

EE31 Junior Design
Spring 2019
Project Design Phase 01A
Pre-Studio

Assignment Date and Due Date: check Assignment/Due Date Listing

Pre-studio assignments are to be recorded in your Bound Lab Notebook and reviewed by the instructor at the start of class before starting your design work.

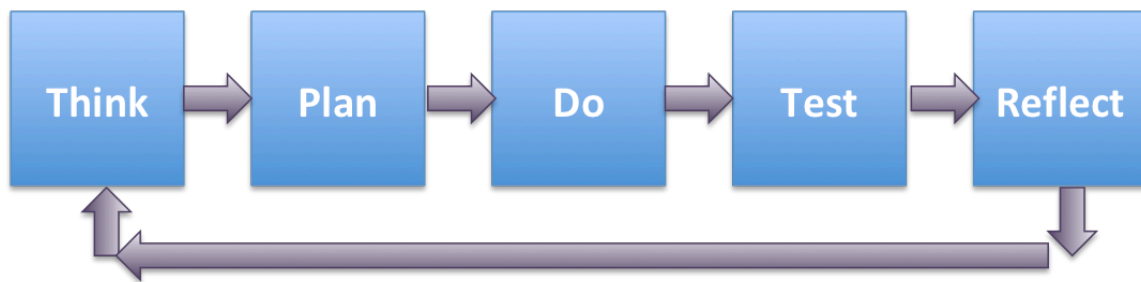
If you are not sure what to do on this assignment, ask your instructor or TAs.

The Goal:

Specification 1:

The goal is to design and demo a state machine. Check the Design Spec for Phase 1A.

The design process may be visualized as a series of iterative steps from start to finish. In reality, the design process is a variable pathway the travels from the start to the finish in anything but a series. For our purposes, we will consider our model of the design process to be: think, plan, do, test, reflect (and iterate back to think). This is shown visually as:



Let's go through the steps of the design process.

Think:

1. What problem are your team trying to solve?
2. Who is the customer? Describe the customer's objectives, cost structure, and critical due dates. What is the customer's level of desire, urgency, severity, and pain?
3. What will make your customer take out their wallet to buy your autonomous vehicle?

4. The mantra for this course is: “If it doesn’t work, it doesn’t matter.” Describe how this will affect your design method?
5. Identify the top five customer requirements. Write the requirements in the appropriate format. Customer requirements are defined by a subject, a verb, and a desired objective: e.g., the user desires to travel at a nominal speed of 1.5 inches/sec; the user must open the box and set up the unit in under five steps; the user must transmit 5 commands within 6.25 seconds via a infrared red signal.
6. Translate the top five customer requirements to the top five functionality and features. Functionality is defined to be the purpose that something is designed or expected to fulfill. For example, the functionality of a subsystem is to add two integers together. The input is two integers and the output is the sum. A feature is a distinctive attribute or aspect of something. For the adder subsystem the feature is the customer get a sum of the input two integers.

Plan:

1. What does success look like? The best thing to do when initiating a design process is to start at the end. Starting at the end of the process identifies what your team needs to do to deliver a solution to the customer. Another way to define success is to define the outcome. What is the outcome of your design process? Another name for the outcome is the artifact. An artifact is something that is human-made. What artifact or artifacts does your team need to produce?
2. What is the penultimate step? The penultimate step the last but one step in a series of things. What is the very last task your team will have to do before you are done with your artifact?
3. Now keep working backwards to the start of your team’s design process identifying all the tasks that must be completed to get from where your team is right now in the process to the final outcome. As you identify the tasks, identify who will be responsible for completing the tasks.

Do:

1. Ah, doing. This must be done in the studio. Or does it? Where will your team be doing the Do step?
2. How much time will it take to complete?

Test:

1. What do you need to test?
2. Is test debugging? Actually, test is different than debugging. Debugging is identifying errors and removing them. Testing is a deliberate activity where an artifact is measured to check the quality, performance, or reliability of it form, fit and function, prior to demonstrating it publically. In a product development specific context, thorough testing is completed before releasing a product or service widespread use or practice in the commercial market place. A test plan is document describing the objectives, resources, equipment, and processes required

- to verify and validate that the artifact meets the customer requirements? What is your test plan?
3. What equipment will be used to test? What is the purpose and function of the equipment?
 4. When testing is successfully completed (everything works as your team intended), your team is ready to demo your artifact. Your team needs to perform a demo of the functionality for this phase. What functionality will your team demo?

Reflect:

1. A significant part of the design process is about reflection. Reflection is the process by which you and your team think deeply or carefully about each step in the process and in how the team collaborates through the process. Reflection is based on situational awareness. Situational awareness is sensitivity to the environmental elements and events with respect to time, space, and human interactions, their understanding, and evaluation on the impact of future events. Situational awareness is acknowledged as a critical foundation for successful decision-making applicable across a range of situations and disciplines. It is essential for high-risk situations where risk and hazards exist and failure occurs often. Design is a high-risk activity. Your team may have a narrow time slot to get it right. As such, reflection on failure—HONEST ASSESSMENT, DOCUMENTATION, LEARNING, and MAKING A NEW PLAN—is a skill that brings competitive advantage. How will you take reflection on failure serious in the course?
2. As you progress this phase and the subsequent phase, record your observations in your studio (lab) notebook. As you set down in writing your reflections, keep in mind that the reflections need to be about all aspects of your project. Make sure your record the project, process, and team failures.

Team:

1. What type of difficult personality are you? What difficult personality types are your teammates? What is your strategy to get to a performing team?
2. How is your team planning to implement being respectful to each other?
3. How will you keep a record of infractions?
4. How will you report bad behavior?
5. Junior Design is an engineering team class where success is not measured by your grade. There are no grades in Industry. Success in Industry is measured by whether or not your team delivered the product and your team's customers accept it. Acceptance is measured by how many customers buy the product, how many products are bought, how much they love it, and the price customers pay for your product. This is called the value proposition. What is the value proposition for this project?

MOST CRITICAL RULE: Be safe at all times. Think about safety before you do anything. Safety is the number one issue.

“If you are caught soldering without wearing acceptable safety glasses/goggles, you will immediately fail this course.” What does this phrase mean?

The Arduino IDE and the State Machine

Specification 2:

1. What is a state?
2. What is a state machine?
3. What is an interrupt?
4. What problem are you trying to solve?
5. What is the functionality being asked to demonstrate?
6. What are the major tasks required to solve the problem?
7. What knowledge do you need to know to solve it?
8. Make a sketch of the block diagram showing the Arduino flashing an LED.
9. How do you show the interrupts on the state diagram?
10. Draw the schematic of a circuit to flash one LED on and off using the Arduino.
11. Draw the schematic of a circuit to fade one LED using the Arduino.
12. Provide pseudo-code that the Arduino could use to flash an LED on and off.
13. Provide pseudo-code that the Arduino could use to fade an LED for a given time constant.
14. How does your schematic and pseudo-code map to your block diagram? Was anything left out?
15. Make a sketch of the block diagram of the state machine showing all the states.
16. Draw a schematic of the state machine showing all the states.
17. Using the Arduino Integrated Development Environment, does this program run? What does it do?

```
#include <SoftwareSerial.h>

SoftwareSerial theSerialPort(10, 11); // RX, TX

void setup()
{
    // Use serial communications
    Serial.begin(9600);
    while (!Serial) {
        ; // port may need time to connect
    }

    Serial.println("Ready to go...");

    // set the data rate
    theSerialPort.begin(2400);
    theSerialPort.println("Hello, world?");
}

void loop() // continue until stopped
{
    if (theSerialPort.available())
```

```
Serial.write(mySerial.read());  
if (Serial.available())  
  theSerialPort.write(Serial.read());  
}
```

18. How much longer in length (with tolerance) is the anode lead when compare to the cathode lead in inches on the LED Uni-Color Red 640nm 2-Pin T-1 diode, Jameco P/N 202471? What is the cost of the part?
19. On page 1 of the data sheet, what does the word Tatings refer to? What is the important learning here?
20. What is the forward voltage rating for the Uni MVL-301DR (Jameco P/N 20247) and under what conditions is it valid?
21. What is the forward current for the Uni MVL-301DR (Jameco P/N 20247)for a forward voltage of 1.7 V?
22. What is the range of wavelengths for the Uni MVL-301DR (Jameco P/N 20247) having a relative luminous intensity greater then 0.5? What are the units for luminous intensity?
23. What do expect will not work when you build this circuit and software in the studio? Or do you think you are all set?
24. Write a test plan to validate the feature/functionality. What are the conditions for a PASS, a FAIL?

Task Questions:

1. What part of the team design tasks are you planning to take responsibility for?
2. What part of the team building and testing tasks are you planning to take responsibility for?
3. What will you need to learn to complete the team tasks for which you have taken responsibility?