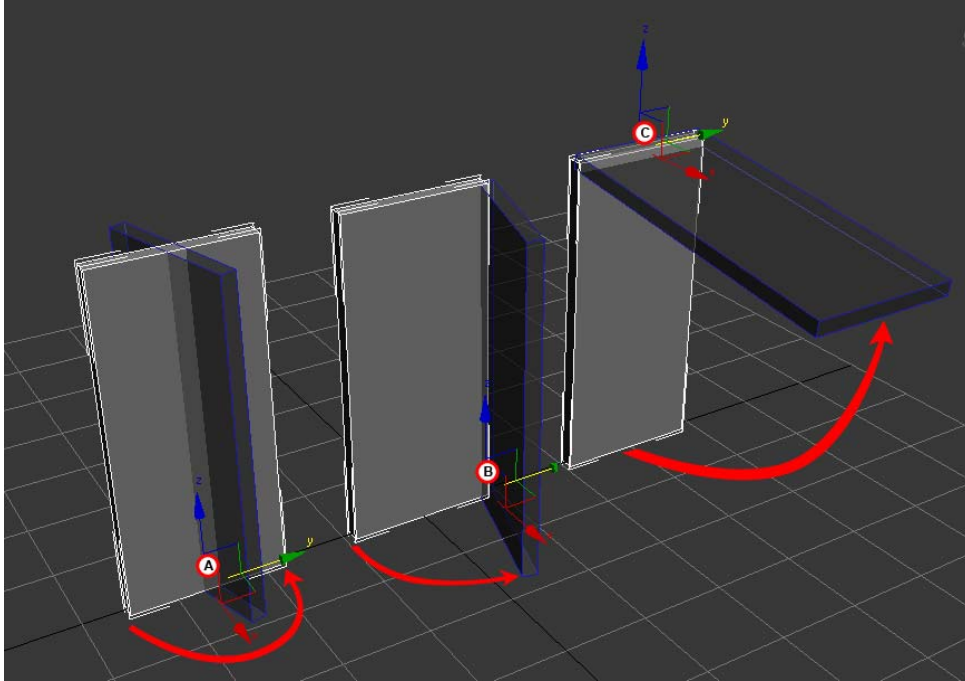# GA2211 – Hard Surfaces Modeling Section A & B – Class Notes – Week 2

Pivots:

Every piece of geometry in Max has a pivot point. Pivots serve as the center for transformation operations like Move, Rotate and Scale. Here are some examples of different pivot points on the same model:

Notice how they affect where the center of the rotation happens.

A) A pivot in the center will cause the mesh to rotate about the center.

B) A pivot at an edge will cause the mesh to rotate at the edge, like a hinge.

C) A pivot at the top will make this mesh rotate about the top edge, like a flap.

Pivots are also important for Animation, because they set where objects can turn from. You can make the job of animating something easier if the pivots are correctly set up for the motion that is intended in the animation.

In games, pivots are crucial, because most game engines rely on the pivot for placement in the engine. Also, games physics systems require careful placement of the pivot to ensure the object behaves as expected.

Adjusting Pivots:

Pivots are adjusted in the **HIERARCHY** panel, under the **PIVOT** sub menu.

1) To adjust the pivot, click the "**AFFECT PIVOT ONLY**" button. You will notice the transform Gizmo has changed in appearance to let you know you are adjusting the PIVOT only.

Move the pivot to the desired location.

**2)** You can quickly center the pivot at the center of its shape by clicking "**CENTER TO OBJECT**".

3) You can also reset the pivot to its starting point by clicking **RESET PIVOT**.
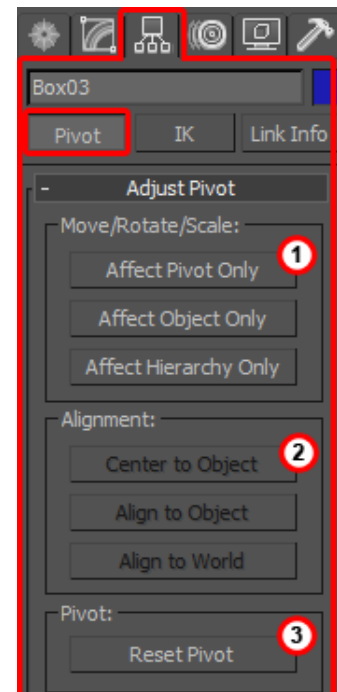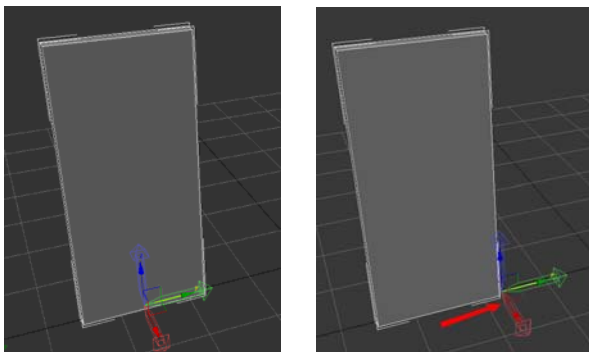
Working Pivot:

Another useful feature that Max has is the concept of the "Working Pivot". The "Working Pivot" is a special pivot you can use while modeling and constructing your scene that is ***independent of the object's pivot***. This gives you the freedom to work with another pivot for placement and other operations, while leaving the object's pivot alone. There is only 1 working pivot to the scene.

To use the Working Pivot:
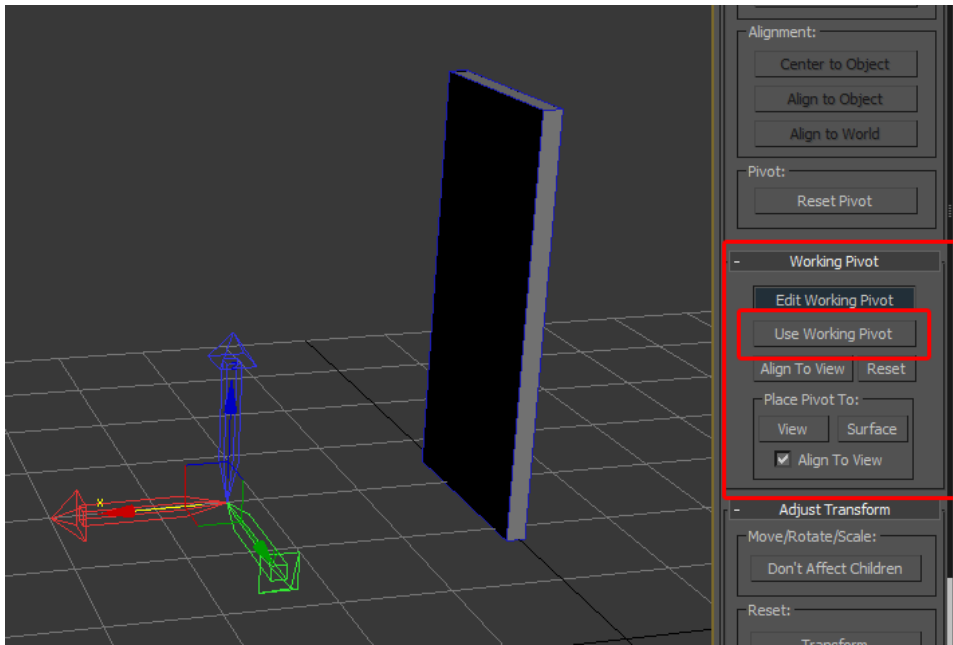
- Click the "**Use Working Pivot**" button.

- You will notice that the pivot displayed is different from your object's pivot.

- To adjust the Working Pivot, click the "**Edit Working Pivot**" button.

Snaps:

Snapping makes certain elements in the UI "sticky" and forces your tools to get attracted to them – this makes it easier to make precise moves. Snapping is essential in modeling, placement of scene objects and certain tool operations. You have options in Max to discreetly snap to the Gird, Vertices, Center or Edges, etc.

To turn on SNAPS:

Right-Click in an open area of the toolbar and hold…select 'SNAPS" from the fly-out menu to bring up the SNAPS toolbar.

You can leave this toolbar up as you model, or dock it to the main toolbar.

The most useful ones, from left to right:

Button	Description
Grid Points	Snaps to grid intersections
Pivot	Snaps to pivot points of objects
Vertex	Snaps to vertices of mesh objects or objects that can be converted to editable meshes. Snaps to segments on splines.
Endpoint	Snaps to the end points of edges on meshes or spline vertices
Midpoint	Snaps to the middle of edges on meshes and spline segments
Face	Snaps anywhere on the surface of a face. Back faces are culled, so they have no effect
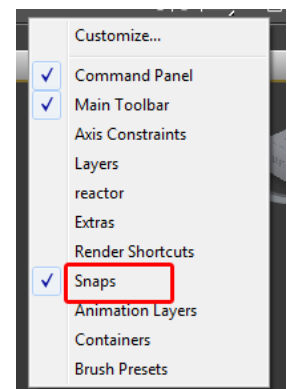
One you have set your snap options, you can now turn SNAPPING ON/OFF with the hotkey:
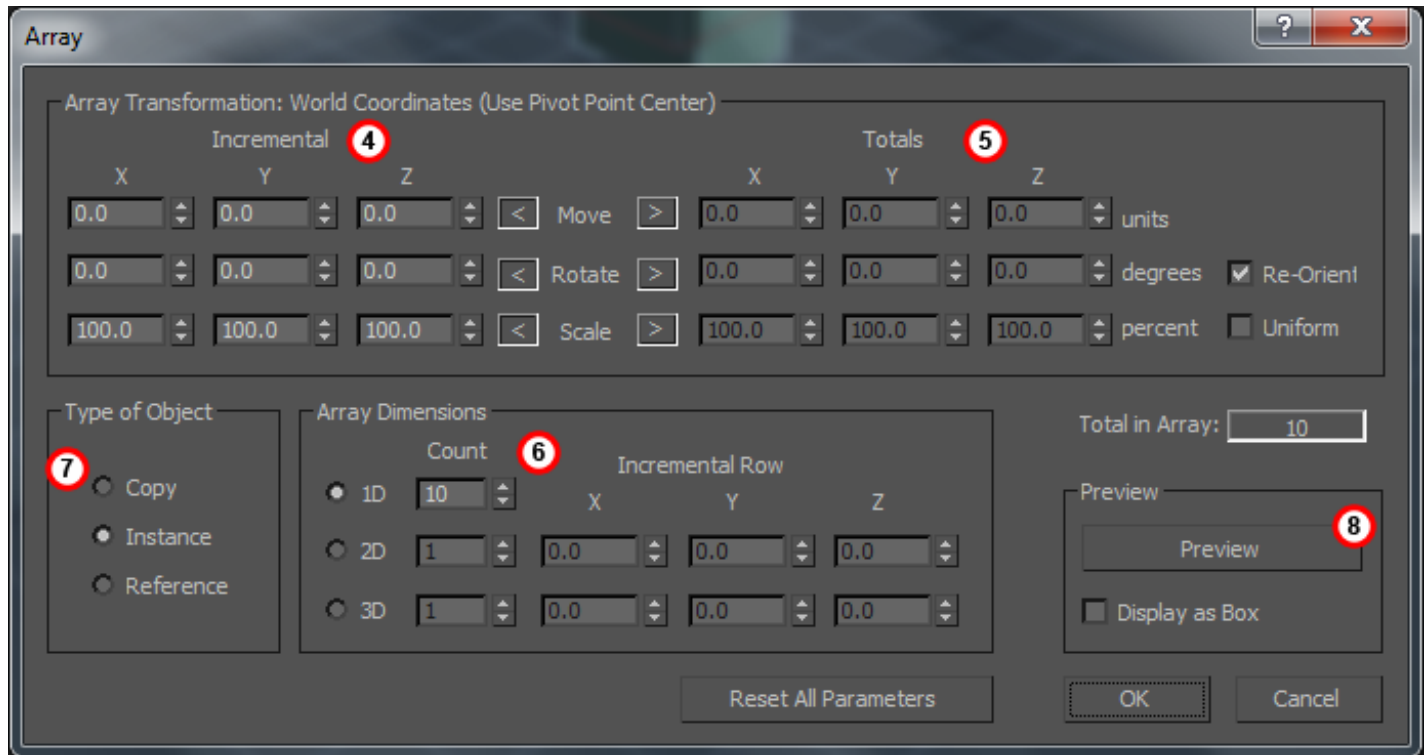
Array:

   The ARRAY tool lets you create copies of your geometry and transform it recursively. This can be very useful in creating repetitive move/rotate/scale and copy functions. It can also help you model complicated objects with some sort of radial symmetry or repeating parts.

To use the Array tool:

Select an object to Array…
Open up from the top Menu: **Tools > Array…**

There are 2 ways to distribute your desired transformations…**Incremental** and **Total**.
4) Incremental distribution will let you type in values for *EACH* copy. These are done for *EACH* copy.

5) Total distribution lets you type in a total value and Array will do the math to distribute the copies evenly within that range.

6) This is where you set the number of copies/instances.

7) You have the option to create unique copies, or instances here. Copies are unique meshes. Instances are tied back to the original mesh – so making a change on the mesh will result in changes for all the instances made from it in your scene.

8) The **PREVIEW** button lets you see the effects of your settings in the viewport before applying the array.

[Note:] *You can combine the WORKING PIVOT with this tool to create Arrays of objects about a discreet working pivot.*

Other Tools Covered in Week 2:

Make Planar: This tool will take your selection (verts, edges, polygons, etc) and try to make all elements line up along a plane.

There are 3 options, each one makes the selection planar to a plane defined by the other two axis : [X]   [Y]   [Z]
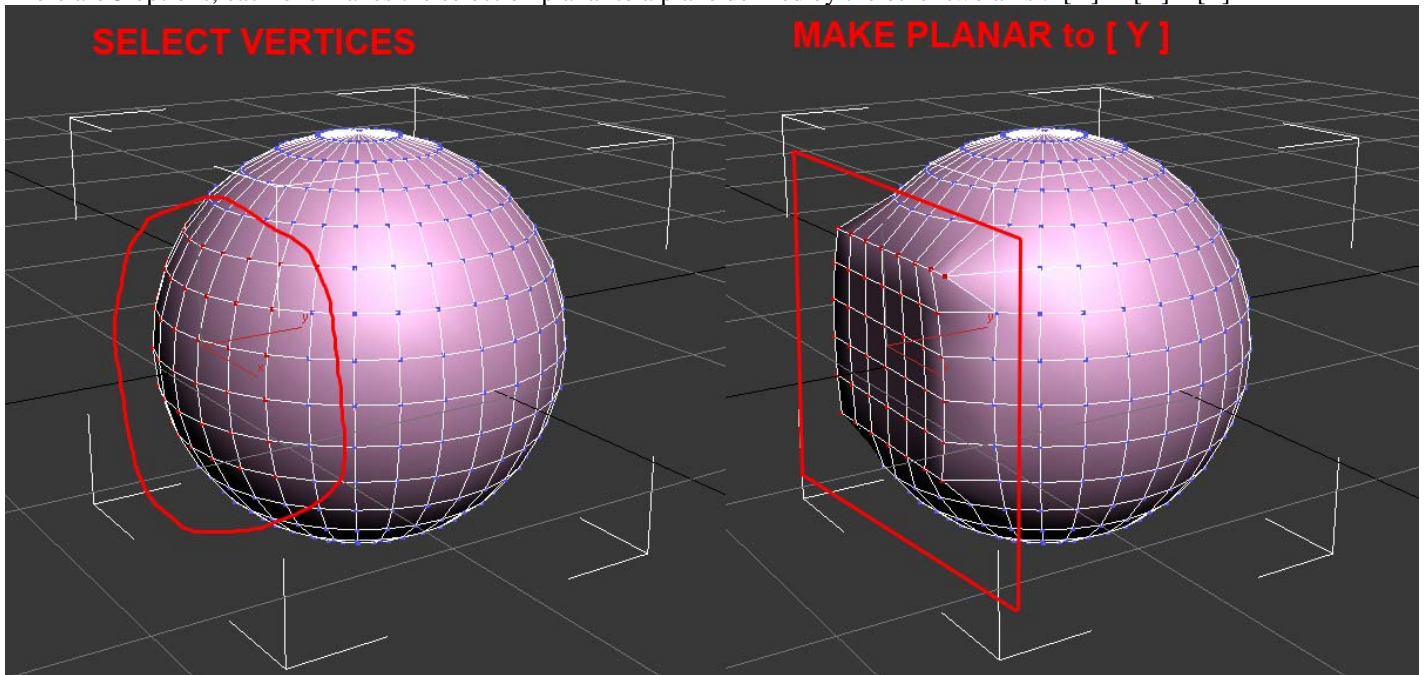
Inset: This tool does an extrusion that is 2 dimensional – meaning it does not push inward or outward on the selected polygon, but rather creates a planer extrusion to create more geometry inside a single polygon (or several).
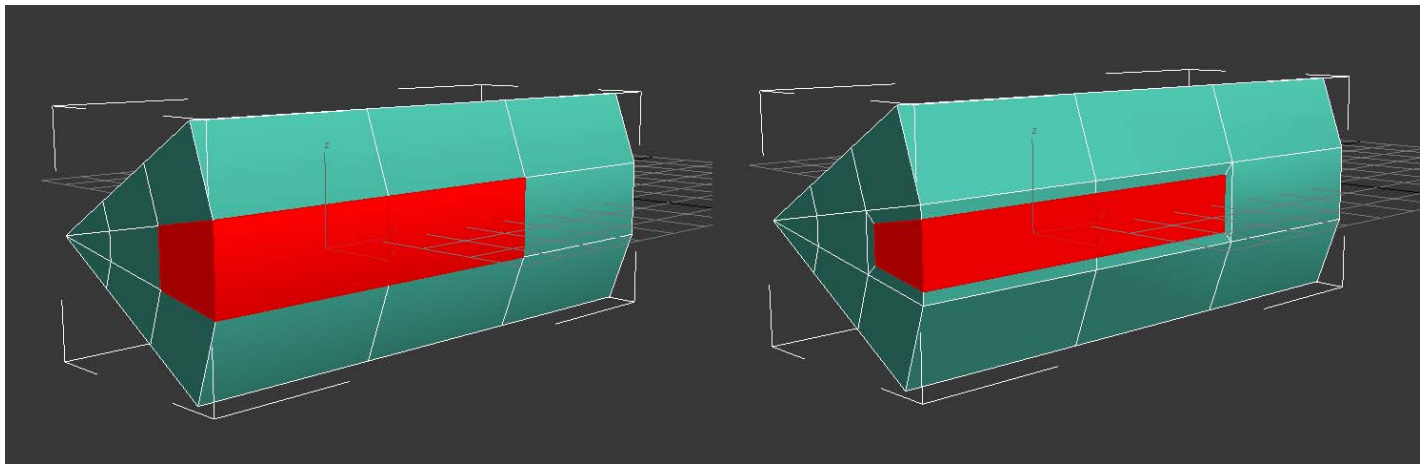
Relax: This tool will attempt to smooth over rough, noisy vertices. You can use it to round out noisy geometry or create organic flow out of hard edges – without adding any geometry.
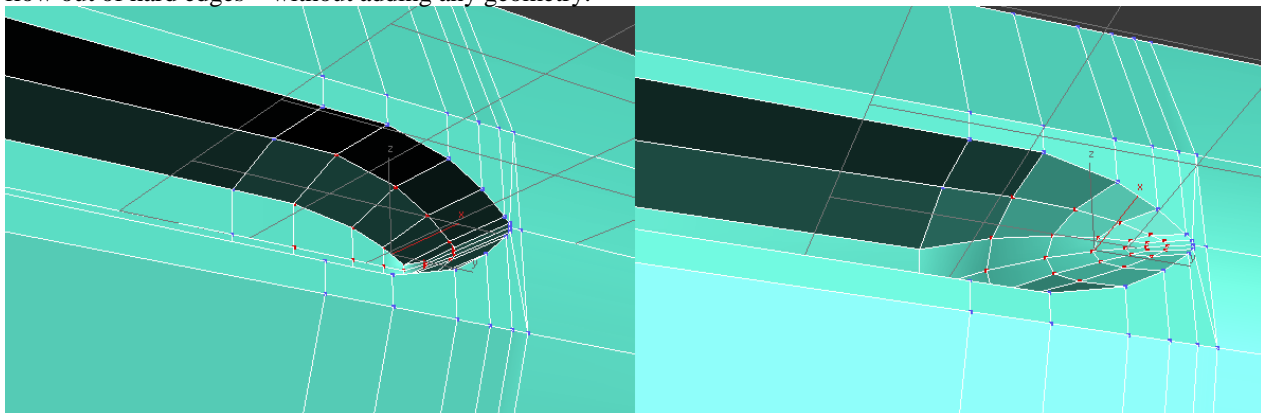
Smooth Groups:

[Note:] *All 3D graphics rendering engines have some conventions in common. One of these is the concept of VERTEX NORMALS. A Normal is simply a direction in space…a vector. Polygons have a Normal (facing direction) and vertices do as well. Each Polygon in a 3D mesh is made of triangles, which are in turn defined from 3 vertices. The secret behind 3D rendering is that all triangles are rendered independently…which leaves the question: "Why are some groups of triangles rendered smooth while others are rendered faceted?"*

The answer is because of VERTEX NORMALS. When 2 coincident vertex normals are parallel, they produce smooth shading across an edge or point junction. When they are divergent, it produces a hard line.

3D Studio Max lets you interact with Vertex Normals in the way of Smooth Groups. Smooth Groups let you tag a group of polygons to have similar rules for Vertex Normals.

To smooth out a group of polygons:

Select the polygons.

9) At the very bottom of the Modify panel, under Smooth Groups, select an index for this group by clicking a number.

10) Set the Smooth Angle to 180.

11) Click "Auto Smooth" to assign this value to this smooth group.

> **[Note:]** *Notice, this did not add any polygons – it simply smoothed the shading over the existing polygons.*

To discretely set the smoothing to ALL SMOOTH …the setting is 180.

To discreetly set the smoothing to ALL HARD/FACETED…the setting is 0.

You can set the smoothing to values in between, and leave the decision up to MAX as to what to smooth and what to make faceted based on angle of the faces…but this is not advised. There is no such thing as half smoothing or fractional smoothing – setting values in the middle only effectively lets Max decide by angle if it should be ALL smooth or ALL faceted. Make this decision yourself.
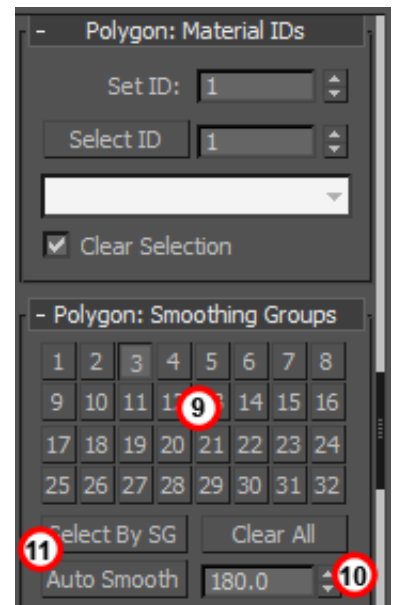
> **[Note:]** *You have to switch smooth groups if you want a hard edge between two sets of smooth faces. Otherwise, if they are in the same Smooth group, the smoothing will continue over the edge you wanted to be hard.*

Here are some examples of the progression to have smooth and hard edges near each other: