Microcontroller Assignment #1

Introduction:

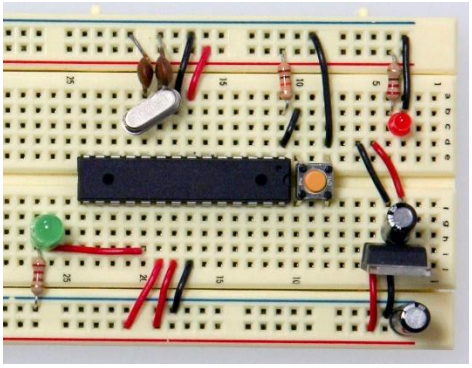
In this assignment you will construct a barebones microcontroller circuit. The microcontroller you will use is the ATmega328p, which is the same microcontroller used in some of the Arduino platforms and also commonly used in a wide variety of commercial applications.

ATmega328p microcontroller

Building the microcontroller circuit on a breadboard

- First, briefly browse through the datasheet for the microcontroller and familiarize yourself with its specifications and capabilities: http://ww1.microchip.com/downloads/en/DeviceDoc/ATmega328_P%20AVR%20MCU%20with%20picoPower%20Technology%20Data%20Sheet%2040001984A.pdf

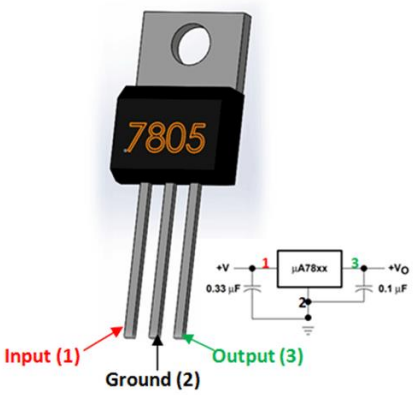
- One of the most well-known use cases for the ATmega328p is serving as the primary processor in the Arduino Uno. On Arduino's website, they provide a guide that shows how to construct an Arduino-compatible ATmega328 circuit on a breadboard. Your first step should be to construct this circuit
  https://www.arduino.cc/en/Main/Standalone



ATmega328p microcontroller

- This circuit is powered via a 7805 voltage regulator. The role of the regulator is to ensure that the output voltage it supplies is constant regardless of variation on the input. The datasheet for this regulator can be found at the following web address, please browse through it:

  https://www.sparkfun.com/datasheets/Components/LM7805.pdf



7805 Voltage Regulator

https://components101.com/7805-voltage-regulator-ic-pinout-datasheet

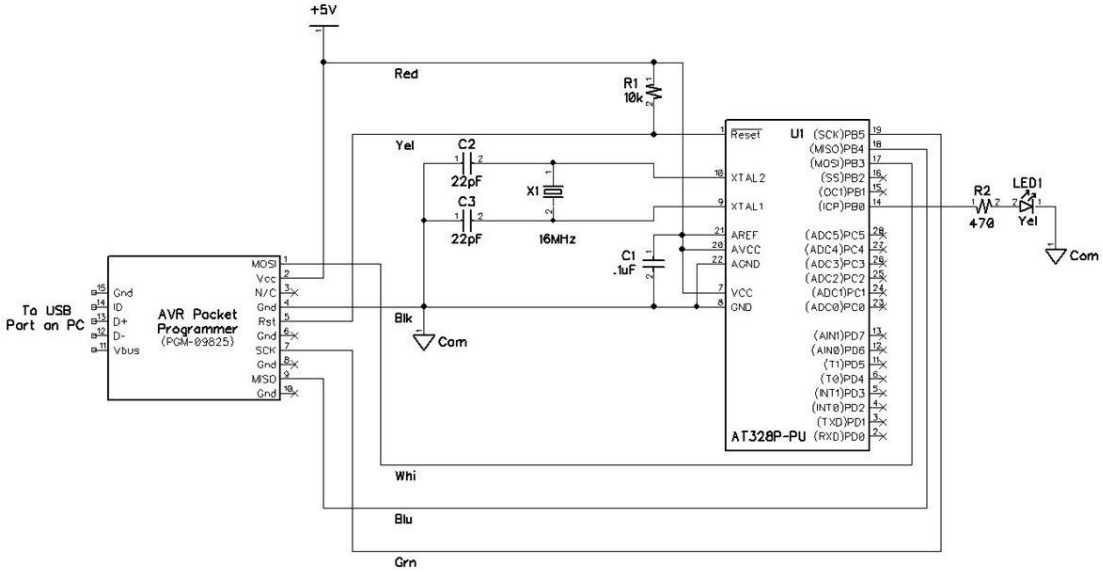
The 7805 produces a constant output voltage of 5V. However, as noted on page 3 of the datasheet, the minimum input voltage needed to produce a constant 5V output voltage is 7V. The maximum input voltage this regulator can withstand is 25V. Any input voltage within that range (7V < V < 25V) will produce a steady 5V output. You can produce suitable input voltages by using a bench supply, a 9V battery or a 12V wall supply. Be careful, when connecting these voltages to your breadboard, make sure that the microcontroller is powered via the regulator output and not directly from one of these high voltage inputs, else you will damage the chip.

Options for providing the Voltage Regulator input

- Since we are using a barebones microcontroller rather than a development platform, we need a means to load software on to the device. In order to do this, we will use an AVR programmer. This web address explains the pocket programmer that we will use for this exercise. Please follow the instructions on this website carefully: https://learn.sparkfun.com/tutorials/pocket-avr-programmer-hookup-guide?_ga=2.181586916.2103969426.1540442848-377410335.1540193575

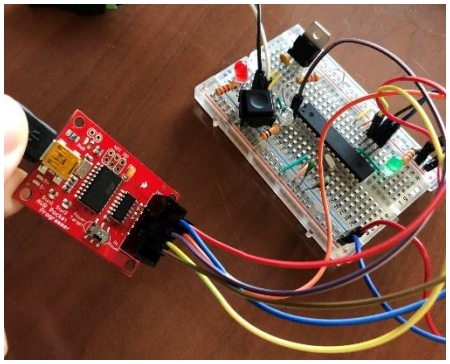
  Please note that the driver installation step is critically important, and your device will not be recognized if those steps are not followed.

- You will need to use female jumper wires to connect your programmer to your microcontroller. Below is a schematic showing the connectivity between the programmer and a ATmega328p microcontroller circuit that is similar, but not identical, to the one you constructed



AT328P Programming Circuit with Crystal Oscillator & AVR Pocket Programmer

https://www.allaboutcircuits.com/projects/atmega328p-fuse-bits-and-an-external-crystal-oscillator/



Microcontroller circuit connected to the AVR pocket programmer

- To simplify development for our microcontroller, we will make use of the Arduino software development environment. The following link is a tutorial that shows how to periodically alternate the voltage on a output pin between high and low voltages.
  https://www.arduino.cc/reference/en/language/functions/digital-io/digitalwrite/

  Here is a listing of the other functions that are available for you to use:
  https://www.arduino.cc/reference/en/

  The link below shows the mapping between ATmega328p pin numbers and their Arduino mnemonics.
  https://www.arduino.cc/en/Hacking/PinMapping168

Submission

- For this assignment, you must write a program for the ATmega328p that causes the microcontroller to periodically blink a LED whenever a button is depressed. When the button is not pressed, the LED should remain off (not illuminated).
- Modify the circuit, adding a new LED and new button that will be used solely to control and display the blinking LED output.
- Submission of this assignment will take place via an in-person demonstration during class on Tuesday 10/30