

---

# Table of Contents

|  |      |
|--|------|
| Introduction   | 1.1  |
| General Essentials                                   | 1.2  |
| Commercial Board Policy                              | 1.3  |
| Principles and Practices, Project Management         | 1.4  |
| Computer-Aided Design                                | 1.5  |
| Computer-Controlled Cutting                          | 1.6  |
| Electronics Production                               | 1.7  |
| 3D Scanning and Printing                             | 1.8  |
| Electronics Design                                   | 1.9  |
| Computer-Controlled Machining                        | 1.10 |
| Embedded Programming                                 | 1.11 |
| Mechanical Design, Machine Design                    | 1.12 |
| Input Devices  | 1.13 |
| Moulding and Casting                                 | 1.14 |
| Output Devices                                       | 1.15 |
| Composites   | 1.16 |
| Embedded Networking and Communications               | 1.17 |
| Interface and Application Programming                | 1.18 |
| Applications and Implications                        | 1.19 |
| Invention, Intellectual Property and Business Models | 1.20 |
| Project Development                                  | 1.21 |
| Final Project Requirements                           | 1.22 |

# Fab Academy Assignments and Assessment

*Created by Anna Kaziunas France & Bas Withagen*

*Maintained by Wendy Neale, Emma Pareschi, Francisco Sanchez & Bas Withagen*

During Fab Academy, you will learn how to envision, prototype and document your ideas through many hours of hands-on experience with digital fabrication tools. This document outlines:

- The assignments (what you'll do)
- What we want you to learn each week (why you're doing it)
- The base-line evidence/proof/things you need to show what you've learnt each week (what you did and how you did it).

Don't rely on a printed document. Refresh your browser to ensure that you're viewing the most up-to-date information for each assignment in this living document each week.

Minor changes will be made to this document throughout Fab Academy, but additions to assessment requirements will only be made to future assignments, not past assignments.

Advise your local instructor when you've completed assignments so they include your work in their weekly round of assessment. Your local instructor will advise of dates and times of assessments.

## General essentials

Imagine that one day you need to reproduce all of your assignments. You have no internet (except fab modules | Mods), no-one is able to help you. You have only your fab academy archive folder and the resources within the fab lab. Ensure that you have documented everything in enough detail in your archive so that you can do this easily.

1. Design files and code must be present in the archive in the form of DXFs or STLs, as well as in the original editable format (antimony, solidworks, eagle, CAD, etc).
2. Externally host your large files (+1MB) and link to them (discuss with instructor first).
3. Acknowledge work done by others.
4. Take photos, notes and screenshots as you work - compress and resize your images for web. Use these to explain and describe what you do. A 'hero shot' is the best photo showing your finished project.
5. Abide by the Commercial Board Policy.
6. All weekly modules must be completed, you must have presented globally with a presentation slide & video before you are considered for Global Evaluation.
7. Final project must meet the basic requirements outlined at the end of this doc.

## Commercial Board Policy

Fab Academy is an experience where you can focus on developing your ideas and skills in a unique, hands-on way. Developing custom boards and building on previously Fabbed boards is part of this valuable process. Rather than using commercial boards (arduinios etc) for your final project, you will create your own personal fabduino-type board, by fabbing or modifying one of the existing designs available. If you make it early in the programme, you can troubleshoot and adjust before time becomes tight.

If you have trouble while building your own fabduino, you must speak with your remote guru about this. Please ensure that you actively seek to solve this before it affects your ability to participate in Fab Academy.

Using commercial boards can seem simpler in the very short term, but in the medium - long term, custom boards are more flexible and effective as development tools.

## Acceptable use of Commercial Boards

### Prefabricated Arduinos

- These can be used as a extra nodes of a network that you have built, with the purpose of showing the network functionality of one of your fabricated boards. **Networking between just commercial boards is not acceptable.**
- You can use them as a base for your designed shields or connector boards.

### Single board computers: Raspberry Pi, Beaglebone etc

They are super cheap computers capable of running full operating systems, like Linux and (recently) Windows. These can be used as a substitute for your desktop/laptop.

### Commercial Board Exemption Process

If you think you have a special case where there should be raised an exemption please talk to your local or remote guru. The case will be addressed to the Global Evaluation Team for analysis.

In any case remember that Commercial Boards are not evaluated. They are not considered as your own work, but a necessary item for your work.

## Principles and Practices, Project Management

- Build a [personal site](#) describing you and your final project.
- Plan and sketch a potential [semester project](#) and add it to your website.
- Upload it to the class archive. Work through a git tutorial.

### Learning outcomes:

- Explore and use website development tools
- Formulate a final project proposal
- Identify version control protocols

### Have you:

- made a website and described how you did it
- introduced yourself
- described and made a sketch of your final project
- documented steps for uploading files to archive
- pushed to the class archive

## Computer-Aided Design

- Model (draw, render, animate, simulate, ...) a possible [final project](#), and post it on your class page with original 2D and 3D files.

Don't rely on a printed document. Check the information for each assignment in this living document each week.

### Learning outcomes:

- Evaluate and select 2D and 3D software
- Demonstrate and describe processes used in modelling with 2D and 3D software

### Have you:

- Modelled experimental objects/part of a possible project in 2D and 3D software
- Shown how you did it with words/images/screenshots
- Included your original design files

# Computer-Controlled Cutting

## Laser Cutting

- make lasercutter test part(s), varying slot dimensions using parametric functions, testing your laser kerf & cutting settings (group project)
- cut something on the vinylcutter
- design, make, and document a parametric press-fit construction kit, accounting for the lasercutter kerf, which can be assembled in multiple ways

### Learning outcomes:

- Demonstrate and describe parametric 2D modelling processes
- Identify and explain processes involved in using the laser cutter.
- Develop, evaluate and construct the final prototype

### Have you:

- Explained how you parametrically designed your files
- Shown how you made your press-fit kit
- Included your design files and photos of your finished project

## Vinyl Cutting

There is no specific project that is focussed on this very useful tool. There are a range of ways you might utilise it throughout the programme, or your local instructor may set a specific project. You might make:

- stickers
- flexible circuit boards
- a textured surface/relief pattern
- screenprint resists/stencils

Ensure that you have used it in some way during this time and met the objectives below.

### Learning outcomes:

- Identify and explain processes involved in using this machine.
- Design and create the final object

### Have you:

- Explained how you drew your files
- Shown how you made your vinyl project
- Included your design files and photos of your finished project





As outlined in the Commercial Boards policy, fabbing your own boards is an important part of Fab Academy. The 'fabbest' way to do this, is by milling your FR1 boards via Fab Modules or Mods.

## **Electronics Production**

- Make an in-circuit programmer by milling the PCB (program it, so that you can use it to program your board in Electronics Design week, and in other weeks)
- Optionally, trying other processes.

### **Learning outcomes:**

- Describe the process of milling, stuffing, de-bugging and programming
- Demonstrate correct workflows and identify areas for improvement if required

### **Have you:**

- Shown how you made and programmed the board
- Explained any problems and how you fixed them
- Included a 'hero shot' of your board

## 3D Scanning and Printing

- Test the design rules for your printer(s) (group project)
- Design and 3D print an object (small, few cm) that could not be made subtractively
- 3D scan an object (and optionally print it)

### Learning outcomes:

- Identify the advantages and limitations of 3D printing and scanning technology
- Apply design methods and production processes to show your understanding.

### Have you:

- Described what you learned by testing the 3D printers
- Shown how you designed and made your object and explained why it could not be made subtractively
- Scanned an object
- Outlined problems and how you fixed them
- Included your design files and 'hero shot' photos of the scan and the final object

# Electronics Design

Redraw the echo hello-world board, add (at least) a button and LED (with current-limiting resistor), check the design rules, make it (*if you have time this week, test it*).

*optional: simulate its operation. Measure its operation*

Don't rely on a printed document. Refresh your browser to ensure that you're viewing the most up-to-date information for each assignment in this living document each week.

## Learning outcomes:

- Select and use software for circuit board design
- Demonstrate workflows used in circuit board design

## Have you:

- Shown your process using words/images/screenshots
- Explained problems and how you fixed them, including how you worked with design rules for milling (DRC in EagleCad and KiCad)
- Included original design files (Eagle, KiCad, Inkscape, .cad - whatever)

NB. Also, if you make a board and it doesn't work; franken-hack that board (with jumper wires etc) until it does work, then make a new one with the knowledge you have gained.

# Computer-Controlled Machining

Make something **big** (on a CNC machine).

Don't rely on a printed document. Refresh your browser to ensure that you're viewing the most up-to-date information for each assignment in this living document each week.

## Learning outcomes:

- Document the process of design and production to demonstrate correct workflows and identify areas for improvement if needed

## Have you:

- Explained how you made your files for machining (2D or 3D)
- Shown how you made something BIG (setting up the machine, using fixings, testing joints, adjusting feeds and speeds, depth of cut etc)
- Described problems and how you fixed them
- Included your design files and 'hero shot' photos of final object

## Embedded Programming

- Read a microcontroller [data sheet](#).
- Program your [board](#) to do something, with as many different programming languages and programming environments as possible.
- Optionally, experiment with other architectures

### Learning outcomes:

- Identify relevant information in a microcontroller data sheet.
- Implement programming protocols.

### Have you:

- Documented what you learned from reading a microcontroller datasheet.
- What questions do you have? What would you like to learn more about?
- Programmed your board
- Described the programming process/es you used
- Included your code

# Mechanical Design, Machine Design

MECHANICAL DESIGN (week 1 of 2)

Make a [machine](#), including the end effector, build the passive parts and operate it manually.

MACHINE DESIGN (week 2 of 2)

Automate your [machine](#). Document the group project and your individual contribution.

## Learning outcomes:

- Work and communicate effectively in a team and independently
- Design, plan and build a system
- Analyse and solve technical problems
- Recognise opportunities for improvements in the design

## Have you:

- Explained your individual contribution to this project on your own website

## On the group page (linked on your Lab page), has your group:

- Shown how your team planned and executed the project
- Described problems and how the team solved them
- Listed future development opportunities for this project
- Included your design files, 1 min video (1920x1080 HTML5 MP4) + slide (1920x1080 PNG)

## Input Devices

The second half of the Fab Academy programme is designed to build on the previous weeks. You will be synthesising information and implementing skills that you were introduced to in the first half of the programme and encouraged to integrate these into your final project proposal.

Measure something: add a sensor to a microcontroller board that you have designed and read it.

### Learning outcomes:

- Demonstrate workflows used in circuit board design and fabrication
- Implement and interpret programming protocols

### Have you:

- Described your design and fabrication process using words/images/screenshots.
- Explained the programming process/es you used and how the microcontroller datasheet helped you.
- Explained problems and how you fixed them
- Included original design files and code

# Moulding and Casting

Design a 3D mould, machine it, and cast parts from it.

## Learning outcomes:

- Design appropriate objects within the limitations of 3 axis machining
- Demonstrate workflows used in mould design, construction and casting

Don't rely on a printed document. Refresh your browser to ensure that you're viewing the most up-to-date information for each assignment in this living document each week.

## Have you:

- Explained how you made your files for machining
- Shown how you made your mould and cast the parts
- Described problems and how you fixed them
- Included your design files and 'hero shot' photos of the mould and the final object



## Output Devices

Add an output device to a microcontroller board you've designed and program it to do something

### Learning outcomes:

- Demonstrate workflows used in circuit board design and fabrication
- Implement and interpret programming protocols

### Have you:

- Described your design and fabrication process using words/images/screenshots.
- Explained the programming process/es you used and how the microcontroller datasheet helped you.
- Outlined problems and how you fixed them
- Included original design files and code

# Composites

Read the material safety data sheet (MSDS) and technical data sheet (TDS) for the resins that you're using

Design and make a 3D mould (~ft2 /30x30cm), and produce a fibre composite part in it

## Learning outcomes:

- Demonstrate workflows used in mould design and construction
- Select and apply suitable materials and processes to create a composite part.

## Have you:

- Shown how you made your mould and created the composite
- Described problems and how you fixed them
- Included your design files and 'hero shot' photos of the mould and the final part
- Read and linked to the material safety data sheet (MSDS) and technical data sheet (TDS) for the resins that you're using

# Embedded Networking and Communications

Design and build a wired &/or wireless network connecting at least two processors

## Issue opened.

Networking needs to be more clearly defined here. Like expressing the need to have multiple controllers communicating using addressing.

## Learning outcomes:

- Demonstrate workflows used in network design and construction
- Implement and interpret networking protocols

## Have you:

- Described your design and fabrication process using words/images/screenshots.
- Explained the programming process/es you used.
- Outlined problems and how you fixed them
- Included original design files and code

## Interface and Application Programming

Write an application that interfaces with an [input](#) and/or [output](#) device **that you made**, comparing as many tool options as possible.

### Learning outcomes:

- Interpret and implement design and programming protocols to create a Graphic User Interface (GUI).

### Have you:

- Described your process using words/images/screenshots
- Explained the the GUI that you made and how you did it
- Outlined problems and how you fixed them
- Included original code

# Applications and Implications

Propose a final project that integrates the range of units covered.

## Learning outcomes:

- Define the scope of a project
- Develop a project plan

Think of your project plan as an 'installation and implementation guide' for the future. How will others be able to make your project by reading your documentation?

## Have you answered these questions:

- what will it do?
- who has done what beforehand?
- what materials and components will be required?
- where will they come from?
- how much will it cost?

The answers to the questions above will allow you to create your BOM, or Bill Of Materials.

- what parts and systems will be made?
- what processes will be used?
- what tasks need to be completed?
- what questions need to be answered?
- what is the schedule?
- how will it be evaluated?

# Invention, Intellectual Property and Business Models

Create and document a license for your final project. Develop a plan for dissemination of your [final project](#). Prepare a summary slide (presentation.png, 1280x1024) and video clip (presentation.mp4, 1080p HTML5, < ~minute, < ~10 MB) in your root directory

## Learning outcomes:

- Recognise the range of licenses available
- Formulate future opportunities

## Have you:

- Summarised two kinds of licences and explained why you chose one.
- Imagined and outlined possibilities and described how to make them probabilities

# Project Development

Complete your final project. Track and document your progress.

## Learning outcomes:

- Evaluate project plan
- Apply time management techniques
- Summarise and communicate the essence of a project

## Have you answered these questions:

- what is the deadline? How much time do I have left?
- what tasks have been completed, and what tasks remain?
- how will I complete the remaining tasks in time?
- what has worked?
- what hasn't?
- what questions still need to be resolved?
- what have you learned?

Congratulations, you have now reached the point of working on your Final Project. The following weeks are an opportunity to demonstrate your mastery of the skills you have developed in the previous weeks. Your goal is to keep it as affordable as possible. Design and fabricate your own parts instead of buying off-the-shelf components. Your project must:

- *be your own design*
- include a fabbed input device and an output device of your own design
- include other components made with additive and subtractive techniques
- include 2D and 3D design elements

## **Have you made a separate *Final Project* page that:**

- briefly summarises your project
- includes the BOM (Bill of Materials) for your project
- links to any weeks that you worked on your final project
- links to your presentation.png and presentation.mp4
- includes all of your design files in the archive (no external hosting of final project files - discuss file sizes with your instructor)
- includes the licence you chose
- acknowledges work done by others

## **Have you made your slide:**

- slide: 1280 x 1024 pixels named presentation.png
- your name
- the name of your project
- the name of the Fab Lab
- photo/render/sketch of your project
- a brief description of what your project is/does

## **Have you made your video:**

- made a ~1 minute (10MB/1080p) video of you explaining your project