POLYGONAL MODELS
- Can be selected from either the create pull-down menu or the Polygons shelf.
- 3D polygonal modeling refers to building a representation of a 3D object using 2D polygons.
- Using this method we can closely approximate a 3D object without making our scene too computationally complex.
- A good candidate for rendering objects that don’t require smooth curvature, or in candidates where it will be difficult for a viewer to tell the difference. Good for limiting the rendering complexity of your scene.
- Useful transformations include, but are not limited to: Extrude, Separate, Split, Merge, Smooth, Roughen, Chamfer
NURBS Models
- Can be selected from either the create pull-down menu or the surfaces shelf.
- NURBS (Non-Uniform Rational Basis Spline) 3D objects are mathematically generated objects.
- They offer an alternative to polygonal 3D modeling by sacrificing some render speed to provide a more accurate appearance.
- Should be used if the object will be scrutinized by the viewer, or if it is particularly curvy.
- NURBS offers more accurate curves, and can exceed polygonal rendering for smooth objects.
- Useful transformations include, but are not limited to: Extrude, Revolve, Birail creation, Bevel, Attach/Detach Surface
- Can be selected from either the create pull-down menu or the Subdivs shelf.

- Subdivision surfaces are a final option for creating 3D models. It creates a 3D polygonal cage to constrain the final object, and then interpolates within the cage to create a rounded object.

- They are able to create very complex curved shapes by converting a low-resolution object to a high-resolution object. This, in conjunction with Gouraud smooth shading, creates a very smooth looking object.

- Can be used most effectively when creating organic-looking objects.

- Use this as a basis for complex 3D sculptures.

- Can modify complexity (number of sub polygons) to achieve goal with highest render speed.
Source: http://plissken.fatalunity.com/tutorials/subdiv/
Objects can often be converted from one type to another.
Splitting Polygons
Extruding Faces
Revolve Surfaces
Loft Surfaces
Extrude Surfaces
Fillet Blend Surfaces
Trim Surfaces
a. What are the Manipulators.

Move Tool, Rotate Tool, Scale Tool, and the Universal Manipulator.
We can move, rotate, or scale the objects (part of object) by dragging handles on the manipulator.
MANIPULATORS

Move Tool/Position Manipulator

a. How to move object

- Drag an arrow to move along that axis.
- Drag the center handle to move freely across the view plane.
- Click a handle, then drag the middle mouse button move along the active handle.
- Hold Shift, drag the middle mouse button up and down or left and right to move in that direction.
- In a perspective view, Ctrl+click an arrow to switch the center handle to move across an axis plane.
- Ctrl+click the center handle to switch it back to moving across the view plane.
Move Tool/Position Manipulator

- **Move Settings**
  - Move Axis: Object, Local, Normal
  - Along rotation axis, Along live object axis
  - Custom axis orientation: 0.0000, 0.0000, 0.0000
  - Preset positions: Set to Point, Set to Edge, Set to Face
  - Discrete move: Relative, Step size: 1.00

- **Move Reflection Settings**
  - Reflection: Origin, Bounding Box
  - Reflection axis: X, Y, Z
  - Tolerance: 0.5000

- **Move Snap Settings**
  - Retain component spacing
  - Snap to live polygon: Face center, Vertex

Reflection
MANIPULATORS

Rotation Tool/Rotation Manipulator

a. How to rotate.
   .Drag the rings to rotate around the different axes.
   .Drag the outer ring to rotate around the view axis.

b. Rotate Settings.

c. Rotate Reflection Settings.
   (Gimbal Lock)
MANIPULATORS

Scale Tool/Scale manipulator

a. How to Scale.
  . Drag a box to scale along that axis.
  . Drag the center box to scale uniformly in all directions.
  . Click a handle to make it active (yellow), then drag the middle mouse button anywhere in a view window to move along the active handle.
  . Hold Shift, drag the middle mouse button up and down or left and right to scale in that direction.
Universal Manipulator

It acts in place of all three tools. When we move/rotate/scale an object, the Universal Manipulator shows the corresponding values.
What are the locators?
a."It's a null object, it doesn't render; it is used for attaching some custom attributes for visual reference measuring from one point to another, and more."

Create a locator menu tool: Create > Locator

when to use?
a. It can be used to create a point in space for eyeballs to follow. Then you can animate the locators to change where the eyeballs are looking.
b. You can parent joints to the locator so moving the locator pushes and pulls the joint
Constrain the IK Handle to the control object (Locator: ArmControl)

Then we can use this locator to control the movement of IKHandle

This model can be found in the GettingStartedLessonData directory that was installed with your Maya software, or from the drive where you copied the Getting Started Files: GettingStartedLessonData/CharSetup/ClusterBS.mb
What are the deformers?

They are high-level tools to manipulate (when modeling) or drive (when animating) the low-level components of a target geometry.
Deformers

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- Duplicate a face (right)
- Select Vertices
- Create Deformers > Cluster, move
- Edit Deformers > Paint Cluster Weight Tool
- We can create more expression from the Blend Shape editor
- Tool Setting window
Deformers

Others
Lattice deformers

Jiggle deformer
--A deformer that causes points on a surface or curve to shake as they move, speed up, or slow down.

Sculpt deformer
--Sculpt deformers are useful for creating any kind of rounded deformation effect.

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Material

The color, shininess, and reflectivity attributes of an object are controlled by its surface material (also referred to as a shader, or shading material).

After assigning new material (Blinn, middle)
Material

Material types
a. Lambert.
b. Blinn.
c. Phong.
d. PhongE
e. Ramp.
f. Anisotropic.

The Hypershade Window

The Hypershade Window -->
Rendering Editors -->
Hypershade

(The use of hypershade in modeling)
Texture Mapping

Let you modify the appearance of your 3D models and scenes in Maya.

A. UV Texture Mapping: UV texture coordinates are two-dimensional coordinates that reside with the vertex component information for a 3D surface.

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Texture Mapping

In the view panel choose Shading > Hardware Texturing

Fix it! Sew UVs
Open Automatic Mapping: select Create UVs > Automatic Mapping > Option
Texture Mapping

Others

Granite (3D textures)  Ramp (2D textures)

When we will use them?
A. apply labels & logos to your surfaces.
B. apply surface relief details and features to a surface.
C. use illustrations as texture maps to create interesting backdrops in your scene
Texture Mapping

Use several images together to wrap the sphere ---- then we get the earth

Hypershade work area
• Node: A packet of information and its attributes which define the node and how it animates.

• Types of hierarchical Modeling:
  • Grouping
  • Parenting
How to display the Hypergraph
Hypergraph
Parenting: An object that is a parent node, passes its transformational information to its children nodes, these nodes inherit all of the transformations of the parents above it.

- There is no new node created like in grouping, the parented object becomes the head of the hierarchy.
- The children nodes still have the ability to be selected and independent of their parent node.
When parenting, selection order in the hierarchy is important. The object that you want to act as the parent is selected last.

To break the hierarchical relationship, select the children nodes and select Menu> Edit> Unparent.
**Grouping**: allows one to group many individual objects into one large group, by creating a new non renderable group node. This allows for transformations to be applied to the group as a whole if the new node was chosen in the hierarchy. Objects may still be chosen independent of the group.

- To Group objects together: go to Menu> Edit> Group
- To select options for grouping go through the same path way and click on the box, or Hot Key Ctrl g.
To the Right we see an example of grouping, selecting the objects using Ctrl g.

To the left we see the Hypergraph is open and we can see the differences in the Hierarchy between parenting and grouping objects together with similar attributes.
This is a useful tool in addition to the Hypergraph, aiding in the organization of a scene. The outliner allows for quick renaming, grouping, parenting, and selection.

Menu>Window>Outliner
Organization
Always name your objects right away!
Instances vs. Copies

- There are two ways that one can copy an object in Maya:
  - Copy (Duplicate)
  - Instance

- Copy (duplicate): Maya makes a copy of the geometry or light.
  - Allows for multiple copies of the object/light.
  - Can assign shaders independent of the original object that was copied.

- Instance: Maya redisplay the geometry being instances, there is no actual copy of the original geometry being created, just displays
  - As no actual copy is made less system memory is used and can increase render times in large files and also help to reduce the size of the file.
  - Making a change to the original object, instances will reflect the same change.
  - There are some limitations with Instances: Instanced lights will have no effect, can not be assigned an independent shader, not able to use extrude functions on the instanced object, creating an instance of an already instanced node does not create a new level.
Select object to be copied then go to Menu > Edit > Duplicate or Edit > Duplicate Special

Keyboard short cut: Ctrl D
Copy vs. Instance

Copy Hypergraph Hierarchy Display

Instance Hypergraph Hierarchy Display
Kinematics – The act of posing and animating a skeleton

- **Forward**: when you pose a joint chain you rotate each joint individually
- **Backwards**: you can pose a joint chain based on a location in space you want the joint chain to reach (aka Inverse)
Inverse/Backwards Kinematics (IK)

Forward Kinematics (FK)
Basically, an IK handle runs through a selected joint chain like a wire, providing you with a way to move the entire joint chain.
IK solvers provide the motor intelligence of IK handles. IK solvers figure out how to rotate all the joints in a joint chain controlled by an IK handle. Maya's interface offers three types of solvers:

- IK Rotate plane (RP) solver
- IK Single chain (SC) solver
  - These are used for regular Kinematic Chains
- Spline IK solver
  - Used for curves or twisted objects
MEL commands related to posing with IK handles include the following:

- ikHandle
- ikHandleCtx
- ikHandleDisplayScale
- ikSolver
- ikSplineHandleCtx
- ikSplineManipCtx
- ikSystem
- ikSystemInfo
- createNode

But you’ll learn more about these later!
Maya carries out inverse kinematics posing with certain dependency graph nodes. As you perform inverse kinematics posing, you can view and select these dependency graph nodes by using the Hypergraph (Window > Hypergraph)

- Can include: handle node, solver node, rotate plane solver node, single chain solver node, etc.
A Hypergraph Example