Rhino tutorial
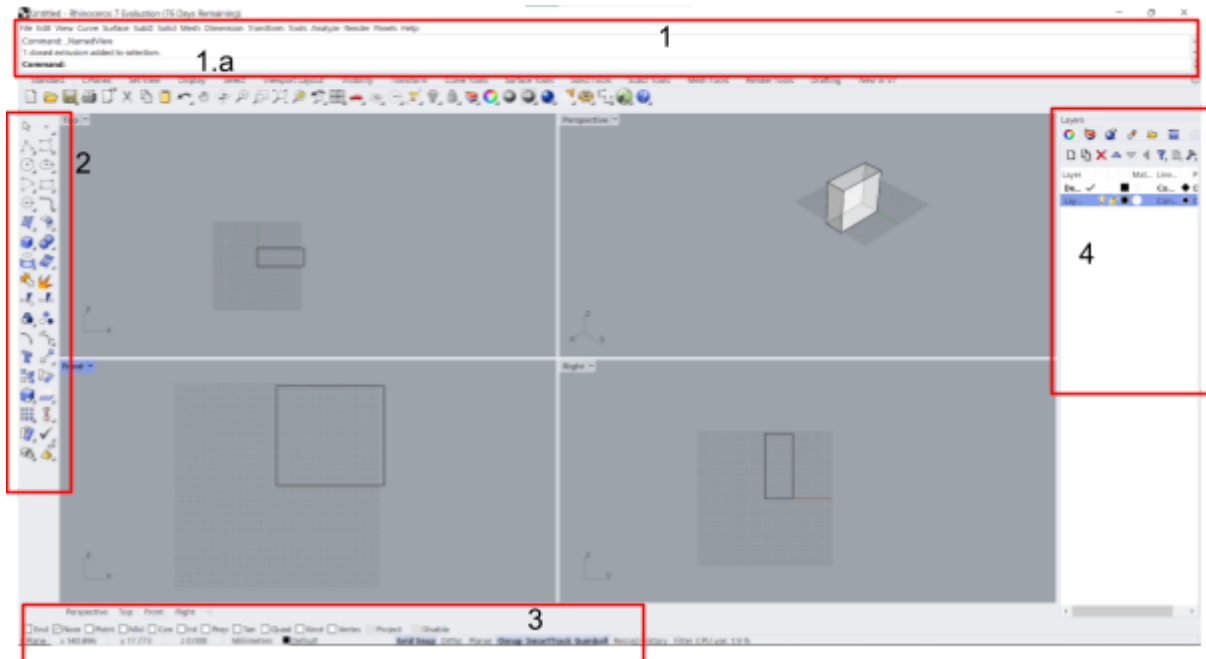
-Basic introduction into using polylines/curve tool
-How to extrude linework into a 3D model / how to make a model on Rhino
-How to produce drawings- plans, sections
-How to create files for fabrication: 3D printing, laser cutting, CNC

Interface

- 1. Toolbar, command bar at the top
- 1.a Type in commands- you remember more and more commands as you use the interface so it becomes faster than trying to find the buttons
- 2. Command icons on the side- find common commands like polyline, shapes, extrude, join, boolean, group etc.
  - Right click icon for full list
- 3. Bottom: toolbar with settings for precision when modelling:
  - Osnap: snaps precisely to the line/ object; e.g. end, near (on the edge/ line), midpoint, centre (circles/ cylinders, spheres), intersection, perpendicular, vertex for meshes
  - Ortho: everything is drawn at 90 degree angles
  - Smarttrack: the interface predicts what you want to draw and gives you a guide
  - Gumball: appears when you select object/ lines; lets you move in one direction along the axis or scale in one direction
- 4. Right side layers bar: good to build models in layers; you can turn layers on/ off; group layers, add new layers
  - Change object layer: select object and change at the bottom; or select object ---> intended layer ---> change object layer

- Mouse:
    - Left key to select
    - Shift + left key to continue selecting objects
    - Ctrl + left key to deselect selected objects
    - Middle roller to zoom in/ out
    - Click right key to repeat last command- tap spacebar to repeat last command
    - Drag right key to orbit
    - Shift+right key to pan
- Ctrl+z to undo, type redo to redo
- Ctrl +x to cut, ctrl+v to paste, ctrl + c to copy; backspace/ delete key to delete
- Ctrl + a to select all/ selall
- Shift to draw temporarily in ortho (straight lines; perpendicular)
- View windows:
    - Move your mouse and build in different windows/ views
    - Drag the side of the windows to make bigger/ smaller
    - Double click the window view tab to make full view; double click again to return to separate views
    - Change view by clicking on tab ---> set view
    - Save view (good for rendering)

Building your model

- Draw straight with polylines: type in or choose from icon bar;
    - line= only one segment
    - polyline= can draw many joined segments
- Coordinates: you can type in coordinates/ lengths for more accuracy
    - 0= origin (0,0,0)
    - After setting the start point, you can type in accurate lengths
- Trim: trim lines/ objects- doesn't have to touch/ cut through to trim
- Join: join separate line segments into one curve- ends must be touching; cannot intersect
- Extrude curve: make 2d drawing into 3d
    - Some settings in the command bar: direction (can be diagonal extrusion)
    - Both sides: extrudes upwards and downwards
    - Solid: choose 'yes' to get a closed shape, otherwise you end up with just surfaces
    - Delete input: get rid of the drawn lines
    - When you change the settings, they carry over for the next extrusions
    - When building floors/ walls etc it's important to give thickness- don't build your buildings as planes/ surfaces!
    - Type in numbers for accurate heights; can type negative numbers to extrude opposite direction that is set (e.g. downwards)
- Curves:
    - 'Curve' to draw control point curve
    - 'Interpcrv' to draw curve that passes through the selected points
    - Draw curves, hold 'ctrl' to change plane when drawing- draw in 3d
    - Degree means the number of control points beyond which the curve doesn't affect anymore when moving a control point

- ○ Can extrude a curve for to create a surface
- ○ 'Loft' several curves to form a surface
- ○ Can edit curves by moving/ deleting control points
- ○ 'Pointson' to see control points (srfs) for editing
- ○ Can draw on 3d objects
- ○ Network surface: create a surface from 4 curve lines- computer automatically predicts surface
- ● Draw 3d objects: box, cylinder, sphere etc
  - ○ Type lengths for accuracy
  - ○ You can build directly on already built objects/ surfaces etc

Creating drawings

- ● Make 2d: make a drawing out of a 3d object
  - ○ Make sure to check which viewpoint you are 'drawing' e.g. top view for plans, side views for sections etc
  - ○ Sent to the make2d layer- check it is turned on; you can group and change layers for it
  - ○ Good to 'join' lines after make 2d- often comes as lots of line segments, difficult to work after exporting to illustrator
- ● Exporting to illustrator:
  - ○ Check scale- often draw the paper/ canvas size and try to fit the make2d onto the page
  - ○ Select make2d and paper size ---> export ---> adobe illustrator---> options ---> snapshot of current view (can get lost if preserve model scale) ---> open illustrator file and drag to proper paper size
- ● Sections:
  - ○ 'section' command for flat section line, move/ gumball out
    - ■ Draw a line where you want the section to be- doesn't have to be the full model
    - ■ Go into a side view for the make2d
  - ○ 'Split': splits model into 2; good for rendered sections with depth
    - ■ Section line to split must fully cut through the whole object
    - ■ 'Cutplane' command to create a large surface that cuts through the entire object- can move the cutplane like a regular surface
    - ■ Split ---> select object ---> select cutplane ---> good to group the objects on either side of the split plane before moving
    - ■ Can make 2d to a get a line section (remember to do in a side view) or render for a perspective section

3D Printing:

https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/b/596/files/2019/08/3d-print-2019-Copy.pdf
- ● Must be a fully enclosed solid volume- have a thickness to it, not a surface, no missing surfaces

- To check if the model is enclosed: 'volume', a window will popup if your model is not enclosed
- Go to the top toolbar: analyse ---> edge tools ---> show edges ---> naked edges; unenclosed edges will be highlighted pink
- Enclose these edges by creating a surface to cover them; remember to 'join' the new surface to original object- it will be unhighlighted after enclosing
- Normals must be facing outwards
  - Select objects and command 'dir' to check the surfaces ---> flip any surfaces that are facing inwards so they face outwards
  - If any faces are facing inwards, the object will not be printable
- Boolean union model
- Save as a .stl
- 2mm min. Thickness
- Save multiple objects as separate files- easy for us to maneuver
- The filament (material) has some thickness when printed- if you need to fit something through it, allow for around 2mm tolerance each side (i.e., make your holes 4mm larger in diameter)

Laser Cutting

https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/b/596/files/2019/08/lasercut2019.pdf

- Draw a shape the same size as your material and lay out your files in rhino, then export as illustrator file
- You can change colour/ make layers in Rhino- it will carry through to illustrator so less work to do!
- Make sure illustrator file is in RGB
- Line weights are 0.01
- Make sure to use different colours for cut/ engrave/ raster and have each command on a different layer!
- One piece of art per board- make multiple files if you have multiple sheets of material to be cut
- Make sure no double lines/ hovering lines- good to Make2d from top view before exporting
- Reduce cut time by reducing lines needed to be cut- e.g. if straight lines, you can layer them so only cut once etc
- Important to keep copies of your files- make sure you have the original/ untampered file saved safely!!!!!

Site model
- Download your contour model as dwg and import into Rhino
- Select contours and 'patch'
- Trim off excess area by drawing a box- remember to 'join' the two pieces to create a single polysurface
- 'Contour' ---> choose direction to cut in ---> type in distance for cuts (i.e. material thickness) ---> lay out the cut pieces one by one (important for everything to be in order- label to make it clearer!) ---> organise onto material for cutting (remember which piece goes where!)
- Export as illustrator files

CNC

https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/b/596/files/2019/08/digi-fab-guide-2019.pdf

- Save your model as a Rhino or .stl file- good to only have the single model to cut in the file
- Make sure your model is an enclosed volume- check naked edges and boolean your objects
- Give your model file to the CNC operator downstairs (L1 workshop)

Useful commands:

- move/ m: move object by selecting a pointas axis
- zsa : (zoom selected area) will quickly zoom all view windows into a particular selected area; good for if you get lost
- Redo
- Group/ ungroup: group objects/ lines together (doesn't have to be the same layer), quick and easy to select and move
- hide/ show: hide objects without turning off the layer
- Lock/ unlock: lock objects so they are still visible but unselectable
- array/ array linear: quickly create a set of objects/ lines
- Offset: duplicate the object in a parallel position away from the object
- rotate/ rotate 3d
- Scale: type in scale (e.g. 1/100, 2)
- Scale 1d: scale one edge of the object
- Explode/ join: object becomes separate surfaces; joined lines become separate segments
- Sellast: selects the objects from the last command
- Selcrv: selects all visible curves
- Cap: create a closed solid from an open object (e.g. missing sides, cut through etc)