

I. Hierarchical Modeling

- A. Limitations of models made from several pieces.
 - i. Transformations applied globally to all pieces of a model are applied about each pieces local coordinate origin(pivot point).
 - ii. Transforming each piece of a model separately becomes tedious and impractical.
- B. Grouping and Transformations
 - i. Logical grouping of several sub elements, or nodes, is accomplished by defining a transformation matrix that propagates downward to the lower levels. This generates a new local coordinate system for the grouping.
 - ii. Transformations can then take place on the group as a whole, or on each individual level.
 - iii. Transformation Stack - the collection of all transformation's currently in effect and how they propagate onto one another.
 - a. Push and Pop - the act of starting and stopping transformations on a particular node, respectively.
 - b. Transformations stay in effect until they are "stopped" at the conclusion of a node in the hierarchy.
- C. Representation of the Hierarchical Structure
 - i. The Hypergraph - used to visualize graphical relationships between components of a scene.
 - a. Scene Hierarchy - shows ordered arrangement of objects, lights, cameras, and other items that make up a scene.
 - b. Dependency Graph - shows the architectural connections between Maya entities that input and output data.(e.g. Shading Group connections).
 - c. Use the Dependency/Scene Graph toggle icons in the Pane Toolbar.
 - ii. Understanding Hierarchical Terminology
 - a. Parent - object or other item that controls attributes of one or more children.
 - b. Child - object having attributes controlled by a parent.
 - c. Node - Any box in the graph. (Subnode - any node below another node in the hierarchy.
 - d. Branch - all nodes from parent to child lay on a branch of the hierarchy.
 - e. Transform node - contains an objects transformation attributes as well as information regarding parent-child relationships.
 - f. Shape node - holds and objects geometry attributes. Shape nodes don't appear in the Hypergraph by default.
 - iii. Working with the Hypergraph(assume menu commands are in the Hypergraph's Pane Menu).
 - a. Displaying special nodes - Use the **Options** menu to toggle visible nodes and connections that are invisible by default.
 - 1. Shape Node - holds an object's geometry, and is a child of the objects transform node.
 - 2. Invisible Nodes - displays any object hidden by **Display -> Hide**.
 - 3. Underworld Nodes - lay below an objects surface node. They hold info on curves on surfaces, they are not evaluated in world coordinate space.
 - b. Collapse/Expand Hierarchy - useful tools for easy viewing.
 - 1. **Edit -> Collapse** to hide the hierarchy under it's parent node. use
 - 2. **Edit -> Expand** to reveal hidden children nodes.
 - c. Frame buttons - allow you to frame up the Hypergraph window around nodes.
 - d. Rearranging scene hierarchy nodes - toggle on the Freeform graph icon on right side of toolbar pane.
- D. Parenting and Grouping
 - i. Parenting
 - a. **MMB** drag the child node onto the parent node.
 - b. **Edit -> Parent** - parents all selected nodes to the node selected last.
 - c. **Edit -> Unparent** - unparents a child from a parent. All children of the unparented child stay parented. Select the node you wish to separate from the hierarchy.
 - d. **MMB** drag a child away from a parent to separate them.

- ii. Grouping
 - a. **Edit -> Group** - allows you to group a selection of objects under a new transformation node.
 - b. **Edit -> Ungroup** - to break up a group by selecting the parent node. (Use unparent to remove individual nodes from a group.)
- E. Duplicating Objects
 - i. **Edit -> Duplicate** - allows you to duplicate any selected object in the world.
 - ii. Workflow - select items you wish to duplicate, then pull the menu.
 - iii. Duplication parameters -
 - a. Translate, Rotate, etc. - this is where you specify the offset values for each duplicate.
 - b. Copy/Instance toggle - select the type of duplicate you wish, see Efficient Modeling below for further info on this topic.
 - c. Smart Transform - concatenates continually on singular duplicates.
 - d. Upstream/Input graph - duplicates all upstream nodes being fed by the select node, and all of the nodes feeding into the selected node.
- II. Curve and Surface Editing - all menu items can be found under **Edit Curves or Edit Surfaces**.
 - A. Insertion - inserting edit points and surface isoparms.
 - i. Simply select two isoparms or edit points you wish to insert the EP or isoparm.
 - ii. Keep originals is always a wise decision until you know exactly what you want.
 - iii. **# Knots to insert** - enter in the number of knots you wish to add between your selected components.
 - iv. To interactively insert a knot/isoparm, click on an isoparm and drag along the surface before selecting **Edit Curves -> Insert**.
 - B. Attach - attaching two object types together, to form one new curve or surface.
 - i. Select two curves to connect then **Edit Curves -> Attach**.
 - ii. Select two surfaces to connect, then **Edit Surfaces -> Attach**.
 - iii. Various Settings
 - a. Connect - join the two curves/surfaces without substantially altering the curvature of the curve/surface.
 - b. Blend - will attempt to impose continuity on the input curves/surfaces based on the blend bias setting.
 - c. Insert knot - only available for blend attach, inserts a knot at the join.
 - C. Detach - used to break a curve/surface into two curves/surfaces.
 - i. Same workflow as the **Insert** tool.
 - ii. To interactively detach a knot/isoparm, click on an isoparm and drag along the surface before selecting **Edit Curves -> Insert**.
 - D. Surface/Curve Direction - if you get unpredictable results from the edit curve/surfaces tools, examine your surfaces, and determine that the UV directions are the same. If they aren't use **Edit Curves -> Reverse Curve Directions** (same with surfaces).
 - E. Rebuilding Curves - used to rebuild curves, changing their parameterization, number of spans, etc.
- III. Efficient Modeling
 - A. Build Smarter - use the least number of edit points/CVs to build your curves.
 - B. Instancing vs. Copying - use instance instead of copy when duplicating objects.
 - i. Instancing
 - a. Merely points to the geometry of the original object.
 - b. A new transformation node is created, without any geometry.
 - c. You can only rotate, scale, and move and instanced object, you can not change the geometry, CVs, isoparms etc.
 - d. Uses less system memory during modeling.
 - ii. Copying
 - a. Makes a copy of an objects geometry and transformation matrix.
 - b. Adds to the amount of memory your models/scene holds.
 - c. Offers you the freedom to manipulate and edit geometry.
 - C. Remove unwanted geometry - remove construction history when done, remove unnecessary edit points, trim curves, etc.