3D MODELING WORKSHOP

OVERVIEW

During this workshop you will learn how to use Tinkercad to create & customize 3D models.

Tinkercad is an easy-to-use tool for creating digital designs that are ready to be 3D printed into physical objects.

And at the end you will have a task to make an object that you can print later on one of our 3D printers

PREPARATIONS

- We will be using browser based software so you don't have to install anything!
- All you need to do is to go to https://tinkercad.com/ & register for a free account.
- Later on we will also be using Google Docs drawing tool (https://docs.google.com/drawings), so if you don't have a Google account this is a good time to go and get one.

MAIN FLOW

1. LEARN THE LAYOUT

Log in to your Tinkercad account, click on "Create new design" button & let's get started!

Take some time to know your way around Tinkercads layout. Basically all the tools you will need are located in the right menu bar.

2. CHECK YOUR GRID

Near the bottom right corner of the workplane you have *"Edit grid"* options & *"Snap grid"* value.

Leave the value as it is, but we need to adjust the grid size to those of the 3D printer bed. It will be easier for you to understand the dimensions you are working in.

3. LEARN THE BASICS.

Drag the red Box to the workplane (close to middle is usually best).

You can drag the box to any place on the workplane. Click & drag to move it in x & y axis, pull the black arrowhead on the top plane to move it in the "z" axis.

Click on the Box and play with the visible controls.

Black dots on the base of the box allow you to scale the box in "y" or "x" axis, and the white dot on the top plane lets you scale it in the "z" axis.

You can also scale the box freely in x&y axis while pulling one of four white dots on the base plane. Use uniform scaling of the objects just by holding shift while pulling any of the control dots.

Notice that you can also rotate the objects in any direction. Holding Shift button while doing so will snap the rotation every 45 degrees.

4. WORKING WITH DIMENSIONS

First of all delete the object you were working on before.

Ok, now get *Cylinder* on the plane. Now from the right menu bar choose the *Ruler* and put it on the workplane.

Notice that when you click on the cylinder now, when the ruler is also on the workplane, you can see the dimensions of the object. You can click on them to enter values.

Change the dimensions to:

- height: 15mm
- diameter: 25mm.

Apart from the object dimensions, you can also change the distance from the workplane & distance from the ruler axis.

5. 3D MODELLING: THE BASICS

Ok, so we have a cylinder with the dimensions set in the previous step. Now lets get one more cylinder to the workplane.

1. Set the cylinder dimensions to

- height: 30mm
- diameter: 5mm.

2. Select both objects either by dragging a window over them, or by shift clicking both of them. Go to *"Adjust"* in the top bar on the right, and choose *"Align"* option.
3. Center align the cylinders in all three dimensions.
4. Copy & paste the thin cylinder and again select all object and center align them in all dimensions. Rotate one of the thin cylinders 90 degrees.
5. Select the horizontal thin cylinder and the big one and group* them together using either keyboard shortcut or command from the top menu bar.

> Group command in Tinkercad "welds" the objects together, you can unweld them simply by ungrouping them.

6. Change the color of the grouped object.
7. Change the diameter of the thin vertical to 20mm. Realign the objects.
8. Click on the thin cylinder and set it to "Hole" in the inspector.
9. Group all objects together and congrats you have your first 3D model ready!

6. USE THE BASIC MODELING TECHNIQUES YOU LEARNED TO CREATE A GAMING DICE

Use the predefined dice model from the right menu bar & the numbers also found there. Feel free to experiment.

ADDITIONAL TASKS

Do you feel good with your skills? If so let's get to the next step if not keep on experimenting or ask us for some help.

UTILIZE YOUR 3D MODELLING SKILLS TO MAKE SOMETHING USEFUL

We dare you to design and model a bottle opener and since the material we will be printing with is not so strong, we will be using a coin in the design, so it will be more sturdy and open the bottle instead of breaking ;)

1.1. USING GOOGLE DOCS DRAWING TOOL TO MAKE CUSTOM SHAPES & TEXT.

Go to https://docs.google.com/drawings to start a new drawing.

Here you can create custom shapes with curve tools or use some predefined shapes that are still much more than the ones in Tinkercad or even create custom text!

When you have your shape or text ready, go to *"File"* -> *"Download as"* -> *".svg"* You can now import this file to Tinkercad using the *"Import"* command at the top of the right menu bar.

1.2. TIPS FOR DESIGNING THE BOTTLE OPENER.

You can visit http://www.thingiverse.com/ and search for some bottle openers to have some inspiration of what you can do. If you don't have the patience you can even download the opener you really like and personalize it.

You should know the dimensions of the coin you will be using in your design - you can use the web to find them or use our calliper to measure it.

Your design should not be bigger than x=60mm, y=60mm, z=30mm - printing takes some time and everyone would like their design to be printed :)

ADDITIONAL SOURCES

You want to tinker more in 3D modelling or Tinkercad did not satisfy you?

Here is a list of free 3D modelling software we created for you:

- Autodesk 123D - design: http://apps.123dapp.com/design/
- Sketchup - http://www.sketchup.com/ (plugin needed for stl exports)
- Blender - http://www.blender.org/
- Rhino4Mac - http://www.rhino3d.com/mac (pre alpha version)
- OpenSCAD - http://www.openscad.org/

DANCING DRONES

OVERVIEW

In this workshop you'll learn about the wonderful world of autonomous flying robots, specifically the AR Drone 2.0 provides a high level API to send commands, read data back and stream video from it's HD camera.

We'll start writing basic programs to take off and land, and before you know it you'll be using feedback from a wealth of onboard sensors to perform more impressive maneuvers and behaviours.

PREPARATIONS

- Insert a fully charged battery into the AR Drone: https://www.youtube.com/watch?v=QdFsd9R3vJ8
- Download the FreeFlight app for your iOS or Android device.
- Create a folder to work in (something like `nodecopter`)
- *Optional*: Install Node.js on your computer: http://nodejs.org/download/
- *Optional*: Install the ar-drone npm module with `npm install ar-drone` into the folder

MAIN FLOW

Now connect to the drone's WiFi with your smartphone, start the FreeFlight app and make a test flight with it's Piloting feature to learn how the drone behaves.

Once you've done that, save this to a file and execute it:

```
var arDrone = require('ar-drone');
var client = arDrone.createClient();

client.takeoff();

client
  .after(5000, function() {
```

```
    this.clockwise(0.5);
  })
  .after(3000, function() {
    this.animate('flipLeft', 15);
  })
  .after(1000, function() {
    this.stop();
    this.land();
  });
```

See how your drone takes of, rotates clockwise and even does a flip! Amazing. Now let's try customising your script with different commands:

Basic directional commands:

- `client.takeoff()`
- `client.land()`
- `client.up(speed)`
- `client.down(speed)`
- `client.clockwise(speed)`
- `client.counterClockwise(speed)`
- `client.front(speed)`
- `client.back(speed)`
- `client.left(speed)`
- `client.right(speed)`
- `client.stop()`

Animation options:

- `phiM30Deg`
- `phi30Deg`
- `thetaM30Deg`
- `theta30Deg`
- …

> More details for the API can be found in the readme: https://github.com/felixge/node-ar-drone#ar-drone

Combine these together and get your drone dancing around the room!

Now that you've got the hang of the basics, there are three different challenges to attempt, you can try them in any order.

MAKE YOUR OWN DRONE CONTROLLER

sending commands from a controller (xbox, keyboard, arduino, browser)

SECOND FLOW

reading nav data from the drone and visualising it (in a browser, or terminal)

EYE IN THE SKY

streaming video/png data back and displaying it (most likely in a browser)

ADDITIONAL TASKS

Additional tasks to be filled here. For those who want more or are more advanced if you don't have second flow.

FAQ

- Crashes
- Won't take off
- The App
- How much can an AR Drone lift? - Not much, about 100g before it becomes unstable.

ADDITIONAL RESOURCES

- Nodecopter website - http://nodecopter.com/hack
- Nodecopter modules on NPM - https://npmjs.org/browse/keyword/nodecopter
- Nodecopter projects on GitHub - https://github.com/search?q=nodecopter