25.108 Introduction to Engineering II
Project # 1: Team Logo Design

Objective

The objective of this project is to introduce you to the use of Matlab and desktop CNC machines. You will design, digitize and fabricate of a rubber stamp logo for your lab team. This logo will be used to stamp your group's lab-work through the semester.

By participating, you will:

- Practice your team-ideation and brainstorming skills
- Learn a little about the Matlab user-interface, variables and plotting.
- Be introduced to the desktop CNC mill software and hardware use.
- Be introduced to wax milling and silicone molding processes.

Schedule

- **Week of January 27th**
  - Form teams
  - Receive the project specification.
  - Brainstorming and sketching
- **Week of February 3rd**
  - Finalize your logo designs
  - Hand-draw toolpaths for your logo
  - Digitize logo into g-code using Matlab (some groups)
  - Test run using CNC as a plotter (some groups)
- **Week of February 10th**
  - Machine your logo in wax
  - Setup and perform a silicone cast
  - Leave mold to cure
- **Week of February 17th**
  - Mount and test the logo stamp
  - Project summary sheet due

Deliverables

The following deliverables are expected for this project

- **w/ Homework # 1:** A JPEG scan/photo of your ideation 2-D decision space
- **w/ Homework # 2:** A JPEG scan of your: logo w/ toolpaths (hand-drawn)
- **Start of class 2/10:** A matlab generated coordinate list of logo toolpaths
- **Week of 2/17:** A completed mold, logo-stamp **and** a project summary sheet

Grading

This project will be 10% of your overall grade in the course. You will be graded on:

- 3 pts: Your scan of the hand-sketched logo & 2D decision space
  - Graded on: neatness, originality, design, following instructions.
- 3 pts: Your Matlab toolpath generation of the CNC g-code.
- 4 pts: Your logo mold and the final stamp

Project #1: Team Logo Design Specification

Your team is tasked to work together to develop a team logo with the following specifications:

- **Logo Size**: Your logo must conform to the following dimensions:
  - Be less than or equal to 2-inches in the *x*-direction.
  - Be less than of equal to 2-inches in the *y*-direction.
- **Logo Milling Constraints:** Due to time constraints, the milled area of the logo must be less than 1 in^2. This means that less than ¼ of the allowable 2" x 2" area may be milled.
- **Logo Design Details**: Your logo will be milled using either a 1/8" or 1/16" end mill. This means all lines/paths on your logo will have a thickness of 1/16".
- Your team will be provided with a single 3" x 3" x 0.5" block of *machinable wax*. Please be careful to use the wax only when you are sure your design will work.

Suggested Laboratory Method: TAs will help to guide your work.

The figure below shows the general logo stamp design process that will be used in this lab. The UMass logo is quite complicated due to the complex curves defining the logo. This would be considered a challenging logo for this project.

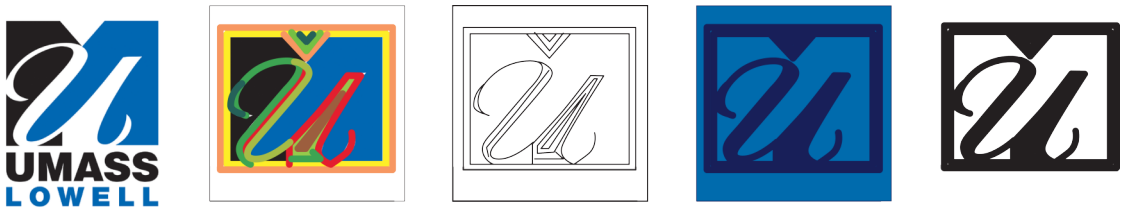

Figure 1: An example logo stamp design process. (a) Define the logo (b) Define how an end-mill will travel to mill the logo (c) Convert the tool-paths to g-code using matlab (d) Make a mold of the logo by milling the "ink areas" of the machinable wax here in dark blue (e) mold the logo using silicone to make an ink stamp.

1) **Week of January 27th: Logo Ideation: In this part of the project, you will brainstorm possible logo designs as a team.**
   a. Start by sharing/collecting examples of logos for products, companies, etc. You may use google images to help you find logos.
   b. Once you each have a collection of logos, discuss what properties you think make a good vs. poor logo.
   c. Discuss as a group and select the ***two properties*** of logos that you think are most important (eg: Simplicity and Aesthetics).
   d. Brainstorm as a team/individually and generate as many ideas as you can for your team's logo. You may want to sketch each of your ideas/thoughts quickly on a post-it note. Be as creative as possible & no negative comments about any ideas presented.
   e. Draw an axis system, and label the axes using the two properties you selected in part 1-c. Discuss each logo from part 1-d and arrange the logo according to where you feel they lie on this graph. Select the 3 idea(s) that you believe are most promising.
   f. Scan or take a photo of your final 2-d decision space and follow instructions on how to submit it with your homework # 1.

2) **Week of January 27th: Refinement & user study: In this part, you will show your most promising 3 x logo ideas to another group for feedback.**
    a. When prompted by the TA, find another student team and share your logo ideas with them. They will share theirs with you.
    b. Provide feedback to your colleagues on their logo. Be constructive not critical. Give them suggestions for improvement and give credit for good ideas.
    c. As a group, select one logo design. This logo now needs to be drawn accurately on graph paper (next week) and turned into a series of path lines that will be machined on the CNCs.

---

3) **Week of February 3rd, 2014: Sketch your logo on graph paper: In this part of the project, you will draw a scale version of your logo on graph paper.**
    a. Start by drawing an axis system – be sure to clearly label the axes to show the origin (0,0) and the maximum dimensions of the logo (x = 2" and y = 2"). Use a scale of 2 large blocks of the graph paper to represent 1".
    b. Using pencil, sketch the outline of your logo as accurately as possible.
    c. If your logo contains *areas* and *lines,* lightly shade in pencil the areas of the logo that will be "ink" on the paper.

4) **Week of February 3rd, 2014: Developing tool paths by hand: In this part of the project, you will develop instructions about how the end-mill will be moved over the machinable wax to form a mold of your logo.**
    a. Once you have created a hand-drawing of your logo you need to define toolpaths that will be used to mill the logo on the CNC. You may want to make a copy of your logo now before moving to the next step.
    b. Start drawing the pathlines for the tool. **Remember:** the end-mill that you will use has a 1/16" or 1/8" diameter, and the lines you are drawing represent the center of the end-mill (ie. the end mill will remove a circle of material with radius 1/32" or 1/16" in all directions around the line that you define).
    c. Once you have completed the toolpath definition, make sure to check that it is correct.

---

5) **Week of February 10th, 2014: Developing actual electronic tool paths: In this part of the project, you will develop instructions about how the end-mill will be moved over the machinable wax to form a mold of your logo.** You will be using a 1/16" end-mill to remove the wax to make your logo.
    a. Scan your logo as a JPEG image.
    b. You should have the MakeLogo directory on your memory stick. Copy it to the computer and Run the code Logo2g.m in matlab.
    c. When prompted, load the JPEG scan/image and calibrate your logo size.
    d. Follow the directions provided to define the digitized toolpaths for CNC machining.
    e. Once you've defined all of the toolpaths, generate the g-code that will be used for your logo milling.

6) **Week of February 10th, 2014: You will be milling your logo mold next using the desktop CNCs and will be using silicone to form the final stamp in the mold. You will receive instruction as a lab-group to do this. If you are ahead of the other groups, use this time to keep brainstorming your term project.**