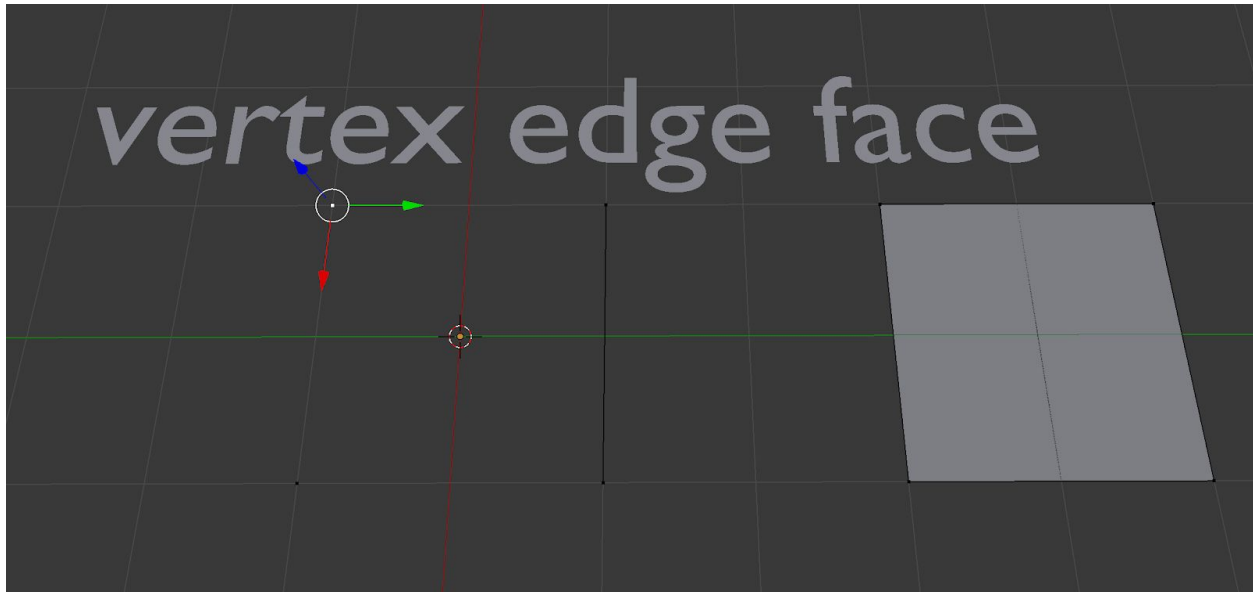


Ben Flanders

Functional Requirements

The most essential function of Blender is the alteration of a mesh. A mesh is a 3-dimensional representation defined by vertices, the edges connecting vertices, and the surfaces that edges can be joined to form. These edges can be used to form surfaces referred to as faces. Blender must allow for the tracking of vertex locations, the edges that connect any two vertices, and the surfaces formed between any two or more edges. These three types of data must be manipulable in an editor that is visually similar to a 3-dimensional space.



Vertex points, edges, and faces must be **transformable**, so they must be movable in the x, y, and z dimensions. Edges and faces must be **rotatable**, so they must be able to be rotated in the x,y, and z dimensions and all vertices should be calculated in relation to one another. Edges and faces should also be **scalable**, so the position of each vertex composing these surfaces should be repositioned in reference to the shape as a whole as well as in relation to the other vertices of the surface.

In order to assist in the creation process, it is important that Blender is able to **import pre-existing models**, provide some **pre-existing meshes** that can form the basis for more complex models, and provide **tools for adding levels of complexity** to any given mesh.

Many users will develop different project **workflows**, and advanced modelers and animators coming to Blender from other applications will want to use their same workflow. A workflow is dependent on both the **tools available and the ability to arrange access to tools** in such a way that it is efficient to use those tools in a given order. For example, some 3d modelers will like multiple views of a mesh available at once so that they don't have to manipulate the view space. This is especially true for engineering type work. A multi-view window should be configurable, but is certainly not necessary for every user.

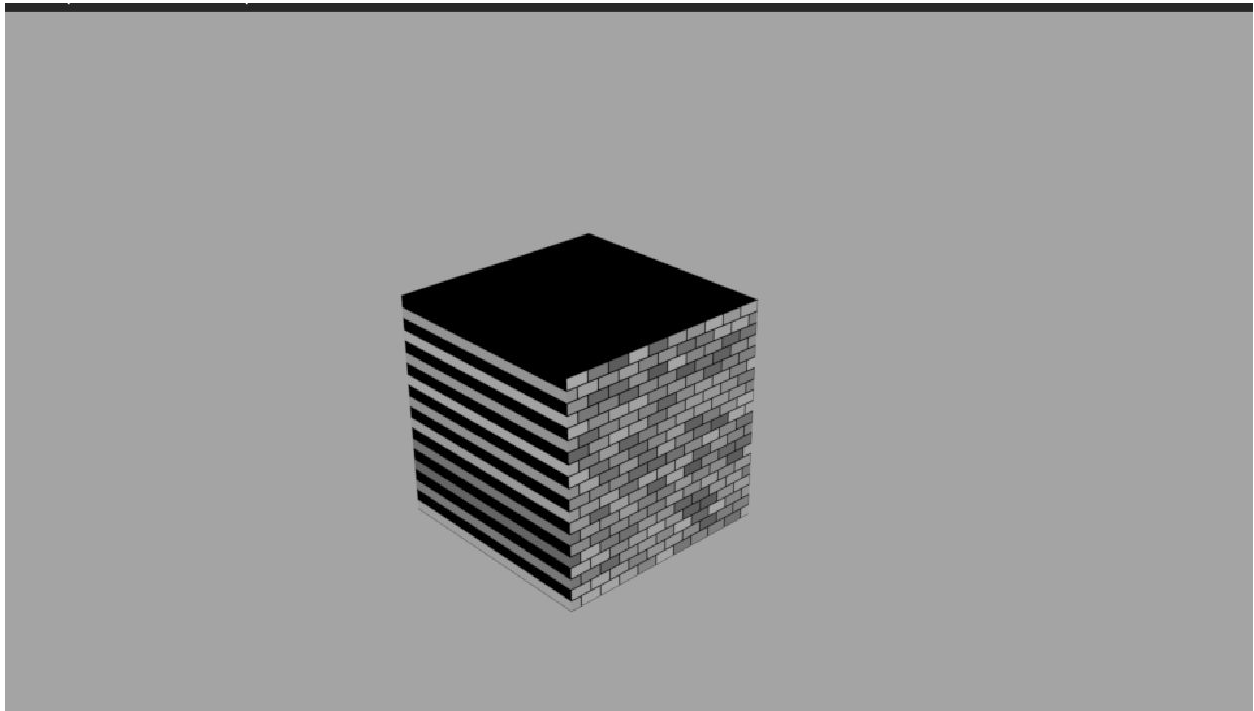
The software should be able to import and provide testing support for tools developed externally.

The software should allow for configuration of areas of the main window. Types of editors, position of editors, and number of editors should all be configurable.

Another major portion of a workflow is being able to **bind keys** to commands that the user deems useful. Hotkey binding support should be available for all commands, even commands created by user made tools. Keystrokes should not overlap between multiple commands. All commands should be accessible through drop down menus. Menus should appear as they are applicable. For example, tools for texture painting should not be present when the user is in a sculpting editor.

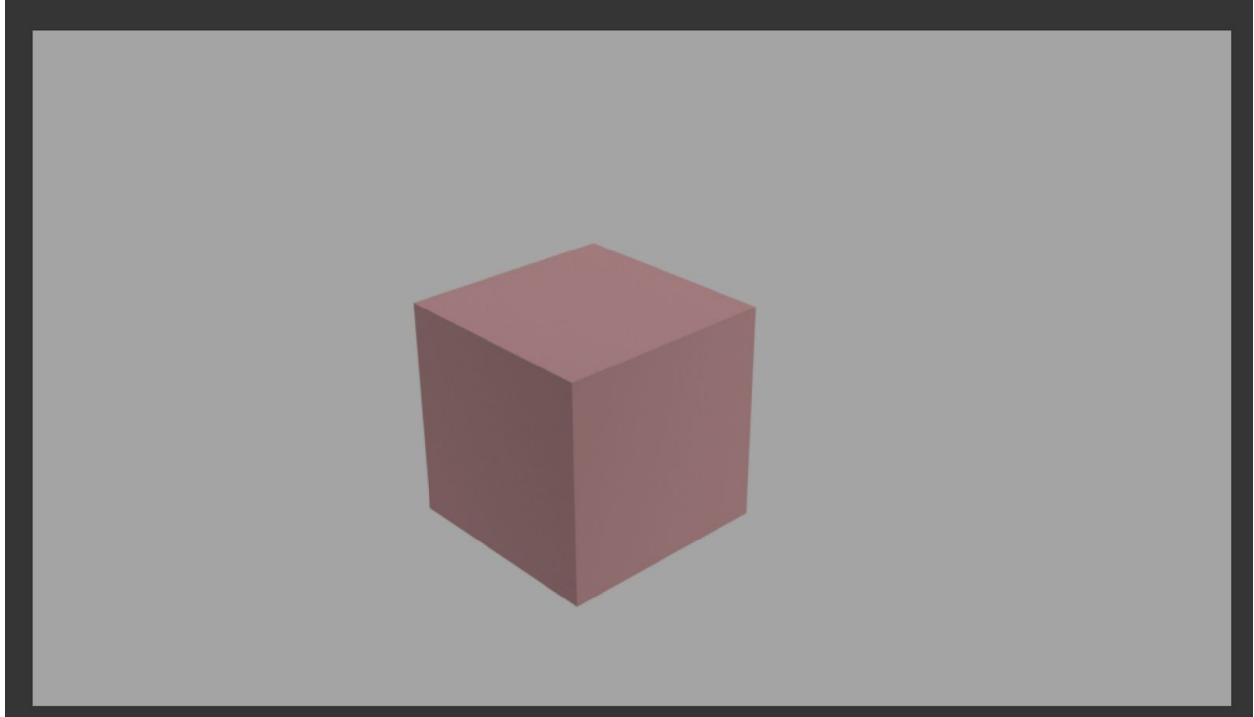
Texture/material editing

A requirement of Blender is to allow users to add visual effects to each individual model. Meshes can be “wrapped” in a 2-d image, and blender should calculate where portions of the 2-d image should correspond to on the 3-dimensional mesh.



- An image of bricks “wrapped” around a cube mesh as a texture

Blender should also allow users to create “materials” which alter the surface of a mesh in order to produce a different visual appearance. Blender should have an interface for creating materials and those created materials should be applied to the visuals appearance of the mesh when rendered.



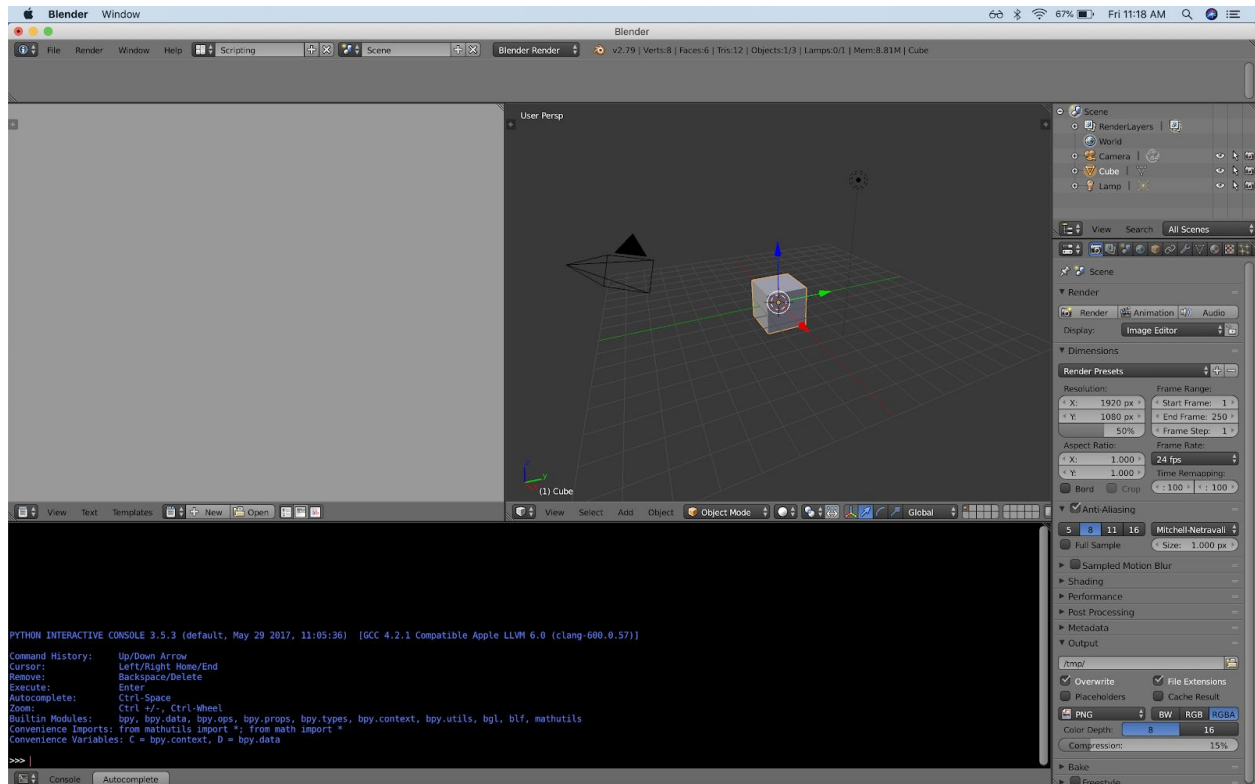
-a “velvet” material with a pink color added to a cube mesh

If a user causes some kind of crash or an error occurs, a status message should appear on the screen.

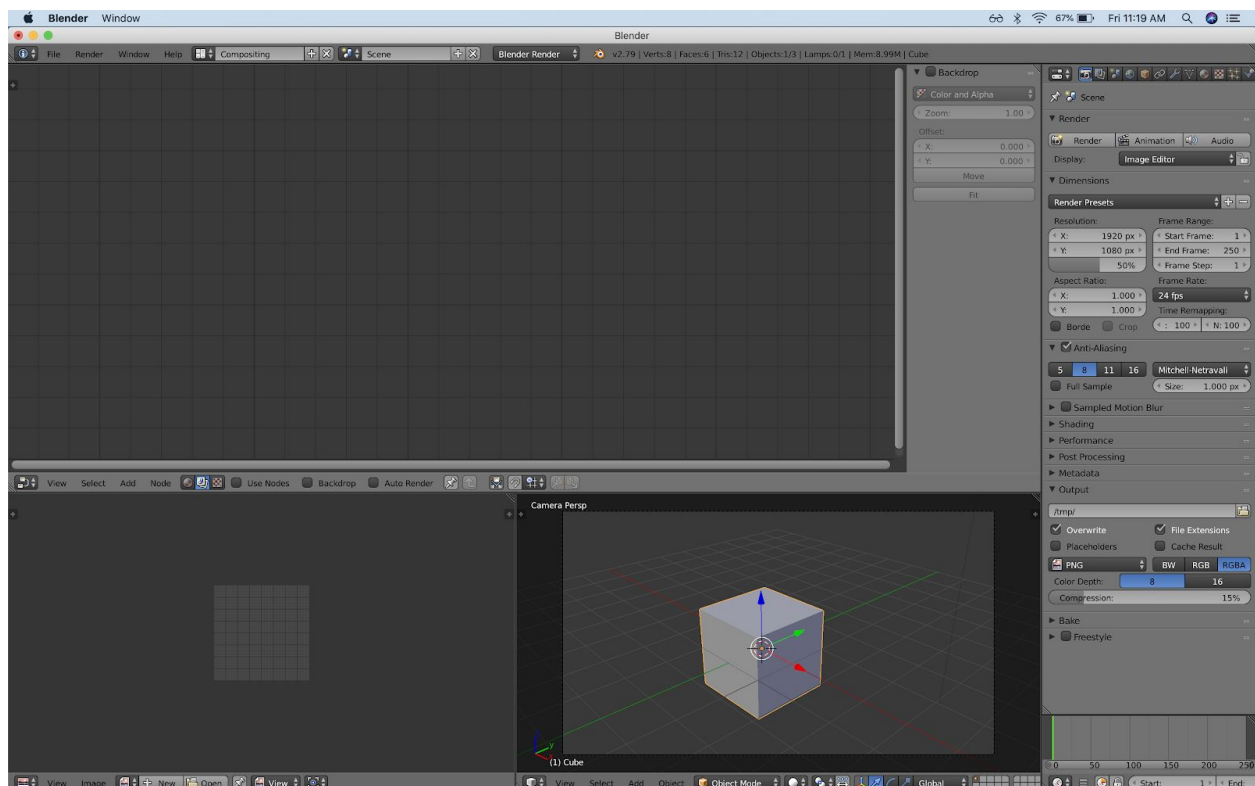
User requirements

- Workflow

The workflow of a user is an essential factor that will determine the required layout of editors, tools required by the user, and input configuration of a user. Users will want to easily configure their screen layout to support different workflows and switch between current project task. **There is no set group of screen layouts that will work for every user, so editor layout must be adaptable.**

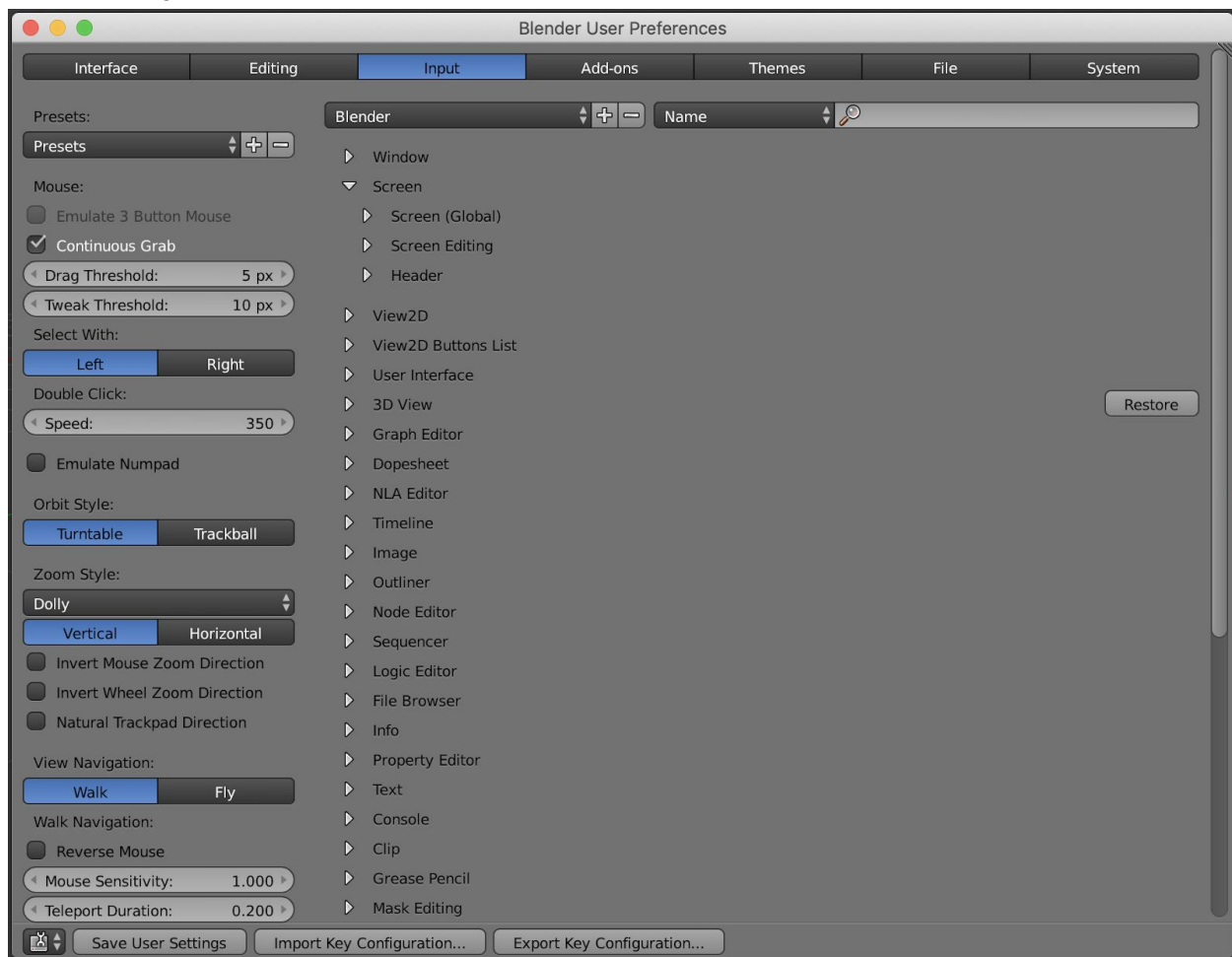


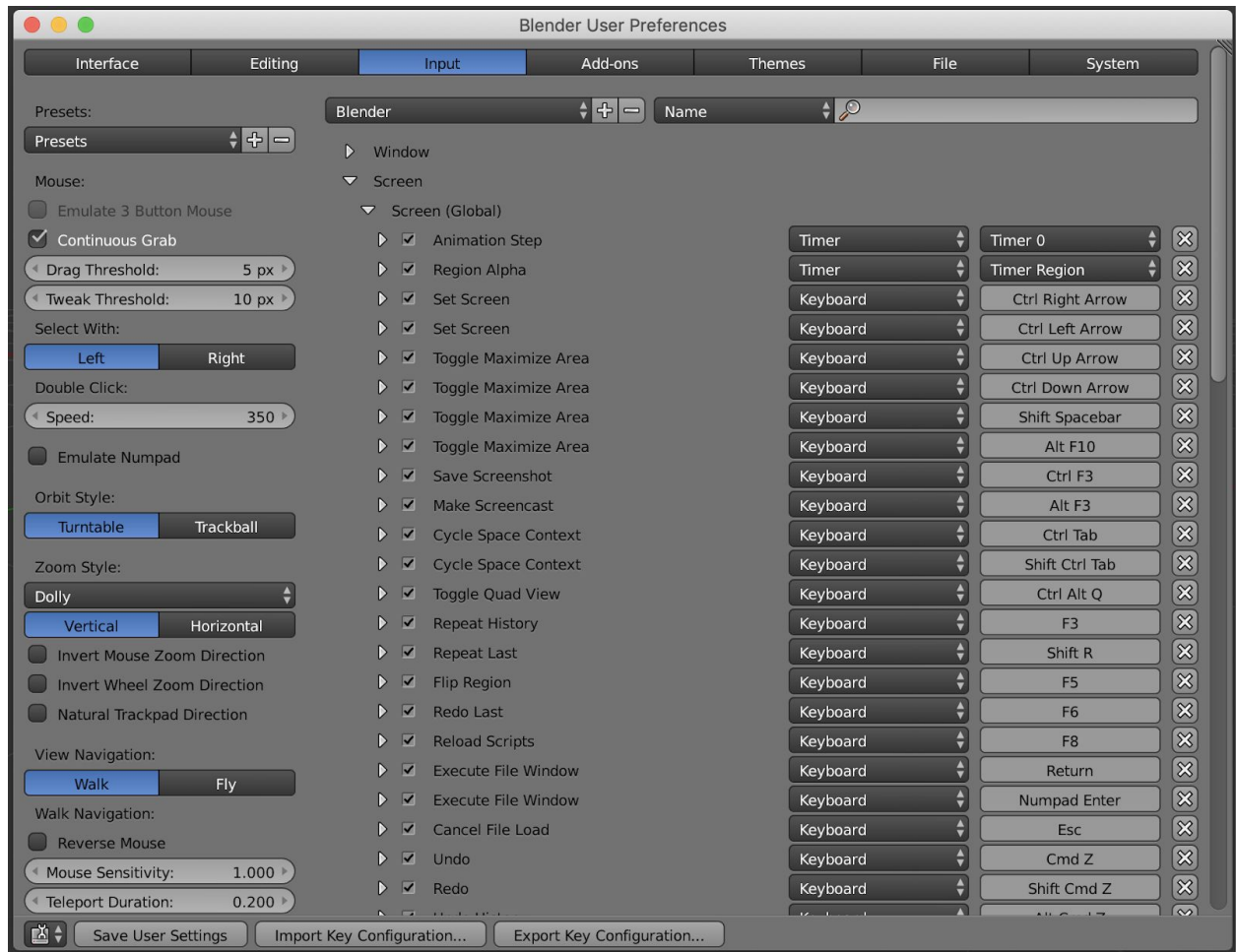
-a sample layout that could be used for scripting new tools



-a sample layout for compositing (material and texture editing)

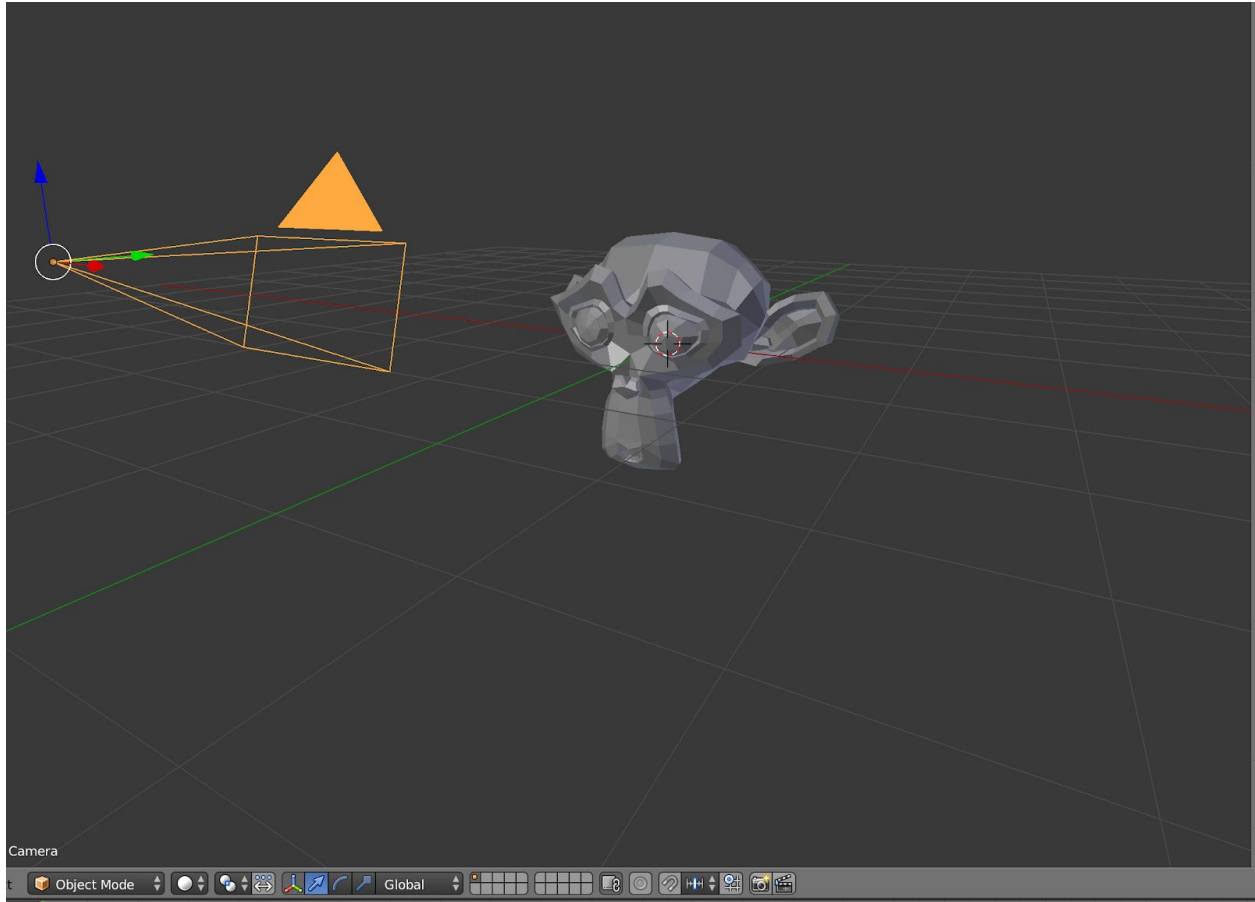
Users will need to bind keystrokes to commands that they think are useful, and even binding keys to commands implemented by imported tools. Keystrokes allow a user to enter commands via their keyboard rather than clicking within a menu or searching for a command. Keystrokes are far quicker and more efficient, as long as they can be memorized by the user and are easy to look up. Since many commands will not be used by a user it doesn't make sense to predefine all commands, and instead allow users to adapt their favorite controls to fit their chosen commands. Users will also be allowed to import new tools in Blender which allows access to new commands that Blender developers cannot anticipate. **Users will need to be able to set keybinding to their newly initialized commands.**



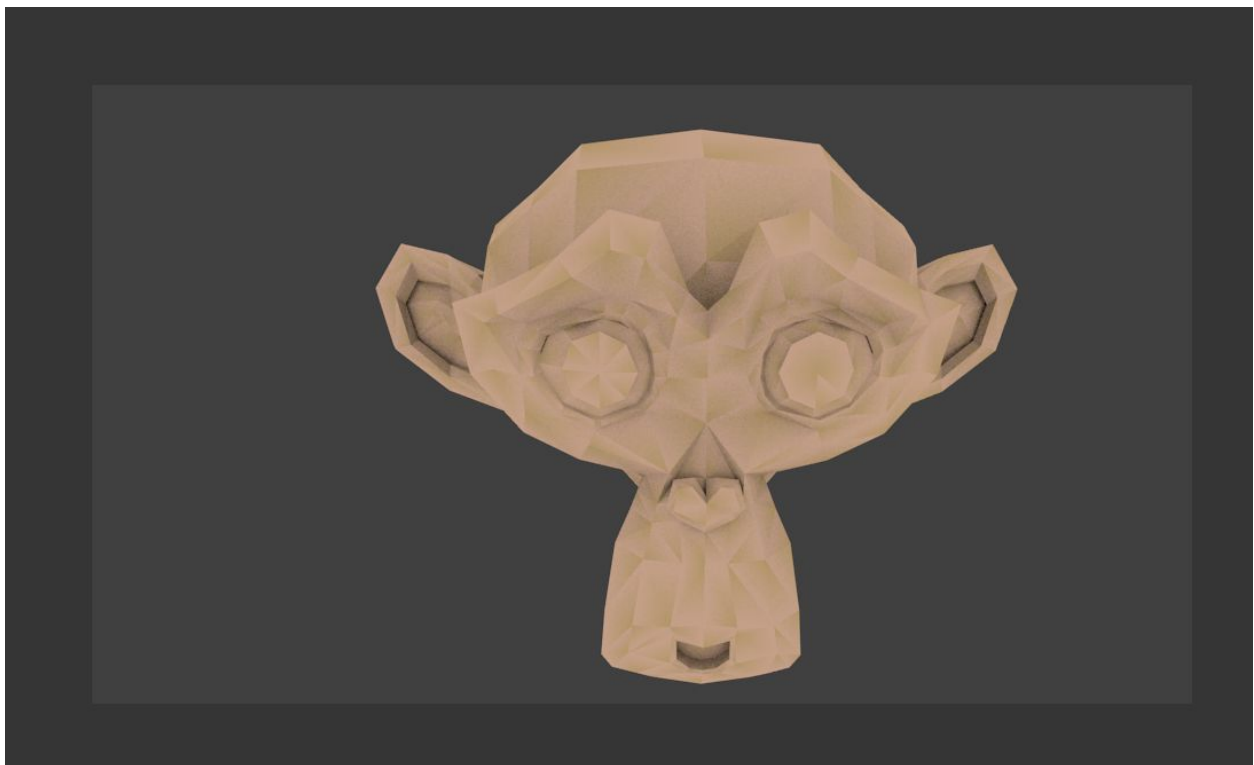
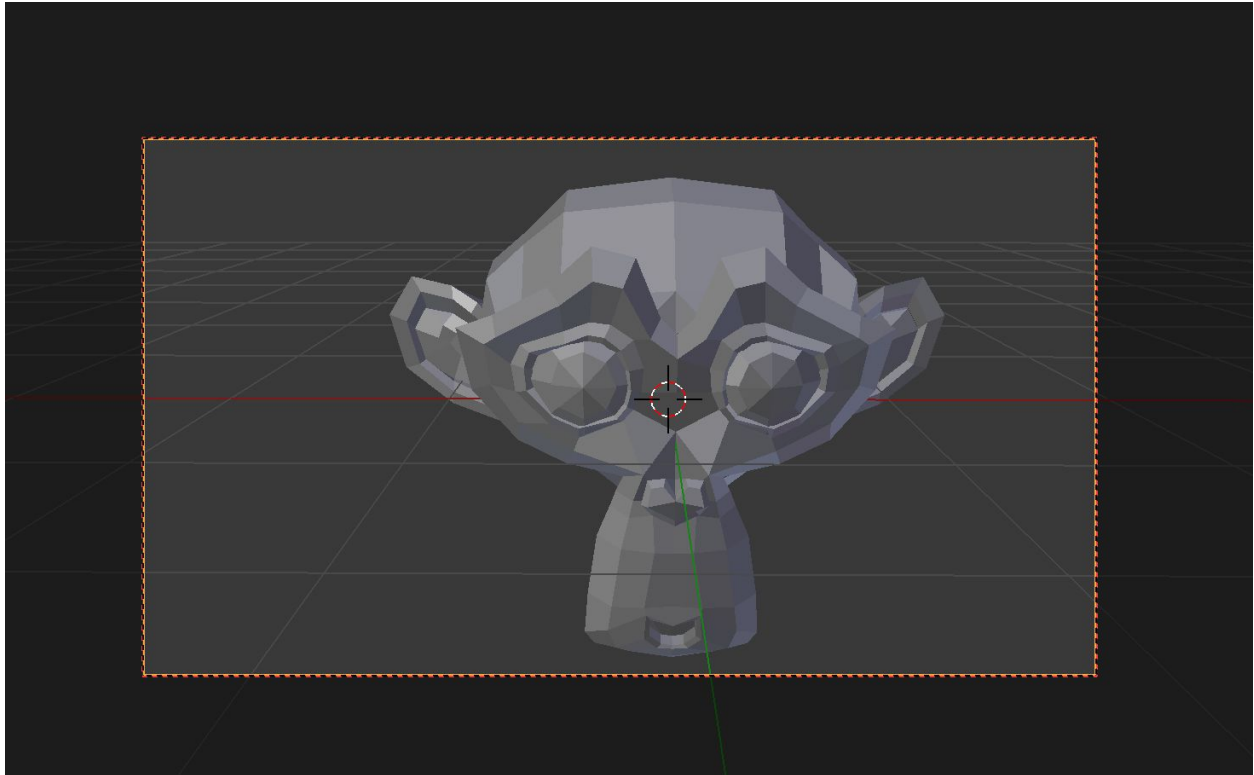


A user must have some way of adding meshes to the screen. The user requires the ability to model an object in 3 dimensions by translating, transforming, and rotating selectable portions of a mesh.

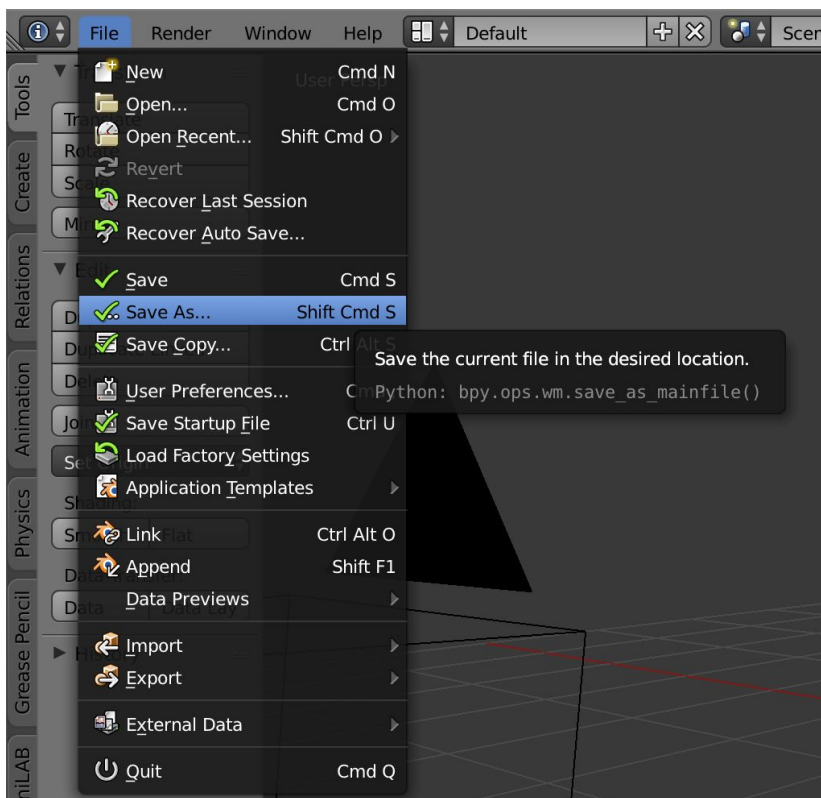
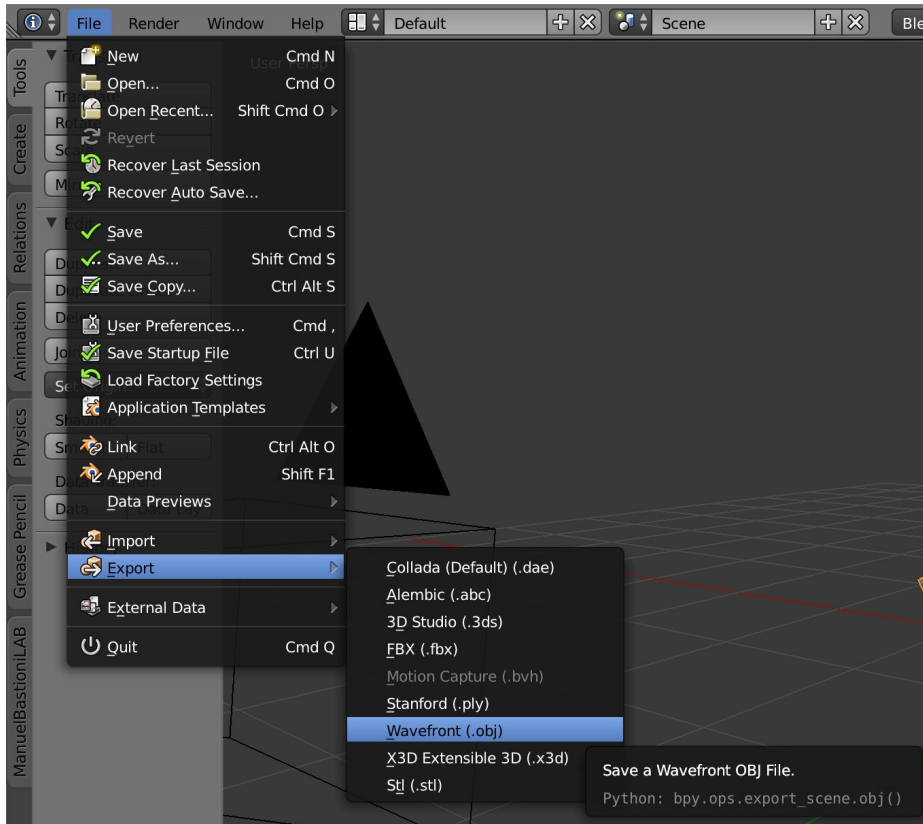
The user requires the ability to wrap a 2-dimensional image (texture) around a 3-D object, and the ability to modify rendered appearances (materials) of a specified area of an object.



Rendering is used for converting a completed object into a single image or sequence of images. Users require the ability to convert all scene objects and their components into a rendered image/sequence of images based upon defined render settings and render focal point (camera) positioning. These rendered images should then be saveable to an easily sharable filetype.



The user must be able to save their models and the program must allow for saving of and sharing of scenes, groups of objects, and individual objects

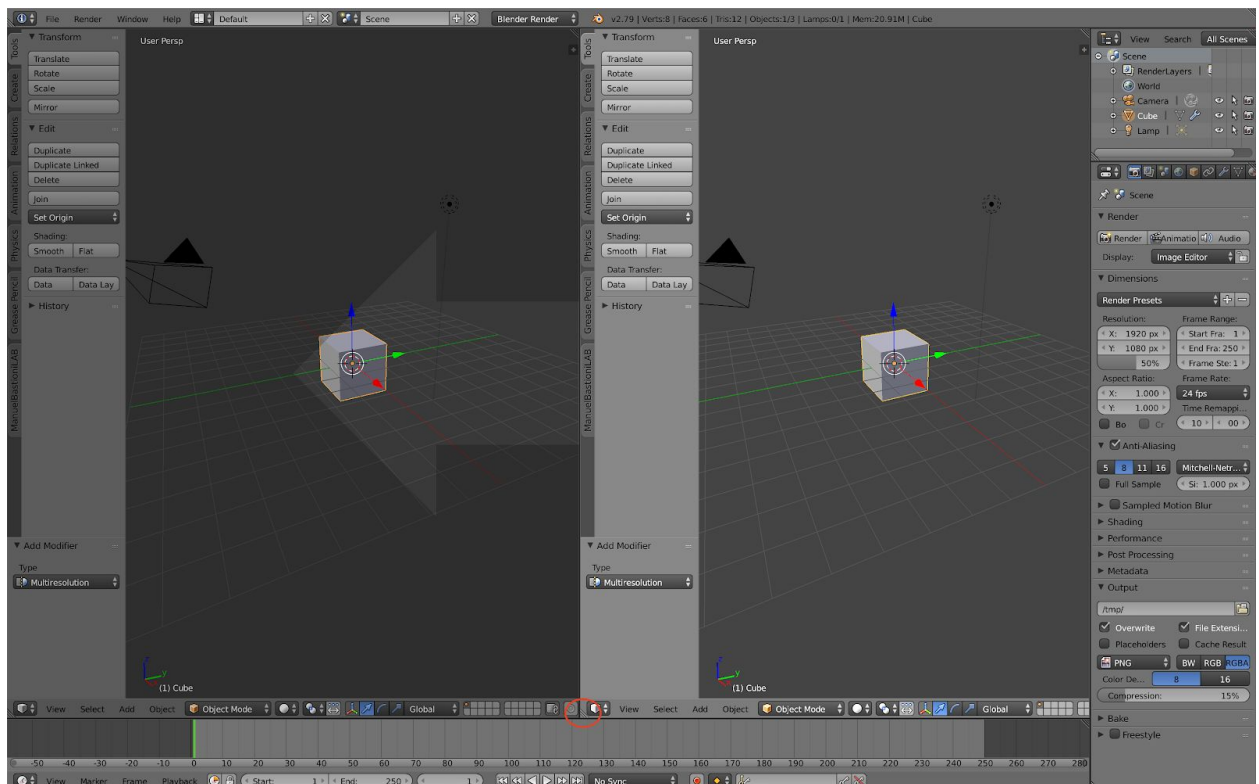


Types of users

- Novice users
 - These users will primarily use the edit mode of Blender in order to morph base shapes into more complex meshes. Gradually novice users will move to texture and material editing after creating a base model. It is the natural workflow to produce a base mesh first and then add visual attributes to the object.
 - Novice user experience:
 - Tutorials were very helpful.
 - Michael primarily used the modeling tools.
- Expert users
 - These users will use the edit mode for beginnings of a project and then begin using modifiers on their objects. Modifiers allow for generative manipulation of an object. For example, a user will model a basic character mesh, then use “multiresolution” modifier to increase the complexity of the model. After familiarity of modifiers and creating basic shapes, users will use the sculpting tools to edit objects in a fashion similar to sculpting in real life. Users will “push and pull” vertices and faces in order to manipulate their mesh. More complex tools are required as a user improves and becomes comfortable with the basic tools. The more complex a tool, the faster and more precise a modeler can work.

User problems - bugs, UI

- No file menu option removing a window within the editor



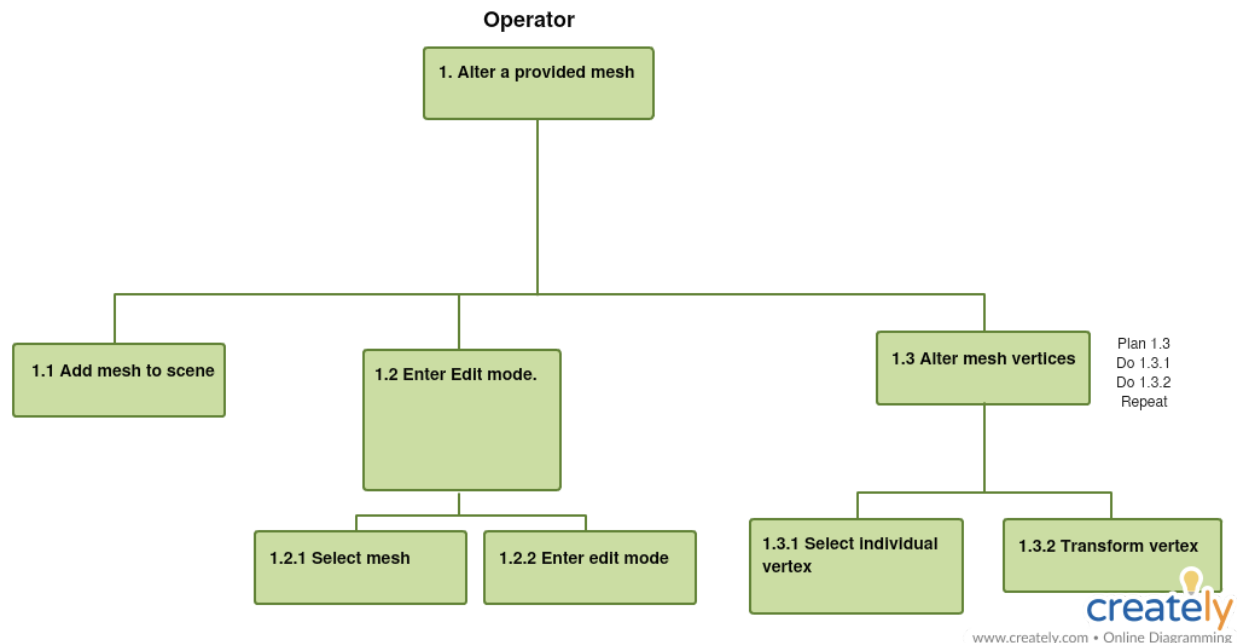
- Accidental clicks are not easily reversible.
 - When the user changes the position of the 3d cursor by right clicking anywhere in the object menu there is no easy way to reset the 3d cursor to the origin of the object editor. The user must either access the properties menu and reset the location of the 3d cursor, press shift+s, or use the search menu and “snap cursor to center.” None of these options are intuitive to a beginner user and will likely require the user to google for a solution.
- Using different modes requires an understanding of what tools are provided along with a mode, meaning users must research before it is apparent what any mode does.
 - Tools related to the selected mode are not immediately apparent and change with each mode.
 - Some taskbar menus change completely and this change is not always within the users level of awareness.
- Object explorer and objects layer are located in different windows
- When pressing “render” another window will always change to UV/Image Editor mode, but the window that changes is not easily selectable.

Hierarchical Task Analysis -

Add the included mesh “monkey” to the scene and alter the right ear.

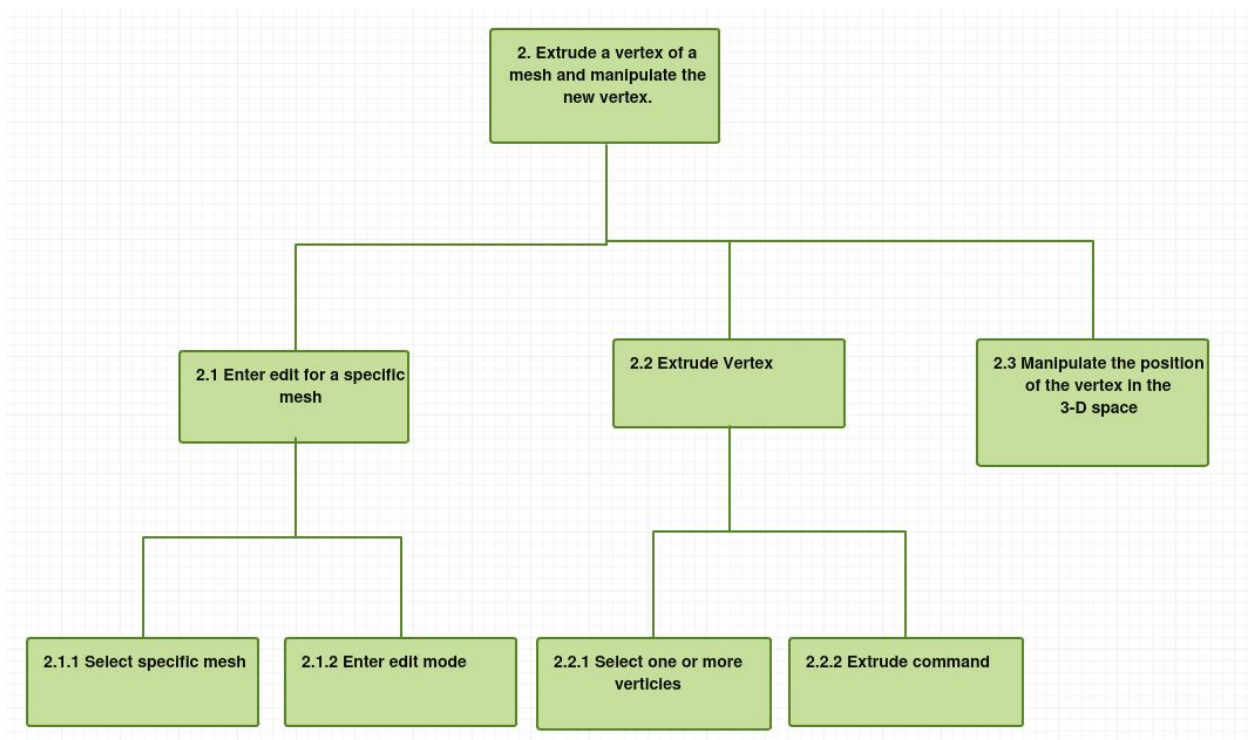
(The monkey is an included mesh provided by blender mostly for testing purposes and introductory uses, alternative shapes are the sphere, square, etc.)

Basic Model editing:



Important modeling tools:

Face fill, loop cut



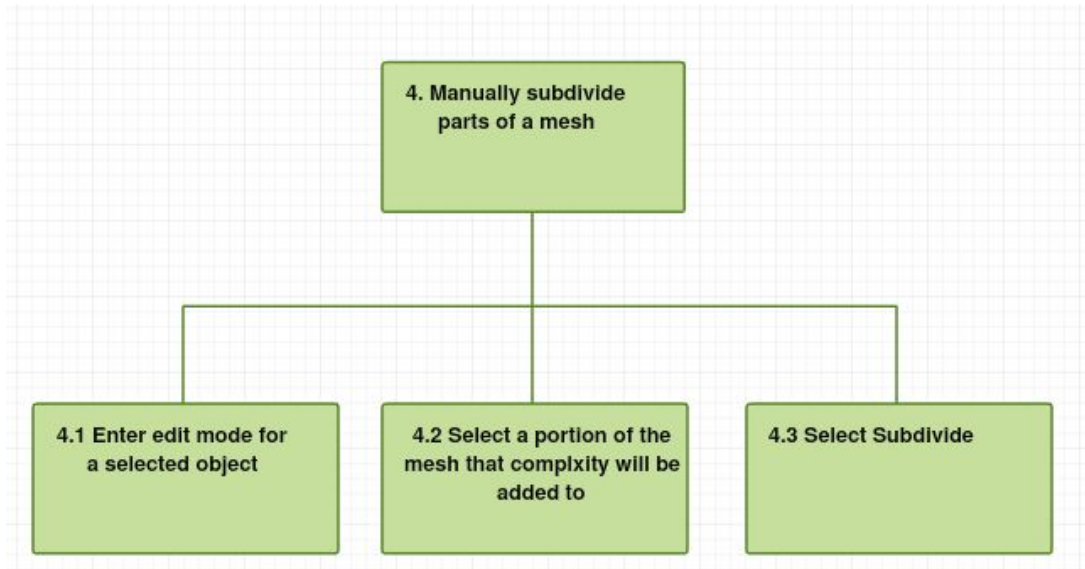
-The extrude tool generates a vertex at the same location as a selected vertex with an edge connecting the two. The new vertex will be selected after extrude and can be transformed at this point.

-Extruding a group of vertex will create a new vertex at the point of each selected vertex and each source vertex will only be connected by an edge to one new vertex; previous connections will remain.

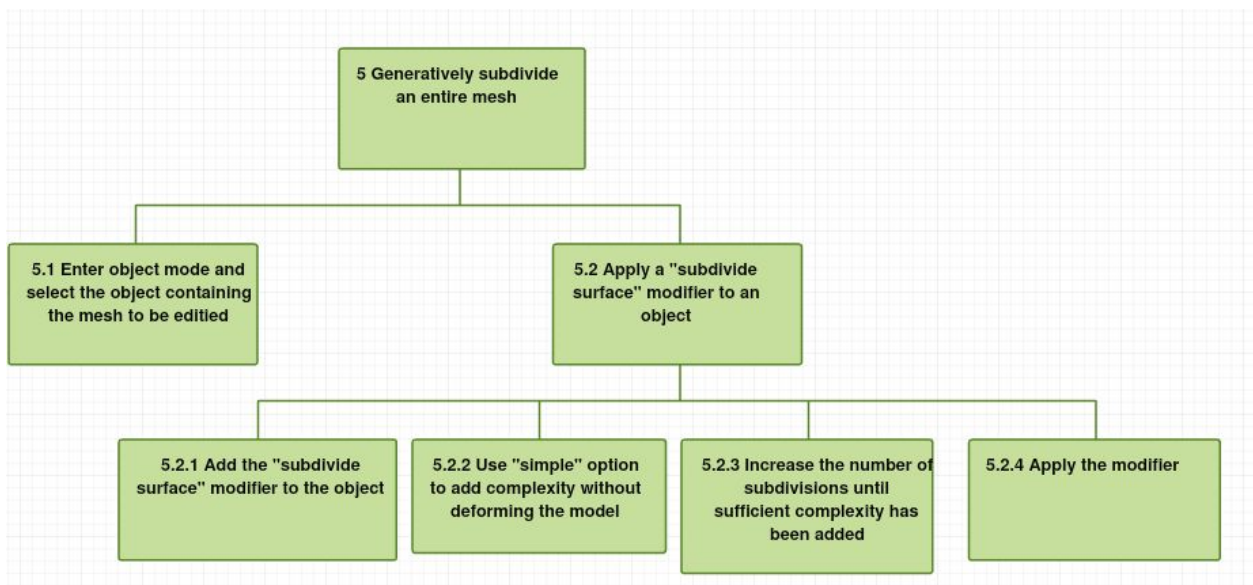
-All new vertex will be selected. All source vertex will be deselected.

Mirror Tool: <https://imgur.com/LBWi08e>

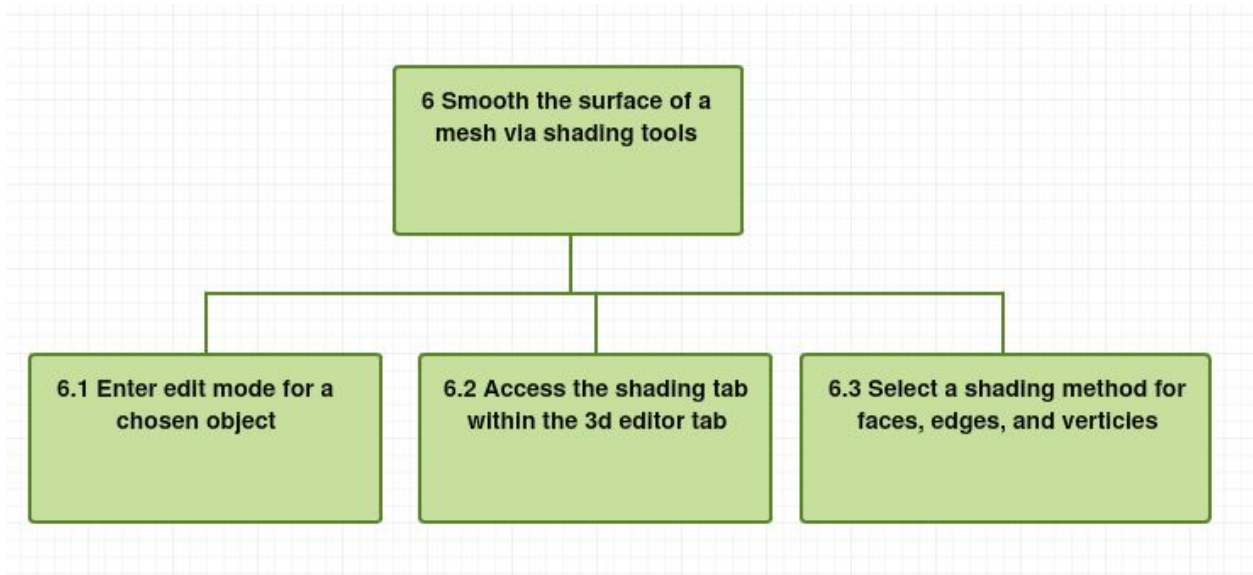
Manual Subdivision:



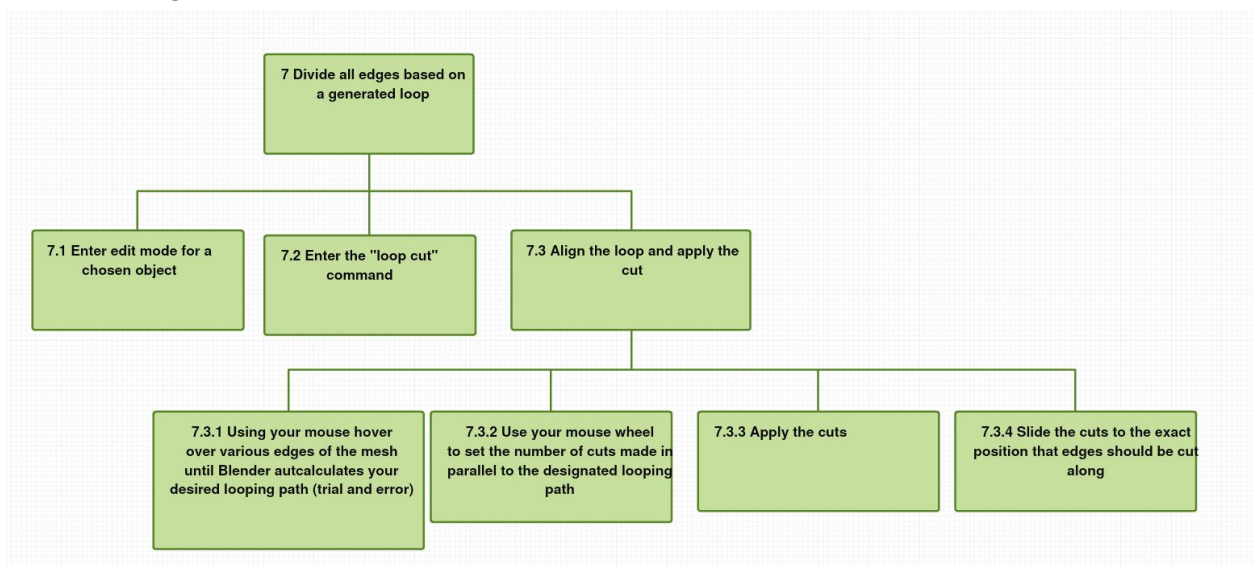
Generative Subdivision:



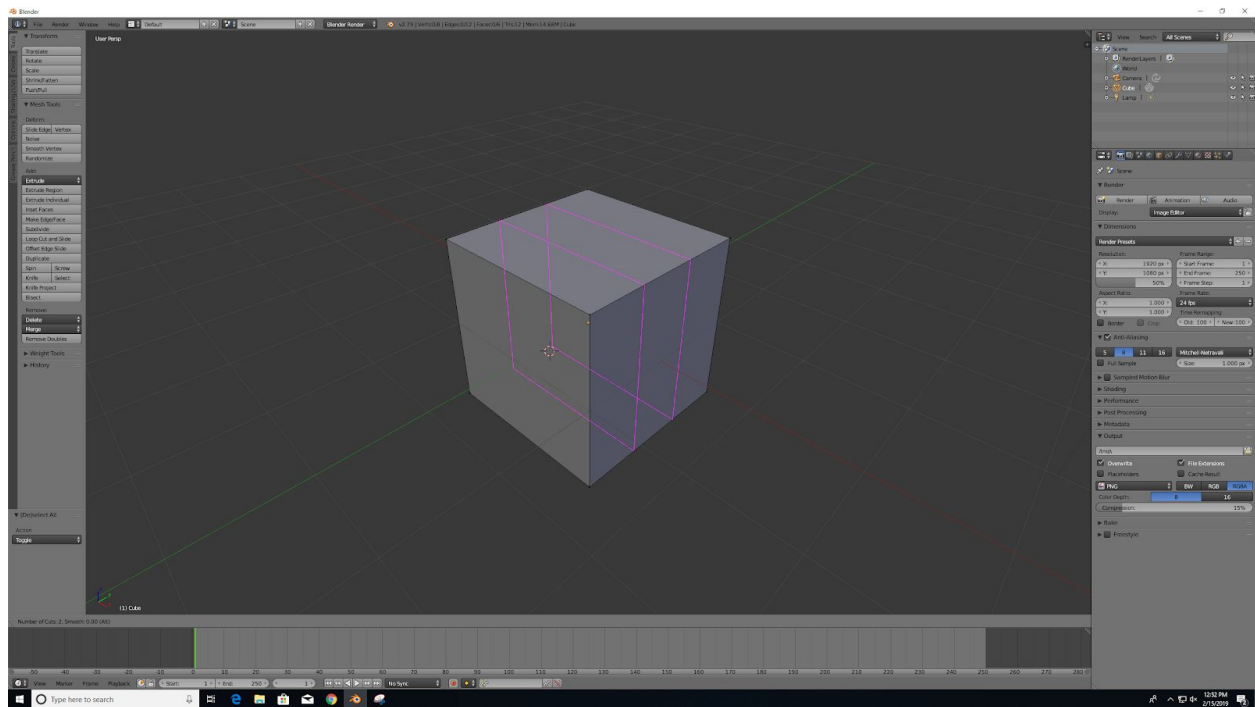
Apply surface smoothing:



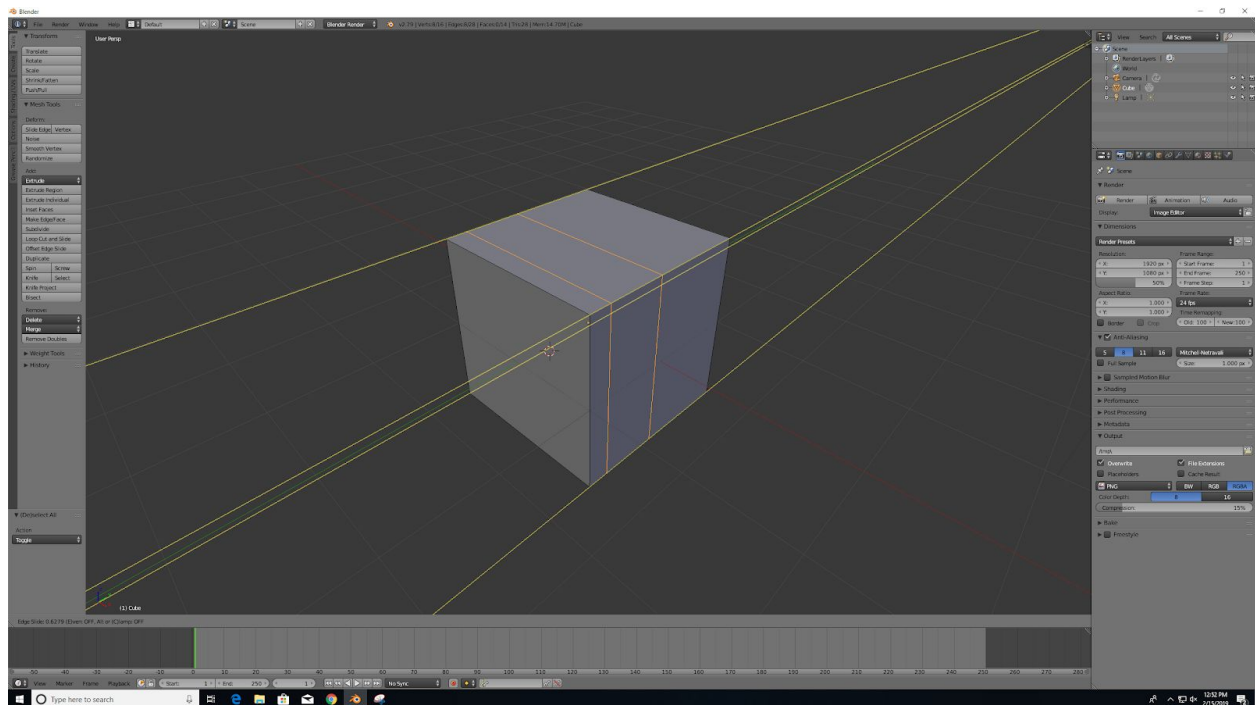
Loop Cutting:



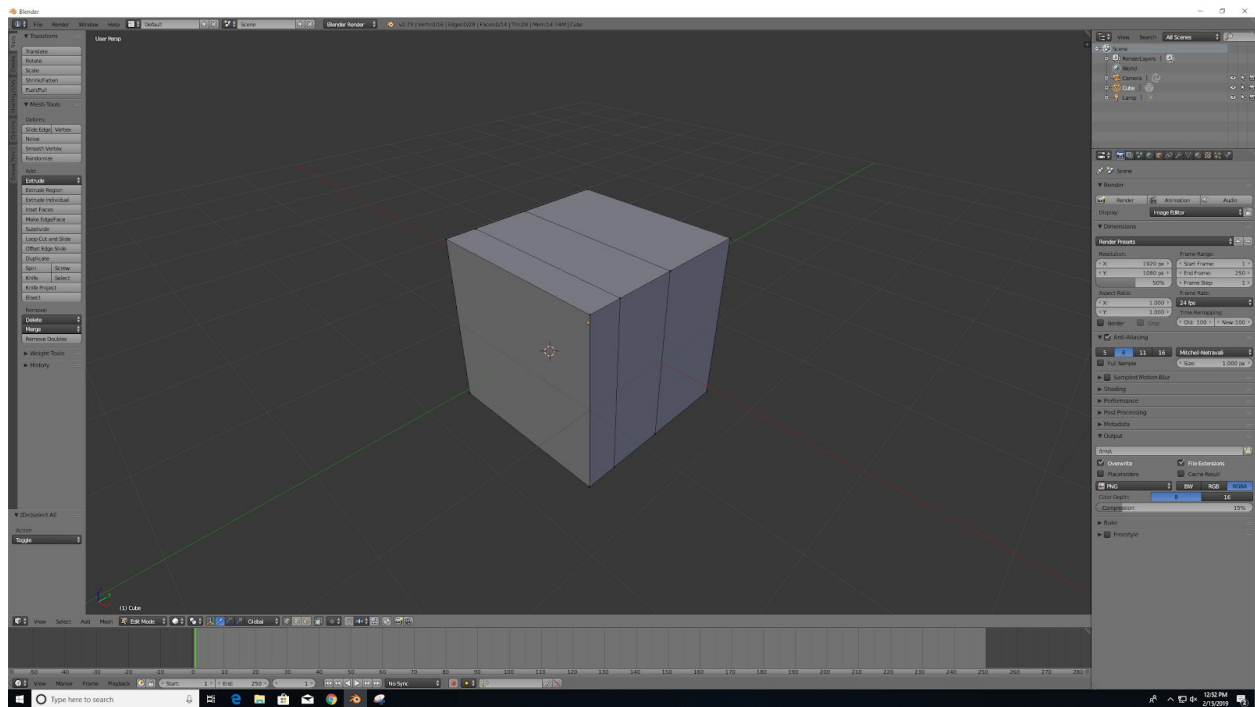
7.3.1-7.3.2



7.3.3-7.3.4



Final Result:



Sources:

<https://en.blender.org/index.php/Dev:Source/Architecture/Overview>