

Blender Software

From the Blender website, <https://www.blender.org/about/>, Blender is “the free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation”

Blender is available for Windows, Mac Intel and Mac Apple Silicon as well as Linux computers. Download and install Blender on your computer and bring a 3 button mouse if you have one.

<https://www.blender.org/download/>



Sample files at WeTransfer

We have 2 files temporarily up on WeTransfer for use in our demonstration this week. There is a Blender model, TwoWheels.blend, a hand modelled e-bike.

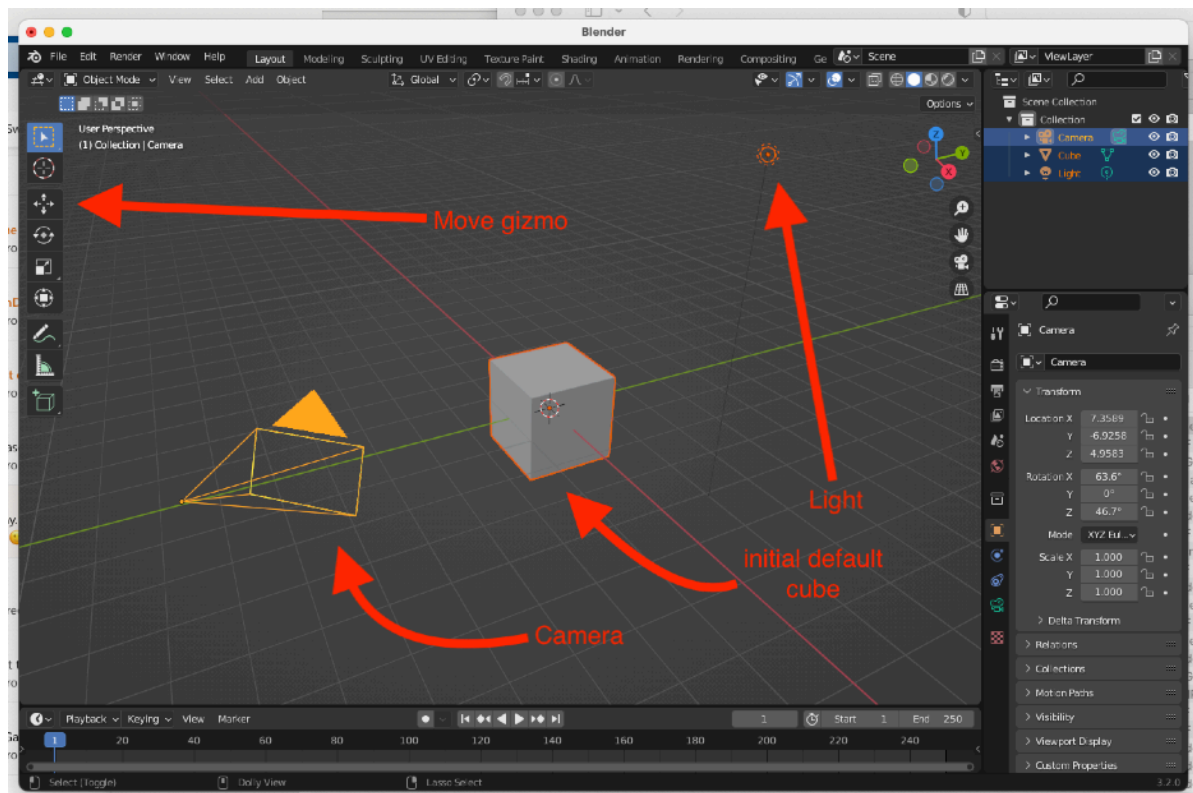
And the second is a ZIP archive, Amarylis.zip, an OBJ scanned flower model.

Download and save both for use in this demonstration.

URL to sample files: <https://we.tl/t-k40yGCOba0>

Blender basics

Once Blender is downloaded and installed, open it up. The default new project has 3 items in it, a cube, a light, and a camera. For scale purposes, the initial starting cube is a 2m cube.



Navigating 3D

Open existing blender file

With Blender installed, double click on a .blend file, or use File, Open, and navigate to file

Movement and viewport control

Will vary with input device, touchpad vs mouse. For example, on a 3 button mouse, press and hold the middle mouse button and move mouse will pan and roll the view. On a touchpad, use 2 finger drag to do the same (Mac).

Select an item

Select an item by Left Mouse Button (LMB) click. A highlight appear around the item. Alternatively, LMB select item in outliner list at top right.

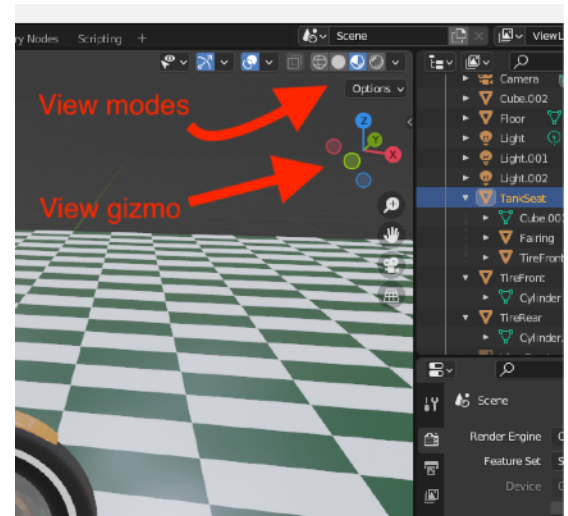
“View, Frame Selected” menu options, or (Numpad .) shortcut

With an object selected, choose menu options View, then Frame Selected to bring the selected object full screen and centered in viewport. The shortcut for this is the period key on the numeric key pad (numpad .)

Fixed Views and numpad shortcuts

X; Y; and Z are the labels for the axes left and right; back and forth; and up and down. You can see these represented in the red; green; blue gizmo in the upper right hand corner of the viewport. LMB clicking on one of the coloured balls will change the view to that angle. Numpad short cuts 1, 3, and 7 will do the same.

View modes - X-ray, modeling, material and rendered
View modes set how the model is displayed. The default is modelling mode where everything appears as a grey material. The material mode applies the coloured material if it exists, and the rendered mode adds light and effects. Another useful mode is wireframe, as is the X-ray option. See the View modes in the upper right corner of the viewport.



Duplicating objects

Objects can be duplicated by selecting them with the LMB, and then the shortcut key Shift-D. Drag duplicate object to new location.

Renaming objects

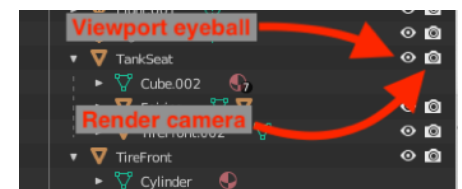
Double click with LMB the object in outliner, enter new name. Outliner auto sorts alphabetically.

Deleting objects

Select the object and press x key, confirm deletion.

Hiding objects from view

An object can be hidden from view by LMB selecting the eyeball icon next to it in the outliner. This hides it from viewing in the viewport only, the object would appear in a render. Turn off the camera icon as well to hide the object from render as well.



Tab to enter edit mode

Selecting an object and pressing Tab enters edit mode. The wireframe grid is displayed. The grid points, lines and faces can be altered in this mode.

Edges, faces, and vertices

Choose point, edge, or face to select type of item to interact with in edit mode.

Selecting

Select a single item with LMB. Select multiple items with Shift-LMB. Drag select LMB for box select. CTRL-Right Mouse Button (RMB) for free form select.

Undo

Commands can be undone with the CTRL-Z shortcut.

Saving files

Save the current file with menu File, Save or CTRL-S. Blender automatically keeps one backup previous version named filename.blend1 in the same folder as the original file. To use the previous version file you would have to rename it to new filename.blend

Viewport control, N key shortcut

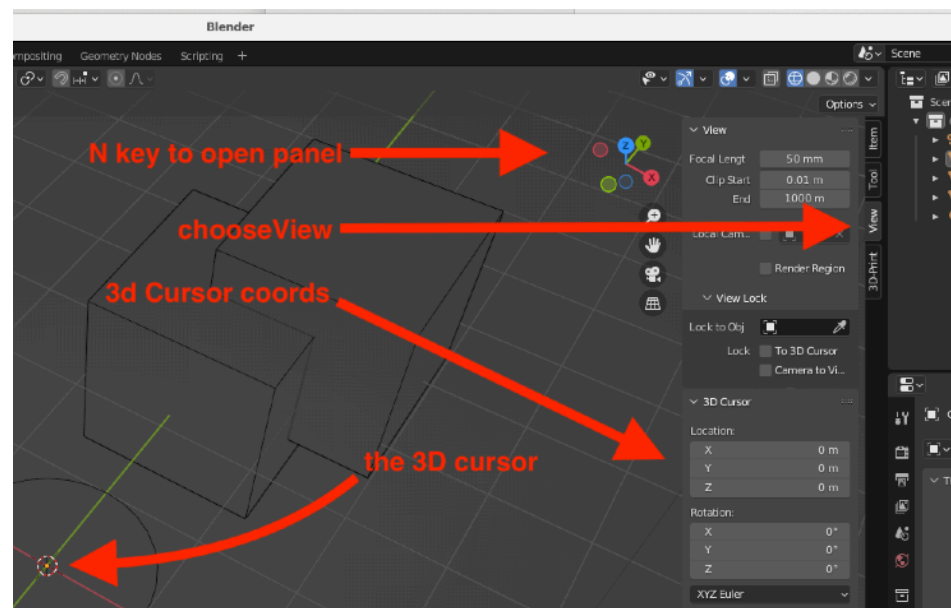
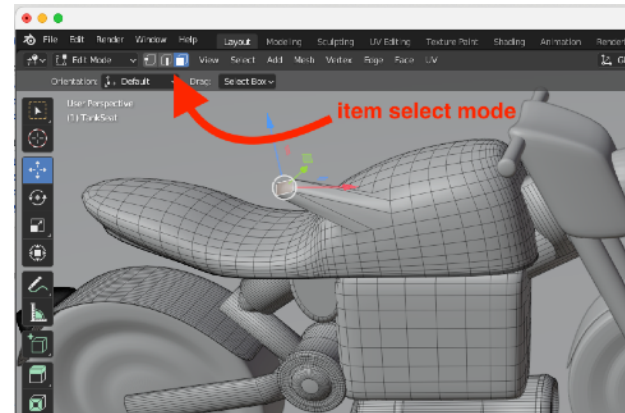
Pressing the shortcut N key in the viewport opens and closes the Viewport control panel.

3D cursor, that red and white circle

Is like the cursor in Word, its where the current items get inserted. By default the 3D cursor is at x, y, z, coordinates 0, 0, 0. The 3D cursor's location can be changed, sometimes accidentally. To reset it open the viewport panel, select View panel, and set 3D cursor coordinates to 0,0,0

Add an object

In the viewport, choose the menu Add, then Mesh, then Cube. A new 2m cube is inserted at the 3D cursor location.

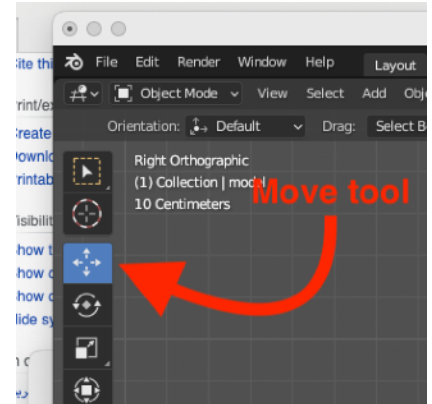


Move tool

The move tool places a three axis gizmo on the selected item. Grab one of the axes to move it in that direction.

ESC key

The escape key cancels a command.

**Why cleanup a model**

Models created from photogrammetry often contain more detail in them than we want or need. We can simplify the meshes to reduce the number of faces in the model and still retain the required details and appearance. Additionally, the photogrammetry process often creates or adds artifacts to the model and may even include unwanted pieces of the background.

In short, we clean up photogrammetry models to remove unwanted artifacts and to reduce model complexity. Simpler, cleaner models will appear better in AR and VR.

Photogrammetry sample model

Many file formats exist for 3D models, two of the most common types for 3D photogrammetry scanned models are USDZ and GLTF.

Models using USDZ typically have a single file with an extension of .usdz, with an alternate usdc extension being less common. Models using GLTF often have the extension .glb, but may also occur as .gltf.

In both cases, the model may be completely contained in the main file with the described extension, but both could also reference other jpg or png files.

Photogrammetry software often outputs to these formats, or an intermediary one such as Wavefront .OBJ. The OBJ file format employs a main data file (the .obj file) for the model wireframe data, and several other files for additional properties of the model.

We'll use Amaryllis.zip for the demonstration which consists of an OBJ model made of several files:

model.obj	the main model file
model.mtl	a file describing object colour and colour map files
texgen_0.png	colour map or material file(s)
texgen_1.png	colour map or material file(s)
texgen_2.png	colour map or material file(s)
texgen_3.png	colour map or material file(s)

Web references

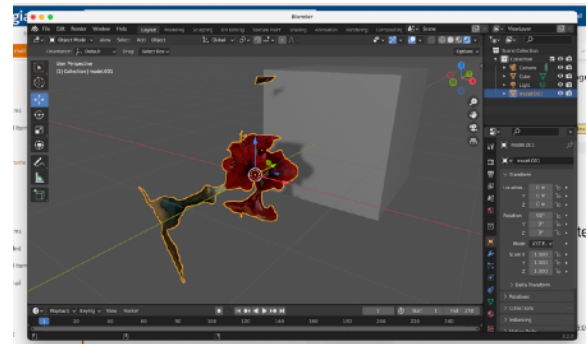
USDZ: https://en.wikipedia.org/wiki/Universal_Scene_Description

GLTF: <https://en.wikipedia.org/wiki/GLTF>

OBJ: https://en.wikipedia.org/wiki/Wavefront_.obj_file

Import, view, and scale the scanned model

1. Locate the Amaryllis.zip downloaded file, and extract it. It will produce a folder with the files above in it.
2. Open Blender to a blank project, or choose File, New, General menu options in Blender.
3. Move the default cube out of the way, don't delete it yet.
4. Under File choose Import, scroll down to Wavefront (OBJ), navigate to the downloaded Amaryllis model file, model.obj in this case.
5. Blender imports the model and its texture files and after a few seconds displays the model, an amaryllis flower in this case.
6. Compare the size of the flower to the size of the default cube, remember the default cube is 2m. Our photogrammetry software's default units of measure, Blender's default units of measure along with the camera and lens may cause the objects scale to be wrong.
7. Scale the flower by LMB selecting the flower, enter S to scale and type 0.6 enter
8. LMB select the cube and press X to delete it, confirm the deletion.
9. Before saving your imported flower, choose File, External data, and make sure Automatically Pack Resources is selected, has a check mark. (this includes pic in .blend)
10. Choose File, then Save, name your blender file and save it
11. Use the view mode icons to change from modelling, to material, or rendered. Note the models coloured textures appear in the modelling or render views
12. Switch back to modelling view
13. Save the blender file , File , Save or CTRL-S

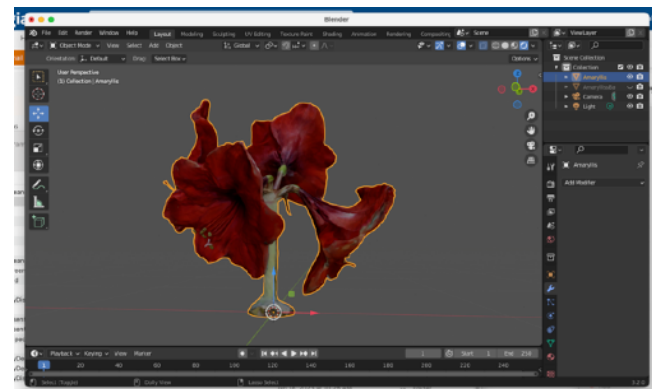


Blender Mesh Cleanup - orientation

With the Blender model from the above section open, in short, make a backup copy of the model, hide the backup, and correct the model's orientation and insertion point. In more detail:

1. LMB select the model and name it in the outliner.
2. LMB select the model and duplicate it with Shift-d
3. Move the duplicate model to a new location
4. Hide the duplicate model using eyeball in outliner
5. LMB click on the red x in the viewport gizmo
6. LMB select model
7. Press R for rotate, then X to constrain rotation to X axis
8. Rotate model so that its perpendicular
9. LMB select green Y in viewport gizmo
10. LMB select model
11. Press R to rotate, then Y to constrain to Y axis

12. Rotate until perpendicular
13. Repeat steps 7 to 12 until model is certainly orientated
14. LMB select the blue Z in the viewport gizmo
15. Press R to rotate, then z to contain to z axis
16. Rotate to desired orientation
17. LMB select red x in viewport gizmo to set side view
18. Save the file, CTRL-s
19. Move model up in the Z axis until the desired base location is at the green y axis line
20. LMB select the model
21. Under Object, choose Set origin, then Origin to 3D Cursor
22. Note the objects origin, and the move gizmo have moved to the 0,0,0 location
23. LMB select model
24. Chose Object, then Apply, then Rotation & Scale
25. Ctrl-s to save
26. LMB select model, then r to rotate
27. Note that the model now rotates around its new origin. This is the insertion point that the model will use when imported into other programs like game engines and AR consoles. Instead of coming in on an angle the way it did when we imported it.
28. Press escape to cancel rotation
29. Ctrl-s to save blender file



Blender Mesh Cleanup - remove unwanted pieces

With the previous file still open, we will remove the unwanted pieces of the model. That is the pieces below our insertion point, and the fragment above the model. In more detail:

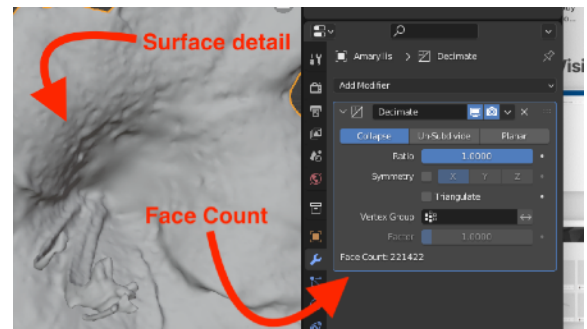
1. Set modeling viewport mode, model is grey no colours
2. Turn on X-ray mode in viewport (model becomes slightly transparent)
3. LMB select the model
4. Choose View, then Frame Selected
5. Press tab to enter edit mode (wireframe appears)
6. Drag elect the unwanted piece of the model above it. Note that due to X-ray mode all the vertices in front and behind the object are selected
7. Press x to delete and confirm by selecting choosing Vertices
8. Press tab to exit edit mode
9. Deselect the model by LMB clicking on the background
10. Choose menu Add, then Mesh, then Cube to add a cube
11. Move cube down so that top of cube is at the insertion point or 0 on the z axis
12. LMB select the model
13. In the details panel on lower right, select the blue wrench Modifiers option, then Add Modifier, then Boolean
14. In the Boolean Modifier's Object field, select the EyeDropper and then select the cube in the viewport

15. Wait a moment
16. In the Boolean Modifiers drop down menu, select Apply
17. The lower portion of the model is deleted
18. LMB select the cube and press X to delete it
19. Review the clean cut and sealed bottom of the flower model
20. CTRL-s to save

Blender Mesh Cleanup - reduce model complexity

Continuing with the same file as above, we will now reduce the Total number of faces or polygons in the model using the decimate tools. Other options for this are the voxel and the quad remesh tools. We'll take the simpler decimate approach.

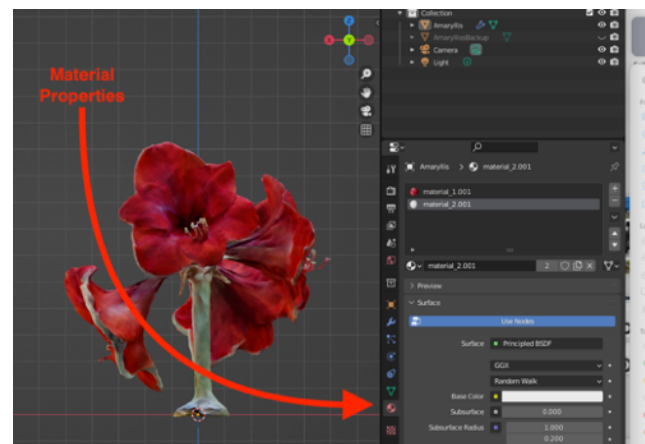
1. Set viewport to the grey modelling mode
2. LMB select the flower
3. In the details panel on lower right, select the blue wrench Modifiers option, then Add Modifier, then Decimate
4. Notice the Face Count; value at the bottom of the panel, approx 222k faces
5. In the Ratio field enter 0.5 to reduce face count by half
6. Observe the change in detail on the model
7. Adjust the ratio up or down to desired level of detail
8. In the drop down menu, choose Apply
9. Set viewport to material or render mode
10. Review model
11. CTRL-s to save



Blender Mesh Cleanup - textures

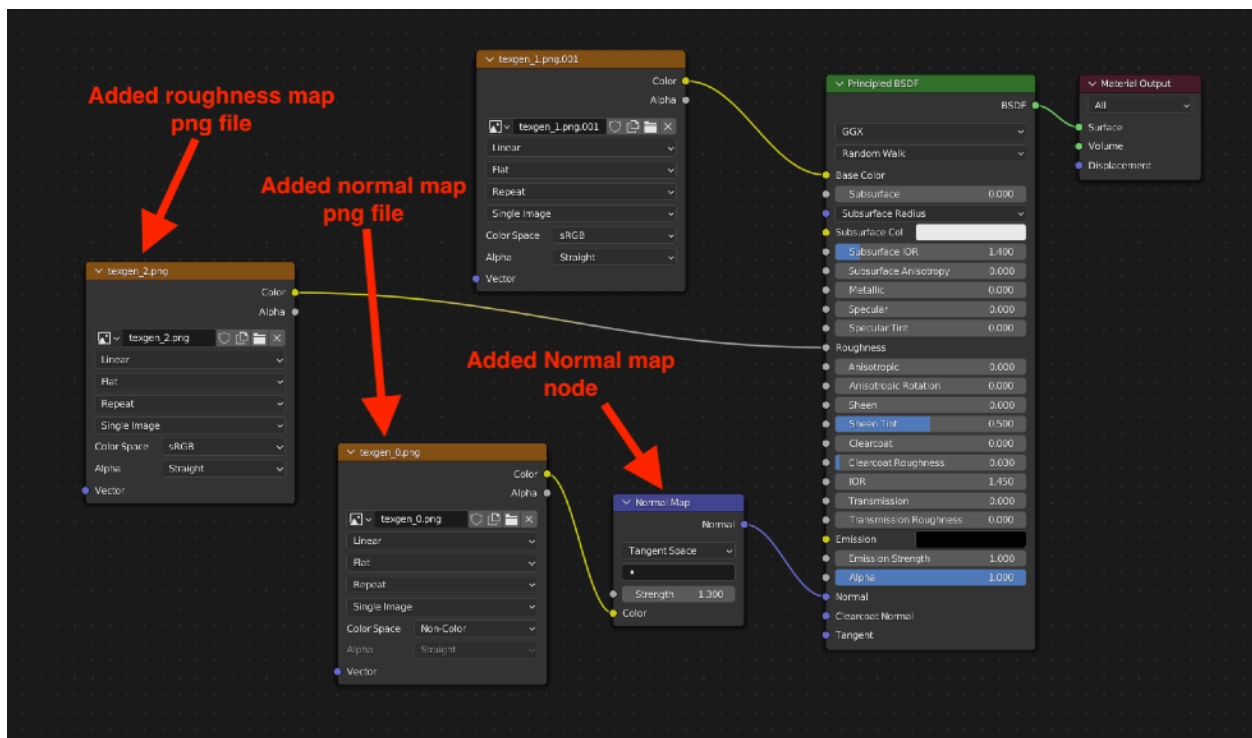
The model in this demonstration has an unused or empty texture as an artifact of this particular model's photogrammetry process and the editing completed here. We'll remove the unused material. We'll also review the material that is applied to the model and check out the PNG files in the folder with the model's obj file.

1. Set viewport to Material mode so model's colour is viewable
2. LMB select mode
3. In the details panel on lower right, select the orange world Material Properties panel
4. Note the 2 materials listed
5. Choose the second material
6. Choose the minus - to the right to remove the material
7. Choose the remaining material, material_1.001
8. From the top menus, choose Shading
9. Notice the panel at the material shader panel at



the bottom of the screen with 3 nodes it

10. The left most node is the main colour and uses the file texgen_1.png
11. Open the model folder and drag the file texgen_2.png onto the shader window
12. On the newly created node, drag the color pin and connect to the Roughness pin on principled BSDF node
13. Open the model folder and drag the file texgen_0.png onto the shader window
14. On the newly created node, change Color Space from sRGB to Non-Color
15. On the same node, drag out from the Color pin and release
16. In the search window type Normal, and choose Normal Map
17. The Normal Ma node is inserted and auto connected to the cold pin
18. Drag out from the Normal pin and connect it to the Principled BSDF node's Normal pin
19. CTRL-s to save



Exporting model

The model has now had extraneous pieces removed, had its orientation and insertion point cleaned up, its total face count reduced, and its textures cleaned up. The next step is to export the model into a format for its intended use. File formats such as fbx are commonly used in game environments. USDZ and GLTF are common AR file formats. Using the same blender file as above:

1. LMB select the the model
2. Choose menus File, then Export, then FBX (.fbx)

3. Choose the following options on the right hand panel
 - A. Selected Objects
 - B. Forward to X Forward
 - C. Up to Z Up
 - D. Geometry, Smoothing to Face
4. Then enter filename at bottom name input box, note .fbx extension
5. Then choose Export FBX

A similar process can be followed to export .glb/.gltf versions of the model as well as .stl files. STL files are commonly used for 3D printing.

Adding USDZ support to Blender

Exporting .usdz files directly from Blender requires an add-on, the add-on is available at this link <https://github.com/robmcrosby/BlenderUSDZ> .

1. Download the file io_scene_usdz.zip
2. Choose menus Edit, preferences
3. In preferences panel, choose install
4. Navigate to io_scene_usdz.zip,
5. Choose InstallAddon
6. Enable the Addon and close preferences

Under File, Export, there is now a USDZ export option. USDZ files are the preferred file format for a number of AR systems including many Apple based devices.

Additional points of Interest

This was a quick review of some options available in Blender for the cleanup of scanned models. Many additional features and options exist in Blender and may be of help in this process. Items such as

- Selection tool options , and selection options such as CTZRL-L to select linked, or invert selection menu option , and circle select mode
- A and Alt-a to select and unselect all
- Using the 3D print add-on for helping to make the model manifold, plugging holes.
- Baking/rebaking textures
- Remapping UV textures
- Double sided materials

Thank you and good luck in your model creation and cleanup!