CS 3651 Skill Demonstrations

Spring 2009 – Complete before the end of the 8th week of the semester (Feb 27th)

The first half of the semester is spent learning skills that will (hopefully) allow you to successfully complete your final project. Although the love of learning should be your primary motivation, as a checklist for you and as a way to assign grades at the end of the class, the following skill demonstrations are required. The skill demonstrations can be performed in any order, but they must all be completed before the midpoint of the class (at which point you will begin work towards your final project). Each skill demonstration may be completed by demonstrating your skill, either using an existing example (from a previous class or project) or by an example constructed specifically for this class. The class instructor has final say on whether you have completed the skill demonstration successfully. For each skill demonstration the basic requirements are outlined below, along with a "minimally complete" example. You are encouraged to go above and beyond the minimal example, especially on skills that you feel will be directly used for your final project.

You are encouraged to combine multiple skill demonstrations into a single project. For example, by building an actuator you could potentially demonstrate soldering, current buffering and basic circuit skills. However, you should schedule your time such that the failure of one project at the last minute will not leave you with multiple incomplete skill demonstrations.

Basic Circuit

You should construct a basic circuit (using your choice of technique: protoboard, prefboard, wirewrap, freespace-soldering, etc) that has some form of input (switch, photo-diode, photo-resistor, capacitive sensor, etc) that changes its output based on the input or due to a time varying oscillation in the circuit. At a minimum you should use resistors, capacitors, and a transistor in some form (integrated circuits / chips / IC's are allowed). You will also be **required to explain** the operation of your circuit. *Minimal example: A circuit that produces one of two tones from a speaker based upon the position of a switch.*

Soldering Skills

You need to demonstrate the ability to solder two electrical conductors (such as the ends of two wires) together, the ability to solder through-hole components to a circuit board (etched or protoboard), and the ability to unsolder components. You must also demonstrate knowledge of proper care of soldering irons. Dealing with surface mount components will be taught, but you are not required to demonstrate

SMT soldering skills (although it is highly recommended, especially if you already know how to solder.) *Minimal example: Solder two wires together, unsolder a few through-hole components from a circuit board and re-solder them.*

Current Buffer

Using TTL logical levels that source/sink no more than 20mA, you must drive a load that uses at least 200 mA (such as a motor or incandescent light bulb) using a current buffer. (Typically a transistor, although you may use a solid state or mechanical relay.) You may use an actual computer or micro-controller output as your input, or you may “fake” one using a switch attached to a NAND gate, etc. *Minimal example: Turning an incandescent light or motor on and off using TTL logic level input.*

Motion Actuator

You must construct a digitally controlled actuator. Using digital signals (TTL logic level) (as if from a micro-controller or computer) you must control motion in the physical world. You must have the ability to stop and start the motion, as well as control it's speed and direction. Suggested Internet search terms: H-bridge (motor controller), servo motor, stepper motor driver. *Minimal Example: Turning a wheel attached to a DC motor in both directions at different speeds.*

Sensor Input

You must display sensor values on a computer in real time. The sensors may be as simple as binary switches (on/off) or more complicated analog sources (temperature, pressure, light level). You are encouraged to use pre-manufactured I/O adapters (such as the USB bitwacker, or a micro-controller) to take sensor input and convert it to digital signals your computer will understand (such as over a serial connection). The display on the computer can be as simple as a scrolling list of numbers that change when the sensor input changes. *Minimal Example: Connecting a switch to a computer's parallel port to display if the switch is on or off.*

CAD/CAM (3D printer)

You must design an object using your choice of 3D modeling tool (RhinoCAD is installed on the computer next to the 3D printer). After you design the object, export it to .STL format (Stereolithography), import it using the Catalyst tool and print it with the 3D printer. (NOTE: Limit the size of your object to less than 2 cubic inches ($10) of plastic and support material total.) The object along with it's digital design file demonstrate your skill with both 3D modeling software and the 3D printer. Your object must be composed of a minimum of 3 distinct parts, one of which must include a curved surface. *Minimal Example: A simple building with a domed roof and front porch.*

CAD/CAM (Laser Cutter)

You must design a (2D) object of your choice and cut it out (of wood, acrylic, paper or cloth) using the laser cutter. You may design the object using any vector drawing tool (Inkscape is a freely available vector drawing tool). The computer next to the laser cutter has Correl installed. Your part should include both vector cuts (to cut it out) and raster etchings (to etch text, a pattern, or icon onto the part). Your design and part must have distinct (intended) dimensions. [This means that you must be able to predict the size of your part before it is cut.] *Minimal example: A bookmark cut from paper that has an icon or text etched onto it.*

Mechanical Structure

You must build a mechanical structure that has moving parts and is self supporting. (You may build two parts, one to demonstrate self support and one to demonstrate the moving parts as long as they could be conceivably work together, I.e. are at the same general scale and strength.) The moving parts must transfer energy from one direction to another (linear to a different linear, linear to rotational, etc). *Minimal Example: A pulley and rope hoist system that can lift objects.*

Optional skills (pick 2)

Special classes will be held by request to teach the following. Schedule a class with the instructor for any topics you are interested in. If you have a skill that you would like to teach the class, suggest it to your instructor. The list below are suggestions, and you may use a class demonstration of some other instructor approved skill to complete the "optional skills" requirement.

- **Molding/Casting**
  Create a (negative) mold of an object and then a (positive) cast to replicate the object. You may use any technique you would like, such as lost wax / wet sand, rubber molding compound, paper-mache, plaster of paris, plastic resin, etc. *Example: Make a mold and cast of your face.*

- **Vacuum Forming**
  Create a mold for the vacuum form machine (out of wood, paper-mache, or on the 3D printer) and then create a vacuum form plastic object from your mold. Example: A plastic mask of your face.

- **Sewing**
  Create a sewn object. This could be a carrying case for a wearable device, a stuffed animal shell for your robot, or a flexible circuit built into an existing piece of clothing. *Example: Wire headphone wires from a plug in an inside pocket of your jacket to a jack on the outside, and include plush push buttons on the sleeve to control the play/pause control.*

- **Circuit Board Etching**
  Etch a custom circuit board onto a copper clad PCB using some form of resist and an acid etching solution.