Des Inv 22 Intro to Prototyping/Making Things

Fall 2017

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- **Week 1**
    - Introductions
        - administrative stuff
            - Arriving late can be disruptive. Please arrive on time. If you miss material it is your responsibility to make it up.

              Class rules:
            - Always bring laptop to class. Bring all materials and project prototypes to class.
            - Homework might include purchasing components. Bring these components to class!!!
            - Always bring your nameplate to class (after you make it)
            - No Facebook, working on other class homework, texting etc. during class, It is distracting to you but more importantly it is distracting to your classmates.
        - Course overview

          Lo-fi to Hi-fi prototyping/what is it and how do we use it in the design process.

          Topics covered:

          Hand tools for quick fabrication

Fasteners, materials, adhesives: knowing what's available and making the right choice.
2D fabrication
3D assemblies from 2D parts
3D modeling
3D fabrication
Breadboarding (wireless)
Soldering
Microcontroller concepts
Programming
Sensors
Motors
Other actuators
Linkages, gears, pulleys, belts
Mechanical adjustability

- Homework rules
    - Upload to Bcourses all project material including video of working project, process photos (documentation of build showing major steps or iterations), Fritzing/123Dcircuits schematic, Arduino code, bill of materials (parts list) and and a description of all the problems you encountered while working on this exercise, and how you figured out what was wrong. Must use correct title of each assignment.

- Lecture
    - Introducing Xacto Knife and Ruler cutting demo.
        - Blades (storage and correct angle of use).
        - Safety - sharp tools use and storage
        - Straight edge- accurate cutting

- Bone- scoring and folding

- Paper folding for designers

  - Slide deck examples and uses
  - Physical examples
  - Buildings and products based on origami - examples.

    Electronic Kits distributed to class

Homework:

- Complete profile including picture on Bcourses.
- Online training for Jacobs Institute https://bcourses.berkeley.edu/courses/1353091
  General Workshop Safety and Electronics Lab
- Orientation for the Invention Lab http://invent.citris-uc.org/about/calendar/
- Grade rubric

Prototyping Homework 01

- Origami/Kamigami-

  - Three models of three different folded and or cut paper structures. One has to be able to change shape.
  - Grade rubric

- 3D CAD

  - Download, install and confirm Autodesk Fusion.

Electronics Homework 01

        - Download, install and confirm Arduino.
        - Read the Introduction of the SparkFun Inventor's Kit for Arduino Experimenter's Guide
        - Read Experiment 1: Blinking an LED in the SparkFun Inventor's Kit for Arduino Experimenter's Guide
        - Read Experiment 2: Reading a Potentiometer in the SparkFun Inventor's Kit for Arduino Experimenter's Guide
        - Grade rubric
        - Hardware required (kits passed out in class):
            - Arduino/Feather
            - USB cable (must fit Arduino)
            - Black solid core wire, 22 AWG, 2'
            - jumper wire kit (any type)
            - LEDs (any colors) Qty 3
            - Solderless Breadboard (1/2 loaf)
            - Photoresistor (LDR) (Qty 2)
            - 10 K Ohm resistors (Qty 5)
            - 1 K Ohm resistors (Qty 5)
            - Momentary switch (pushbutton) suitable for breadboard (Qty 2)
            - Servo motor, any brand or size, NOT continuous rotation (Qty 1)

- **Week 2**
    - **Electronics Lecture 01**
        - Hands on following along.

(Everyone already has Arduino installed.)

- Servo motor (hands-on following my instructions)

- File -> Examples -> Servo -> Sweep
- File -> Examples -> Servo -> Knob
  - map function

- Servo motor and photoresistor (hands-on follow along lecture)
- Demonstrate the continuous rotation servo
- How to mount servo and how to attach things to the servo horn
- Time permitting, start homework in class

- Homework

- **Prototyping Homework 02**: Combine one of your origami from last week's homework with the Arduino servo sketch to create something that changes shape (mechanical linkage, accordion, etc.). Feel free to remake your origami if you decide that what you have is not conducive to the servo assignment.

  Servo and origami must be mounted and brought to class.

- **Week 3**

- **Lecture**
    - Introduction to 2D CAD Demo with simple shapes.
        - Fusion 360 (3D Cad program introduction)
    - Intro to laser cutter
        - Training on laser cutter (should have completed)
        - Name plate style guide, the do's and don'ts
    - Intro to basic linkages
    - Gear generator introduction.
    - Physical prototyping: beyond the basic box (Slide Deck and Samples).

- **Prototyping Homework 03:**
    - 3.1 Fabricate a name plate to put on your desk in class.
    - 3.2 Design and Laser cut a set of gears and linkages to convert rotary motion into linear motion.
        - Can be hand powered but must have some affordances to actuate it ergonomically and move a physical component.
        - No touching the gear directly, output motion should be highlighted by physical design.
        - Grade rubric

- **Week 4 Prototyping Mechanisms**

  Lecture-Push rods, Cams,Springs:

Function-Demo with prototypes
Fabrication-Physical examples demo

- **Week 5 Motors**

  Lecture- Electronics
  - DC motor and transistor
  - DC motor and H-bridge (L293D)

  Lecture-Prototyping
  Motor output: how to harness:
  Couplers and hubs.

- **Week 6 Introduction to Perforated Breadboard, and more motors types**

  - Perforated breadboard prototyping demonstration
  - Arduino prototyping shield introduction
  - Motor comparisons

- **Week 7**

  - Holding it all together, maybe? Adhesives and fasteners lecture and hands on demo.
  - Arduino shield show and tell- what and why.
    survey of available shields on the market.

- **Week 8**

  - Electronics/Programming:
    - Wire lecture

        - Power distribution

    - Mechanical

        - Chassis
        - Joints
        - couplings
        - mounts
        - steering

    - Drive trains

        - Direct Drive
        - Gears
        - Belts
        - Shafts

- **Week 9**

    - Project status

        - Test drive of current vehicle
        - Working steering, working motors.
        - We will set up a test track and your vehicle will be graded on how well it performs the required criteria, i.e. does it steer, can it move on its own, climb the ramp?

    - In-class project work time

- **Week 10** Second project due; third project assigned

    - Scheduling activities without using delay()

- **Week 11**
    - Electronics/Programming
        - Finishing touches
            - Switches
            - More connectors
            - Standoffs
    - Prototyping
        - Fit and Finish
        - coatings/paint
        - lubrication
- **Week 12:**
    - Electronics/Programming
        - Code debugging
    - Prototyping
        - Review of vehicle designs
        - Failure proofing demo
- **Week 13:**
    - Electronics/Programming
        - Review as needed

    - Prototyping
        - Best practices/what have we learned?
        - Emerging/future technology
    - Homework
        - Clean up/refine prototype vehicles

- **Week 14:** Final project due. Vehicles must complete obstacles course.
- **Week 15:** Projects presented in Jacobs Design Showcase.
- **Week 16 (and beyond):** Design your world!