Final Exam

**ELTN 117 ELTN 117 – Introduction to Microcontrollers and Digital Logic: Take Home Final**

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ELTN 117

**ELTN 117 – Introduction to Microcontrollers and Digital Logic: Take Home Final**

**Due Wednesday, 5/6/15 5:00 pm**

**100 points maximum**

**For this exam** please submit a typed copy of your answers. No cover sheet is required; however please include the Course number and title, your name, student ID, date, and FINAL EXAM at the top. Please do your own work. Check your answers before turning in your paper.

PART 1: SHORT ANSWER (+30 pts.)

1. What are the main differences between the setup and loop parts of an Arduino program?

**The setup portion of the program is run only once while the loop portion cycles indefinitely unless otherwise prevented by an interrupt or nested function such as a while loop.**

1. What are the differences between local and global variables?

**A local variable is exclusive to a particular function and cannot be accessed or modified unless passed up or down. Global variable can be accessed/modified anywhere in the function and it also retains its value after a loop ends.**

1. What three parts are required to implement an interrupt? What pins can be used? Write a short example.

**The three prerequisites of interrupt implementation are an Interrupt Service Routine name, pin declaration, and trigger. Digital pins 2&3 on an Arduino Uno can be used as interrupts 0 &1 respectively.**

**Ex: attachInterrupt(0,lightSensor,FALLING);**

1. What is the difference between the Serial.print and the Serial.println commands?

**Serial.print, will print its contents on the Serial Monitor and does not skip to the next line down.**

**Serial.println will print its contents on the Monitor and then skips down the next line.**

1. What is an internal pullup? Show by writing a few lines of code how it is implemented.

**An internal pullup is a resistor that is built into the development board and connects to power internally. They are most commonly used with switches. While powered the pullup pin is considered ON, until a button is pressed diverting voltage elsewhere, and setting the pullup pin to OFF. It’s an example of negative logic.**

**Ex:**

**Int pinLED = 2;**

**boolean booleanVar = false;**

**Void setup()**

**{**

**pinMode(13,INPUT\_PULLUP);**

**digitalWrite(13, HIGH);**

**}**

**void loop()**

**{**

**if (digitalRead(13) == LOW)**

**{**

**delay(50);**

**booleanVar= !booleanVar;**

**digitalWrite(2, booleanVar);**

**}**

**}**

1. What are the minimum and maximum values for analog inputs and analog outputs?

**Minimum & Maximum values for analog inputs & outputs are 0 to 1015 which correspond to 0-5 volts.**

1. Why should resistors be connected between output pins and LED’s?

**To prevent voltage overloads as the voltage drop for an LED is typically less than 2 volts.**

1. What code is required to read an analog voltage? What code is required to output an analog voltage?

**The required functions are as follows, readAnalog (read value) & analogWrite (output) respectively.**

1. Which pins are used for analog inputs / outputs?

**Pins A0-A5 of the Arduino Uno are used as analog inputs and outputs.**

1. Why would you use a “while loop” instead of an “if loop” (explain differences / advantages)?

PART 2: CODE ANALYSIS (+20 pts.)

1. For the following program segment, what are the final values of count1, count2, x, and y after loop 1 has completed? Explain your answers for full credit.

int x = 0;

int y = 100;

for (int count1 = 0; count1 < 10; count1++) // loop 1

{

x++;

for (int count2 = 0; count2 < 5; count2++) // loop 2

{

y--;

}

} // End of loop 1

**Count1 is a variable nested within a “for” function that increments its value 11 times in which case the conditions of the “for” loop are satisfied. Count 1 will have a value of 11.**

**Count2 is also a variable nested within the “for” function, and it is incremented 6 times up to the value of 6. Then the “for” loop conditions are satisfied.**

**X is incremented within a “for” function up to the value of 10, by which then the “for” loops conditions will have been satisfied.**

**Y begins with a value of 100 and is decremented within a “for” function down to the value of 95.**

1. The following program is designed to alternately flash a green LED and a red LED every second.
   1. What are the errors in the program? Identify as many as possible.
      1. **Throughout the code, GreenLED should be written as greenLED in order to match the variable definition**
      2. **Setup should be written as void Setup()**
      3. **Missing Bracket after pinMode in Setup**
      4. **pinMode in Setup should be OUTPUT not INPUT**
      5. **missing void loop() & brackets**
      6. **while loop is unnecessary for function**
      7. **Bracket after while loop should be removed**
      8. **digitalWrite should contain HIGH not high**
      9. **DigitalWrite should be written as digitalWrite**
      10. **digitalWrite should contain LOW not low**
      11. **Delay should be written as delay.**
      12. **The program needs additional lines of code to alternate the flashing of the red & green LED**
   2. Re-write the program so it works properly.

\\ Flashing program – alternately flashes red and green LED’s

int greenLED = 5;

int redLED = 6;

count = 0;

setup

{

pinMode(GreenLED, INPUT)

}

while (count <10);

{

digitalWrite (redLED, high);

delay(1000);

DigitalWrite (GreenLED, low);

Delay(1000);

}

**// New code, highlighted changes when possible**

**int greenLED = 5;**

**int redLED = 6;**

**void setup()**

**{**

**pinMode(greenLED, OUTPUT);**

**pinMode(redLED, OUTPUT);**

**}**

**void loop()**

**{**

**digitalWrite (redLED, HIGH);**

**digitalWrite(greenLED, LOW);**

**delay(1000);**

**digitalWrite(redLED, LOW);**

**digitalWrite (greenLED, HIGH);**

**delay(1000);**

**}**

1. Programming issues. (+20 pts.)

You are working on a program, and try to download it, but the program doesn’t work as expected. List at least 10 possible problems (preferably ones you have personally experienced!) that might be the cause. *Note: If 10 problems seem like a lot, think about how many times it takes to get your programs to work!!*

**-Semicolon missing on a line of code**

**-Brackets missing**

**-Incorrect variable type**

**-Overburdened Interrupt function**

**-Incorrect Resistors used**

**-Incorrect Wiring**

**-Trying to call a local variable outside its host function**

**-Placing a semicolon after a while, if, or for loop call**

**-Damaged IC**

**-Damaged Pins**

1. Programming (+30 pts.)

Write a short program that prompts the user ONLY ONCE for an input value called flashNum. When the input value is entered through the keyboard, an LED will flash flashNum times – however, each time it flashes it will add another 100 milliseconds between each flash. When the cycle has completed, play a tone on a speaker connected to an output pin for 3 seconds and display the text “ALL DONE” once. Use functions and loops to implement the program. Use extensive comments to explain what the program is doing. For the grade on this part of the program, you need to print a hard copy and either A) demonstrate the program during the finals time, or B) e-mail me a working program that I can run on an Arduino (use pin 13 for the LED).

If you cannot get the program to run, explain how far you got, and send me what you have completed.

// Global variables defined below

nt flashNum = 0; // user defined variable for number of LED flashes

int delayLED = 100; // Delay for LED flashes, starts at 100 m/s and then increments in loop by 100

int pinLED = 13; // pin 13 is the built in LED on the Arduino

int speakerPin = 3; // configures a digital pin for use with a small speaker

void setup()

{

Serial.begin(9600); // inititates Serial Monitor at 9600 BAUD

pinMode(pinLED, OUTPUT); // configures the built in LED on pin 13 as an output

pinMode(speakerPin,OUTPUT); //Configures pin 3 as an output for the small speaker

}

void loop()

{

flashNum = userInterface(); // Prompts user for number of flashes

lightShow(flashNum); // passes value of flashNum, and flashes LEDS accordingly

crescendo(); // Beeps noise, resets flashNum, and ends loop with ALL DONE

}

//Functions defined below

int userInterface()

{

Serial.println("Hello, how many times would you like the LEDs to flash?");

Serial.print("Number of flashes: ");

int userInput =0; // defines user variable as an integer value

while(userInput <=0) // Waits for user to submit a value greater than 0

{

if (Serial.available() > 0)

{

userInput = Serial.parseInt(); // converts user input into an integer

Serial.println(userInput);

}

}

return userInput;// passes value back to main loop, where is it used in lightshow()

}

int lightShow(int userInput) //declares the user defined value as an integer to be used in this function

{

for(int count = 0; count< userInput; count++) // Flashes the LEDs a number of times equal to the user defined value of flashNum, which is now userInput

{

digitalWrite(pinLED, HIGH); // LED is on

delay(delayLED);

digitalWrite(pinLED,LOW); //LED is off

delay(delayLED);

delayLED = delayLED + 100; // increments delay by 100 m/s for next loop

}

}

int crescendo() // Emits beep for 3 seconds, then makes final prompt and resets flashNum

{

digitalWrite(speakerPin, HIGH);

tone(speakerPin,261,3000); // Beeps speaker for 3 seconds, speaker is still ON

digitalWrite(speakerPin, 261);// turns speaker OFF

flashNum = 0; // resets value so loop can run again

Serial.println("ALL DONE"); // C'est Finis

}