FABLAB O SHANGHAI “FABO ACADEMY X CHINA”

Fablab O Shanghai “Fabo Academy X China”, is a 8 week course into digital manufacturing and rapid prototyping. The course is based on MIT’s “How To Make (Almost) Anything” class and Fab Academy global class.

CLASS SCHEDULE:

DESIGN FOR FABRICATION
Class 1 - Introduction, make a documentation website.
Class 2 - 2D Design software and Laser Cutter.
Class 3 - 3D Modeling software and 3D Printer.

DIGITAL MANUFACTURING
Class 4 - 3D Scanning: scan, modify and print yourself.
Class 5 - Electronic Production: Precision CNC PCB Milling.
Class 6 - Electronic Production: soldering your first PCB.

PRODUCT DEVELOPMENT
Class 7 - Programming: test your PCB and program it to do something.
Class 8 - Programming: add Input & Output devices to your PCB.

Final Project: design and manufacture a prototype

Final Documentation & Presentation.

GENERAL CLASS STRUCTURE

The principal for teaching is hands-on learning: keeping the theory short but dense before continuing on practical applications. The student will be required to work on his/her own during each week. Each student is required to bring his/her own laptop, in good working order, with a mouse and basic softwares installed.

COURSE SCHEDULE

Classes will take place every Tuesday at 1.00AM. During the week the student will have to complete an assignment. On the first part of the next class there will be a random review of previous class assignment, by checking the student documentation website.

CONTACT INFORMATION

Director: 丁峻峰 Jeff - 18621832152
Instructor: Saverio Silli - 13524015379
Instructor: J. Travis Russett

WEEK 1: DESIGN FOR FABRICATION

Introduction to the Fablab Network. Building the documentation website. Learn the basics of 2D Graphic and 3D Modeling software and start training on laser cutting and 3D printing. Understand the constraints and best practices to design objects for digital fabrication tools. Get used to move from design to prototype and back for improvements.

CLASS 1: INTRODUCTION, MAKE A DOCUMENTATION WEBSITE.

Overview of what a Fablab is, its rules and the Fab Charter. Using Bootstrap framework for building a documentation website.

Assignment:

1. Read the fab charter and reflect what it means in practice.
2. Build the basic structure and homepage of your website.

Learning outcomes:

- Understand the Fablab philosophy.
- Know how HTML code and CSS style sheet are used.

Software: Brackets, Bootstrap

CLASS 2. 2D DESIGN SOFTWARE, DESIGN AND LASER CUT YOUR NAME TAG.

Introduction to the basic commands of a 2D design software. Learning key concepts of designing 2D objects and understand the possibilities and limitations of laser cutting.

Assignment:

1. Design a multi-part name tag with engraved and scored element and press fit joints.
2. Laser cut your name tag and assemble it without using glue.
3. Analyze the parts and modify the model, cut an improved version.

Learning outcomes:

- Learn the basic commands of 2D Graphic software.
- Know what kerf is and how to compensate for it in the design.
- Learn how to safely and efficiently use the Laser Cutter and the stock material.

Software: Rhinoceros
Device: Laser Cutter

CLASS 3. 3D MODELING SOFTWARE, DESIGN AND 3D PRINT A 3D MODEL

An introduction to the basic commands of a 3D modeling software and to the different 3D printing technologies. Learn the limitations of what can be printed and the workflow going

from design to print. Analyze and debug printer errors. Design thinking, quickly going from idea to design to 3D printed prototype and then back to design.

Assignment:

1. Design a small 3D model and use it for testing the printer and its design rules.
2. Design and print something that could not be laser cut.
3. Analyze your print and modify the model, print an improved version.

Learning outcomes:

- Learn the basic operations of 3D Modeling software.
- Learn the toolchain and workflow for 3D printing.
- Identify and solve printer errors.
- Apply design thinking to rapid prototyping.

Software: Rhinoceros, Cura
Device: 3D Printer

WEEK 2: DIGITAL MANUFACTURING

A broad view on digital manufacturing techniques such as additive and subtractive manufacturing, 3D scanning and PCB making. Understanding how the machines work, what they are used for and what are the materials available. Understand how to adapt the design process to the machine or technique used. Introducing electronics and soldering techniques for PCB making.

CLASS 4. 3D SCANNING: SCAN, MODIFY AND PRINT YOURSELF

Learn how to digitize the physical world using the 3D scanner. Learn how to modify and repair a 3D scan model. Practice more on a 3D Modeling software and use it to modify the file and prepare it for printing.

Assignment:

1. Scan yourself with a 3D Scanner and repair the mesh.
2. Design a base or pedestal with an engraved text to make a bust model.
3. Print the model and check the result.

Learning outcomes:

- Understand the advantages and limitations of 3D Scanning.
- Learn the basic operations of 3D Modeling software.
- Understand the difference between mesh and NURBS polysurface.

Software: Rhinoceros, Skanect, Meshmixer, Cura
Device: 3D Scanner, 3D Printer

CLASS 5. ELECTRONIC PRODUCTION: PRECISION CNC PCB MILLING

Introduction to CNC Milling. Make the Shanghaino PCB Board using Fab Modules to generate the toolpaths and the Roland SRM-20 to mill the traces.

Assignment:

1. Generate toolpaths using Fab Modules and the provided PNG image.
2. Choose appropriate Endmill and setup the Roland SRM-20 milling machine.
3. Perform the cutting job: mill the traces (1/64 mill) and cut the outline (1/32 mill).

Learning outcomes:

- Understand the workflow of PCB milling from PNG image.
- Learn how to work with Fab Modules.
- Develop the skills needed to operate the desktop CNC Mill.

Software: Fab Modules, Roland V-Panel.
Device: Roland SRM-20, Shanghaino Kit

CLASS 6. ELECTRONIC PRODUCTION: SOLDERING YOUR FIRST PCB

Introduction to electronic circuits and electronic components. Learn the basics of soldering with the “Shanghaino” kit, a simplified Arduino clone, and understand how it works.

Assignment:

4. Make a list of the Shanghaino’s components and specify what they are used for.
5. Solder all the components on the PCB.
6. Connect it to the computer and upload a test program with Arduino IDE.

Learning outcomes:

- Understand the functions of electronic components.
- Develop basic soldering skills.
- Understand the workflow of uploading a program on the PCB.

Software: Arduino IDE
Device: Soldering Iron, Shanghaino Kit

PRODUCT DEVELOPMENT

Discuss with the class a final project proposal with input and output capabilities. Overview of input and output devices, how to connect them to the Shanghaino and how to write a program to use them. Make a prototype of the final project, write or modify a program to make it work. Complete the documentation website and present the final project to the class.

CLASS 7. PROGRAMMING: TEST PCB AND PROGRAM IT TO DO SOMETHING.

Introduction to the Arduino IDE development environment, its programming language and basic structures. Upload the first program and test the board for bugs. Program the Shanghaino board to do something with the integrated LED and BUTTON.

Assignment:

1. Upload the example Blink Sketch to the Shanghaino.
2. Test the board's functionality and try to identify any bug.
3. Write at least 3 different programs that make use of the integrated LED and BUTTON.

Learning outcomes:

- Learn how to check for bugs and solve potential issues.
- Familiarize with the programming language and its structures.
- Learn Arduino's basic functions and their uses.

Software: Arduino IDE
Devices: Shanghaino Kit

Elaborate a final project proposal based on the research conducted in week-one. Learning how analog and digital ports work and how to add Input and Output (I/O) devices to the microcontroller. Make a prototype circuit using the Shanghaino PCB and I/O devices, write or modify a program and test it.

CLASS 8. PROGRAMMING: ADD INPUT & OUTPUT DEVICES TO YOUR PCB.

Learning how analog and digital ports work and how to add Input and Output (I/O) devices to the microcontroller. Make a prototype circuit using the Shanghaino PCB and I/O devices, write or modify a program and test it. Elaborate a final project proposal.

Assignment:

1. Use the Arduino IDE to write or modify a program with I/O devices.
2. Assemble your circuit on a breadboard and test it.
3. Elaborate a final project proposal.

Learning outcomes:

- Conduct simultaneous hardware and software development.
- Work with electronic components on the breadboard.
- Analyze a question and prototype a solution.

Software: Arduino IDE
Devices: Shanghaino Kit

FINALS. FINAL PROJECT: DESIGN AND MANUFACTURE A PROTOTYPE.

Create a group of three students and choose one final project idea. Define functions and components for the project. Prototype the electronic circuit, write a program and test it. Design and fabricate a final product that integrates electronics, functions and shapes. Follow the principles of spiral development. Use as many techniques learnt: 3d printing, 3D scanning, laser cutting, CNC milling.

Assignment:

1. Test the electronic circuit and the program.
2. Design and fabricate all the parts of your project.
3. Assemble your project, test it, modify, improve (use spiral development).

Learning outcomes:

- Understand system integration, materials and processes needed.
- Manage time, break down development in simple tasks, iterate, add features.
- Collaborate, solve problems and deliver solutions in a short amount of time.

FINAL DOCUMENTATION & PRESENTATION.

Present your documentation website and your group project to the class.

Assignment:

1. Complete all the work of previous classes and the documentation website.
2. Present your work to the class.

Learning outcomes:

- Be able to talk in public and make an effective exposition of your work.