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Fab Academy Assignments and Assessment

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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).

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

> 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.

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 generically readable forms such as DXFs, STLs, etc., 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 globally presented an MTM project with video and a Final Project presentation video & slide before you are considered for Global Evaluation.

7. Final project must meet the basic requirements outlined at the end of this doc.

FAQ:

I am a continuing student. Am I assessed by 2017 standards?

> Answer: 1. Yes. You will be always assessed by the current standards.

Is it mandatory to use Fab Modules/antimony/other recommended software?

> Answer: 1. No. But it is strongly encouraged, since they were designed to make your life easier. Explain why you used other software instead.

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 (arduinos 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 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 - please see the above graphic showing the process.

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

FAQ:

Is it OK to use someone else's template to create my website?

Answer: 1. Yes - acknowledge other people's work. Show you understand how the template works by describing/changing parts of it.

Can I store photos and files off the archive?

Answer: 1. No. Photos should be resized and compressed and stored in the archive. See General Essentials. 2. The Global Evaluation team should be able to pull and then assess your work offline.

What size should my website be?

Answer: 1. In the order of tens of megabytes. Read the General Essentials, compress, resize, etc.

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.

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

FAQ:

Is it compulsory to do parametric design this week?

> Answer: 1. No, but it is next week. So it is a good idea to start learning now.

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

FAQ:

Can I use the Inkscape clone tool for my pressfit kit?

> Answer: 1. No. The clone tool is not a real parametric software.

Is it compulsory to design my own file in Vinyl cutting?

> Answer: 1. Yes. Or modify existing one, and acknowledge where you found it.

Can I use the Inkscape clone tool for my pressfit kit?

> Answer: 1. No. The clone tool is not a real parametric software.

Is it compulsory to design my own file in Vinyl cutting?

> 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

FAQ:

Does the FabISP need to work to complete the assignment?

> Answer: 1. Yes. Explain ALL the debugging that you did to try to find out problems.

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

FAQ:

Define 'cannot be made subtractively'

Answer: 1. That cannot be fabricated with 3 axis limitations OR even if it's possible to make it, it is too complicated.

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

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.

FAQ:

Can I modify an existing design board?

> Answer: 1. Yes as long as you acknowledge the original design and explain your contribution to the board.

Do I need to create a schematic file?

> Answer: 1. If your software does not generate it no, otherwise yes. You can draw or use kokopelli which does not create schematic files.

Computer-Controlled Machining

Make something big (on a CNC machine).

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

FAQ:

How big is big?

> Answer: 1. Big enough to show you understand many of the possibilities of CNC machining - drill, pocket, dogbones, nesting, etc.

Does it have to be wood or wood products?

> Answer: 1. No. But the lab is only responsible for providing you with a full size wood board.

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

FAQ:

If I adjust existing code, is that now my code?

> Answer: 1. You must acknowledge whoever made it. See General Essentials. 2. To succeed in this project, experiment with changing the code, understand how that worked, and write your own.

How do I prove I've read the Data Sheet?

> Answer: 1. Point out things in your code and board design that you learnt from the Data Sheet. Also point to other weeks when you used a Data Sheet.

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)

FAQ:

Does we have to design new boards for this?

> Answers: 1. No. You can use the gestalt or other existing commercial boards.

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

FAQ:

Is the satsha kit/fabduino I fabricated considered a valid board for this assignment?

> Answer: 1. Fabricating an unmodified board is considered as electronics production but does not count towards any design skill.
> 2. If you changed the original satsha kit/fabduino, it is a valid board.

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

Have you:

- Explained how you designed your 3D mould and created your rough and finish toolpaths 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

FAQ:

Should I read the MSDS and TDS this week?

Answer: 1. It is always a good idea to read these documents.

I want to only make a wax mould, and cast something in it - is that acceptable?

Answer: 1. Learn and go through the 3 step process first . To break the rules you have to master the rules.

Can I 3D print the mold? Can I do a lasercut?

Answer: 1. No, for this assignment you must mill the mould using a CNC milling machine.

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

FAQ:

Does the mould have to be 3D milled?

Answer: 1. No. It could be a torsion box (interlocking and skillfully joined) made on the laser or CNC, or a 3D mould.

If the composite object is made without vacuum bag/compress/compact, is it acceptable?

Answer: 1. You must prove you can use compression (two molds or vacuum bag) to remove extra resin. So if you just use wet layout you should make some test coupons showing you know how to do compaction. See 2017 composite review video at 1h11m10s

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

FAQ:

Can we use arduino/commercial boards for networking?

> Answer: 1. It depends on the case: you can use commercial boards for wireless devices. But you can't use Arduino or similar commercial microcontroller boards because they can be made in the fab lab. For this week, you can use the original satcha-kit/fab-kit/fabduino.

Must each board have a unique identity?

> Answer: 1. It does not have to be hard-coded but you must use some form of addressing.

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.

> see Final Project Requirements for details.

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

FAQ:

What does 'summarised two kinds of licence' mean?

> Answer: 1. To show that you understand Neil's lecture, and what your licence is for, you need to compare licences so that you can choose the correct one for you. 2. You can compare two kinds of Open Licences, or compare two options for one kind of Open Licence. Or more...two is the minimum.

Project Development

Complete your final project.

> Please see Final Project Requirements for details.

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 reached the point of working on your Final Project. This is your opportunity to demonstrate synthesis of skills you 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. Each student, whether working individually or in a group, must prove mastery of the skills gained during the program.

Learning Outcomes:

- create your own integrated design

- demonstrate 2D & 3D modelling capabilities applied to your own designs

- select and apply appropriate additive and subtractive techniques

- demonstrate competence in design, fabrication and programming of your own fabbed microcontroller PCB, including an input & output device

This page probably looks different than when you last looked. **Don't panic!** The content is still the same, it has only been reformatted for consistancy and for the webapp. Keep up the good work!

Have you:

- made your **slide**: 1280 x 1024 pixels with your name, project name, Fab Lab name, a photo/render/sketch of your project, a brief description of what your project is/does

- made a ~1 minute (10MB/1080p/720p) **video** of you explaining your project

- made a separate **Final Project page** that briefly summarises your project *and*

- included the BOM (Bill of Materials) for your project

- linked from this page to any weeks that you worked on your final project

- linked to your presentation.png and presentation.mp4

- included all of your original design files in the archive (2D & 3D, board files & code) No external hosting of final project files - discuss file sizes with your instructor

- included the licence you chose

- acknowledged work done by others

FAQ:

Can I just design a shield for a commercial board in my final project?

Answer: 1. No. Please check the learning outcomes above. See Commercial Boards Policy.

Can I use the satshakit/fabduino/raspberry pi for my final project?

Answer: 1. You have to design your own board(s). 2. You can use it to program your own input/output devices. Fabricating an unmodified board is considered as electronics production but does not count towards any design skill. 3. You can only use a Raspberry Pi instead of a laptop. See Commercial Boards Policy.

My final projects electronics is a tangle of wires but it works. So I guess this is it.

> Answer: 1. No. Your final project must show integration of the skills beyond early stage prototyping. That includes arranging the wiring, use of connectors, etc.

How do we present a Group Project?

> Answer: 1. Each student will make a specific slide that shows it's a group project (names the project and the other collaborator/s) and details the parts developed by the individual 2. Each student will make a specific video that will have some shared content, but mainly shows the parts developed by the individual

What does 'original design files' mean?

> Answer: 1. That you designed or modified them significantly. They are ones that you made or evolved to change the way they work. If you evolved them into something new, acknowledge where they came from and, point out what you did *to improve them*. Pay attention to the original license that is used, and do not breach it. This may affect the licence you can choose for your final project. Read it all, but pay particular attention to #3, #23, #29, #35 & #37 in Bruce Mau's Incomplete Manifesto. This is slightly different than files in the 'orginal editable format', check General Essentials.