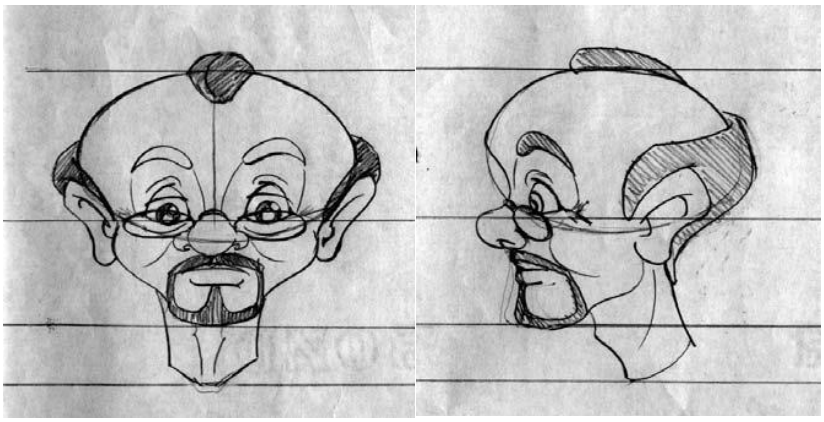
Fore head pose



Pose from down for neck

By using these poses it will become easy to make a good unwrapped map for a face of the same character. While merging the pictures of different sides you will have to merge the layers as per requirement.
At the end you will find the file like the following one.

This map is an open map for the same character's face.
Here if you are making a map for a character who belongs to the fantasy category like not existing In the world then you can unwrap the map from MAYA unwrap and take a snap shot from it then bring the image to Photoshop and paint it as you want it to look. Again take it to MAYA and apply it on the face of the character.
Here you can create the textures for hands, legs etc in Photoshop by merging the images or painting them and use them.
The same technique can be used for making the maps of faces for any cartoon character by using the sketch of it by arranging them in the same way and painting them as you want the colours of the character.



2.3.8 UVs

UV texture space is another coordinate system in 3D and it is used for mapping textures on surfaces and UVs are points that provide the information needed to apply textures to the surface. Subdivision surfaces and polygons require specific arrangement of the UVs

so that textures look correct when applied to the surface material. Typically, you arrange UVs after you have completed your modeling and before you assign textures to the model. UVs act as marker points that control which points (pixels) on the texture map correspond to which points (vertices) on the mesh. You can see the texture space coordinates in UV Texture Editor.

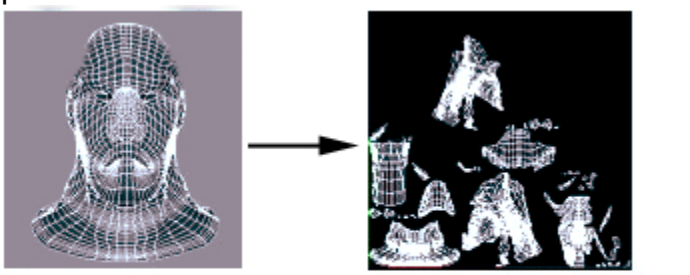
Mapping

UV mapping is a process whereby you create, edit, and otherwise arrange the UVs that appear as a flattened, two-dimensional representation of the surface mesh, over top of the two-dimensional image to be used as a texture as it appears in the UV Texture Editor. UV mapping is a critical skill to master for accurate and realistic textures on polygonal surfaces. In Maya, UV texture coordinates (UVs) can be created for polygon surface meshes using the following UV mapping techniques:

1. Automatic UV mapping
2. Planar UV mapping
3. Cylindrical UV mapping
4. Spherical UV mapping
5. User-defined UV mapping
6. Camera UV mapping

Automatic UV mapping

Automatic mapping creates several UV
map pieces or shells in texture space by
attempting to find the best UV placement by simultaneously projecting from multiple planes.



Polygonal model in scene view

Automatic Mapping produces multiple UV shells when viewed in the UV Texture Editor

Planar UV mapping

Planar mapping projects UVs onto a mesh through a plane. This type of mapping is best suited for planer objects.

Figure 0083

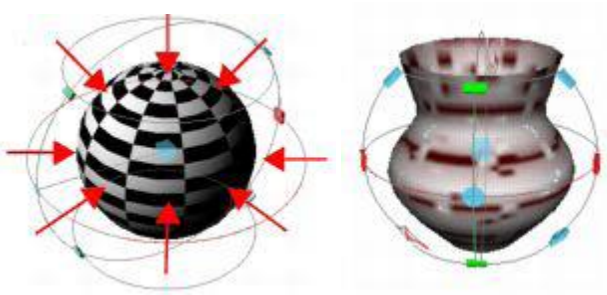
Cylindrical UV mapping

Cylindrical mapping creates UVs for an object based on a cylindrical projection shape that gets wrapped around the mesh. This type of mapping is best suited for cylindrical objects.

Figure 0084

Spherical UV mapping

Spherical mapping create UVs using a projection that is based on a spherical shape wrapped around the mesh. This type of mapping is best suited for spherical objects.



User-defined UV mapping

User-defined UV mapping is same as the automatic mapping. The only difference is that in user-defined you can map UV texture coordinates by specifying user-defined planes for UV projection using the Load Projection option.

Camera UV mapping

The camera UV mapping creates a Planar UV mapping. The current camera view plane is used as the plane for the planar projection.

UV Texture Editor

The UV Texture Editor lets you interactively edit UV texture coordinates for polygons and subdivision surfaces. You can select, move, scale, and generally modify the UV topology for a surface. You can also view the image associated with the assigned texture map as a backdrop within the UV Texture Editor and modify the UV layout to match as required.

UV Toolbar

UV Lattice Tool

This tool is used to manipulate the layout of UVs as a group by letting you create a lattice around the UVs for deformation purposes.

Move UV Shell Tool

Move UV Shell tool lets you select and reposition a UV shell by selecting a single UV on the shell.

UV Smudge Tool

UV Smudge Tool moves the position of selected UVs and their neighboring UVs.

Select Shortest Edge Path Tool

The Select Shortest Edge Path Tool determines the most direct path between any two selection points and selects the polygon edges in between.

Flip U

It flips the positions of the selected UVs in the U direction.

Flip V

It flips the positions of the selected UVs in the V direction.

Rotate UVs counterclockwise

It rotates the positions of the selected UVs by 45 degrees in a counterclockwise direction.

Rotate UVs clockwise

It rotates the positions of the selected UVs by 45 degrees in a clockwise direction.

Cut UVs along selection

This tool separates UVs along the selected edges, creating borders.

Split UVs

This tool separates UVs from each other along the edges connected to the selected UV points, creating borders.

Sew **UVs**

Attaches UVs along the selected borders, but does not move them together in the texture editor view.

Move and Sew UVs

Attaches UVs along the selected borders, and moves them together in the texture editor view.

Layout

This tool attempts to arrange the UVs into a cleaner layout.

Grid UVs

This tool moves every selected UV to its nearest grid intersection in editor window.

Unfold

Unfold unwraps the selected UV mesh while attempting to ensure that the UVs do not overlap.

Relax

Relax spreads out the selected UV mesh to make it easier to work with.

Align Min U

This tool aligns the positions of the selected UVs to the minimum U value.

Align Max U

This tool aligns the positions of the selected UVs to the maximum U value.

Align Min V

This tool aligns the positions of the selected UVs to the minimum V value.

Align Max V

This tool aligns the positions of the selected UVs to the maximum V value.

Toggle Isolate Select Mode

This tool switches between showing all UVs and only the isolated UVs.

Add selected to isolation

This tool adds the selected UVs to the set of isolated UVs.

Remove selected from isolation

This tool removes the selected UVs from the set of isolated UVs.

Remove all

This tool clears the isolated subset.

Display Image

Display Image tool shows or hides the texture image in the editor window.

Toggle Filtered Image

This tool switches the background image between hardware texture filtering and sharply defined pixels.

Dim Image

This tool reduces the brightness of the currently displayed background image.

View Grid

View Grid option displays or removes the grid.

Pixel Snap

If this is on, UVs automatically snap to pixel boundaries.

Shade UVs

This tool shades selected UV shells in a semi-transparent fashion so you can determine areas where UVs overlap.

Toggle Texture Borders

This option toggles the display of texture borders on UV shells.

Display RGB Channels

This option displays the RGB channels of the selected texture.

Display Alpha Channel

This option displays the Alpha channel of the selected texture.

UV Texture Editor Baking

This option bakes the texture and stores it in memory.

Update PSD Networks

This option updates or refreshes the PSD textures currently in use for the scene.

Force editor texture rebake

This option rebakes the texture after you make changes to the textures.

Use Image Ratio

If this is on, the texture will be shown in its aspect ratio.

Create UVs >

Create UVs based on Camera

Creates UV texture coordinates for the selected object based on the current camera view as a planar projection. That is, the camera view becomes the plane of projection.

Best Plane Texturing Tool

Assigns UVs to the faces you select based on a plane computed from vertices you specify.

Assign Shader to each Projection

When Assign Shader to each Projection is turned on, a shader with a checkerboard texture is assigned to the selected mesh as you project UV texture coordinates. This aids in determining the alignment of the UVs by providing a known visual reference. The default setting is off.

Create Empty UV set

Creates a new, empty UV set on the current object. You can then create the UVs in the set using one of the mapping/projection methods. This feature is also available for use from the Polygons menu in the UV Texture Editor.

Copy UVs to UV set

Creates a new UV set based on an existing UV layout or transfers a UV layout from one set to another. This feature is also available for use from the Polygons menu in the UV Texture Editor.

Set Current UV set

Lets you specify which UV set you want to use for a particular polygon mesh. You specify which set you want by typing the name of the UV set in the text field that appears. This feature is also available for use from the Polygons menu in the UV Texture Editor.

Rename Current UV set

Lets you rename the currently selected UV set. This feature is also available for use from the Polygons menu in the UV Texture Editor.

Delete Current UV set

Deletes the currently selected UV set. This feature is also available for use from the Polygons menu in the UV Texture Editor.

2.2.9 Edit UVs >

Normalize

Normalize command normalizes the UV texture coordinates. The following options are available in the option box.

1. **Collectively**: This option will set the UV coordinates of all the selected faces between 0 and 1.

2. **Each face separately**: This option will set the UV coordinates of each selected face between 0 and 1.
3. **Preserve the aspect ratio**: If this options is on, the UVs scale proportionally to the image.

Unitize

Unitize repositions the UVs of the selected faces on the boundary of the UV texture space as they appear in the UV Texture Editor.

Flip

Flip command flips the UVs horizontally or vertically.

Rotate

Rotate command rotates the UVs. You can provide the rotate angle in the option box.

Grid

Grid command snaps the selected UVs to the specified grid.

Align

Align command aligns the selected UVs to the min/max U or min/max V

Warp Image

Warp image modifies a texture image by comparing two UV sets on a single polygonal mesh and produces a new bitmap image.

Map UV Border

Map UV Border repositions border UVs on a selected UV shell to a square or circle within the 0 to 1 range of the UV texture space. Map UV Border is useful for untangling borders before you use Relax UVs to untangle interior UVs. The available options are:

1. **Border target shape**: This option select the shape type that you want to map the UV border to Square or Circle.
2. **Automatic**: If this option is on, it will map the UV border automatically in a shape that approximates the best texture space while maintaining the world-space relationships between edges.
3. **Preserve original shape**: Preserve original shape determines how closely the border mapping will match the selected Border Target Shape.

Straighten UV Border

Straighten UV Border untangles the border of the currently selected UV shell, such as an edge that loops around itself. The available options are:

1. **Curvature**: This option pushes the selected border area outward or inward by the specified amount.
2. **Preserve length ratio**: This option controls the size of UV texture edges when straightened.
3. **Blend original shape**: This option affects the shape of the straightened border by blending it with the original border shape.
4. **Fill gaps in selection**: The Fill gaps in selection options helps you straighten UVs that are missing from your selection.

Layout

Layout repositions the UV shells for selected objects so their arrangement is improved. The options available are:

1. **Layout Multiple Objects**:

a. **Overlapping**: When multiple objects are selected in the scene this option specifies to lay out the UV shells for each object individually within the UV Texture Editor.

b. **Non-overlapping**: This option specifies the multiple UVs to be

positioned in the UV Texture Editor as if it were one single object.
2. **Separate Shells**: This option specifies how you want to cut and separate overlapping UV shells.
3. **Flip reversed**: Flips UV shells that have normals pointing in opposite UV winding order.
4. **Shell Layout**: This option specifies where the UV shells will lie in UV texture space.
5. **Scale mode**: You can choose the way, how you want the UV shells scaled within the UV texture space with this option.
6. **Shell stacking**: Shell stacking determines how the UV shells get stacked in relation to each other when laid out in the UV Texture Editor.
7. **Rotate**: Rotate allows the UV texture shells to be rotated in order to better fit the UV texture space.
8. **Spacing presets**: You can specify a spacing preset to ensure that there is at least one pixel separating the individual UV bounding boxes. Select a preset that corresponds to your texture map size.
9. **Percentage space**: When the Spacing presets is set to Custom you can specify a distance measurement to specify the space between bounding boxes as a percentage of the map size.

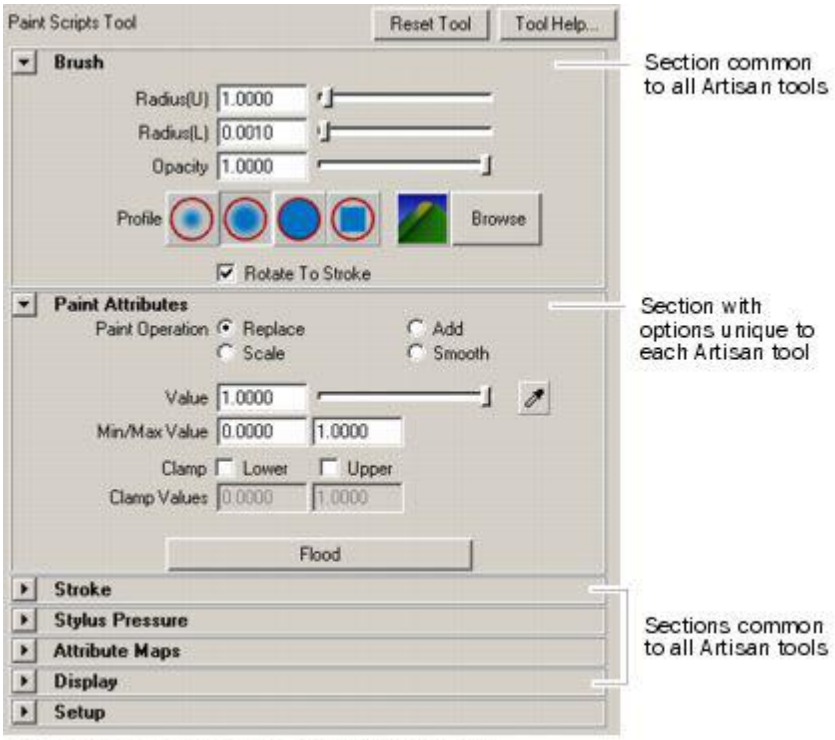
UV Linking

UV Linking is used to link different nodes like textures, paint effects, hair and fur to UV sets using relationship editor.

Texturing Using Painting Tools: Maya's paint tools work like paint brushes, providing you with an intuitive, efficient way to change the properties of your objects or create various effects.

Maya has three types of paint tools: Paint Effects is a unique paint technology that lets you paint strokes on a 2D canvas to create 2D images or textures, or to paint strokes in a scene to create paint effects in 3D space.

1. **Maya Artisan paint tools:** Artisan tools let you manipulate your geometry in a more artistic manner by allowing you to paint their values and properties



Artisan interface in the Maya Tool Settings Editor

with the brush tool.

Artisan uses the Maya Tool Settings editor to set tool properties. All Artisan tools share common options, which are described in Common Artisan Brush Tool Settings.

For each Artisan tool, the Tool Settings editor contains a section with settings that are specific to that tool.

2. **Maya Paint Effects Tool:** Paint Effects is a component of Maya used to quickly and easily paint brush strokes and particle effects on a 2D canvas or on or between 3D geometry.

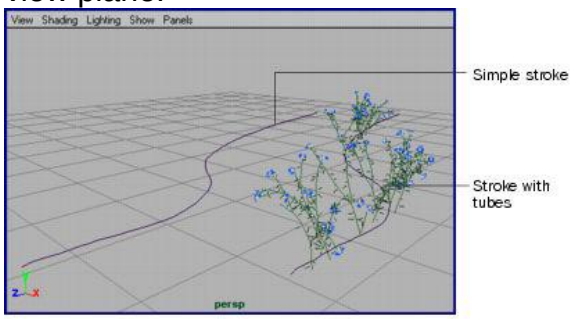
Image created by Duncan Brinsmead

You can use Paint Effects as a traditional paint program to paint images on a canvas, or to paint repeatable textures that you can apply to geometry in your

scenes.
Paint Effects goes beyond traditional painting as you can paint entire particle effects on your canvas or scene with a single brush stroke. On a 2D canvas a single brush stroke can produce complex images, for example trees or flowers or fire. In your scene, that same brush stroke produces these entities three-dimensionally. Imagine being able to paint an orchard in your scene where the painted trees exist as objects that your characters can move around. You can also apply dynamic forces to the effects you paint in your scenes and animate the display and movement of the effects. For example, you can make plants grow, make long hair blow in the wind, or make a river flow.
You can get immediate high-quality feedback by rendering brush strokes while you paint. Paint Effects strokes render seamlessly with the rest of your scene during a post process in the final render.

3. 3D Paint Tool:

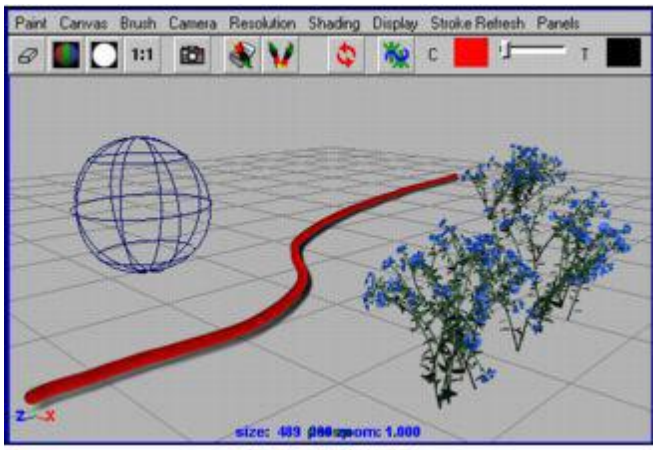
While dragging the Paint Effects Tool, Paint Effects creates a curve and attaches a stroke and new brush to it which define the appearance and behaviour of the paint applied along the stroke path.
Whether you paint in the scene view or the scene painting view, you can paint strokes on the grid plane of the perspective view, directly on objects, and on the view plane.



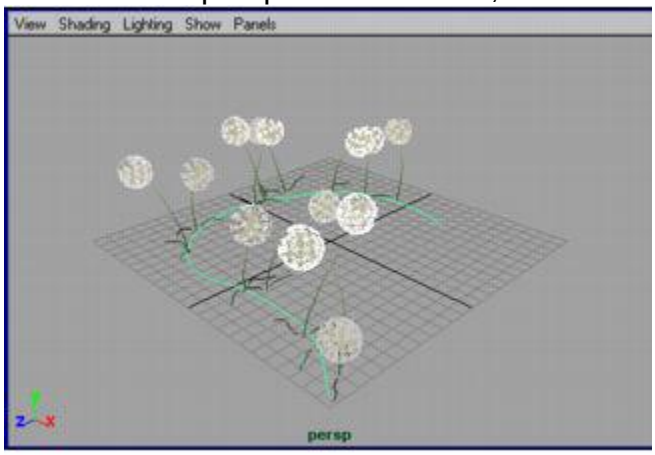
When you paint in the scene view, simple strokes display as curves. Strokes with tubes display as wire frame representations of the rendered stroke. Paint is not applied to the strokes until you do a post-process render, which makes painting in the scene view very quick. It provides immediate feedback in enough detail to see what you're doing. To improve redraw speed, you can adjust the display quality of the wireframe strokes, just as you can adjust the display quality of objects displayed as wireframe. Paint in the scene view when speed is an issue, but the final appearance of the strokes is not.

Render strokes as you paint:

To preview the rendered look of the strokes as you paint, click on the Draw as

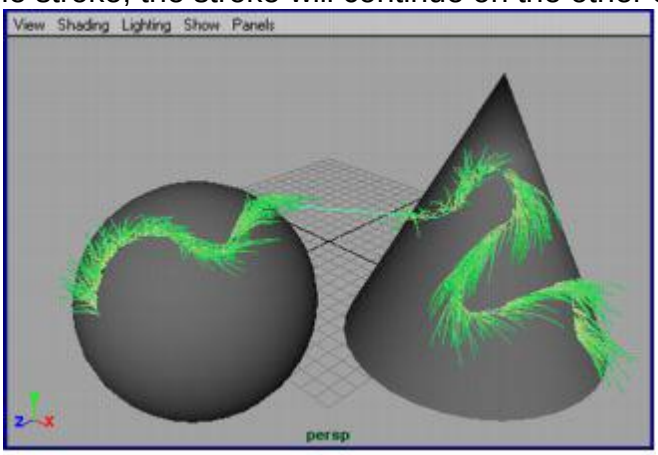


Mesh option in the Paint Effects panel.
Alternatively, you can render the strokes as you paint them in the Paint Effects scene painting view. The scene painting view is a snapshot of the scene view. You can zoom, tumble, track, and dolly this view, and the scene painting view will update accordingly. You can render all the Paint Effects strokes or render them individually.
Paint in the scene painting view when you need to see what the strokes look like, but you don't want to do a final render. You cannot use the transform tools, or any tools for Modeling in this view. Although you can select objects in the scene painting view and transform them in the Attribute Editor or Channel Box, it is best to use the scene view for non-painting tasks.
To display the scene painting view:
On the view menu bar, select Panels > Panel > Paint Effects to open the Paint Effects panel. The Paint Effects Tool is automatically selected.
Select Paint > Paint Scene. The Paint Effects scene painting view displays.
3D Paint tool provides you more facilities to work in different styles like followings:
1. **Paint on the grid plane of the perspective view:** While painting on the grid of the perspective view, the stroke lies on that plane.

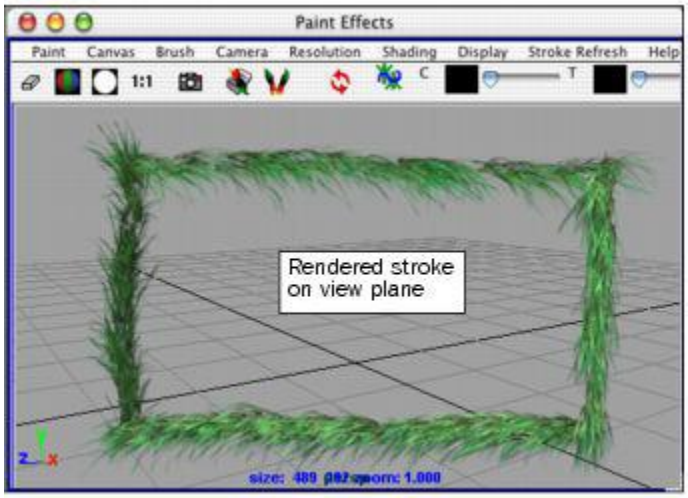


2. **Paint on objects**: To paint on NURBS or polygonal objects, you must first make the objects paint able. When you paint directly on a paint able object, Paint Effects creates a curve on the surface along the stroke path and attaches the stroke and new brush to it. While translation of the object, the stroke moves with it. Also, you can offset the brush from the surface.
While painting, the stroke does not leave the surface unless you paint over

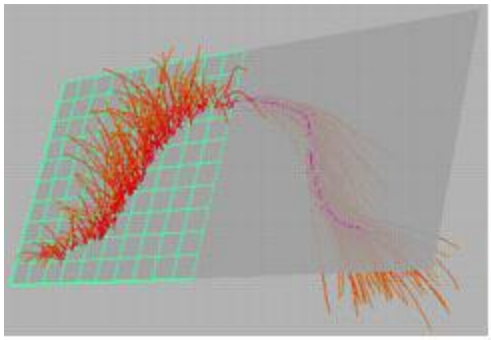
another object that is paintable. If you do paint across another paintable object during the stroke, the stroke will continue on the other object, bridging the two objects.



3. **Paint on the view plane**: You can paint on the view plane in the scene painting view not the scene view. When you paint on the view plane in the scene painting view, each stroke renders on the view plane, as you would expect. However, the wire frame representation of each stroke displays between 0 and 1 in world space on the XY plane (near the origin). Although the wireframe representation of the strokes appear to overlap in this area, the rendered strokes display where you painted them.



4. **Reverse surface normals**: When you paint a stroke on a paint able object, the tube growth is relative to the surface normal. You may find yourself painting on surfaces with reversed normals, In which case the tubes will grow in the opposite direction.



2.3 Assignment

1. Facial Animation
2. Photoshop Texture Room
3. Unwrapping Head
4. Texture Head

UNIT 3 Light

	Time Required to Complete the unit

The time required to study thus Unit is broken as follows

. 1st Reading: It will need 2 Hrs for reading a unit

. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit

- Self Assessment: It will need 3 Hrs for reading and understanding a unit
- Revision and Further Reading: It is continuous process

BCA (DES)305- 3rd YEAR

ILLUSION-02

Babasaheb Ambedkar

Open University

Block 1

BCA(DES)-305
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Publications that are mentioned in Bibliography. The content developed represents the breadth of research excellence in this multidisciplinary academic field. Some of the information, illustrations and examples are taken "as is" and as available in the references mentioned in Bibliography for academic purpose and better understanding by learner.'

ROLE OF SELF INSTRUCTIONAL MATERIAL INDISTANCELEARNING

The need to plan effective instruction is imperative for a

Successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual

Involvement and contain all the necessary learning instructional activities ties that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect,

Students 'assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make

use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge isbuilt.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices pros vided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive

Communication clues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to r e d u c e

This. Divide and to bring this Self Instructional Material as the b e s t

teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts.

Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline.

These could be in the form of students 'assignments, a research project

or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you

Expect.

All the best for your studies from our team!

All the best for your studies from our team!

3.1 Introduction

Light can be defined as something that makes things visible. It is the sensation produced by stimulation of the organs of sight. In Maya also, Lights are used to Illuminate the objects and cast shadows in the scene. Maya provides you different type of lights to simulate different type of light sources. The available lights are:

1. Directional Light
2. Ambient Light
3. Point Light
4. Spot Light
5. Area Light
6. Volume Light

3.1.2 Lighting Types

Directional Light

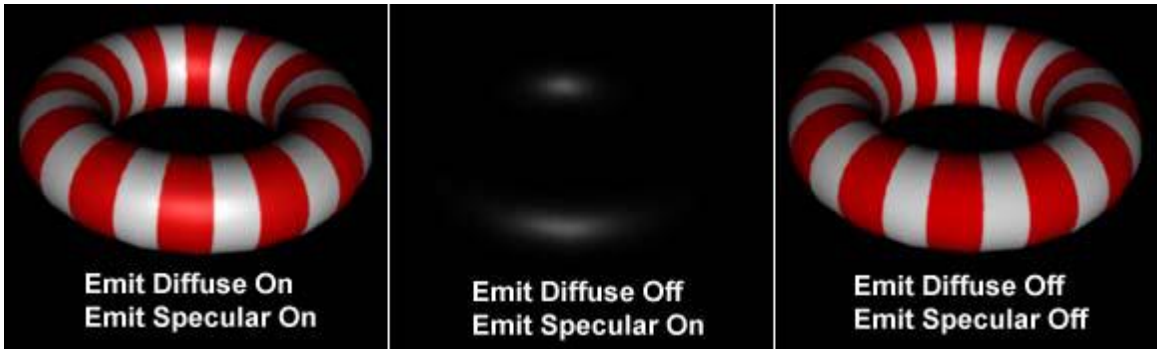
Directional Light simulates the distant light source i.e. light coming from infinite. The directional light rays are parallel. The attributes for directional light are:

1. **Intensity**: Intensity represents the brightness of the light.
2. **Color**: Color determines the light's color. You can also map a texture on the color.
3. **Cast Shadows**: Turn this option on, if you want to generate shadows. Shadows bring realism in the rendered scene. Shadows are of two types: Depth maps and Ray Traced.

a. **Depth Map Shadows**: A depth map represents the distance from a specific light to the surfaces the light illuminates. Each pixel in the depth map represents the distance from the light to the nearest shadow casting surface in a specific direction. Depth map shadows produce very good results, with marginal increase to rendering time.

b. **Ray traced Shadows**: Raytracing is a type of shadow rendering where the path of individual light rays is calculated from their source to their destination. Use raytraced shadows to produce more physically accurate shadows like those in the real world. Raytraced shadows can produce soft and transparent shadows but can be very time consuming.

4. **Shadow color**: Shadow color determines the Color of the shadow. You can also map textures to shadows to create interesting effects.
5. **Interactive Placement**: If this option is on, you will be automatically looking through the directional light upon its creation.
6. **Emit Diffuse and Emit Specular**: Turn Either Emit Diffuse or Emit Specular or both on to create the respective shadings.



Note: In Maya, most of the light attributes are common

Ambient light
An ambient light works in two ways: some of the light shines evenly in all directions from the location of the light, and some of the light shines evenly in all directions from all directions. Use an ambient light to simulate a combination of direct light and indirect light. Ambient lights produce only raytraced shadows. The attributes of Ambient light are:
1. **Ambient Shade**: Ambient shade is the proportion of directional light to ambient light.
2. **Shadow Rays**: Shadow Rays controls the graininess of shadow edges. Low values produce grainy shadows at the edges but takes less time to render.

Point Light
Point light emits light in all direction from the location of the light. Point light can represent a light bulb or a star. The attributes of point light are:
1. **Decay Rate**: Decay Rate controls how the light's intensity decreases with distance. Following options are available:
a. **No Decay**: If this is set, the light will reach every object.
b. **Linear**: If this is set, the light intensity decreases linearly with distance.
c. **Quadratic**: If this is set, the light intensity decreases proportionally with the square of distance. In the real world light decays with the quadratic rate.
d. **Cubic**: If this is set, the light intensity decreases proportionally with the cube of distance.

Spot Light
A spot light projects a beam of light evenly within a cone. You can adjust the softness of the light to create or eliminate the harsh circle of projected light. You can also project image maps from spot lights. The attributes of the spot light are:
1. **Cone Angle**: Cone angle is the angle from edge to edge of the spot light's beam.
2. **Penumbra Angle**: Penumbra Angle is the angle from the edge of the spot light's beam over which the intensity of the spot light falls off linearly to zero.
3. **Dropoff**: Dropoff controls the rate at which light intensity decreases from the center to the edge of the spot light beam.

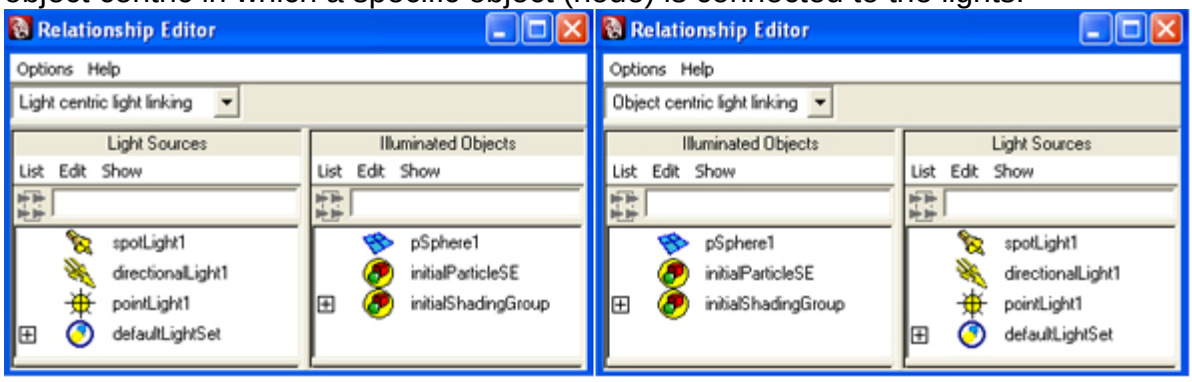
Area Light
Area Light simulates light coming from a window or a reflection from mirror or

window. The area lights takes longer to render but produce good results. The area light behaves like point light the deference between the two is that the area light uses a rectangular surface to emit light and it emits light from one face of the rectangle. The attributes of the area light are same as that of point light.

Volume Light
Volume lights illuminate objects which are enclosed in the volumetric shape of the light. The falloff of the volume light can be controlled with the help of a color ramp. The light shape option in the attribute editor determines the volumetric shape of the light. A volumetric light can be in the shape of: Box, Sphere, Cylinder, or Cone.

3.1.3 Light Linking

With the help of light linking you can link lights with the nodes in the scene. When you link the light to a specific node, the light will affect that node only. Light linking is done using Relationship editor. Two type of light linking are available: light centric in which you connect light to the illuminated objects and other one is object centric in which a specific object (node) is connected to the lights.



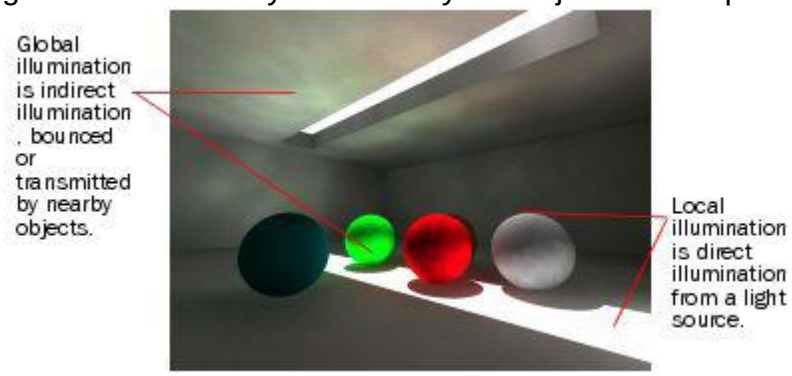
Light Centric Light Linking Object Centric Light Linking

3.1.4 Light Baking:

This process is also called Light Mapping.
Light Baking is a method of sampling an object before rendering, and storing the results for later on uses.
It is the most common application that samples illumination for each point of a texture image wrapped around to the object and stores that illumination in the texture. Here the Illumination is effectively frozen into the texture and later it can be mapped onto an object in the conventional way.
Light Baking was introduced with mental ray 3.0. It is very flexible and user friendly to use as it is given in mental ray. Here Lightmap Shaders are very supportable with this option here. When you attach Lightmap Shader to the material then the Light Baking gets on for the object on which you have applied the same material.
The advantage of Light Baking is that rendering can obtain illumination quickly from the frozen illumination, instead of computing it at rendering time which takes a long time as per the file size and the calculation of the bounced lights. It is especially valuable for indirect illumination which takes more time to compute than direct illumination. So, it is very useful in gaming.

3.1.5 Indirect Illumination

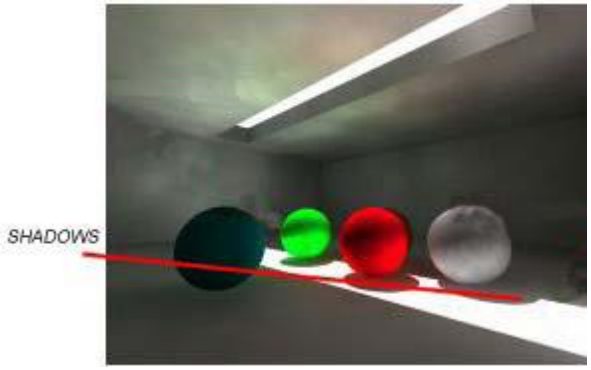
Indirect Illumination is also called Global Illumination.
Indirect Illumination is the technique used to capture indirect illumination, the natural phenomenon where light gets bounced off anything in its path until it is completely absorbed in the environment. Illumination is the calculation of the bounced light. Direct Illumination is the light which falls on the object directly and gets bounced from the object and the object is visible. Indirect Illumination is the light which is already bounced by the object and is spread in the environment.



Here the objects in the place where the light is not falling they are also becoming visible to our eyes. For example – If the light enters in a dark closed room from a small window then also all the area and objects are becoming visible to our eyes. They are not very bright to see but you can see each of them at least. This happens due to the light which gets bounced by the object on which it falls. Here the intensity and material of the object which bounces the light is also very important.

3.1.6 Shadows

Shadows are the darkened areas which appear on a surface as an object gets in the path of a light source. Shadows fall onto the area of a surface
that doesn't directly receive light and which is opposite to the light. Shadows ground the objects in your scene and help in defining their three-dimensional appearance. Shadows make your scene real looking.



3.2 Cameras

In Maya, two types of cameras are available: Perspective and Orthographic. By default, you have three orthographic cameras, Top, Front and Side and one perspective camera Perspective (persp). For rendering, you must use custom (user) cameras. You can place custom cameras anywhere in the scene; even inside a very small thing as well as you can animate custom cameras. You have three types of custom cameras:
a) **Camera**: You can use camera for static scenes or simple animation.
b) **Camera and Aim**: You can use camera and aim to create little complex animations where camera should focus on something like a randomly flying insect
c) **Camera, Aim and Up**: You can use camera, aim and up in such animation where you want to control the up axis of the camera too.
A camera's exposure settings determine depth of field (the region of sharp focus), and whether or not subject matter is crisp or blurred by motion. In realworld photography, together the fStop and shutter speed determine how much light is exposed to film. However, fStop and shutter speed also determine what is in focus. The length of time light is allowed to pass through the camera lens to the film is determined by the shutter speed. The higher the speed, the shorter the exposure time, the less light exposed to the film. The amount of light that is allowed to pass through the camera lens to the film is determined by the camera's aperture setting (also known as the fStop). The wider the aperture, the more light exposed to the film.

3.2.1 Motion Blur

Motion blur gives the feeling of motion. Motion blur is determined by the shutter speed. Fast motion appears motion blurred at slower shutter speeds. Motion blur can be turned on and off on a per-object basis.

3.2.2 Depth of Field

Depth of field is the region of sharp focus in a photograph. Depth of field is determined by the camera's aperture setting. At wide aperture settings, the depth of field is shallow. At narrow aperture settings, the depth of field is deep, and more of the foreground and background is in focus.
Major Attributes of the camera are:

3.2.3 Angle of view/Focal Length

The focal length of a lens is the distance from the center of the lens to the film plane. The shorter the focal length, the closer the focal plane is to the back of the lens. Increasing the Focal Length zooms the camera in and increases the size of objects in the camera's view. Decreasing the Focal Length zooms the camera out and decreases the size of objects in the camera's view. Lenses are identified by their focal length. Focal length is expressed in millimeters.

Camera scale
Scales the size of the camera relative to the scene. If camera Scale is 0.5, the camera's view covers an area half as large, but objects in the camera's view are twice as large.

Auto Render Clip Plane
If this is on, the near and far clipping planes are automatically set so they enclose all objects within the camera's view. This option works only with Maya software renderer. If off, the near and far clipping planes are set to the Near Clip Plane and Far Clip Plane attribute values.

3.2.5 Film Back

The Film Back attributes control the basic properties of a camera.
1. **Film Gate**: Film Gate lets you select a preset camera type.
2. **Camera Aperture**: The height and width of the camera's Film Gate setting, measured in inches.
3. **Film Aspect Ratio**: The ratio of the camera aperture's width to its height.
4. **Lens Squeeze Ratio**: The amount the camera's lens compresses the image horizontally. Some cameras, anamorphic cameras, compress the image horizontally to record a large aspect ratio image onto a square area on film.
5. **Fit Resolution Gate**: Fit resolution gate controls the size of the resolution gate relative to the film gate.
6. **Film Fit Offset**: Film fit offset offsets the resolution gate relative to the film gate either vertically or horizontally.
7. **Film Offset**: Film offset offsets vertically and horizontally the resolution gate and the film gate relative to the scene.
8. **Pre Scale**: This value indicates the artificial 2D camera zoom.
9. **Film Translate**: The Film Translate value indicates the artificial 2D camera pan.
10. **Film Roll Pivot**: The Film pivot point is used to rotate from the center of the film back.
11. **Film Roll Value**: This specifies the amount of rotation around the film back.
12. **Film Roll Order**: Film Roll order specifies how the roll is applied with respect to the pivot value.

Output Settings
Output settings controls whether the camera generates an image during rendering, and what types of images the camera renders.
1. **Renderable**: If on, the camera can create an image file, mask file, and, or depth file during rendering.
2. **Image**: If on, the camera creates an image file during rendering.
3. **Mask**: If on, the camera creates a mask during rendering.
4. **Depth**: If on, the camera creates a depth file during rendering. A depth file is a type of data file that represents the distance of objects from the camera.
5. **Depth Type**: This option determines how to compute the depth of each pixel.

3.2.5 Environment

Environment control the appearance of the scene's background as seen from the camera.
1. **Background Color**: This is the color of the scene's background when it is rendered.

2. **Image Plane**: You can not apply texture to background color. For textures, you can create an Image plane and then apply texture on the plane.

Shutter Angle
The Shutter Angle influences the blurriness of objects of motion blurred objects. The larger the Shutter angle setting, the more blurry objects. Shutter Angle is measured in degrees.

3.2.6 Batch Rendering

Generally Maya renders only the current frame. If you want to render number of frames (animation), you have to use batch render. You can give the batch render command from the Maya and you can also batch render from the command prompt. Before giving the command, make the following changes in the render options:
1. Set the filename.
2. Set the Frame/Animation extension for the file.
3. Set the Image format, for example single file like avi or you can generate sequence of images.
4. Set the video compression.
5. Set the starting and ending frames.
6. Set the camera through which you want to render.
7. Set the Image size in which you want to render.
8. In Maya Software tab set Anti-aliasing quality to Production quality.
9. If Reflection and Refraction is used then Activate Raytracing.
10. Then go to Rendering menu set, Render Menu and choose batch render.
In the batch render option box you can specify whether to you all the available processors or you can enter number of processes. These work only on multiprocessor
machines. You can continue using the Maya or you can close Maya
and start working on different application while batch rendering is going.

3.3 Assignment

1. Light Character in Room

UNIT 4 Skinning

	Time Required to Complete the unit
The time required to study thus Unit is broken as follows 1. 1st Reading: It will need 2 Hrs for reading a unit	
1. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit 2. Self Assessment: It will need 3 Hrs for reading and understanding a unit 3. Revision and Further Reading: It is continuous process	

4.1 Introduction

Skinning is the process of setting up a character's model so that it can be deformed by a skeleton. You skin a model by binding a skeleton to the model. You can bind a model to a skeleton by a variety of skinning methods, including smooth skinning and rigid skinning. Smooth skinning and rigid skinning are direct skinning methods. You can also use indirect skinning methods, which combine the use of lattice or wrap deformers with either smooth or rigid skinning.

4.1.1 Rigid Skinning

Rigid skinning provides articulated deformation effects by enabling joints to influence sets of deformable object points. With rigid skinning, only one joint can influence each CV, vertex, or lattice point. This provides rigid deformation effects that you can smooth by using lattice deformers, cluster deformers, or flexors

4.1.2 Bind Skin > Rigid Bind

Rigid bind binds deformable object with the skeleton. The options available are:
1. **Bind to**: This option specifies whether to bind to an entire skeleton or only to selected joints.
2. **Coloring**: This option specifies whether to color the joints according to the colors automatically assigned to skin point sets.
3. **Bind Method**: This option specifies whether you want to bind by closest point or by partition set.
a. **Closest Point**: This option specifies that software automatically organize deformable object points into skin point sets for you based on the proximity of each point to a joint.
Partition Set: This option specifies that Maya bind points that you've already organized into sets in a partition.

Edit Rigid Skin > Create Flexor
Create flexor creates flexor at the joint(s) or bone(s). The available options are:
1. **Flexor Type**: This option specifies whether to create lattice flexors, sculpt flexors, or joint cluster flexors.
2. **Joints**: This option specifies whether to create joint lattice, joint sculpt, or joint cluster flexors at selected joints only, or at all a skeleton's joints.

3. **Bones**: This option specifies whether to create bone lattice or bone sculpt flexors at selected bones only or at all bones.

Lattice Options: If Flexor Type is lattice, you can specify the Lattice Options:
4. **S, T, U Divisions**: These specify the structure of the lattice in the lattice's local STU space.
5. **Position the Flexor**: This option enables you to adjust the lattice before it starts having an effect on skin objects.
Sculpt Options: If Flexor Type is sculpt, you can specify the Sculpt Options:
6. **Max Displacement**: This option specifies the distance that the sculpt sphere can push a skin object's points from the sculpt sphere's surface.
7. **Dropoff Distance**: This option specifies the sculpt sphere's range of influence.
8. **Dropoff Type**: This option specifies how the sculpt sphere's range of influence declines or drops off. There are two Dropoff Types: None and Linear.
9. **Mode**: This option specifies the sculpt sphere's deformation mode as flip, project, or stretch.
10. **Inside Mode**: This option specifies how the sculpt sphere influences the skin points located inside the sculpt sphere. There are two modes:
a. Ring mode pushes inside points outside of the sculpt sphere, creating a contoured, ring-like effect around the sculpt sphere.
b. Even mode spreads the inside points all around the sculpt sphere evenly, creating a smooth, spherical effect.

Reassign Bone Lattice Joint
Reassign Bone Lattice Joint sets a new driver joint for the current bone lattice flexor. The joint that drives a bone lattice flexor is the child of the bone that the flexor's influence lattice surrounds.

Preserve Skin Groups > Detach Skeleton
This option disconnects the current skeleton from its skin. Detaching the skeleton preserves the rigid skin point sets and the rigid skin point weights, and unlocks the transformation attributes of its skin objects.

Preserve Skin Groups > Reattach Skeleton
This option reconnects the current skeleton to its skin objects. Reattaching the skeleton locks the transformation attributes of its skin objects.

Deform > Edit membership Tool
You can directly edit deformer set memberships by selecting deformable object points with the Edit Membership Tool.

4.1.3 Smooth skinning

Smooth skinning provides smooth, articulated deformation effects by enabling several joints to influence the same deformable object points. During smooth skinning, for each smooth skin point, software assigns a smooth skin point weight for each joint that controls the influence of that joint on each point. If you want to

change the results of smooth skinning to create unique skeletal deformation effects, you can edit or paint the weights of smooth skinning at the point level. Joints closer to a smooth skin point will have a greater influence than joints far from the skin point.

Bind pose
When you bind skin, software creates a bind pose node for each skeleton. This bind pose node keeps track of the joints' transformation attributes when skinning takes place. The bind pose node also keeps track of the transformation attributes of any influence objects. The bind pose node facilitates putting the skeleton back into the bind pose at any time after binding skin.

4.1.4 Bind Skin > Smooth Bind

You can bind geometry to any transform node or hierarchy of nodes such as an empty group node or a locator. With either Closest Joint or Closest Distance, you can limit the number of joints that influence nearby skin points by setting Max Influences. The options available in the option box are:
1. **Bind to**: This option specifies whether to bind to an entire skeleton or only to selected joints.
a. **Joint Hierarchy**: This option specifies that the selected deformable objects will be bound to the entire skeleton, from the root joint on down through the skeleton's hierarchy, even if you have selected some joint other than the root joint.
b. **Selected Joints**: This option specifies that the selected deformable objects will be bound to only the selected joints, not the entire skeleton.
c. **Object Hierarchy**: When this option is selected, the selected deformable geometry is bound to the entire hierarchy of the selected joint or non-joint transform node, from the top node down through the entire node hierarchy.
2. **Bind Method**: This selection includes Closest Joint or Closest Distance.
a. **Closest In Hierarchy**: This option specifies that joint influence is based on the skeleton's hierarchy.
b. **Closest Distance**: This option specifies that joint influence is based only on proximity to the skin points.
3. **Max Influences**: This option specifies the number of joints that can influence each skin point.
4. **After Bind (Maintain Max Influences)**: When this option is on, smooth skinned geometry cannot have a number of influences greater than that specified by Max Influences.
5. **Dropoff Rate**: This option specifies how rapidly the influence of each joint on skin points will decrease with the distance from each joint.
6. **Remove Unused Influences**: When this option is on, weighted influences that would receive a zero weighting are prevented from being included in the bind.
7. **Colorize Skeleton**: When this option is on, bound skeletons and their skin's vertices are colorized so that their vertices appear the same color as the joints and bones that influence them.

Edit Smooth Skin > Add Influence

Add Influence option adds additional deformer objects to the skin. The options available are:
1. **Geometry**: Click Use Geometry on if you want the influence object's shape as well as its transform attributes to influence the skin's shape.
2. **Dropoff**: This option specifies the rate at which the influence of the influence object's position drops as the distance from the influence object increases.
3. **Polygon Smoothness**: This option specifies how accurately the smooth skin points follow a given polygonal influence object.
4. **NURBS Samples**: This option specifies the number of samples used to evaluate the influence of a NURBS influence object's shape.
5. **Weight Locking**: This option specifies that you want to prevent the influence object's weights from being changed indirectly, typically because of weight normalization during weight painting and editing.
6. **Default Weight**: This option specifies the default holding weight if Weight Holding is on.

Remove Influence
Remove Influence removes the current influence object's influence from the skin. Remove Influence does not delete the current influence object from the scene.

4.1.5 Paint Skin Weights Tool

With the Paint Skin Weights Tool, you can paint a weight intensity value on the current smooth skin. Paint Skin Weights Tool settings are:

Influence:
1. **Sort Transforms**: This option sorts the joints that influence skin weights for the current character.
2. **Toggle Hold Weights On Selected**: This button locks the weight of the current influence so that when the weights of other influences are painted, the influence that is held is not affected.

Paint Weights:
3. **Paint Operation** : The following operations are available:
a. **Replace**: The brush stroke replaces the skin weight with the weight set for the brush.
b. **Add**: The brush stroke increases the influence of nearby joints.
c. **Scale**: The brush stroke decreases the influence of far away joints.
d. **Smooth**: The brush stroke smoothes out the influences of the joints.
4. **Value**: You can specify the weight value the brush stroke applies.
5. **Min/Max Value**: This option sets the minimum and maximum possible paint values.
6. **Clamp**: Clamp sets whether you want to clamp the values within a specified range, regardless of the Value set when you paint.
7. **Clamp Values**: If you turns on the Lower and Upper clamping fields you can specify the value for them.
8. **Flood**: You can click Flood to apply the brush settings to all the weights on the selected skin. The result depends on the brush settings defined when you perform the flood.

Mirror Skin Weights
This option copies and pastes the reflected skin weights on the opposite side of the character. The options available are:
1. **Mirror Across**: This option specifies mirroring weights about the global plane you choose.
2. **Direction**: Positive to Negative (+Z to -Z) specifies direction of the mirroring along the specified Mirror Across plane.

Copy Skin Weights
Copy skin weights copies the skin weights of the selected source skin to the selected destination skin. The only option available is:
1. **Use Smooth Skin Weight Copy**: This option improves the results of your skin weight copy by smoothing the distribution of copied weights on the destination skin. This option is most useful when copying smooth skin weights from a low resolution polygonal mesh to a high resolution polygonal mesh.
Normalize Weights
Normalize weights adjusts the weighting of the selected skeleton so that all its smooth skin weights add up to one.
Detach Skin
Detach Skin detaches the deformable body from the skeleton. The options available are:
History: Set this setting to Delete History, Keep History, or Bake History.
Coloring: This option specifies whether to remove the joint colors assigned during binding or not.

4.2. Animation

The act, process, or result of imparting life, interest, spirit, motion, or activity to an object or picture is called as Animation.
Animation is a sequence of consecutive images that creates an illusion (false imagination) of movement, when it is viewed with a rapid cycle.

4.2.1 Types of Animations in Maya

1. **Keyframe Animation**: Key frame animation lets you animate objects over time by creating keyframes.
2. **Driven key Animation**: Driven key animation lets you link and drive the attributes of one object with those of another object by setting driven keys.
3. **Nonlinear Animation**: Nonlinear animation lets you split, duplicate, and blend animation clips to achieve the motion effects.
4. **Path Animation**: Path animation enables you to move an object along a path. You can also give deformation and rotation to the object along with movement.
5. **Dynamic Animation**: Dynamic animation lets you create the real life like motion using the rules of physics.
6. **Motion Capture Animation**: Motion capture animation lets you use

imported motion capture data to apply realistic motion to the characters.
7. **Animation with Expressions**: Expressions are short set of instructions. You can also animate the attributes of an object with the help of expressions.

4.2.2 Keyframes

Animation is the process of creating and editing the properties of objects that change over time. Keyframes or simply keys are arbitrary markers on the timeline that designate the property values of an object at a particular time. In simple word, keyframes is the frames on which changes will occur.

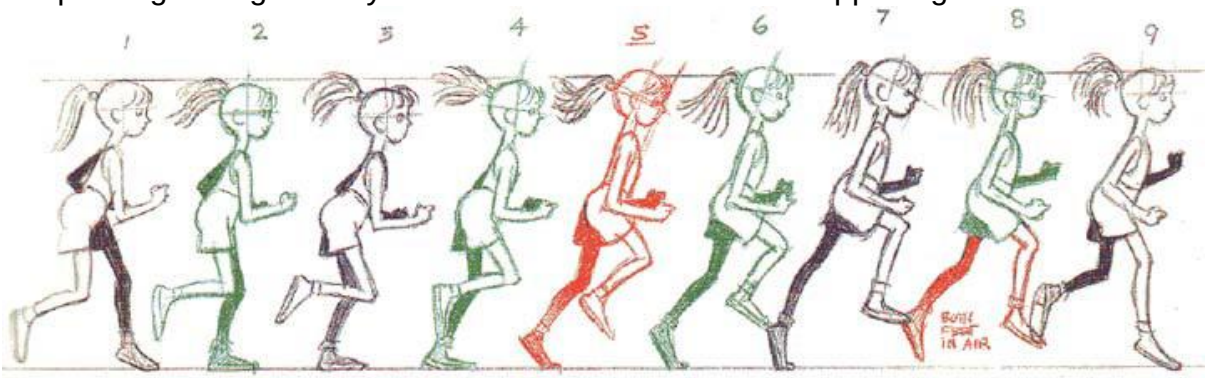
Breakdowns

Breakdowns are special keyframes that maintain proportional time relationships with adjacent keyframes. Breakdowns are used to adjust the timing of an animation while holding attribute values at points on the animation curve.

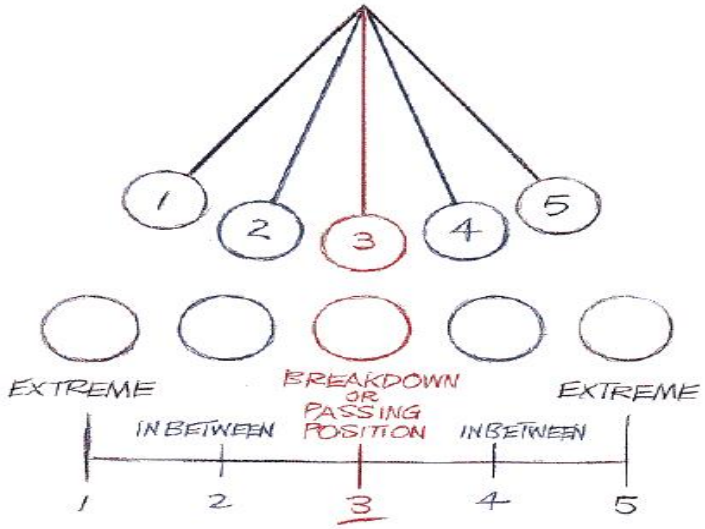
4.2.3 Methods of Animation.

There are Three methods of animation as under:-

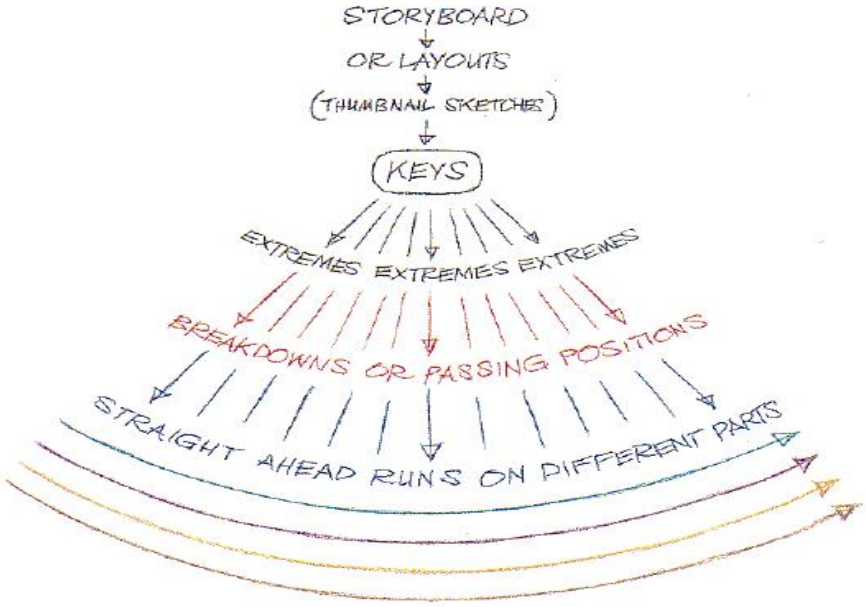
1) Straight Ahead Method: - Keying the first and the last frame is called straight ahead method. This method is also called as Traditional Animation method where all the frames are supposed to be drawn by hand only. Then the frames are passing through our eyes and we see the animation happening.



2) Pose to Pose Method: - Keying the frames between first and last frame is called pose to pose method. This method is called Tweening also as here you can make two situations or poses and the in between are generated by them selves as an Illusion according to the arrangements of the poses or by any animation software like MAYA, 3DS MAX or in 2d Animation Flash etc. Here the arrangements of the poses is given in the following image.



4) **Hybrid Method: -** Combination of above two methods are called Hybrid method. So, if any technical person asks you, which method you are using for animation? Then answer is always Hybrid method. Combination of above two methods is called Hybrid method. So, if any technical person asks you, which method you are using for animation? Then answer is always Hybrid method.
This method is a composition of both the straight ahead and pose to pose method and it is having the advantages of both of them. Here you can easily arrange the tining and poses according to your requirements.



4.2.4 Animation controls

Animate >
Set Key
Set Key command is used to insert a key at the current position of the playback head in the timeline. The options available in the option window are:
1. **Set Keys on**: This option specifies which attributes will have keys set on them. The sub options are:
• **All Manipulator Handles and Keyable Attributes**: If you select

this option, it will set a key for the current manipulator, and if there is none, then the current object.
• **All Keyable Attributes**: If you choose this option, it will set keys on all attributes of the selected object(s).
• **All Manipulator Handles**: If you choose this option, it will set keys on attributes affected by the selected manipulator.
• **Current Manipulator Handle**: This option will set keys on attributes affected by the selected manipulator handle.
2. **Set Keys at**: It specifies on what time the keys will be set. The sub options are:
• **Current Time**: It will set keys at the current time only.
• **Prompt**: If this option is selected then you will be prompted for the time when setting keys.
3. **Set IK/FK Keys**: When keying an IK handle or joint chain, Set IK/FK Keys adds keys for all attributes of the handle and all joint of the chain. This lets you create smooth IK/FK animations. This option is available only when "All Keyable Attributes" is on.
4. **Hierarchy**: This option specifies which objects in a parent-child hierarchy will have keys set on them.
5. **Channels**: This option specifies what channels will have keys set on them.
• **All Keyable**: It sets keys on all the channels of the selected object.
• **From Channel Box**: It sets keys on the selected channels of the selected object.
6. **Control Points**: Control Points option sets keys on the control points of the selected objects. Control points are NURBS CVs, polygonal vertices, or lattice points.

Set Breakdown
Set Breakdown command is used to insert Breakdowns on the timeline at the current position of the playback head in the timeline.

Hold Current Keys
Hold Current Keys sets keys for all animated attributes of a selected object at the current time. This command is most useful with Auto Key because Auto Key sets keys only for attributes that change value.

4.3 Assignment

1. Ball Bounce

UNIT 5 Path animation

	Time Required to Complete the unit

The time required to study thus Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading a unit
2. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit
3. Self Assessment: It will need 3 Hrs for reading and understanding a unit
4. Revision and Further Reading: It is continuous process

5.1 Path animation

A path animation controls the position and rotation of an object along a curve. The point at which your object attaches to the path animation curve is the rotate pivot.

Set Motion Path Key

Set Motion Path Key adds a motion path marker to the selected motion path curve at the current time.

Attach to Motion Path

Attach to Motion Path places and links the selected object to the current curve. The current curve becomes the motion path. The options available in option box are:

1. **Start Time**: This option specifies the start time of the motion path animation. This option is only available when Start or Start/End in Time Range is on.
2. **End Time**: This option specifies the end time of the motion path animation.
3. **Parametric Length**: This option specifies the method Maya uses to position an object as it moves along a curve. There are two methods:
   a. **Parametric space method**: In the parametric space method, the markers represent positions in the U-parameter space of the curve.
   b. **Parametric Length method**: In the parametric length method, the markers represent positions as a percentage of the total curve length.
4. **Follow**: If Follow is on, Maya computes the object's orientation as it moves along the curve.
5. **Front Axis**: This option specifies the frontward orientation of the object as it travels along the curve.

6. **Up Axis**: This option specifies which of the object's local axes aligns with the up vector. This specifies the upwards orientation of the object as it travels along the curve.
7. **Inverse Up**: If this option is on, Up Axis tries to align itself with the inverse of up vector.
8. **Inverse Front**: This option reverses the frontward direction an object is pointing along the curve. This is especially useful when you are trying to orient a camera so that it points frontward along a curve.
9. **Bank**: Banking means the object will lean in towards the center of the curvature of the curve that it travels along. The bank option is only available if the Follow option is on, as banking also affects the rotations of the object.
10. **Bank Scale**: If you increase the Bank Scale, then the banking effects will be more.
11. **Bank Limit**: The Bank Limit lets you restrict the amount of leaning.

Flow Path Object

This option creates a flow path along the current motion path or around the current object. The options available in the option box are:
1. **Divisions**: These values represent the number of lattice sections that will be created. The Front, Up, and Side correspond to the axes that were specified when the path animation was created.
2. **Lattice Around**: This option specifies the object around which lattice will be created. The options are:
a. **Object**: This option creates the lattice around the object.
b. **Curve** This option creates the lattice around the path curve.
3. **Local Effect**: This option is most useful when you create the lattice around the curve. If the lattice is large, you probably don't want to have the lattice points at one end of the lattice affect the object when it is close to the other end of the lattice.

Driven keys

Maya has special driven keys that link one attribute value to another. In regular animation, an attribute has values keyed to times in the Time Slider. For a driven key, an attribute has values keyed to the value of a driving attribute. A change in a driver attribute alters the value of the driven attribute. An attribute can be driven by multiple attributes. For example, you can make a muscle bulge when an elbow rotates. You can make the muscle bulge even more when the wrist rotates.

Set Driven Key > Set

This option opens the Set driven key window. The options available in the window are:
1. **Driver list**: This list consists of a left column and a right column. The driver object'sname appears in the left column, and the object's keyable attributes appear in the right column.
2. **Driven list**: The driven object's name appears in the left column, and the object's keyable attributes appear in the right column.
3. **Key Button**: Key button is used to connect the attributes of Driver and Driven objects. Select the attributes which you want to connect and press key button.
4. **Load Driver**: Load Driver button loads the selected object as driver object

in the driver list.
5. **Load Driven**: Load Driven button loads the selected object as driven object in the driven list.

Set Driven Key > Go to Previous and Go to Next
These options cycle you through the keys for the driven attributes of the current object and view the objects state at each of these keys.
Set Transform Keys
Translate
This option adds a regular key at the current time on the X, Y, and Z translation channels of the selected object.
Rotate
This option adds a regular key at the current time on the X, Y, and Z rotation channels of the selected object.
Scale
This option adds a regular key at the current time on the X, Y, and Z scaling channels of the selected object.

5.1.1 Create Animation Snapshot

This option creates an animation snapshot for the current object. The options available are:
Time Range
1. **Start/End**: This option, if selected, creates a Snapshot for the frames specified by the Start Time and End Time.
2. **Time Slider**: This option creates a Snapshot for all the frames in the time slider.
3. **Increment**: This option specifies the number of frames between which the Snapshot is drawn.
4. **Update**: This option specifies how the snapshots will be updated:
a. **On Demand**: This option updates the snapshot only when you select Animate > Update Motion Trail/Snapshot.
b. **Fast (Update Only When Keyframes Change)**: This option updates the snapshot when you add or change a keyframe for the object with the snapshot.
c. **Slow (Always Update)**: This option updates the snapshot if you change anything in the shape or animation of the object with the snapshot.
Create Animated Sweep
This option creates an animated sweep for the selected objects. The options available are:
Time Range
1. **Time Slider**: This option creates an animated sweep for the length of time defined by the length of the time slider.
2. **Start/End**: This option lets you set a specific a Start time and End Time for the animated sweep.
3. **By Time**: This option evaluates the animation and creates geometry for each By Time position.
Parameterization
4. **Uniform knot**: This option makes the profile curves run parallel to the V direction. The parameter values of the resulting surface in the U direction are equally spaced.

5. **Chord Length**: This option causes the parameter values on the resulting surface in the U direction to be based on the distance between the start points of the profile curves.
6. **Surface Degree**: This option sets the lofted surface to linear or cubic in the U direction.
7. **Surface**: This option specifies whether an open or closed surface is created.
8. **Output Geometry**: This option specifies the type of geometry created. You can choose form NURB or Polygons.

Turntable
This option adds a turntable camera i.e. a camera which revolves around an object in 360 degrees, to your scene. This camera generates a turntable animation for the number of frames you specify in the Number of Frames field of the Create Turntable Animation options window. The options available in the option box are:
1. **Number of Frames**: This option specifies the duration and speed of the turntable animation.
2. **Direction**: The direction in which camera revolves:
a. **Clockwise**: When this option is on, the turntable camera orbits clockwise around the selected objects.
Counter Clockwise: When this option is on, the turntable camera orbits counterclockwise around the selected objects.

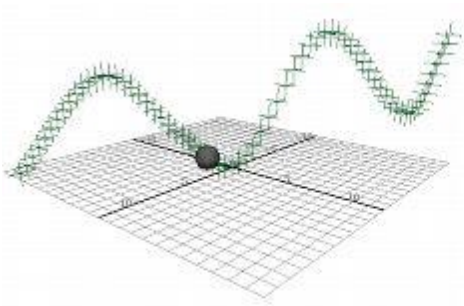
Trax Editor
The Trax Editor is a nonlinear animation tool. The Trax Editor is a high-level animation tool that lets you select and control characters and their animation clips, layer and blend animation sequences, synchronize your animation and audio clips, and drag-and-drop animation clips between mapped characters. With the Trax Editor, you can manipulate and arrange your animation sequences from a higher level than from the Graph Editor or Dope Sheet.

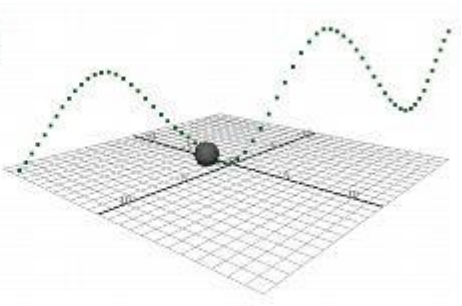
Animate >Create Clip
Create Clip creates an animation clip. A clip is a collection of animation curves for a character. Animation clips can be used for non-linear animation. Clips can also store in the visor so that they can be reused. The options available are:
1. **Name field**: You can specify a name for the clip.
2. **Keys (Leave Keys in Timeline)**: If this option is on, the current character set's keys are not removed from the Time Slider when you create a clip for the current character's animation curves. When off, the current character set's keys are removed from the Time Slider when you create a clip for the current character's animation curves.
3. **Clip**: This option specifies where to put the clip you're creating:
a. **Put Clip in Visor Only**: This setting is useful if you won't use the clip currently but want to store it for future use.
b. **Put Clip in Trax Editor and Visor**: This setting lets you work on the clip in the Trax Editor as well as stores it in the visor.
4. **Time Range**: This option specifies the clip's time range in the Trax Editor:
a. **Selected**: This option uses a time range you've selected in the Timeline for the clip. To select a time range, drag through the desired times in the Time Slider's Timeline.

b. **Time Slider**: This setting uses a time range defined by the Playback Start and End times of the Timeline.
c. **Animation Curve**: This setting uses a time range that spans the range of the character set's animation curves.
d. **Start/End**: This setting specifies a time range from Start Time to End Time.
e. **Start Time**: This option specifies the start of the time range.
f. **End Time**: This option specifies the end of the time range.
5. **Subcharacters (Include Subcharacters in Clip)**: When this option is on, it creates a single source clip that includes all animation curves for the character set and all its subcharacter sets.
6. **Timewarp (Create Timewarp Curve)**: This option creates a time warp curve for the selected clip.

Animate >Create Pose
Create Pose creates a pose of the current character. You can store a snapshot of a character's current position for any moment in its animation. The options available are:
Name field: This option defines the name of the pose as it is displayed in the Visor.

Previewing your animation ghosting: Like all the frames you are able to see in the straight ahead method of animation, here you can see all the frames which are generated while making the animation in the software. You need to see each and every frame to make the animation smooth and realistic and for that you need to use the Hybrid method where you are going to make the poses as well as straight animations. So, you can use the ghosting as it shows each and every frame in the view port when it is on.
Ghosting is the simulation of a technique in classical animation where an animator rapidly flips through a handful of cell drawings to get a feel for the timing of the action he is working on.
Select the object and select Animate > Create Motion Trail >


Motion Trail - locator draw style


Motion Trail - point draw style

5.2 Assinment

1. Ball Bounce – Lab

BCA (DES)305- 3rd YEAR

ILLUSION-02

Babasaheb Ambedkar

Open University

Block 3

BCA(DES)-305

ILLUSION-02

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Publications that are mentioned in Bibliography. The content developed represents the breadth of research excellence in this multidisciplinary academic field. Some of the information, illustrations and examples are taken "as is" and as available in the references mentioned in Bibliography for academic purpose and better understanding by learner.'

ROLE OF SELF INSTRUCTIONAL MATERIAL INDISTANCELEARNING

The need to plan effective instruction is imperative for a

Successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual

Involvement and contain all the necessary learning instructional activities ties that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect,

Students 'assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make

use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge isbuilt.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices pros vided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive

Communication clues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to r e d u c e

This. Divide and to bring this Self Instructional Material as the b e s t

teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts.

Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline.

These could be in the form of students 'assignments, a research project

or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you

Expect.

All the best for your studies from our team!

All the best for your studies from our team!

6.1 Introduction

Rendering is the final stage in the 3D computer graphics production process. Though the wider context of rendering begins with shading and texturing objects and lighting your scene, the rendering process ends when surfaces, materials,

lights, and motion are processed into a final image or image sequence

6.1.1 Visualization vs. the final render

As you build your scenes like shade and texture objects, light scenes, position cameras, and so on, you'll want to visualize your scene many times before you produce the final rendered image or image sequence. This process may involve creating and setting up additional cameras. Rendering involves a large number of complex calculations which can keep your computer busy for a long time. Producing rendered images always involves making choices that affect the quality of the images, the speed with which the images are rendered, or both.

6.1.2 Software Rendering

Software rendering produces images of the highest quality, letting you achieve the most sophisticated results. Maya has the following software renderers:

1. **The Maya software renderer**: Maya's software renderer is an advanced, multi-threaded renderer. It is a hybrid renderer, offering true raytracing plus the speed advantages of a scan-line renderer. The Maya software renderer supports all of the various entity types found within Maya including particles, various geometry and paint effects and fluid effects. The Maya software renderer features IPR, a tool designed to allow you to make interactive adjustments to the final rendered image, and which greatly enhances rendering productivity. Most importantly, the nature of Maya's integrated architecture allows complex interconnections, like procedural textures and ramps that govern particle emission and other unpredictable relationships that are capable of producing stunning visual effects.
2. **mental images mental ray for Maya**: mental ray for Maya offers all the features traditionally expected of photorealistic rendering and includes functionality not found in most rendering software. mental ray for Maya allows interactive and batch mental ray rendering from within the Maya user interface.

6.1.3 Hardware Rendering

Hardware rendering uses the computer's video card and drivers installed on the machine to render images to disk. Hardware rendering is generally faster than software rendering, but typically produces images of lower quality compared to software rendering. Hardware rendering cannot produce some of the most sophisticated effects, such as some advanced shadows, reflections, and postprocess effects. To produce these kind of effects, you must use software rendering.

Vector Rendering

Vector rendering lets you create stylized renderings in various bitmap image formats and 2D vector formats. You can use the Maya Vector renderer to create stylized renderings for example, cartoon, tonal art, line art, hidden line, wireframe in various bitmap image formats or in the following 2D vector formats:

- Macromedia Flash (non-interactive) (SWF)
- Adobe Illustrator (AI)
- Encapsulated PostScript (EPS)
- Scalable Vector Graphics (SVG).

The Maya Vector renderer cannot render the following Maya features.

- Bump maps
- Displacement maps
- Maya Fluid Effects
- Image planes
- Lights (only point lights are used)
- Maya Fur
- Multiple UVs
- Maya Paint Effects
- Particles
- Post-render effects
- Shaders (only Anisotropic, Lambert, Blinn, Phong and Phong E shaders are used)
- Multiple shaders assigned to a single NURBS or subdivision surface are not rendered.
- Textures (Texture rendering is limited by the Fill Style and the number of polygons)

Render > Render Current Frame

Render Current Frame opens the Render View window and renders the current scene. The options available only for mental ray renderer are:

1. **Number of Rendering Threads to Use**: This option specifies the number of rendering threads to be used by mental ray for Maya for rendering.
2. **Render on this machine**: This option is used for network rendering only. This specifies whether the local machine renders the scene, or whether slaves render the scene. This is useful in reducing the workload on the master machine where Maya is running.

Render > IPR Render Current Frame

IPR Render Current Frame opens the Render View window and IPR renders the current scene.

Shockwave 3D

The Maya Shockwave 3D Exporter provides you with a fast and efficient way to get your Maya content into Macromedia Director. Your content exports in a form that can be authored for use with an interactive experience and played on the Macromedia Director Shockwave player.

Render > Render Settings

Render settings for the Maya Hardware renderer, the mental ray for Maya renderer, the Maya Software renderer, the Maya Vector renderer are consolidated into one Render Settings window. Use the settings in this window to set scene-wide

render options. Especially when used in conjunction with perobject render settings, the render settings give you a great deal of control over quality of rendered images and the speed with which they are rendered.

Common tab

1. **Image File Output**: The name of rendered image files can consist of three separate components: file name, frame number extension, and file format extension. A combination of these three components is referred to as the file name syntax.
2. **File Name Prefix**: The File name prefix attribute to add one or more of these fields to the file name for your scene: scene name, layer name, camera name, version number, current date or current time. You can also create subdirectories to save out rendered images by adding a / (slash) in your file name prefix.
3. **Frame/Animation Ext**: This option defines the format of rendered image file names.
4. **Image Format**: This is the format (extension) for saving rendered image files.
5. **Compression**: Click this button to select the compression method for AVI or QuickTime movie files.
6. **Start Frame, End Frame**: This option specifies the first and last frames to render. Start Frame and End Frame are only available if Frame/Animation Ext is set to an option containing #.
7. **By Frame**: The increment between the frames you want to render. If you use a value less than 1, make sure the Renumber Frames Using option is turned on. Otherwise, many frames will appear to be missing when they are just being overwritten.
8. **Frame Padding**: The number of digits in frame number extensions. For example, if Frame/Animation Ext is set to name.#, and Frame Padding is 3, Maya names rendered image files name.001, name.002, and so on.

Renderable Cameras: Render a scene from one or more cameras. The default is to render from one camera. If you are rendering the scene from one camera, select the camera from the drop-down list. The drop-down list is divided into three sections, separated by dashes:

- The first section is the camera currently selected as renderable.
- The second section lists existing cameras that you can select as renderable.
- The third section is the Add Renderable Camera option. If you want to add another existing camera to the list of renderable cameras, you can select Add Renderable Camera.

9. **Alpha Channel (Mask)**: This setting controls whether rendered images contain a mask channel.
10. **Depth Channel (Z Depth)**: This setting controls whether rendered images contain a depth channel.

Image Size: The Image Size attributes control the resolution and pixel aspect ratio of rendered images.

11. **Presets**: Select a film- or video-industry standard resolution. When you select an option from the Presets drop-down list, Maya automatically sets

the Width, Height, Device Aspect Ratio, and Pixel Aspect Ratio.
12. **Maintain Width/Height Ratio**: Turn on this setting when you want to scale the image size proportionally in width and height. When you enter a value for either Width or Height, the other value is automatically calculated.
13. **Maintain Ratio**: This setting specifies the type of rendering resolution ratio you want to use, Pixel Aspect or Device Aspect.
14. **Width**: This setting specifies the width of the image in the unit specified in the Size Units setting.
15. **Height**: This setting specifies the height of the image in the unit specified in the Size Units setting.
16. **Size Units**: This option sets the unit that you want to specify the image size in.
17. **Resolution**: This setting specifies the resolution of the image in the unit specified in the Resolution Units setting.
18. **Resolution Units**: This option sets the unit that you want to specify the image resolution.
19. **Device Aspect Ratio**: The aspect ratio of the display device on which you view the rendered image. The device aspect ratio represents the image aspect ratio multiplied by the pixel aspect ratio.
20. **Pixel Aspect Ratio**: The aspect ratio of the individual pixels of the display device on which you are viewing the rendered image.
Renderings available in Maya are:

Mental Ray Custom Shaders: Here Custom shaders are the custom-coded mental ray shaders which help you in creating looks over and above those that can be achieved with the standard mental ray for Maya Base shaders. You can create them in C or C++ language, then process them into modes that you can see and use in Maya.
A collection of custom shaders make up a Custom Shader Library. Custom shaders are typically distributed in custom shader libraries. To see a particular custom shader in Maya, you must load the shader library that contains that custom shader.
Custom mental ray shaders with color attributes create corresponding RGBA attributes in Maya. This means that the alpha_component of color values on custom shaders can drive or can be driven by Maya shading networks. Custom shaders written for Maya's Software renderer can be related to mental ray for Maya custom shaders. The correspondence is driven by an .mi declaration that is loaded in the Shader Manager. Then, mental ray for Maya detects the corresponding Maya shading node. The corresponding parameters or attributes and connections to other supported nodes are associated. As a result, you can create a single shading network that is compatible for both Maya and mental ray rendering.
A custom shader library consists of two files:
One declaration file (for example, mayabase.mi) that contains descriptions of the interfaces of the shaders and One library file (for example mayabase.so or mayabase.dll) that contains the actual implementations of the shaders.

Mental Ray Lights, Shadows And Fog:
Mental Ray Motion Blur:

Mental ray computes motion blur of highlights, textures, shadows, reflections, refractions, transparency, and intersecting objects. There are two methods of defining motion blur:

• Instance motion blur defines a transformation matrix that controls the orientation of the instanced object, light, or camera after a shutter interval of one time unit, in addition to the regular transformation matrix that defines the orientation at the beginning of the shutter interval. Moving lights cause blurred highlights and shadows.

• Motion vectors can be defined at object vertices to create internal motion caused by shape changes. Each vertex has a vector associated with it that describes how far that vertex moves in one time unit. For deferred objects, where the vertices are created later during rendering, it is necessary to supply a motion bounding box that describes the lowest and highest expected motion vector components. mental ray supports motion blur both in scanline and raytracing mode. Motion blur does introduce rendering overhead only where blur must be computed; if the camera moves this could be the entire image but if only a small object moves the overhead is small.

6.1.4 Final Gathering

Final gather is a method of global illumination to create very diffuse scenes where the indirect illumination changes slowly. Final gathering is a technique for estimating global illumination for a given point by either sampling a number of directions in the hemisphere over that point, or by averaging a number of final gather points nearby since final gather points are too expensive to compute for every illuminated point. Without final gathering, the global illumination on a diffuse surface is computed by estimating the photon density near that point. With final gathering, many new rays are sent out to sample the hemisphere above the point to determine the incident illumination. Final gathering is useful in scenes where the indirect illumination varies slowly, such as purely diffuse scenes. For such scenes, final gathering eliminates photon map artifacts such as low frequency noise and dark corners.

If you want to use Final Gather, you have to enable the Final Gather from the render setting for mental ray for Maya renderer. The options available are:

1. **Final Gather**: Use this setting to turn Final gathering for global illumination on or off.
2. **Precompute Photon Lookup**: This option causes photon tracing to compute and store an estimate of the local irradiance at every photon location. This means that far fewer final gathering points are required because the photon map carried a good approximation of the irradiance in the scene—mental ray for Maya can estimate irradiance with a single lookup, instead of many photons. In this case, photon tracing takes longer than before and requires slightly more memory, but rendering is faster.
3. **Final Gather Rays**: This setting controls how many rays are shot in each final gathering step to compute the indirect illumination.
4. **Min Radius, Max Radius**: Max Radius and Min Radius control the size of the sampling region within which Final Gather rays search for irradiance information from other surfaces.
5. **View (Radii in Pixel Size)**: This option causes the Min Radius and Max Radius of final gather rays to be calculated in pixel size, rather than in

object space. This allows you to set the visual quality in pixel size, without knowing the object or scene bounds.
6. **Final Gather Scale**: The Scale value allows you to easily control the intensity and color of the final gather contribution on a global scene level.

6.4 Dynamics

Dynamics
Dynamics is a branch of physics that uses rules of physics to simulate natural forces. Dynamic animation lets you create realistic motion that's hard to achieve with traditional keyframe animation.

Particles
Particles are chunks that display as dots, streaks, spheres, blobby surfaces, etc. You can animate the display and movement of particles. A particle object is a collection of particles that share the same attributes. You can create particle objects containing a single particle or millions of particles.

Particles > Particle Tool
Particle tool creates static particle objects. You can create random particles, a 2D and 3D particle object grid and you can also sketch particles. The options available in the option box are:
1. **Particle Name**: You can give name to the particle object. The name helps you identify the object in the Outliner.
2. **Conserve**: Conserve influences the motion of particles whose velocity and acceleration attributes are controlled by dynamic effects. The Conserve value controls how much of a particle object's velocity is retained from frame to frame. Conserve doesn't affect motion created by keyframes.
3. **Number of Particles**: Enter the number of particles you want to create per mouse click.
4. **Maximum Radius**: If you choose a number greater than 1 for Number of Particles, you can distribute particles randomly in a spherical region where you click.
5. **Sketch Particles**: When this option is selected, you can sketch particles.
6. **Sketch Interval**: Sketch Interval sets the pixel spacing between particles.
7. **Create Particle Grid**: When this option is on, it creates a particle grid.
8. **Particle Spacing**: This option sets the spacing between particles in the grid.
9. **Placement**: You can choose to draw the grid with the cursor or with the text fields.
10. **Minimum Corner**: The x, y, z co-ordinates of the lower left corner of the 3D particle grid.
11. **Maximum Corner**: The x, y, z co-ordinates of the upper right corner of the 3D particle grid.

6.4.1 Create Emitter

Emitters generate particles when an animation plays. Maya includes the following types of emitters:

1. **Point emitters**: These emit particles from a position in the workspace. When you select a NURBS surface or curve and add a default emitter, you create a point emitter that emits from all CVs. There are two type of point emitters:
   a. **Omni**: Omni creates an omnidirectional point emitter.
   b. **Directional**: Directional creates a directional point emitter. Particles emit in the direction you specify with the Direction X, Y, and Z attributes.
2. **Surface emitters**: These emit particles from random, evenly distributed positions on the outer faces of NURBS or polygonal surfaces.
3. **Curve emitters**: These emit particles from random, evenly distributed positions of a NURBS curve.
4. **Volume emitters**: These emit particles from a closed volume. You can choose from cube, sphere, cylinder, cone, and torus.

The options available in the option box are:

1. **Rate**: Rate sets the average rate at which particles are emitted per second.
2. **Scale Rate by Object Size**: This option is only available when the current Emitter Type is Surface, Curve, or Volume. If you turn on this attribute, the size of the object emitting the particles affects the rate of particles emitted per frame.
3. **Need Parent UV NURBS**: If you turn this on in the Emitter Options window, Maya adds parentU and parentV attributes to the particle shape and sets the needparentUV attribute to on.
4. **Cycle Emission**: Cycle Emission lets you restart the random number sequence of the emission.
5. **Cycle Interval**: Cycle Interval defines the interval in frames for restarting the random number sequence when using Cycle Emission.

Distance/Direction Attributes

6. **Min Distance**: This option sets the minimum distance from the emitter at which emission occurs. Particles are emitted randomly and uniformly between the Min Distance and Max Distance.
7. **Max Distance**: This option sets the maximum distance from the emitter at which emission occurs.
8. **Direction X, Y, Z**: This option sets the emission direction relative to the emitter's position and orientation.
9. **Spread**: Spread defines a conical region where the particles are emitted randomly.
10. **Speed**: Speed sets a speed multiplier for the original emission speed of the emitted particles.
11. **Speed Random**: The Speed Random attribute lets you add randomness to your emission speeds without using expressions.
12. **Tangent Speed**: This option sets the magnitude of the tangent component of emission speed for surface and curve emission.
13. **Normal Speed**: This option sets the magnitude of the normal component of emission speed for surface and curve emission

Volume Emitter Attributes

14. **Volume Shape**: Volume Shape specifies the shape of the volume that the particles are emitted into.
15. **Volume Offset**: Volume offset offsets the emitting volume from the location of the emitter. If you rotate the emitter, you also rotate the offset direction because it operates in local space.
16. **Volume Sweep**: This option defines the extent of rotation for all volumes except cubes.
17. **Section Radius**: This option defines the thickness of the solid portion of the torus, relative to the radius of the torus central ring.
18. **Die on Emission Volume Exit**: If you turn this attribute on, the emitted particles die when they exit the volume.
19. **Volume Speed Attributes**: The Volume Speed Attributes apply only to the initial velocity of the particles.
20. **Away From Center**: This option specifies the speed at which particles move away from the center point of volumes.
21. **Away From Axis**: This option specifies the speed at which particles move away from the central axis of volumes.
22. **Along Axis**: This option specifies the speed at which particles move along the central axis of all volumes.
23. **Around Axis**: This option specifies the speed at which particles move around the central axis of all volumes.
24. **Random Direction**: Random direction adds irregularity to the direction and initial speed of the particle's Volume Speed attributes.
25. **Directional Speed**: Direction speed adds speed in the direction specified by the Direction XYZ attributes of all volume emitters.
26. **Scale Speed by Size**: If you turn this attribute on, when you increase the size of the volume, the speed of the particles increases.

Emit From Object
Emit from object converts an object into an emitter. The particles are emitted from the vertex, CVs etc. The option are same as that of the create emitter.

Use Selected Emitter
Use selected emitter connects a particle object with the selected emitter.

Per-Point Emission Rates
Per-Point emission rates let you vary emission rates on a per particle basis.

Goal
Goal sets a goal for a particle. When you play animation, particle rush towards the goal object. The available options are:
1. **Goal Weight**: The goal weight sets how much all particles of the trailing object are attracted to the goal. You can set the goal weight before you create the goal using the Goal options window. A goal value of 0 means that the goal's position has no effect where as a value of 1 move the trailing particles to the goal object position immediately and a value between 0 and 1 cause the particles to move toward the goal.
2. **Use Transform as Goal**: This option makes particles follow the object's transform rather than its particles, CVs, vertices, or lattice points.
Instancer

Instancer replaces the traditional particles with an object you select. You can apply the particle instancer two or more times to the same particle object. The options available are:
1. **Particle Instancer Name**: You can provide name for the instancer.
2. **Rotation Units**: If you set the Rotation settings for particles, this option specifies whether the value is interpreted as degrees or radians.
3. **Rotation Order**: If you set the Rotation settings for particles, this option sets the precedence order of rotation, for instance, XYZ, XZY, or ZXY.
4. **Level of Detail**: This option sets whether the source geometry appears at the particle locations or whether a bounding box or boxes appear instead.
5. **Cycle**: Cycle changes the instanced objects with time.
a. **None**: If none is selected, it instance a single object.
b. **Sequential**: If sequential is selected, it cycle through the objects in the Instanced Objects list.
6. **Cycle Step Unit**: If you're using an object sequence, select whether frames or seconds are used for the Cycle Step Size value.
7. **Cycle Step Size**: If you're using an object sequence, enter the particle age interval at which the next object in the sequence appears.

Sprite Wizard
The particle Sprite Wizard simplifies the process for displaying a texture image or image sequences on particles. The particle Sprite Wizard leads you through the steps necessary to associate image files with sprites. You can assign a single image or a sequence of images to each particle.

Connect to Time
Connect to time reconnects the current time to the scene time for particles. You can use connect to time to stop the particle in between the animation.

General Control Attributes for particles Is Dynamic
If you turn on this option, Dynamics will be calculated for the particles.

Dynamics Weight
This option controls the effect of fields, collisions, springs, and goals connected to the particle object.

Conserve
The Conserve value controls how much of a particle object's velocity is retained from frame to frame.

Forces in World
If you turn this option on, World space calculations will be converted to local space coordinates.

Cache Data
You can cache the particles' animation. Once cached, Maya will not calculate particle animation every frame. To see the effect of any changes made after caching, you have to disable and then enable the cache.

Emission Attributes

Max Count

This option contains the maximum count of particles this shape will allow. If some particles die off, new particles will again be accepted up to the max count, and so on.

Lifespan Attributes

Lifespan Mode

This attribute defines the life of the emitted particles.

Live forever

All particles live forever, unless killed by collision events or emission volume exit.

Constant

This setting allows you to input a constant lifespan for the particles. The particles will die at the specified time.

Random range

This attribute must be set to enable Lifespan Random.

Lifespan

This setting allows you to input a lifespan for the particles.

Lifespan Random

This attribute is used only if lifespanMode is set to Random Range.

General Seed

This attribute represents the seed for random number generation.

Time Attributes

Start Frame

This attribute represents the frame after which dynamics will be solved.

Current Time

This attribute represents the current time in the timeline.

Collision Attributes

Trace Depth

This attribute represents the maximum number of consecutive collisions that are detected within a frame for each particle.

Offset

Offset attribute lets you offset the position of the current particle when it collides with the surface. Offset also prevents the current particle from penetrating the surface of the specified collision object. This attribute is only available when the current particle has a collision object.

Goal Weights and Objects

Goal Smoothness

This value is used to control the smoothness of the change in the goal forces as the weight changes. The higher the value, the smoother the change.

Goal Active

This option makes the goal active.

goalWeightNPP

This option provides per-particle goal weights for the Nth goal object.

Instancer

Instancer Nodes

This option selects which instancer is used for the instanced objects.

Particle Object To Instance

This attribute sets the particle object to which the geometry is applied.

General Options

Position

This attribute sets position of the instanced objects.

Scale

This attribute sets scale of the instanced objects.

Shear

This attribute sets shear value of the instanced objects.

Visibility

This attribute sets whether display of each instanced object is on or off.

ObjectIndex

If you set the Cycle option of the Instancer to None, this option sets which object from the Instanced Objects list is instanced for each particle. If you set Cycle to Sequence, ObjectIndex is ignored.

Rotation Options

RotationType

You can choose one of three methods to set their orientation: Rotation, AimDirection, and AimPosition.

Rotation

This attributes sets the orientation of the instanced objects relative to their initial orientation.

AimDirection

This attribute sets the orientation of the instanced objects by specifying the direction along which each instanced object points relative to the original position of its local origin.

AimPosition

This attribute sets the orientation of the instanced objects by specifying the location where each instanced object points relative to the original position of its local origin.

AimAxis

This option specifies the object axis that points directly at the AimDirection or AimPosition.

AimUpAxis

This attribute specifies the object axis that points up relative to how the AimAxis points at the AimDirection or AimPosition.

Cycle Options

CycleStartObject

CycleStartObject specifies the cycle’s starting object from the Instanced Objects list.

Age

Age works with the Instancer’s Cycle Step setting to set how often Maya changes from one object to another.

6.4.2 Render Attributes

Particle Render Type

This attribute specifies the hardware rendering method for the particles. You can choose whether to have Hardware Render or Software Render Particles.

Add attributes for

Add attributes for displays the attributes for the current selected particle render type.

Per Particle (Array) Attributes

These attributes are assigned on per particle basis i.e. you can assign different values to the different particles of the same object.

Add Dynamic Attribute

You can add dynamic attributes which can be controlled and change with the time.

Solvers

Create Particle Disk Cache

This option creates a particle disk cache. The options available in the Particle Render Cache Options window are:

1. **Cache Directory**: You can specify where to store the disk cache.
2. **Only Update particles**: If Only Update particles are off (default), the particles will be evaluated by normal DG evaluation, and the cache is guaranteed to have the same result as in interactive playback. If Only Update particles are on, Maya optimizes the evaluation by triggering the evaluation only on particles. This optimization can create a discrepancy if one particle system is dependent on another particle system.

Particle systems to cache: You can specify to cache either Selected or All particle systems.

Fields

You can simulate the motion of natural forces with dynamic fields. Fields in Maya can be categorized as: Stand alone Fields, Object Fields and Volume Fields. The Fields available in Maya are:

Air

This creates an Air field which simulates the real life air. The options for an Air field are:

Air Field Predefined Settings

1. **Wind**: Wind button sets the Air Field attributes to default settings that approximate the effects of wind.
2. **Wake:** Wake button sets the Air Field attributes to default settings that approximate the movement of air disrupted and pulled along by a moving object.
3. **Fan:** Fan button sets the Air Field attributes to default settings that approximate a local fan effect.
4. **Magnitude**: Magnitude sets the strength of the air field, which sets the speed along the direction the air is moving.
5. **Attenuation**: Attenuation sets how much the strength of the field diminishes as distance to the affected object increases.
6. **Direction X, Y, Z**: These options specify the direction in which the air blows.
7. **Speed**: Speed controls how quickly the connected objects match the velocity of the air field.

8. **Inherit Velocity**: When an air field is moving or parented to a moving object, Inherit Velocity specifies how much the moving air field's velocity that is added to the Direction and Magnitude.
9. **Inherit Rotation**: If you turn on Inherit Rotation and the air field is rotating or parented to a rotating object, the air flow undergoes that same rotation.

Distance

10. **Use Max Distance**: If you turn on Use Max Distance, connected objects within the area defined by the Max Distance setting are affected by the air field.
11. **Max Distance**: This option sets the maximum distance after which air field has no effect.
12. **Volume shape**: You can choose one out of None, Cube, Sphere, Cylinder, Cone or Torus.
13. **Volume Exclusion**: When Volume Exclusion is turned on, the volume defines the region in space where the field has no effect on particles or rigid bodies.
14. **Volume Offset X, Y, Z**: This option offsets the volume from the location of the field.
15. **Volume Sweep**: Volume sweep defines the extent of rotation for all volumes except cubes.
16. **Section Radius**: Section radius defines the thickness of the solid portion of the torus, relative to the radius of the torus's central ring.

Drag

This creates a Drag field which can be used to slow down the fast moving particles. The options for drag field are:
1. **Magnitude**: Magnitude sets the strength of the drag field.
2. **Attenuation**: Attenuation sets how much the strength of the field diminishes as distance to the affected object increases.
3. **Speed Attenuation**: This option weakens the amount of drag when the speed of the particle is less than the Speed Attenuation value.

Gravity

This option creates a Gravity field which simulates the gravity. It pulls every thing specified direction. The available options are:
1. **Magnitude**: This option sets the strength of the gravity field. The greater the magnitude, the faster the objects will accelerate in the direction of the gravitational force.
2. **Direction X, Y, Z**: These options specify the direction in which the gravity works.

Newton

This option creates a Newton field which works some what like gravity but it pulls the thing towards its or the objects center. The options available are:
1. **Magnitude**: This option sets the strength of the Newton field. A positive number pulls objects toward the field. A negative number pushes objects away.
2. **Min Distance**: Min Distance sets the minimum distance from the Newton field at which the field is exerted.
3. **Max Distance**: Max Distance sets the maximum distance from the Newton field at which the field is exerted.

Radial
This option creates a Radial field. The options available are:
1. **Magnitude**: Magnitude sets the strength of the radial field.
2. **Attenuation**: Attenuation sets how much the strength of the field diminishes as distance to the affected object increases.
3. **Radial Type**: Radial Type specifies how the radial field's effect diminishes with Attenuation.

Distance:
4. **Use Max Distance**: If you turn on Use Max Distance, connected objects within the area defined by the Max Distance setting are affected by the radial field.
5. **Max Distance**: This option sets the maximum distance from the radial field that the field is exerted.

Turbulence
This option creates a Turbulence field which causes random motion. The options available are:
1. **Magnitude**: Magnitude sets the strength of the turbulence field. You can use positive or negative values to move the influenced objects in random directions.
2. **Frequency**: Frequency sets the frequency of the turbulence field. Higher values cause more frequent irregularities in the motion.
3. **Phase X, Y, Z**: These options determine the direction of the disruption.
4. **Interpolation Type**: Linear specifies a linear interpolation between values in the noise table. This can create noticeable breaks along lines of force. Quadratic interpolation creates a smoother look but requires noticeably more execution time.
5. **Noise Level:** The Noise Level attribute specifies the number of additional lookups in the noise table.
6. **Noise Ratio:** Noise Ratio specifies the weighting of successive lookups.

Uniform
This option creates a Uniform field. The available options are:
1. **Magnitude**: This option sets the strength of the uniform field. A positive number pushes the influenced object away. A negative number pulls the object toward the field.
2. **Direction X, Y, Z**: These options specify the direction the uniform field pushes objects.

Vortex
This option creates a Vortex field which produces the swirl effects. The available options are:
1. **Magnitude**: Magnitude sets the strength of the vortex field. A positive number moves the influenced object counterclockwise. A negative number moves the object clockwise.
2. **Axis X, Y, Z**: Axis specifies the axis around which the vortex field exerts its force.

Volume Axis
This option creates a Volume Axis field. The available options are:
1. **Magnitude**: Magnitude specifies the strength of the volume axis field.
2. **Attenuation**: This option sets how much the strength of the field diminishes from the central axis of the volume axis field.

Volume Control Attributes

3. **Volume Shape**: This option specifies the closed volume that defines the area in which the volume axis field affects particles and rigid bodies. You can choose from five volume shapes: cube, sphere, cylinder, cone, and torus.
4. **Volume Offset X, Y, Z**: This option offsets the volume axis field from the actual location of the field.
5. **Volume Sweep**: This option defines the extent of the rotation for all volume shapes except cube.
6. **Section Radius**: This option defines the thickness of the solid portion of a torus volume shape.

Volume Speed Attributes

7. **Invert Attenuation**: When you turn on Invert Attenuation, the strength of the volume axis field is strongest at the edge of the volume and diminishes to 0 at the central axis of the volume axis field.
8. **Away From Center**: You can use this attribute to create explosive effects.
9. **Away From Axis**: This option specifies the speed at which particles move away from the central axis of cylinder, cone, or torus volumes.
10. **Along Axis**: This option specifies the speed at which particles move along the central axis of all volumes.
11. **Around Axis**: This option specifies the speed at which particles move around the central axis of all volumes.
12. **Directional Speed**: This adds speed in the direction specified by the Direction XYZ attributes of all volumes.
13. **Direction X, Y, Z**: This moves particles in the directions specified by the X, Y, and Z axes.

Use Selected as Source of Field

Use Selected as Source of Field is used to add a field to the object which creates a object field.

Collision

You can make particle objects collide with geometry. You can make particles split, emit new particles, die, or run a MEL script when they collide with geometry. There are two main types of particles:

1. **Hardware Rendered Particles**: Hardware rendering of particle makes use of computer's graphics hardware, and is much faster than software rendering. However, the quality of hardware rendered images may not always be as high as software rendered images. Hardware rendered particles have a render type of MultiPoint, MultiStreak, Numeric, Points, Spheres, Sprites, or Streak.
2. **Software Rendered Particles**: Software rendered particles have a render type of Blobby Surface, Cloud, or Tube.

Particles > Make Collide

Make collide option makes particles collide with geometry. The options available in the option box are:

1. **Resilience**: Resilience sets how much rebound (bounce) occurs.
2. **Friction**: Friction sets how much the colliding particle's velocity parallel to the surface decreases or increases as it bounces off the collision surface. It controls the sliding of particles.

Particle Collision Events Editor
Objects and Events
Click a particle object in the Objects list to select it. All events belonging to the selected particle object are displayed in the Events window.
Update Object List
This option updates the list of objects if you have added or deleted particle objects while the editor is displayed.
Selected Object
This option displays the selected object.
Selected Event
This option displays the selected event.
Set Event Name
You can give name or edit the name of the event.

CREATING/EDITING EVENT
New Event
You can create a new event with this button.
All Collisions
You can check this box to have the event occur on all collisions.
Collision Number
You can adjust this value to have the event occur on a specific collision number.

6.4.3 Event Type
Emit
You can check this box to set the particle event type to Emit i.e. after collision new particles will be emitted.
Split
You can check this box to set the particle event type to Split i.e. after collision the colliding particle will be splited.
Random # Particles
You can check this box to instruct the event to use a random number of particles.
Num Particles
You can adjust this value to affect the number of particles involved in the event.
Spread
You can adjust this value to affect the spread of the particles involved in the event.
Target Particle
You can input a particle into this field to be used as a target for the event.
Inherit Velocity
Adjust this value to affect the percentage of velocity that particles inherit during the event.
Event Actions
Original Particle Dies
You can check this box if you want the original particle to die during the event.
Event Procedure
The Event Procedure is a MEL script procedure that will be executed whenever any particle in the particle object that owns the event collides with an object.

6.3 Assignment

1. Make objects collide with geometry.

Unit 7 Fields

	Time Required to Complete the unit

The time required to study thus Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading a unit
2. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit
3. Self Assessment: It will need 3 Hrs for reading and understanding a unit
4. Assignment: It will need 4 Hrs for completing an assignment
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7.1 Fields

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Distance
10. **Use Max Distance**: If you turn on Use Max Distance, connected objects within the area defined by the Max Distance setting are affected by the air field.
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13. **Volume Exclusion**: When Volume Exclusion is turned on, the volume defines the region in space where the field has no effect on particles or rigid bodies.
14. **Volume Offset X, Y, Z**: This option offsets the volume from the location of the field.
15. **Volume Sweep**: Volume sweep defines the extent of rotation for all volumes except cubes.
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This option creates a Newton field which works some what like gravity but it pulls the thing towards its or the objects center. The options available are:
1. **Magnitude**: This option sets the strength of the Newton field. A positive number pulls objects toward the field. A negative number pushes objects away.
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3. **Radial Type**: Radial Type specifies how the radial field's effect diminishes with Attenuation.

Distance:

4. **Use Max Distance**: If you turn on Use Max Distance, connected objects within the area defined by the Max Distance setting are affected by the radial field.
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3. **Phase X, Y, Z**: These options determine the direction of the disruption.
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in the noise table. This can create noticeable breaks along lines of force. Quadratic interpolation creates a smoother look but requires noticeably more execution time.
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6. **Noise Ratio:** Noise Ratio specifies the weighting of successive lookups.

Uniform
This option creates a Uniform field. The available options are:
1. **Magnitude**: This option sets the strength of the uniform field. A positive number pushes the influenced object away. A negative number pulls the object toward the field.
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Vortex
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This option creates a Volume Axis field. The available options are:
1. **Magnitude**: Magnitude specifies the strength of the volume axis field.
2. **Attenuation**: This option sets how much the strength of the field diminishes from the central axis of the volume axis field.

Volume Control Attributes
3. **Volume Shape**: This option specifies the closed volume that defines the area in which the volume axis field affects particles and rigid bodies. You can choose from five volume shapes: cube, sphere, cylinder, cone, and torus.
4. **Volume Offset X, Y, Z**: This option offsets the volume axis field from the actual location of the field.
5. **Volume Sweep**: This option defines the extent of the rotation for all volume shapes except cube.
6. **Section Radius**: This option defines the thickness of the solid portion of a torus volume shape.

7.2 Collision

You can make particle objects collide with geometry. You can make particles split, emit new particles, die, or run a MEL script when they collide with geometry. There are two main types of particles:
1. **Hardware Rendered Particles**: Hardware rendering of particle makes use of computer's graphics hardware, and is much faster than software

rendering. However, the quality of hardware rendered images may not always be as high as software rendered images. Hardware rendered particles have a render type of MultiPoint, MultiStreak, Numeric, Points, Spheres, Sprites, or Streak.
2. **Software Rendered Particles**: Software rendered particles have a render type of Blobby Surface, Cloud, or Tube.

Particles > Make Collide
Make collide option makes particles collide with geometry. The options available in the option box are:
1. **Resilience**: Resilience sets how much rebound (bounce) occurs.
2. **Friction**: Friction sets how much the colliding particle's velocity parallel to the surface decreases or increases as it bounces off the collision surface. It controls the sliding of particles.

7.3 Instancer

Instancer replaces the traditional particles with an object you select. You can apply the particle instancer two or more times to the same particle object. The options available are:
1. **Particle Instancer Name**: You can provide name for the instancer.
2. **Rotation Units**: If you set the Rotation settings for particles, this option specifies whether the value is interpreted as degrees or radians.
3. **Rotation Order**: If you set the Rotation settings for particles, this option sets the precedence order of rotation, for instance, XYZ, XZY, or ZXY.
4. **Level of Detail**: This option sets whether the source geometry appears at the particle locations or whether a bounding box or boxes appear instead.
5. **Cycle**: Cycle changes the instanced objects with time.
a. **None**: If none is selected, it instance a single object.
b. **Sequential**: If sequential is selected, it cycle through the objects in the Instanced Objects list.
6. **Cycle Step Unit**: If you're using an object sequence, select whether frames or seconds are used for the Cycle Step Size value.
7. **Cycle Step Size**: If you're using an object sequence, enter the particle age interval at which the next object in the sequence appears.

7.4 Assignment

1. Pool Table

Unit 8 Rigid-body Dynamics

Time Required to Complete the unit

The time required to study thus Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading a unit
2. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit
3. Self Assessment: It will need 3 Hrs for readng and understanding a unit
4. Assignment: It will need 4 Hrs for completing an assignment
5. Revision and Further Reading: It is continuous process

8.1 Rigid - body Dynamics

Rigid bodies
A rigid body is a polygonal or NURBS surface converted to an unyielding shape. Rigid bodies collide rather than pass through each other during animation. To animate rigid body motion, you use fields, keys, expressions, rigid body constraints, or collisions with particles.
Maya has two kinds of rigid bodies—active and passive. An active rigid body reacts to dynamics—fields, collisions, and springs—not to keys. A passive rigid body can have active rigid bodies collide with it. You can key its Translate and Rotate attributes, but dynamics have no effect on it.
Note: You can make a rigid body collide inside another. Place the object inside the other object; reverse the normals or surface of the outer object, then animate the inner object in an outward direction.

8.1.1 Create Active/Passive Rigid Body

This option creates an active rigid body. The attributes/options of a rigid body are:
1. **Rigid Body Name**: You can assign a name to rigid body for easy identification.
2. **Active**: This attribute makes the rigid body an active rigid body. If this option is off, the rigid body is passive.
3. **Particle Collision**: If you've made particles collide with the surface and the surface is an active rigid body.
4. **Mass**: This attribute sets the mass of an active rigid body. Maya ignores the mass attribute of passive rigid bodies.
5. **Center of Mass X, Y, Z**: This attribute specifies the position of an active rigid body's center of mass in local space coordinates.
6. **Static Friction**: This option sets how much a rigid body resists moving from resting contact with another rigid body. Static friction has little or no effect after an object is moving.
7. **Dynamic Friction**: Dynamic Friction sets how much a moving rigid body resists movement against another rigid body's surface.
8. **Bounciness**: Bounciness sets the resilience of the rigid body.
9. **Damping**: Damping sets an opposing force against the rigid body's movement. A positive value diminishes movement where as a negative value increases movement.
10. **Impulse X, Y, Z**: This option creates an instantaneous force, with magnitude and direction, on the rigid body at the local space position specified in Impulse Position X, Y, Z.
11. **Impulse Position X, Y, Z**: This option specifies the position in the rigid body's local space where the impulse strikes.
12. **Spin Impulse X, Y, Z**: This option applies an instantaneous rotational force on the rigid body's center of mass in the direction you specify by the X, Y, and Z values.

Initial Settings attributes
13. **Initial Spin X, Y, Z**: This option sets the initial angular velocity of the rigid body.

14. **Initial Position X, Y, Z**: This option sets the initial position of the rigid body in world space.
15. **Initial Orientation X, Y, Z**: This option sets the initial local space orientation of the rigid body.
16. **Initial Velocity X, Y, Z**: This option sets the initial speed and direction of the rigid body.
17. **Collision Layer**: You can use collision layers to create exclusive groups of objects that collide with each other. Only rigid bodies with the same collision layer number can collide with each other.
Tip: A value of '-1' in the collision layer makes it a universal collision object.
18. **Collisions**: This option tells Maya whether to calculate collisions for the object or not.

8.1.2 Solvers >

Rigid Body Solver Attributes

Dynamic animation of rigid bodies and rigid body constraints is controlled by a Maya component called a rigid body solver. Dynamic animation of rigid bodies refers to motion created by fields and collisions. You can change attributes of the rigid body solver to adjust aspects of the dynamic animation. Select **Solver > Rigid Body Solver Attributes** to edit the rigid body solver attributes.

Rigid Solver Attributes

Step Size: Sets how often within a frame the rigid body calculations occur. For example, if each frame of the animation is 0.1 seconds and the Step Size is 0.033 seconds, the solver calculates rigid body animation three times in the frame.
Generally, decreasing the Step Size value improves rigid body animation accuracy but slows scene play. If you have fast-moving rigid bodies that don't collide as expected, decrease the Step Size. *This is a nonkeyable attribute available in the Attribute Editor only.*
Collision Tolerance: Sets how accurately and quickly a rigid body solver detects collisions. Generally, smaller Collision Tolerance values increase the calculation time and collision accuracy. A small Collision Tolerance is often necessary to create accurate collisions involving tiny or thin objects. *This is a nonkeyable attribute available in the Attribute Editor only.*
Scale Velocity: Scale Velocity is used with the Display Velocity attribute. If you turn on Display Velocity, a moving rigid body displays a velocity arrow icon that represents the magnitude and direction of the rigid body motion. You can change the Scale Velocity to scale the arrow.
Start Time: Sets the Time Slider frame when the solver starts animating dynamics for the rigid bodies it controls.
Current Time: Lets you speed up or slow down dynamic animation for all rigid bodies connected to the solver. Current Time works the same for rigid bodies as it does for particle objects.

Current Rigid Solver

If there are more than one solver and you want any one of them as a Current Rigid Solver then from **Solver > Current Rigid Solver >** select the solver from the list.

Create Rigid Body Solver
Create a new Rigid Body Solver and makes it current.
Set Rigid Body Interpenetration
Set Rigid Body Collision

8.2 Soft - body Dynamics

Soft bodies
You can recreate a geometric object as a flexible object called a soft body. You can use various animation techniques to make the soft body bend, ripple, and bulge like soft objects in nature. When you make a soft body from geometry or a lattice, Maya creates a corresponding particle object. The combination of the geometry and particles is a soft body. The particle object has one particle for each CV or vertex in the geometry.

8.2.1 Create Soft Body

This option creates a soft body. The attributes/ options available are:
1. **Make Soft**: This option converts the object to a soft body.
2. **Duplicate, Make Copy Soft**: Makes a copy of the object a soft body without altering the original object.
3. **Duplicate, Make Original Soft**: This option works like Duplicate, Make Copy Soft, except it makes the original object a soft body, and makes a copy of the original object.
4. **Hide Non-Soft Object**: If you turn on this option, the object that's not a soft body is hidden.
5. **Make Non-Soft a Goal**: Turn this option on to make the soft body trail or move towards the goal object made from the original or duplicate geometry.
6. **Weight**: This option sets how closely the soft body follows the goal object made from the original or duplicate geometry.

Paint Soft Body Weights Tool
Using the Paint Soft Body Weights Tool, you can set goal weights on a soft body on a per particle basis by painting on the soft body surface. The tool provides color feedback so you know which parts of the soft body have particles with different goal weights. Weights display as a range of grayscale values, with a weight of 1 displaying as white and 0 as black.
Select the soft body you want to paint goal weights on. The soft body must have been created with goal weights. Select the Paint Soft Body Weights Tool and open the Tool Settings editor (**Soft/Rigid Bodies > Paint Soft Body Weights Tool >**).
The Paint Soft Body Weights Tool automatically detects the soft body and goalPP attributes and selects the soft body for painting.
There are attributes unique to the Paint Soft Body Weights Tool in the Paint Attributes section. These unique attributes are described below.
Paint Attributes
These are descriptions of the attributes in the Paint Attributes section.

Displays the name of the particle node selected to paint and the attribute you are

painting (goalPP weights). To select another particle node to paint, click this button and select the appropriate particle node goalPP weights name. By default, the tool selects the first particle node it detects.
When you select the soft body, the Paint Soft Body Weight Tool automatically detects the particle node and goalPP attribute on the soft body. The name of the node and attribute displays on the top button.

Filter: particle: Sets a filter so that only particle nodes display on the menu for the button above this one. You are painting particle goalPP weights with the Paint Soft Body Weights Tool, so you do not need to change this filter unless you want to paint other types of attributes.

Paint Operation: Select an operation to define how you want painted goalPP values to be affected.

Replace: Replaces the goalPP values for the soft body particles you paint over with the specified Value and Opacity.

Add: Adds the specified Value and Opacity to the current goalPP values you paint over. If the value is negative (possible if you set Min or Max to a negative value), the value actually decreases.

Scale: Scales the current goalPP values you paint over by the Value and Opacity factors.

Smooth: Changes the goalPP values to be the average values of the surrounding goalPP values.

Value: Set the value to apply when you perform any of the painting operations.

Min/Max Value: Set the minimum and maximum possible paint values. By default, you can paint values between 0 and 1. Setting the Min/Max Values you can extend or narrow the range of values. Negative values are useful for subtracting weight. For example, if you set Min Value to -1, Value to -0.5, and select Add for the operation, you would subtract 0.5 from the weight of vertices you paint. Positive values are added.

Tip: To help you differentiate paint values when you paint with ranges greater than 0 to 1 (for example, -5 to 5), and to maximize the range of values that display when you paint values with ranges between 0 to 1 (for example, 0.2 to 0.8), set Min Color and Max Color (in the Display section) to correspond with the Min/Max values.

Clamp: Select whether you want to clamp the values within a specified range when you paint, regardless of the Value set.

Lower: Turn this on to clamp the lower value to the Clamp Value specified below. For example, if you clamp Lower and set the lower Clamp Value to 0.5, the values you paint will never be less than 0.5, even if you set the Value to 0.25.

Upper: Turn this on to clamp the upper value to the Clamp Value specified below. For example, if you clamp Upper, set the upper Clamp Value to 0.75, and set Value to 1, the values you paint will never be greater than 0.75.

Clamp Values: Set the Lower and Upper values for clamping.

Flood: Click Flood to apply the brush settings to all the particle goals on the selected soft body. The result depends on the brush settings defined when you perform the flood.

Vector Index: If you are painting a three channel attribute (RGB or XYZ), select the channel you want to paint. Soft body goalPP weight is a single channel attribute, therefore you do not need to change this setting.

Springs

You can add springs to a soft body's particles to give the soft body internal structure and improve your deformation control. You can also add springs to regular particles to give them reactive, interconnected motion.

Note: You can also create springs on emitted particles. This provides a cohesive mass of particles, for example, a gas cloud.

8.2.2 Create Springs

This option creates a spring. The available options are:

1. **Spring Name**: You can assign a name to the spring for easy identification in the Outliner.
2. **Add to Existing Spring**: This option adds springs to an existing spring object rather than a new one.
3. **Don't Duplicate Springs**: If this is on, it avoids creating a spring between two points if a spring already exists there.

Spring Attributes

4. **Stiffness**: Stiffness sets the rigidity of the spring constraint. The greater the value, the greater the force the spring exerts on the object for the same displacement.
5. **Damping**: Damping mutes the spring action. A high value brings the springs to rest faster.
6. **End1 Weight**: This option sets the amount of the spring's force applied to the spring's starting point.
7. **End2 Weight**: This option sets the amount of the spring's force applied to the spring's ending point.

The Dynamic relationship editor

The Dynamic Relationships Editor lets you connect and disconnect dynamic relationships between objects and fields, emitters, and collisions. You can display the Dynamic Relationships Editor as a separate window or as a panel in the workspace.

From the menu bar, select **Window >Relationship Editors > Dynamic Relationships**.

Or

From the Panels menu of the current panel, select **Panel > Dynamic**

Relationships. To display the Dynamic Relationships Editor.

8.3 Assignment

1. Pool Table
2. Pool Table - LAB

Unit 9 Maya Fluids

Time Required to Complete the unit

The time required to study thus Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading a unit
2. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit
3. Self Assessment: It will need 3 Hrs for reading and understanding a unit
4. Assignment: It will need 4 Hrs for completing an assignment
5. Revision and Further Reading: It is continuous process

9.1 Fluid Effects

Maya Fluid Effects is a technology for realistically simulating and rendering fluid motion. Fluid Effects lets you create a wide variety of 2D and 3D atmospheric, pyrotechnic, space, and viscous liquid effects. You can use the Fluid Effects solvers to simulate effects, or you can use fluid animated textures for more unique, distinguishing effects.

9.1.2 Types of fluids

In Maya, there are three basic types of fluid effects:

• **Dynamic fluid effects**: Dynamic fluid effects behave according to the natural laws of fluid dynamics, a branch of physics that uses mathematical equations to calculate how things flow. For dynamic fluid effects, Maya simulates fluid motion by solving the Navier-Stokes fluid dynamics equations at each time step. You can texture dynamic fluids, apply forces to them, and have them collide with and move geometry, affect soft bodies, and interact with particles.

• **Non-dynamic fluid effects**: 3D fluids inherently require extra data to define them, which can make them very large. This extra data can slow a dynamic simulation exponentially because more calculations must be performed at every step of the simulation. For a less memory intensive effect, you can use a 2D fluid, or you can create a non-dynamic fluid. Nondynamic fluid effects do not use the fluid solvers to simulate fluid motion.
For non-dynamic fluid effects, you create the look of fluid using textures and you create fluid motion by animating texture attributes.

• **Oceans and Ponds**: You can create Ocean and Pond fluids to simulate large realistic water surfaces, such as stormy oceans with foam and swimming pools. Oceans are NURBS planes with ocean shaders assigned to them. Ponds are 2D fluids that use a spring mesh solver and a height field. Also, you can add Wakes to Oceans and Ponds to create boat wakes, add additional turbulence, or generate bubbling and ripple.
The components of a fluid are:

9.1.3 Fluid containers

A fluid container is a rectangular 2D or 3D boundary that defines the space in which the fluid exists. Fluid effects cannot exist outside a container. The fluid container is the principle component for any dynamic or non-dynamic fluid effect. Fluid containers are divided into three dimensional grids, and each unit of one of these grids is called a voxel. To create a fluid effect, you need to add contents to the container and then modify the look and behavior of the fluid by modifying the container attributes.

1. **2D containers**: A 2D fluid container is a 3D fluid container with a depth of one voxel.
2. **3D containers**: A 3D fluid container is a fluid container with a depth of two or more voxels.

Fluid emitters
You can add fluid properties to a fluid container using a fluid emitter. A fluid emitter creates fluid property values and populates the voxels of a grid with those values as a simulation plays. The fluid emitter must be within the bounds of the fluid container to emit.

Container contents
You define a fluid effect by putting values for any or all of the following fluid properties into its container: Density, Velocity, Temperature, Fuel, and Color. You can use different methods to define these properties, depending on the effect you want and whether the effect is dynamic or non-dynamic.
1. **Density**: Density represents the material property of the fluid in the real world.
2. **Velocity**: Velocity affects the behavior of dynamic fluids by moving Density, Temperature, Fuel, and Color values inside the container. Velocity has both magnitude and direction values. Direction defines the moving fluid values' path.
3. **Temperature**: Temperature affects the behavior of a dynamic fluid, causing it to rise or react.
4. **Fuel**: For dynamic fluids, Fuel combined with Density creates a fluid where a reaction can take place. Density values represent the substance being reacted, and Fuel values describe the state of the reaction. Temperature can ignite Fuel to start a reaction. During the course of the reaction, the Density and Fuel values get smaller until the reaction is complete.
5. **Color**: This property applies color to Density. Color appears only where there is Density. There are two ways to color fluids:
a. **Using the built-in shader color**: The shader is built into the fluid making this an efficient way to color your fluids.
b. **Using grids**: Grids give you control over where color is placed in each voxel. You can also make color behave dynamically, which means you can make colors interact and mix.

Defining the contents of a fluid container
There are two ways you can define a fluid property for a fluid container:
1. **Preset gradients**: You can set the property values of a fluid container as predefined gradients. Predefined gradients are sets of values in the form of gradients that are provided with Maya. Predefined gradient property values stay constant over time and they require no calculations at render time; making them render more quickly than dynamic grid fluid properties.
2. **Grids**: When you define a fluid property as a grid, you can place different property values in each individual grid unit called a voxel (volume pixel). Grids give you precise control over what the values are in the container.

Fluid Effects > Create 2D Container
Create 2D container creates an empty 2D container for fluids. The options available in the option box are:
1. **X, Y Resolution**: These options define the resolution of the fluid in voxels. Higher resolutions produce finer detail, but increase rendering time and slow the interactive simulation.

2. **X, Y, Z Size**: Define the physical dimensions of the fluid container in the working units set for Maya.

Fluid Effects > Create 2D Container with Emitter
This command creates a 2D container for fluids with an Emitter. The options available in the option box are:
1. **Emitter Name**: You can provide a name for the emitter.
2. **Parent to Container**: Turn this option on to parent the emitter to the container. When the emitter is parented to the container, selecting the container automatically selects the emitter automatically.

Basic Emitter Attributes:
3. **Emitter Type**: You can set the emitter type for the fluids. The available types are Omni and volume emitters.
4. **Density Rate (/Voxel/Sec)**: This option sets the average rate at which Density values are emitted into the grid voxels per second.
5. **Heat Rate (/Voxel/Sec)**: This option sets the average rate at which Temperature values are emitted into the grid voxels per second.
6. **Fuel Rate (/Voxel/Sec)**: This option sets the average rate at which Fuel values are emitted into the grid voxels per second.
7. **Fluid Dropoff**: This option sets the dropoff value for fluid emission.
8. **Cycle Emission**: Cycling emission restarts the random number stream after an interval in frames, specified by the Cycle Interval attribute.
9. **Cycle Interval**: This option specifies the number of frames between restarts of the random number stream.
Distance Attributes:
10. **Max Distance**: Maximum distance at which new property values are created from emitter.
11. **Min Distance**: Minimum distance at which new property values are created from emitter.

Volume Emitter Attributes:
12. **Volume Shape**: This setting sets the shape of volume the emitter will use if the emitter is of volume type.
13. **Volume Offset X, Y, Z**: This is the parent attribute for the translational offset of the emission volume's center from the emitter's origin.
14. **Volume Sweep**: The arc of the volume emission. Used for sphere, cone, cylinder and torus.
15. **Section Radius**: This setting applies to torus volumes only. This defines the radius of a section of the torus.

Add/Edit Contents > Gradients
This option will add gradient to the container.

Density/Velocity/Temperature/Fuel: You can turn on the properties you want to be represented by gradients. You must select at least one property.
1. **Density/Velocity/Temperature/Fuel Gradient**: You can select which predefined set of values you want to place in the container:
2. **Constant**: This option sets the value to 1 throughout the fluid.
3. **X Gradient**: This option sets a ramp of values from 1 to 0 along the X

axis.
4. **Y Gradient**: This option sets a ramp of values from 1 to 0 along the Y axis.
5. **Z Gradient**: This option sets a ramp of values from 1 to 0 along the Z axis.
6. **-X Gradient**: This option sets a ramp of values from 0 to 1 along the X axis.
7. **-Y Gradient**: This option sets a ramp of values from 0 to 1 along the Y axis.
8. **-Z Gradient**: This option sets a ramp of values from 0 to 1 along the Z axis.
9. **Center Gradient**: This option sets a ramp of values from 1 at the center, to 0 along the edges.

Add/Edit Contents > Initial States
This Initial State Options window lets you set the resolution of your fluid to that of an example fluid's initial state. The options available are:
Fluid Resolution:
1. **As Is**: This setting sets the fluid example's resolution to that of the current fluid container's initial state.
2. **From Initial State**: This setting sets the current fluid container's resolution to that of the fluid example's initial state.

Make Collide
Make Collide turns on the collision between the selected object and fluids. The option in the option box is:
1. **Tessellation Factor**: Maya internally converts NURBS objects to polygons before it animates the simulation. The Tessellation Factor sets the number of polygons created during the conversion.

Make Motion Field
Motion fields let you accurately simulate objects moving through a fluid. This field applies a force to its parent object, so that the object then appears to move or push its fluid. For example, for the animation of a boat pulling a water-skier through a fluid, you can apply a motion field to the boat and the water-skies so that they appear to push through the water while they are in motion.
The attributes available in the attribute editor are:

Basic Emitter Attributes
1. **Emitter Type**
a. **Omni**: This sets the emitter type to an Omni directional point emitter.
b. **Surface**: This emits fluid properties from randomly distributed positions on or near a NURBS or polygonal surface. When you emit from an object, the emitter is a surface emitter.
c. **Curve**: This emits fluid properties from randomly distributed positions on or near a curve.
d. **Volume**: This emits fluid properties from a closed volume. You pick the shape from the Volume Shape option.

Fluid Attributes
2. **Fluid Emission Turbulence**

Turbulence Type: Select the type of turbulence to apply to fluid emission.
a. **Gradient**: This option applies turbulence that ranges smoothly through space.
b. **Random**: This option applies random turbulence.
3. **Turbulence**: The intensity of a force simulating a turbulent wind that evolves over time.
4. **Turbulence Speed**: The rate of change of the turbulence over time. To animate this, attach a new time node to the time input and animate the time value on the time node.
5. **Turbulence Freq**: This option controls how many repeats of the turbulence function fit inside the bounding volume of the emitter. Low values create a very smooth turbulence.
6. **Turbulence Offset**: Use this option to translate the turbulence within the volume. Animating it can simulate blowing turbulent wind.

Texturing Fluids
Procedural texturing capabilities are built into the fluid container. You can apply the built-in noise textures to both dynamic and non-dynamic fluid effects. By animating textures set for non-dynamic fluids, you can produce beautiful effects that take much less time to render than dynamic effects.

Fluids as textures
You can create 2D and 3D fluid textures and map them to surface shaders. The fluid can be dynamic or non-dynamic.

2D fluid textures
Mapping a 2D fluid texture to a surface shader creates the fluid pattern on the surface.

3D fluid textures
When you map a 3D fluid texture to a surface shader, the geometry that the surface is assigned to must be inside the fluid container for the texture to render. The texture renders only where Density contacts the surface geometry.

Fluids as materials
You can create a fluidShape in Hypershade and assign it to any volume primitive node using the volumetric Fluid Shape material. This is possible because a fluidShape is actually both a volume shader and a volume shape node.

Fluids Effects
The attributes which define the basic characteristics of the fluid container are:
1. **Resolution**: This attribute defines the resolution of the fluid container in voxels.
2. **Size**: This attribute defines the size of the fluid container in world space units.
3. **Boundary X, Y, Z**: The boundary attributes control the way the solver treats property values at the boundaries of the fluid container.
a. **None**: This makes all boundaries of the fluid container open so that fluid behaves as though the boundary isn’t there.

b. **Both Sides**: This closes both boundaries of the fluid container so they act like walls.
c. **-X, -Y, or -Z Side**: This closes the -X, -Y, or -Z boundary, respectively, so it acts like a wall.
d. **X, Y, or Z Side**: This closes the X, Y, or Z boundary, respectively, so it acts like a wall.
e. **Wrapping**: This attribute causes the fluid flowing off one side of the fluid container to enter at the opposite side. This can be useful if you want to have a windy fog, but you do not want to continually replenish the Density at the in-flowing regions.
4. **Color Method**: Color displays and renders only where Density is defined. Select which method to use to define color.
a. **Use Shading Color**: This defines color using the Color ramp attribute in the Shading section of the Attribute Editor.
b. **Static Grid**: This creates a color grid which you can populate with specific color values. While these values can be used in dynamic simulations, they cannot change due to any dynamic simulation.
c. **Dynamic Grid**: This creates a color grid which you can populate with specific color values for use in a dynamic simulation.
5. **Falloff Method**: This adds falloff edges to the display of fluids, so that you can prevent the fluid from appearing in part of the volume.

Dynamic Simulation: To simulate flow for a fluid property, the Contents Method for that property must be set to Dynamic Grid and Velocity cannot be off.
6. **Gravity**: The Gravity setting is a built-in gravitational constant that simulates the gravitational attraction of the mass of the world in which the simulation is occurring.
7. **Viscosity**: Viscosity represents the resistance of the fluid to flow, or how thick, and non-liquid the material is. When this value is high, the fluid flows like tar. When this value is small, the fluid flows more like water.
8. **Friction**: Friction defines internal friction used in Velocity solving.
9. **Damp**: Damp defines the amount the Velocity solution is damped towards zero at each time step. Small amounts of damping can be useful when boundaries are open to keep strong winds from building up and leading to instability.
10. **Start Frame**: This attribute sets the frame after which the fluid simulation will start. Nothing will play back for this object prior to this frame. You could use this attribute to delay the effect of a field on a fluid until the frame of your choice.
11. **Conserve Mass**: Turn this option on to conserve mass when updating the Density values during solving.
12. **Use Collisions**: Turn this option off to disable the collision of fluid with collision geometry in the container.
13. **Use Emission**: Turn this option to off to ignore all connected fluid emitters during simulation.
14. **Use Fields**: Turn this option to off to ignore all connected external fields during simulation.

9.1.4 Create 3D Container with Emitter

This command creates a 3D container for fluids with an Emitter. The options available are:
1. **Emitter Name**: You can provide a name for the emitter.
2. **Parent to Container**: Turn this option on to parent the emitter to the container. When the emitter is parented to the container, selecting the container automatically selects the emitter automatically.

Basic Emitter Attributes:
3. **Emitter Type**: You can set the emitter type for the fluids. The available types are Omni and volume emitters.
4. **Density Rate (/Voxel/Sec)**: This option sets the average rate at which Density values are emitted into the grid voxels per second.
5. **Heat Rate (/Voxel/Sec)**: This option sets the average rate at which Temperature values are emitted into the grid voxels per second.
6. **Fuel Rate (/Voxel/Sec)**: This option sets the average rate at which Fuel values are emitted into the grid voxels per second.
7. **Fluid Dropoff**: This option sets the dropoff value for fluid emission.
8. **Cycle Emission**: Cycling emission restarts the random number stream after an interval in frames, specified by the Cycle Interval attribute.
9. **Cycle Interval**: This option specifies the number of frames between restarts of the random number stream.

Distance Attributes:
10. **Max Distance**: Maximum distance at which new property values are created from emitter.
11. **Min Distance**: Minimum distance at which new property values are created from emitter.

Volume Emitter Attributes:
12. **Volume Shape**: This setting sets the shape of volume the emitter will use if the emitter is of volume type.
13. **Volume Offset X, Y, Z**: This is the parent attribute for the translational offset of the emission volume's center from the emitter's origin.
14. **Volume Sweep**: The arc of the volume emission. Used for sphere, cone, cylinder and torus.
15. **Section Radius**: This setting applies to torus volumes only. This defines the radius of a section of the torus.

9.1.5 Fluids | Oceans

An ocean is defined by a flat surface with an ocean shader assigned to it. Fluid Effects simplifies the process of creating an ocean by providing a single command that creates a plane that is optimized for best results and an ocean shader, with appropriate connections. The ocean plane is a NURBS plane with more detail concentrated in the center so you can have the ocean extend to the horizon, but see a reasonable resolution locally. Since interactive shading would slow down playback, the shading is turned off for the surface. You need a preview plane to see displacement and shading in hardware display.

Wakes
A Wake is a fluid container with a Spring Mesh solver. A fluid emitter is used to

drive the motion of the Wake fluid. With Wakes you can create boat wakes, add additional turbulence to an ocean, or generate bubbling and ripple. Ocean Wakes differ from Pond Wakes. For Oceans, a Wake is a fluid texture with a Spring Mesh solver that adds additional displacement and/or foam to the Ocean shader. For Ponds, a Wake is a 2D fluid with a Spring Mesh solver that is rendered directly as a fluid.

Floating objects
You can float objects in your Oceans and Ponds using fluid locators. You can add these locators to objects individually, or you can use commands in the Ocean or Pond menus to quickly create a buoy, float an object, or make a boat. Fluid locators are connected to the displacement channel of fluid waves and are controlled by predefined expressions. These expressions define the attributes that control the movement of the target object.

Fluid Effects > Ocean > Create Ocean
Create Ocean command creates an ocean. The options for creating an ocean are:
1. **Attach to Camera**: Turn this option on to attach the ocean to the camera. Attaching the ocean automatically scales and translates the ocean based on the camera, thus maintaining an optimum amount of detail for the given point of view.
2. **Create Preview Plane**: Turn this option on to create a preview plane that shows a shaded patch of the ocean with displacement in shaded display mode. You can scale and translate it to preview different parts of the ocean. If you do not create this plane at the time you create the ocean, you can create the plane later by selecting the ocean plane and then selecting Fluid Effects > Ocean > Add Preview Plane.

Fluid Effects > Ocean > Add Dynamic Locator
Dynamic locators follow the motion of the ocean in the Y direction, but additionally react appropriately to dynamic attributes. You can parent Dynamic Locator to an object in the scene.

Fluid Effects > Ocean > Add Boat Locator
Boat locators follow the motion of the ocean in the Y direction, but additionally rotate in X and Z to allow the boat to pitch and roll in the waves.

Fluid Effects > Ocean > Float Selected Objects
You can make an object float by adding a dynamic locator to it. Dynamic locators follow the motion of the ocean in the Y direction and also react to dynamic attributes such as buoyancy, gravity, and damping.

Fluid Effects > Ocean > Make Boats
You can make an object float like a boat by adding a boat locator to it. Standard boat locators behave like dynamic locators, but also rotate in X and Z.

Fluid Effects > Ocean > Make Motor Boats
You can make an object float like a boat by adding a boat locator to it. Motor boat locators include throttle, rudder and roll attributes to realistically simulate the

motion of a motor boat.

Fluid Effects > Ocean > Create Wake
Create Wake create an ocean wake. The options available are:
1. **Wake Size**: Wake Size sets the size attribute of the Wake fluid.
2. **Wake Intensity**: This value determines the magnitude of the wakes. In the fluid emitter attributes, this value is Density/Voxel/Second.
3. **Foam Creation**: This value determines the amount of foam generated by the fluid emitter. In the fluid emitter attributes, this value is the Heat/Voxel/Second. For Oceans, this value directly affects the foam.

Ocean Shader / Ocean Texture
The Ocean texture can be used to simulate a range of water wave patterns, from small scale waves in a bathtub to large stormy sea swells. It is designed to be used as a displacement map. The Ocean shader simulates the way color changes with light and view angle for an ocean effect.
The attributes of Ocean shaders are:
1. **Scale**: Scale controls the size in meters that corresponds to the 0 to 1 texture space in UV.
2. **Time**: You can use this attribute to animate the Ocean texture. You can keyframe the Time attribute to control the rate and amount of change of the ocean texture in your scene.
3. **Wind UV**: Wind UV controls the average direction that the waves will travel, simulating the effect of wind.
4. **Wave Speed**: This attribute defines how fast waves move.
Tip: To freeze the waves, make the speed zero.
5. **Num Frequencies**: This attribute controls the number of interpolated frequencies between Wave Length Min and Wave Length Max.
6. **Wave Length Min**: This attribute controls the minimum length of waves in meters.
7. **Wave Length Max**: This attribute controls the maximum length of waves in meters.
8. **Wave Height**: This attribute controls the size of waves relative to their wave length.
9. **Wave Turbulence**: This attribute controls the amount of turbulence at different wave frequencies.
10. **Wave Peaking**: This attribute controls the amount of crest formation for waves across the range of wave frequencies. Wave Peaking simulates a side to side sloshing of waves, as opposed to up-down motion. Wave Turbulence must be non-zero for this attribute to have an effect, as it is only applied to the turbulent waves.
11. **Foam Emission**: This attribute controls the density of foam generated above the Foam Threshold. The Foam Emission value is output to the outFoam attribute, which can be used to define opacity of a layered foam shader.
12. **Foam Threshold**: This attribute controls the Wave Amplitude required to generate foam and how long the foam will last.
13. **Foam Offset**: This option adds uniform foam everywhere. It is useful when you need to add a custom foam texture.
14. **Water Color**: This attribute defines the basic color of the surface.

15. **Foam Color**: This attribute defines the color of the foam layer. Part of the simulated foam might be considered submerged, in which case the color is blended with the material color.
16. **Transparency**: This attribute controls how transparent or opaque the material is. Black means completely opaque and white means completely transparent.
17. **Refractive Index**: This attribute defines how much a ray of light will bend when it passes through an object. This attribute only works if your material is partially or completely transparent, refractions are turned on, and you are rendering using Ray Tracing.
18. **Diffuse**: This attribute controls how much of the light in the scene is scattered from the object. Most materials absorb some of the light falling on them, and scatter the rest.
19. **Trough Shadowing**: This attribute darkens the diffuse color in the wave troughs. This can simulate certain lighting conditions where wave peaks are brighter, scattering light. This attribute works well when the wave color is in a blue-green range.
20. **Environment**: This attribute defines a simple sky to ground environmental reflection using a ramp. The left of the ramp is the top of the sky and the right is the bottom.
21. **Refractions**: Turn on Refractions to make your material refract light when you are rendering with Ray Tracing.

9.1.6 Fluid | Ponds

Ponds are 2D fluids that use a spring mesh solver and a height field. With the pond options and attributes, you can set the size and color of your fluid surface. You can generate waves, bubbles, and ripples in the fluid surface using Wakes. Increasing the size of your pond extends the range of your waves and ripples.

Fluid Effects > Pond > Create Pond

Create Pond creates a pond fluid in the scene. The available option is:
1. **Size**: This option defines the size of your Pond fluid. The size of the Pond can be modified by using the container properties of the Pond fluid shape.

Fluid Effects > Pond > Create Wake

The options available for the pond wake are:
1. **Wake Size**: The size of the Wake fluid is determined by the size attribute of the Pond fluid container.
2. **Wake Intensity**: This value determines the magnitude of the wakes. In the fluid emitter attributes, this value is Density/Voxel/Second.
3. **Foam Creation**: This value determines the amount of foam generated by the fluid emitter. In the fluid emitter attributes, this value is the Heat/Voxel/Second.

9.2 Maya Cloth

With Maya Cloth, you can create realistic animated cloth within the Maya environment. Maya Cloth gives you the ability to model garments for any

animated 3D figure, apply dynamic effects, and simulate the cloth behavior. In addition to clothing characters, you can create many other types of cloth animation, including sheets, bedding, drapery, flags, and fabric goods of all kinds.

9.2.1 Creating Cloth

With Cloth, you can create a simple piece of cloth, such as a tablecloth or flag, or a complicated article of clothing that is fitted on a model.

Draping and fitting

After you create the garment, you drape it and fit it to the character. To drape the garment on the model, you specify the model as a collision object and use the cloth solver to drape the garment over the model. Fitting involves modifying the original garment to accommodate peculiarities of the character on which it is draped. You can influence how the cloth settles on the character using constraints and dynamic fields.

Applying properties to cloth in Maya

Cloth properties work much like shaders. However, instead of assigning a color or texture like a shader, cloth properties specify the physical properties of the cloth. These properties affect how the cloth behaves when it moves. For example, you could create a property that makes your cloth behave like denim.

Animating Cloth

When you animate your character, cloth solver calculates the collisions and motion of the cloth. Before you begin animating your character, you need to move your character from the dress-up pose to the animation start pose. To modify the movement of the cloth during the animation, you can add constraints or fields from Maya Dynamics.

Playing back Cloth simulation

When you run your simulation, you can cache the results for quick playback. You can save different cache files for the same scene to compare. Playback can be speed up by disabling the solver or the collision objects.

Adding textures and shaders

It adds a life like realism to your cloth. You use the standard Maya tools to add textures and shaders to your cloth just like you add them to any object in Maya.

Cloth > Create Panel

Use this command to create a cloth panel from the selected curves.

Cloth > Create Garment

Use this command to create a cloth garment from the selected panel or curves.

Cloth > Create Seam

Use this command to create a cloth seam from the selected curve(s).

Cloth > Create Cloth Object

Use this command to create a cloth object from the selected polygon.

Differences between a garment and a cloth object

A cloth object is a piece of geometry simulated as cloth. If you select a NURBS shape and make it a cloth object, Cloth first converts the NURBS to a polygonal

object.
A garment is one or more panels that are seamed together to form a cloth. A panel is made up of two or more NURBS curves that are on the same plane and form a closed region.

Garments

When you create a garment from curves, Cloth creates a mesh with varying sizes of triangles that are randomly distributed. The mesh has no regularity or stress lines. This creates more natural folds. In addition, if you change the resolution of a garment after simulating, Cloth can update the geometry without resimulating. However, you need to simulate for the cloth to move with the new resolution.

Cloth

You create cloth objects from polygonal shapes or NURBS shapes. The original shape is hidden and the tessellated cloth shape is displayed. The original shape and the cloth shape are grouped under the object's transform. With NURBS objects and certain procedurally-generated polygonal objects, you can get artificial stress lines caused by the regular tessellation.

Cloth > Create Collision Object

This command sets the selected object as a collision object.

Cloth > Create Collision Offset/Depth Mesh

This command displays a collision mesh for the selected collision objects.

Paint Collision Properties Tool

This tool lets you use the Paint Collision Properties Tool to paint collision properties of cloth objects. In the Paint section there are some attributes unique to the Paint Collision Properties Tool. These unique attributes are described below.

Paint section:

1. Select Attribute: Be sure to first select a Cloth collision object in the scene view, and then select a cloth attribute from the drop-down list. When you paint, you paint values for that attribute.
2. **Priority Map**: This is a per-vertex value. These values are averaged over a face and added to Collision Priority.
3. **Depth Map Offset**: This is a per-vertex value. These values are averaged over a face and then used as a percentage offset applied to the calculated depth at that face. This is used to adjust for situations where the depth map calculation method does not produce perfect results. The effective depth can be painted up or down as needed.
4. **Collision Offset Map**: This is a per-vertex value. These values are averaged over a face and then used as a percentage offset applied to the calculated offset at that face. This is used to adjust for situations where the depth offset calculation method does not produce perfect results. The effective offset can be painted up or down as needed.

Collision Cloth Sets

This command lets you control cloth collisions on a per-face basis, which is helpful if you want a subset of faces on a collision object to collide. All created collision cloth sets are stored in the Cloth > Collision Cloth Sets submenu.

9.2.2 Constraints > Button

This creates a button constraint. When it is created a transform is created and updated every frame, which tracks the position and orientation of the cloth. You can parent an object to the transform and it will follow cloth like a button does. The options available in the option box are:
1. **Button Name**: Enter a name for the button.
2. **Preserve Translation**: This preserves the position of the button in world space. The button does not move after the constraint is created.
3. **Translate**: When Preserve Translation is turned off, you can set the translate X, Y, Z values.
4. **Preserve Rotation**: This preserves the offset of the button in world space. The button does not move after the constraint is created.
5. **Rotate**: When Preserve Rotation is turned off, you can set the rotate X, Y, Z values.

Constraints > Field
You can use this command to connect a dynamic field to cloth.
Constraints > Collision
You can use a collision constraint to let you control collisions on a per-vertex basis and animate the control over time.
Constraints > Cloth
You can use a cloth constraint to bind cloth vertices to cloth. Useful for creating pockets etc.
Constraints > Mesh
You can use a mesh constraint to constrain cloth to a collision object. Sometimes you may want to constrain certain parts of your clothing to your character so the clothing doesn't fall away.
Constraints > Transform
You can use this to create a transform constraint that constrains the cloth to the object at a certain distance, as though it were welded. If the object moves, the points on the cloth that are constrained also move.
Simulation > Properties > Create Cloth Property
Use this to create a new property.
Simulation > Properties > Paint Cloth Properties Tool
Lets you use the Paint Cloth Properties Tool to paint properties and wrinkling effects across the entire surface of a garment.

Properties (Attributes) of the Cloth object
These are the attributes of the Cloth object:
1. **U/V Bend Resistance**: This attribute controls how much the cloth resists bending in the U and V directions. The greater the U/V Bend Resistance value, the stiffer the cloth.
2. **U/V Bend Rate**: The U/V Bend Resistance may increase non-linearly as the cloth triangles are folded from 0 degrees to 180 degrees. The U/V Bend Rate attribute controls the exponent of how much the U/V Bend Resistance increases from 0 to 180 degrees.
3. **U/V Stretch Resistance**: This attribute controls how much the cloth resists stretching in the U and V directions. The greater the value, the more the cloth resists stretching.
4. **Shear Resistance**: This attribute controls how much individual triangles resist moving in an opposite but parallel sliding motion. The higher the

number, the less the triangles can shear.
5. **U/V Scale**: This attribute controls the scale of the cloth in the U and V directions.
6. **Density**: This attribute controls the mass per unit area of the cloth.
7. **Thickness**: This attribute controls the depth dimension of the cloth. The value specifies the collision offset of the cloth when it collides with itself and with other cloth bodies. The amount of offset may vary depending on the Thickness Force attribute.
8. **Thickness Force**: This attribute controls the force used to maintain the collision offset specified by the Thickness attribute during cloth-to-cloth collisions. If a heavy piece of cloth gets closer to another piece of cloth than the distance specified by the Thickness attribute, you can increase this value to keep the heavier cloth at the proper distance.
9. **Cloth Friction**: This attribute controls friction between the cloth and other cloth bodies.
10. **Cloth Damping**: This attribute specifies how strongly the overall motion of the cloth is diminished.
11. **Air Damping**: This attribute specifies how strongly the motion of the cloth is diminished by the physical properties of the air. Air damping provides air resistance to triangles that are normal to the direction of travel. If the triangles on the cloth are parallel to the direction of travel, Air Damping has no effect.

Solvers > Create Solver
Create Solver lets you create a solver so you can segment cloth simulations into multiple independent simulations that are solved separately. The options available are:
1. **Name**: Enter a name for the solver.
2. **Start Frame**: You can specify at what frame the solver starts calculating.
3. **Frame Samples**: You can specify the number of times the solver samples the time interval between successive frames. Frame Samples and Time Step Size work together.
4. **Time Step Size**: This option specifies the maximum time, in seconds, that the internal dynamic solution advances.
5. **Gravity**: This option specifies the value for gravity.
6. **Relax Frame Length**: This option specifies the number of frames that a rubbery “relax material” is applied to a garment and the garment does not react to gravity. After the specified number of frames, the normal material is applied and the cloth reacts to gravity.

Save as Initial Cloth State
Use this option to tell the cloth solver to use the current position as its start position.
Update Cloth State
Use this option to give the new cloth positions to the solver, but it doesn’t delete the cache.

9.2.3 Simulation
Once you have your cloth ready to drape over your character, you can start the simulation. The simulation is performed by the cloth solver, which assembles information on all the garments, cloth objects, the bodies they interact with, and

any fields or constraints applied to the cloth.

9.2.4 Start Local Simulation

This command starts the Cloth simulation.

9.2.5 Show Cloth Stress

Use this option to turn on the display of stress feedback on the cloth.

9.2..6 Manipulators > Drag Control

This command activates the Drag Control Cloth manipulator and the locator at the end of the path is selected.

9.3 Assignment

1. Create dress for a model
2. Flood in the city

Unit 10 Maya Hair

	Time Required to Complete the unit

The time required to study thus Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading a unit
2. 2nd Reading with understanding: It will need 3 Hrs for reading and understanding a unit
3. Self Assessment: It will need 3 Hrs for reading and understanding a unit
4. Assignment: It will need 4 Hrs for completing an assignment
5. Revision and Further Reading: It is continuous process

10.1 Maya Hair

Maya Hair is a component of Maya Unlimited that you use to

create a dynamic hair system so you can model realistic hairstyles and hair behavior. Since Hair is a generic dynamic curve simulation, you can also use these curves to create nonhair effects. With Hair you can simulate:

- Natural movement and collisions of long hair
- Hair blowing in the wind or being blow dried
- Hair when swimming underwater
- Various hairstyles, including ponytails, braids, and updos
- Other dynamic curve effects such as ropes, chains, cables, wires, a suspension bridge, sea creatures, or even a lofted surface from a curve.

A hair system is a collection of hair follicles. A NURBS or polygonal surface can have multiple hair systems on the same surface and one hair system can span multiple surfaces. A hair follicle in human hair typically hosts one hair, whereas in Maya each hair follicle hosts a hair curve. The hair follicle controls the attributes and curves associated with a particular hair clump, and how the hairs attach to a NURBS or polygonal surface.

Paint Hair Tool

With the Paint Hair Tool you can create hair, add and remove follicles, as well as paint follicle attributes, including Hair Scale, Stiffness, and Braid.

Rendering Hair

Paint Effects hair can be rendered using the Maya Software renderer. You can also convert Paint Effects hair to polygons and render in another renderer, such as mental ray.

10.1.2 Create Hair

Use create Hair to create dynamic hair on a NURBS or polygon surface. The options in the Create Hair options box are:

1. **Output**: This is the hair system's output. Select from one of the following:
   a. **Paint Effects**: Each follicle has hair clump containing information about the color and shading of the hair, as well as its position.
   b. **NURBS Curves**: Each follicle contains one NURBS curve that represents the position of the hair in that follicle.
   c. **Paint Effects and NURBS Curves**: Each follicle contains one NURBS curve that represents the position of the hair in that follicle. Each follicle also has a hair clump containing information about the

color and shading of the hair.
2. **Create Rest Curves**: When turned on, this creates a set of Rest curves that are straight and normal to the surface.
3. **Grid, At Selected Points/Faces**: These options specify whether the hair to be created is placed on the grid of the selected surface, or at the selected surface points/faces.
4. **U Count**: The number of follicles to be created along the U direction.
5. **V Count**: The number of follicles to be created along the V direction.
6. **Passive Fill**: The number of passive curves to active curves. Passive curves interpolate the dynamic behavior of active curves, but are less expensive than simulating every curve.
7. **Randomization**: The degree of randomization for the placement of follicles along the U and V directions. With a value of 0 there is no randomization and the follicles are lined up. With a value of 1 the follicles are extremely random.
8. **Edge Bounded**: When turned on, the follicles are created along the edge of the U and V parameters.
9. **Equalize**: Turn this on so when hair is created Maya compensates for uneven mapping between UV space and world space, equalizing the distribution of the follicles so they aren't cluttered at the poles.
10. **Static, Dynamic**: These options specify whether the hair to be created is Static or Dynamic. Static hair does not respond to the dynamic forces, but can be manually keyframed, whereas dynamic hair does respond to the dynamic forces.
11. **Points Per Hair**: The number of points/segments per hair. As this value increases the hair curve becomes smoother. Keep in mind for relatively short stiff hair use fewer points, but for long flowing hair use more points, especially if you plan to style the hair curves.
12. **Length**: The length of the hair in world space units.
13. **Place Hairs into**: Place the hairs to be created in a new hair system, or an existing hair system.

Scale Hair Tool
Lets you change the scale of the selected hair system. Drag right to make the hair larger or longer and drag left to make the hair smaller or shorter.

10.1.3 Paint Hair Follicles

You can use the Paint Hair Follicles Tool to add dynamic hair to a NURBS or polygonal surface, to remove hair, or to paint follicle attributes of an existing hair system. Paint Hair Follicles Settings are:
1. **Paint Modes**: These are descriptions of the Paint Modes you can select in the Paint Hair Tool Settings window.
a. **Create Follicles**: This option adds follicles to the surface as you paint. The follicles that are created and their appearance are based on the Density, Points Per hair and Hair Length settings in the Paint Hair Tool Settings window.
b. **Create Passive Follicles**: This option adds passive follicles to the surface as you paint. Passive follicles draw their attributes and

behavior from their neighboring active follicles/curves at the start of the simulation.
c. **Delete Follicles**: This option removes follicles from the surface as you paint.
d. **Edit Follicle Attributes**: This option modifies the follicles you paint based on the settings in the Paint Hair Tool Settings window.
e. **Trim Hairs**: As you paint over the hairs they are trimmed based on the Value you specify for the Replace operation in the Paint Hair Tool Attribute Editor. The length that is trimmed is relative to the existing hair Length value.
f. **Extend Hairs**: As you paint over the hairs they are lengthened based on the Value you specify for the Replace/Add operation in the Paint Hair Tool Attribute Editor. The length that is extended is relative to the existing hair Length value.
2. **Follicle Attribute**: Select the follicle attribute to paint using the Edit Follicle Attributes Paint Mode. Specifically, you can paint Clump Width Mult, Density Mult, Curl Mult, Clump Twist Offset, Color Blend, Braid, Hair Scale, Inclination, Roll, Polar, Surface Inset, Stiffness.
3. **Hair System**: Select which hair system to paint.
4. **Output**: If Paint Mode is Creating Follicles, then select the type of hair output.
5. **Follicle Density U**: If Paint Mode is Creating Follicle, this value represents the number of follicles to create in the U direction.
6. **Follicle Density V**: If Paint Mode is Creating Follicle, this value represents the number of follicles to create in the V direction on the surface.
7. **Points Per hair**: If Paint Mode is Creating Follicles, this value represents the number of points each new hair has. As this value increases the hair curve becomes smoother. If the Paint Mode is Trim Hairs or Extend Hairs, this value represents the number of points along the hair affected by the operation.
8. **Hair Length**: The length of the hair in world space units.
9. **Follicle Override Color**: You can specify a follicle color override if you select Edit Follicle Attributes as the Paint Mode and then select Color Blend as the attribute. You control the value of the Color Blend by adjusting the Value in the Tool Settings editor.

Paint Hair Textures
This command lets you paint maps for various Hair attributes, such as baldness, hair color, and specular color.

Get Hair Example
This command opens the Visor window, where you can choose from a selection of Hair Presets.

Set Start Position
Select this to set the position for the Start curves based on the Current Position or the Rest Position. The Start Position represents the position of the hair at the start of the simulation.

Modify Curves

Use these menu items to manipulate the hair curves to achieve the hairstyle you want.

Lock Length
This command locks the length of the hull for the selected curve or CV(s).

Straighten
Use this to straighten the hair curves. You can set the Straightness and turn on or off the Preserve Length in the Straighten Curves Options window.

Curl
Use this to add curl to or adjust the curl of the hair curves. You can set the Curl Amount and Curl Frequency values in the Curl Curves Options window.

Bend
Use this to add bend or adjust the bend in the hair curves. You can set the Bend Amount and Twist values in the Bend Curves Options window.

Hair > Create Constraint
Use these menu items to add constraints to selected hair curves.

Create Constraint > Rubber Band
Rubber Band adds a Rubber Band constraint to the selected hair curves. This is like attaching rubber bands from the constraint to the point set. The length of each rubber band is the distance from the constraint to the point at the start frame. If the distance between a point and the constraint becomes greater than the rubber band length a force is applied pulling it toward the constraint.

Create Constraint > Stick
Stick adds a Stick constraint to the selected hair curves. This is like attaching sticks from the constraint to the point set, where the sticks may rotate freely about the constraint center. This is similar to the Rubber Band constraint, except that when the distance between the constraint and points is less than the start distance a repulse force is also applied. This tends to keep all the constrained points at a fixed distance from the constraint center.

Create Constraint > Transform
Transform adds a Transform constraint to the selected hair curves. This is like constraining the points to a block of jelly at the start frame. This is useful when constraining hair to fall along a contact point, like a shoulder. Also this can be used to simulate hair being grabbed and twisted by a hand. If you animate the constraint's scale the hair can be pulled together or pushed apart.

Create Constraint > Hair to Hair
Hair to Hair adds a Hair to Hair constraint to the selected hair curves. This allows you to bind hairs together where the hair group is free to move with respect to the constraint position.

Create Constraint > Hair Bunch
Hair Bunch adds a Hair Bunch constraint to the selected hair curves. This can

help create body to the hair as it animates in a fashion similar to self collision, but with much less computation. The initial set of points nearest the constraint will repel each other where they overlap. There is also a slight static cling where the points stick together slightly when they touch. If the hair clumps overlap at the start frame they may suddenly push apart.

Assign Hair System
Assigns the selection to the specified hair system, which can either be a new hair system or an existing hair system.

10.1.4 Make Selected Curves Dynamic

Any NURBS curve can be made into a dynamic hair, such as a curve deformer or input curves to a lofted surface. In addition to creating long hair and hairstyles you can use hair curves to create:
• ropes and chains
• a fish
• a fishing line
• a tied-back beaded curtain
• an octopus
• a suspension bridge
• a wire deformer on particles

Make Collide
Make Collide sets the selected object to collide with the selected hair system. First select the object and then select the hair system.

10.2 Maya Fur

Maya Fur is a component of Maya Unlimited that you use to create realistic, self-shadowing fur and short hair on multi-surface NURBS, polygonal and subdivision surface models. You can set fur attributes, such as color, width, length, baldness, opacity, scraggle, curl, and direction globally, or map them on a local basis. Using an attractor system, you can also keyframe fur movement, or have fur react to dynamic forces within Maya.

10.2.1 Modifying fur attributes

You can modify fur description attributes so that all surfaces with the fur description attached have the new attributes. You can also style a fur description,

such as shorten or lengthen the fur on some parts of the model, by mapping attribute values, or by painting fur attribute values directly on the model.

Animating fur attributes
You can keyframe the changes you make to fur attributes, and thus animate effects like growing fur or changing fur color.

Adding movement to fur
If you are animating your scenes, you can add movement to fur for a more natural effect. Using attractors, you can manually keyframe fur movement, or using Dynamics, you can make the fur react to forces or have fur react to the movement of the surface the fur is attached to for example, a shaking dog.

Attach Fur Description
Attach fur Description is used to attach a new or existing fur description to the selected surface(s).

Edit Fur Description
Use this to select a fur description and view its Attribute Editor:
1. **FurDescription**: You can assign a name to the fur.
2. **Light Model**: Select the light model you want applied to the fur description.
a. **Ambient Only**: Only the Base Ambient Color and Tip Ambient Color of the fur are used in the final color calculation.
b. **Ambient + Diffuse**: The Base Ambient Color and Tip Ambient Color values are added to the Base Color and Tip Color values respectively.
c. **Ambient + Diffuse + Specular**: The Base Ambient Color and Tip Ambient Color values are added to the Base Color and Tip Color values respectively, and the Specular values are added to the hairs according to the Specular Sharpness.
d. **Specular Only**: Only the specular lights for the fur are rendered.
3. **Density**: Type the number of hairs you want distributed either across all surfaces the fur description is attached to or on each surface the fur description is attached to.
4. **Global Scale**: Use this setting to adjust the Base Width, Tip Width, Length, and Offset values by a common factor. This scales the hairs uniformly.
5. **Assigned Surfaces**: This option lists the surfaces that have the current fur description assigned to them.
6. **Base Color**: Base color defines the color of the fur base.
7. **Tip Color**: Tip Color defines the color of the fur tip.
8. **Specular Color**: Specular color defines the color of shiny highlights on the fur.
9. **Length**: Length defines the fur length in world units.
10. **Baldness**: Baldness defines how much fur is on the surface.
11. **Inclination**: Inclination sets the amount of inclination.
12. **Roll**: Roll rotates the fur about the surface V axis. You can achieve almost any fur angle using Polar and Inclination, so use this option only when the fur has curl and you want the curls to lie flat.

13. **Polar**: Polar rotates the fur about the surface normal.
14. **Base Width**: Base Width defines the width of each hair at the base, in world units.
15. **Tip Width**: Tip width defines the width of each hair at the tip, in world units.
16. **Base Curl**: Base curl defines the amount of curl at the base of the fur.
17. **Tip Curl**: Tip curl defines the amount of curl at the tip of the fur.
18. **Scraggle**: Scraggle defines how crooked the fur is.
19. **Scraggle Frequency**: This defines the amount of change over each length of hair.
20. **Attraction**: Attraction defines the amount of attraction this fur description has towards attractors. Attractors are used to add movement to fur.

Fur Render Settings
Use this to set the render settings attributes for the Fur Description.

10.2.2 Fur > Fur Shadowing attributes

This is use to add or remove from a light's Attribute Editor the Fur Shading/Shadowing attributes.
Tip: This applies only to lights set up to render Fur with the Maya Software renderer.

Add to selected Light
To create more realistic looking fur with self-shading and shadows, you must first add fur light attributes. Then you can set up one of the following effects per light:
• No shadows, no shading (less realistic)
• No shadows, simple shading (relatively realistic)
• (Depth Map) Shadows (most realistic, but longer rendering time)

Remove from selected Light
Adding lights with fur shading/shadowing attributes increases render time. Therefore the more lights that have fur shading/shadowing attributes, the longer the scene takes to render. Including many lights that have fur shading/shadowing attributes may not noticeably improve the look of the fur. Experiment with the number of lights with fur shading/shadowing you need to achieve the effect you want and optimize render time.
You can easily remove fur shading/shadowing attributes from a light. However they only exist on a light if you've previously assigned them.

Attach Hair System to Fur
Use this to attach a hair system to a specified fur description. You can attach more than one fur description to the same hair system.

Edit Curve Attractor Set
Use this to open the FurCurveAttractors node in the Attribute Editor for the selected fur curve attractor set. The FurCurveAttractors node is created when you attach a hair system to a Fur description.
1. **FurCurveAttractors**: You can assign a name to the attractors.
2. **Attractor Model**: Select the type of curve attractor you want.
a. **Local**: Local attraction affects the direction and shape of the fur by

the amount the nearest attractor varies from its initial state. This lets you accurately propagate the exact changes in the attractors to the fur, whether those changes are subtle or extreme.
b. **Global**: Global attraction attracts the fur towards the nearest attractor hair, causing a clumping effect.
3. **Curves Per Fur**: Type the number of curves a fur should be influenced by.
4. **Influence**: Influence set how much influence the curve will have on the fur. The value you enter linearly increases or decreases the influence over the length of the fur.

Set Start Position To
Use this to set the starting position of dynamic curves of a hair system based on the combed position of the fur.

10.3 Maya Paint Effects

Paint Effects is a component of Maya used to quickly and easily paint brush strokes and particle effects on a 2D canvas or on or between 3D geometry. You can use Paint Effects as a traditional paint program to paint images on a canvas, or to paint repeatable textures that you can apply to geometry in your scenes. Paint Effects goes beyond traditional painting—you can paint entire particle effects on your canvas or scene with a single brush stroke. On a 2D canvas a single brush stroke can produce complex images, for example trees or flowers. In your scene, that same brush stroke produces these entities three-dimensionally. You can also apply dynamic forces to the effects you paint in your scenes and animate the display and movement of the effects. Paint Effects strokes render seamlessly with the rest of your scene during a post process in the final render.

10.3.1 Paint Effects > Paint Effects Tool

This tool allows you to paint strokes with Paint Effects brushes. The available Paint Effects Tool settings are:
1. **Draw As Mesh**: This setting lets you preview the rendered look of your strokes interactively in the scene view; you don't have to view them in the Paint Effects panel. You can also edit brush attributes and see the changes happening to the stroke in the scene view.
2. **Paint at Depth**: When Paint at Depth is off, the depth values of the paint change as you drag the brush into the scene. If the stroke has tubes, the tubes grow from the surface you paint. When Paint at Depth is on, the depth value of the stroke is determined when you first click the brush, and is then fixed at that value. If the stroke has tubes, the tubes grow from the plane orthogonal to the path at each step. This is useful for creating effects where you want tubes to sprout out from the path. The Paint Effects Tool cursor changes to project ortho-normal to the view, to indicate you are painting at depth.
3. **Display Quality**: This setting set the display quality of the wireframe for the next stroke. The higher the percentage, the more closely the stroke wireframe represents the rendered stroke.
4. **Surface Offset**: This setting set the distance you want the next stroke offset from the object or plane you paint the stroke on.
5. **Pressure Mapping 1, 2, and 3**: Select which value you want to map to

pressure. Select Off for no pressure sensitivity.
6. **Pressure Min1, 2, and 3**: This setting set the minimum pressure at which the pressure mapping will start to take effect. The minimum attribute value that you can paint is determined by multiplying the Pressure Min by the value set for the mapped attribute.
7. **Pressure Max1, 2, and 3**: This setting set the maximum pressure at which the pressure mapping will take effect. The maximum attribute value that you can paint is determined by multiplying the Pressure Max by the value set for the mapped attribute.

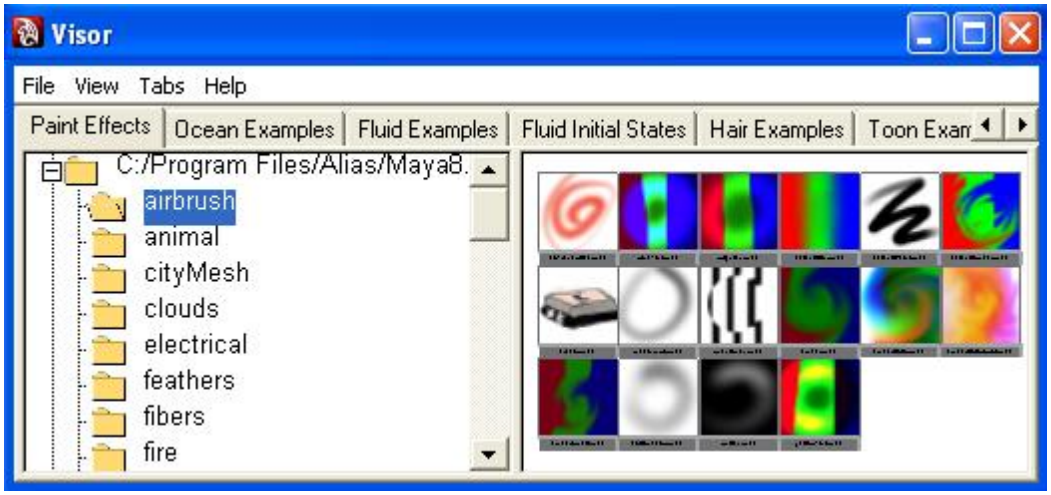
Make Paintable
Make Paintable allows you to paint the selected NURBS or polygonal objects. To paint on NURBS or polygonal objects, you must first make the objects paintable.

Share One Brush
Share one brush forces the selected strokes to share the brush of the last selected stroke. When strokes share a brush, any changes you make to the brush affect all the strokes that brush is attached to.

Get Brush
Get Brush opens the Visor so you can select a preset brush.

10.3.2 Visor

The window that displays the rendering-related nodes currently used in a scene, and provides access to files on disk which the user may wish to bring into the scene like animation clips, brushes, shader libraries, or texture libraries



10.4 Assignment

1. Create Hair
2. Character with fur

3. Character Weighting