Project G - Blender

In this assignment, you will follow a tutorial to create a 3D model of a duck, create a simple animation of the duck walking, and export the model of the duck walking. Submit the video of the duck created in the last step to complete the assignment.

Blender Controls Reference

Middle click and drag to rotate
Shift + middle-click to move side to side (pan)
Scroll wheel to zoom
Click and drag arrows on an object to move it

Delete key deletes
b key selects vertices in a region
a key unselects / selects all
alt + click selects a loop of vertices
ctrl-r adds a cut of vertices within a shape
Tab changes between object mode and edit mode

r key rotates selected vertices
e key extrudes from selected vertices
g key moves selected vertices
Any of these plus an axis (ex: g then y) performs that command along/about that axis.

Setting up blender

You’ll need to install blender using the instructions at blender.org.

This assignment much easier to perform with a three-button mouse (and, though less important, a number pad). If that’s not an option, blender has a couple options for emulating the 3rd mouse button and numpad that can be found here. You can also install and use blender on the machines in room 100 if you want to.

Watch this tutorial to become familiar with the blender interface and terminology.

You will also need this image of a duck to use as a reference.
Tutorial for creating a Duck

Step 1

Open Blender to the default new project. You should see a cube, a lamp, and a camera. Delete the camera and lamp (select it, then hit delete on the keyboard).

Step 2

Select the cube, then enter edit mode (hit tab). Also, turn off visible selection so we can select vertices in both the front and back of the cube.

Vertices at the back of the shape are now selectable:

Step 3

Press 3 on the numpad to get a right side view, and press 5 to get an orthographic view. Press the B key, then drag to select the four vertices on the right side of the cube.
This box will select all four vertices on the right side of the cube because we enabled selecting all vertices earlier.

Step 4

Press e to extrude, then move the mouse to the right a little bit, then left click to confirm. This will create new vertices extruded from each of the selected ones, and should look something like this.

Step 5

With these new vertices selected, press R to rotate the selected vertices, then x to rotate them about the x axis. Rotate them to a roughly 45 degree angle.

Step 6

With the same vertices selected, press G to move them, move them down some, then left click to confirm.
Step 7

Perform the same “extrude, rotate, move” set of steps 3 more times to create something that looks like a backwards c as shown below. The angles and lengths don’t have to be exact for this part, but the shape should be there. Use b, g, and r commands to select individual vertices or groups of vertices and adjust them as needed. The a key deselects all / selects all vertices.

Step 8

Now we can add a background image as a reference. Click somewhere in the 3D view, then press the n key to show the properties panel. Scroll down to “Background Images” and click the checkbox. Also click the dropdown arrow, then click “Add Image”.
Open the Duck_Reference.png image, and the Background Image panel should look like this.
Press n again to hide the properties panel.

Step 9

Press the A key to select all vertices, then press g to move them. Move the vertices over to the Duck’s head on the reference image. Press s with the vertices selected to scale them to match the size of the head.

Step 10

Using the move (g), rotate (r), and scale (s) commands, move the vertices to match the front of the head of the duck. The z command toggles wireframe view on and off.
Step 11

Switch to a top view by pressing 7 on the numpad. Select all vertices with a, then use the red arrow to drag the geometry directly over the y axis.
Step 12
Create a cut through the center of the geometry along the y axis. Press ctrl+r, move the mouse to the center of the shape until a line bisects the shape length-wise, then click once to create a cut and once more to place the cut without scaling it side to side.

Step 13
Next, box select the left half of the geometry with b, and delete it. If necessary, select all vertices with a and slide them with the red arrow until they line up exactly with the y axis (zoom in to verify).
Step 14

Next, we are going to use the mirror modifier to duplicate half of the shape. This way, we can model half of the duck, and the other half will be updated in real time to match what we’ve done to the first side. To do this, click on the wrench in the panel on the left.

Click “Add Modifier” -> “Mirror”. Select the “clipping” checkbox, and the “Adjust edit cage to modifier result” box. Do not click apply yet (this saves the results of the modifier as part of the shape, and will stop the real-time mirroring).
Step 14.

Switch to “Face Select” mode. Select the face on the rear of the head, then press e to extrude, move the mouse, and left click to confirm.
Step 15

Press 7 on the numpad to switch into a top view, and switch back to “vertex select” mode. Use box select to select all vertices on the right side except for the last one, and press r to rotate, then rotate them to taper the beak as shown below.

Step 16

Select the back two vertices on the head (The two left unselected in the previous step). Drag the red arrow to move them inwards.
Step 17

Switch to “face select” mode, Select the two faces on the side of the beak, and move them inwards as shown below.

Step 18

Switch to “line select” move (located between “face select” and “vertex select”). Press 3 on the numpad to go to a side view. Then press g and move the lines down a little to create the angle on the beak. Also, select the front top vertex on the beak (vertex select mode) and move it forward a little.

Step 19

Go to a side view (3 on numpad), then use ctrl+r to create a cut along the side of the back of the duck head. Move the mouse until the pink line shown below appears, then click once to create the cut, move the mouse sideways to position the cut, then click again to confirm.
Create 2 more cuts like this, then use box select and g to move the vertices to match the duck head in the reference.

Step 20

Use ctrl+r to create another cut, this time horizontally along the head (perpendicular to the ones in the previous step). Then switch to edge select mode and select the edges along the top and back of the head (see below). Use the red arrow to drag them inwards and create some roundness on top of the head. Also select the top first vertex along the top of the head and drag it inwards a bit via the red arrow.
Step 21

Do the same thing on the bottom of the head (select the bottom row of vertices, move it inwards, then select the first vertex and move it inwards a bit.

Step 22

Create the eyes. Select the face shown below, the press e to extrude and right click (not left click)s immediately. This will give us another face in the same location as the first one. Then, with that face still selected, press s and scale it down to the size of an eye.
Step 23

With the eye plane still selected, press r then z to rotate about the z axis, then rotate the eye so it is facing more forward.

Step 24

Tweak individual vertices until you are happy with how the head looks. Use the reference drawing to help. Pressing z in edit mode toggles the transparency, so you can see the reference drawing in the side view (numpad 3).

Step 25

Now it is time to create the body. Select the vertices shown below on the underside of the duck and delete them.
Step 26

Select the loop of edges around the deleted vertex by alt + clicking on one of the edges in the loop. Then go to a side view (numpad 3), press e to extrude, and create the first part of the neck.

Step 27

Make another extrude along the neck and use the reference drawing to create the rest of the neck.
Step 28

Select the first four edges on the front of the duck neck (shown below) and extrude them down along the reference drawing (see second picture). Then select the three vertices shown in the second picture and press f to create a face between them.
Step 29
Do the same thing again, this time selecting only the front three edges, and extrude and add a triangular face.
Step 30
Do the same thing two more times, each time leaving out the last edge and adding a new triangular face.

Step 31
Select the open edge loop by alt + clicking on it. Then extrude it with e as shown below, and tweak the edges and vertices to line up with the reference drawing.
Step 32

Continue extruding along the body of the duck until you reach the tail.

Step 33

Taper the tail in a little bit, then extrude one more time along that edge loop. Press s z to scale the vertices along the z axis, and bring them close together into a nearly horizontal line. Finally, press f to create a face between the vertices, finishing up the body and tail.
Step 34

Going up and down the duck, tweak the vertices, lines, and faces until you’re happy with how the body looks. Pay particular attention to the width, as the duck is likely far too skinny right now. This is probably easier to do in perspective view (hit numpad 5 to toggle between orthographic view and perspective view).
Step 35

Time to create the duck’s legs and feet. Select the face shown below, then click the subdivide button on the left. The result should look like this.

Manually move the lines in the cut you just made with the green and red arrows until they look like the picture shown below. This will give us a face to work with when constructing the legs and feet.
Step 36

Select the largest of the faces you just created, then press e, right click without moving the mouse, then press s and scale it to the size of the duck foot in the reference. You might have to move it with the arrows to get it in the correct location. The result should look like this.
Step 37

Use three extrudes from the plane created in the previous step to create the legs and the base of the feet.

![Image of three extrudes from a plane to create legs and base of feet]

Step 38

Extrude from the forward-facing plane on the foot, and adjust the vertices until you’re happy with the webbed foot.

![Image of an extruded webbed foot]

![Image of webbed foot with adjusted vertices]
Creating an animation of duck walking

Recommended: Watch this excellent video tutorial about the basics of animation in blender to get a feel for blender’s capabilities

Next, we are going to create a simple animation of the duck walking to get a feel for some of the other things blender is capable of.

Step 39

Select the duck in object mode. Then click the “Material” button on the right.

Select your desired colors for diffuse and specular lighting. You can create more materials (with different colors) by clicking the plus sign to the right of the materials box. Then you can assign these materials to individual surfaces by going into edit mode, selecting the face you want to change, and clicking assign with the new material selected.
Important: Finally, go back into object mode, select the duck, click the wrench modifier on the right, find the mirror modifier, and click apply. This will save the results of the mirror modifier as part of the object, and will no longer mirror changes in real time.

Step 40

Next, we are going to create an armature for the duck. This means to add “bones” to the duck that we can position, and blender will use that to modify the duck to create realistic looking motion.
Open a different layer by clicking on one of the boxes below the 3D view window. This should produce an empty 3D view window.

Add a bone by clicking “Add” -> “Armature” -> “Single Bone” On the 3D window toolbar (next to the “object” button in the screenshot above).

Go into edit mode, then select the armature bone and rotate it upside down with the r key. Select the little sphere on the bottom of the bone, and extrude a bone from it. Extrude three more bones until the structure shown below is achieved.
Go back into object mode, then shift click on the layer the duck is in to bring both the duck and the armature into view.

Use the move and rotate commands, and arrows, position the bone structure in line with the ducks feet as shown below. This is probably easiest be selecting the spheres at the end of the bones, rather than the bones themselves. The top bone should be inside the duck’s body, with one bone going down each leg and one bone along each foot.
Step 41

Hit tab to go back into object mode, then hit A to unselect everything. Select the duck body, then hold down shift and select the armature as well. The duck body should be outlined in dark orange, and the armature in light orange. Then hit control + p and click “Armature deform with automatic weights”. This will tie the bones to the duck object so that moving the bones will also move the duck.

Step 42

Now to create the animation. Select the armature and go into pose mode. If everything is set up properly, rotating one of the bones with r should rotate the duck foot as well.

What we are going to do is create a simple loop of the duck walking, so we need one pose with the right foot in front, and one pose with the left foot in front.

Use rotate commands to rotate the bones in the left foot to achieve the position shown below (or something like it).
Now, we are going to save this pose as our first keyframe (reference frame). Press a to deselect everything, then a again to select the entire armature. Then press i, then click “LocRot” to save both the location and rotation of the bones.
Next, we want to also save this pose as our third keyframe, so the duck will go back to this position once it has taken a step. Right click on the timeline below the 3D toolbar around the 60 frame mark.

Make sure the entire armature is selected, then press i and select “LocRot” again. Now the duck knows to be in this pose at frame 1 and frame 60.

Now, we need to set up the other keyframe. Right click in the timeline around the 30 frame mark, pose the duck in a pose with the right leg forward, select the entire armature, then press “I” and select LocRot.

Now if you press play below the timeline, you should see the duck in motion. If nothing happens, repeat the above steps, and make sure you selected the entire armature before setting each keyframe.

Set time timeline start and end frames to 0 and 60 so you don’t have to wait til frame 250 for the animation to repeat.

Step 43

In these final few steps we’ll render the animation and save it as an avi file.

First, add a camera by clicking add -> camera in object mode. Add a light source by clicking add -> lamp -> sun. Move the light source somewhere above the duck, and move the camera somewhere where it can see the whole duck. You can check what the camera is seeing by clicking render (the camera on the right) (red arrow below), then render (blue arrow).
You can switch back to the 3D View with the button shown below.
Step 44

Once you’re happy with how the rendering preview looks (you can add different light sources, move the camera around, etc), select “AVI JPEG” in the output format on the bottom right, and select an output filename (“duck.avi” or something).

Then click “animation” at the top and you’re done! Check the output file and make sure the animation turned out how you thought it would.