Embedded Software

CS 145/145L

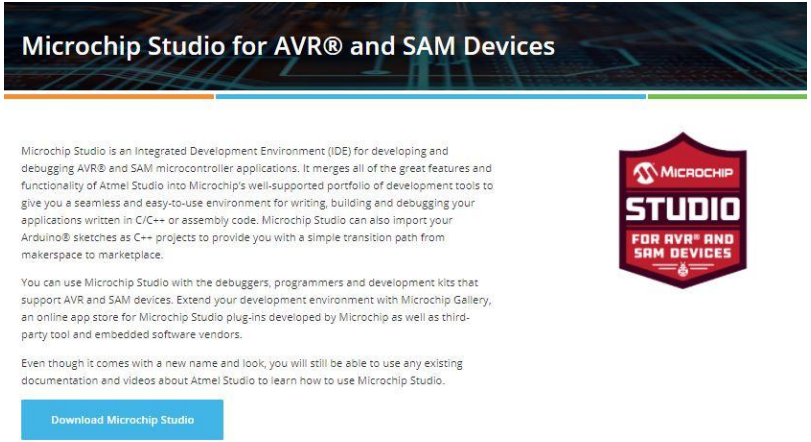
Caio Batista de Melo

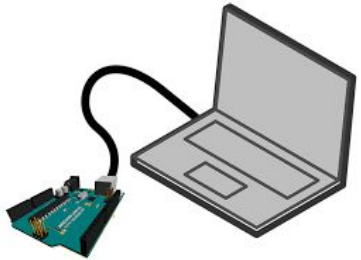
Project 1

- Design an embedded computer centred around the ATMega32 microcontroller. For input, use a push button. For output, use an LED.
  - Write a C program that blinks the LED on/off for as long as the push button is pressed. Initially, use **instruction timing** to control the LED on/off rate (for this step, use the **internal 1MHz clock**).
  - Then, revise your timing based on one of the ATMega32 internal timers (for this step, use the **external 8MHz crystal**). The blinking rate should be 500ms on and 500ms off.
- Template resources on Canvas
  - https://canvas.eee.uci.edu/courses/45047/assignments/929268

How to Start?

- First of all we need cross compilers cause there is one computer which you program and the other is the Device – Under – Development.





Connected using USBs

Integrated Development Environment (IDE) Using Microchip Studio

- Create Project
- Add source code
- Compile using provided compilers
- Menu for types of programmers

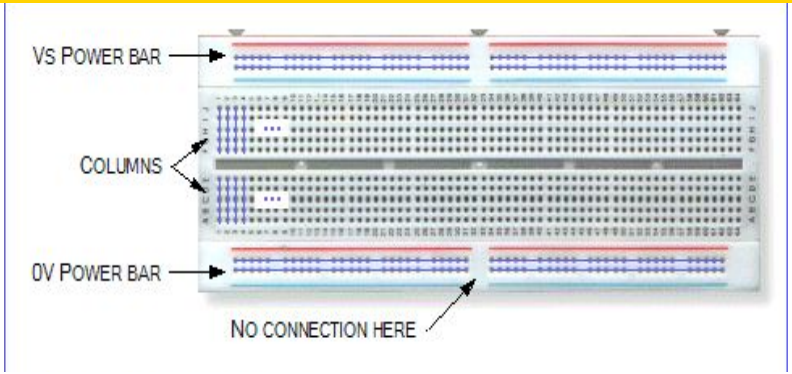
Homework assignment

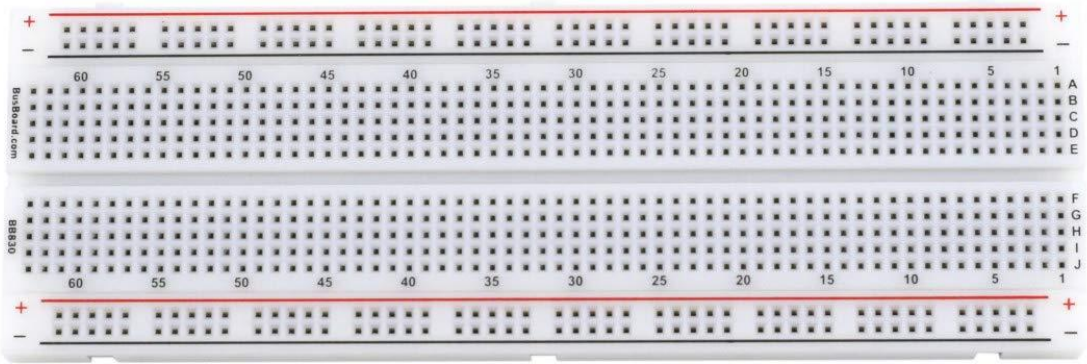
- Download Microchip Studio (Only on Windows or respective virtual machines in case of Mac) and USB Drivers

Parts

Item	Vendor	Part #	Quantity
Breadboard	www.digikey.com	438-1046-ND	1
Programmar	www.digikey.com	ATATMEL-ICE-BASIC-ND	1
Microcontroller	www.digikey.com	ATMEGA32-16PU-ND	2
9V Battery Connector	www.digikey.com	BS6I-ND	1
9V Battery	www.digikey.com	P687-ND	2
Display	www.digikey.com	67-1768-ND	1
LED	www.digikey.com	67-1068-ND	10
8MHz Crystal	www.digikey.com	CTX406-ND	2
5V Voltage Regulator	www.digikey.com	MC7805CT-BPMS-ND	2
0.1uF Capacitor	www.digikey.com	399-3526-ND	10
Push Button	www.digikey.com	P12230SCT-ND	1
Speaker	www.digikey.com	102-3851-ND	1
100 Resistor	www.digikey.com	CF14JT100RCT-ND	10
1K Resistor	www.digikey.com	CF14JT1K00CT-ND	10
10K Resistor	www.digikey.com	CF14JT10K0CT-ND	10
Keypad	www.digikey.com	GH5004-ND	1
Display Connector	www.digikey.com	A835AR-ND	1

Breadboard





https://www.youtube.com/watch?v=mE33WpRWrXas

Building the Project

Power Supply

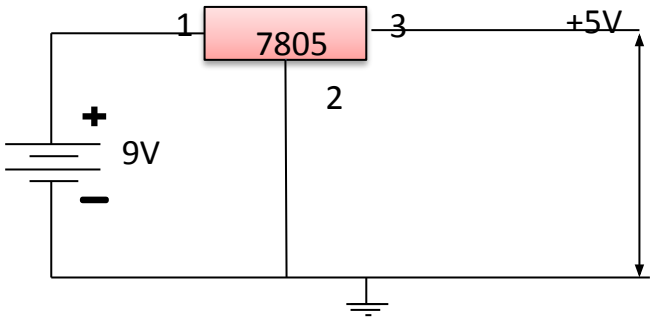
LET'S START WITH THE SCHEMATIC (BLUEPRINT)

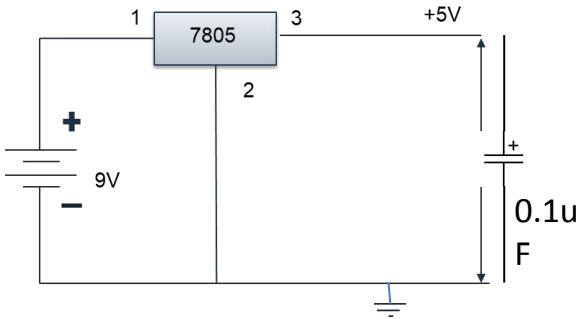
- Requirements
  - 9V Battery (input)
  - 5V Power Supply (generate)
  - Reliable

How do we draw a 5V supply from a 9V Battery?

- We need a regulator

Voltage Regulator

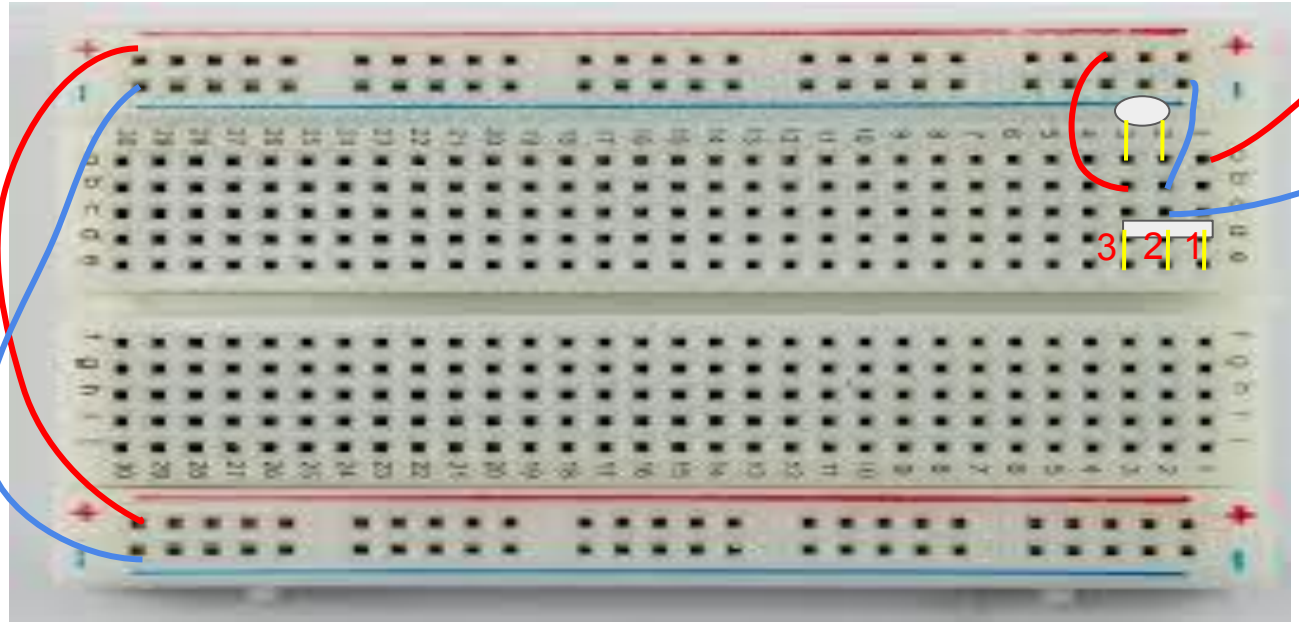




9V -> 5V using LM7805

Connection according to Datasheet and way to identify connections of polarized capacitors(need for extra surge of power)

Layout on Breadboard



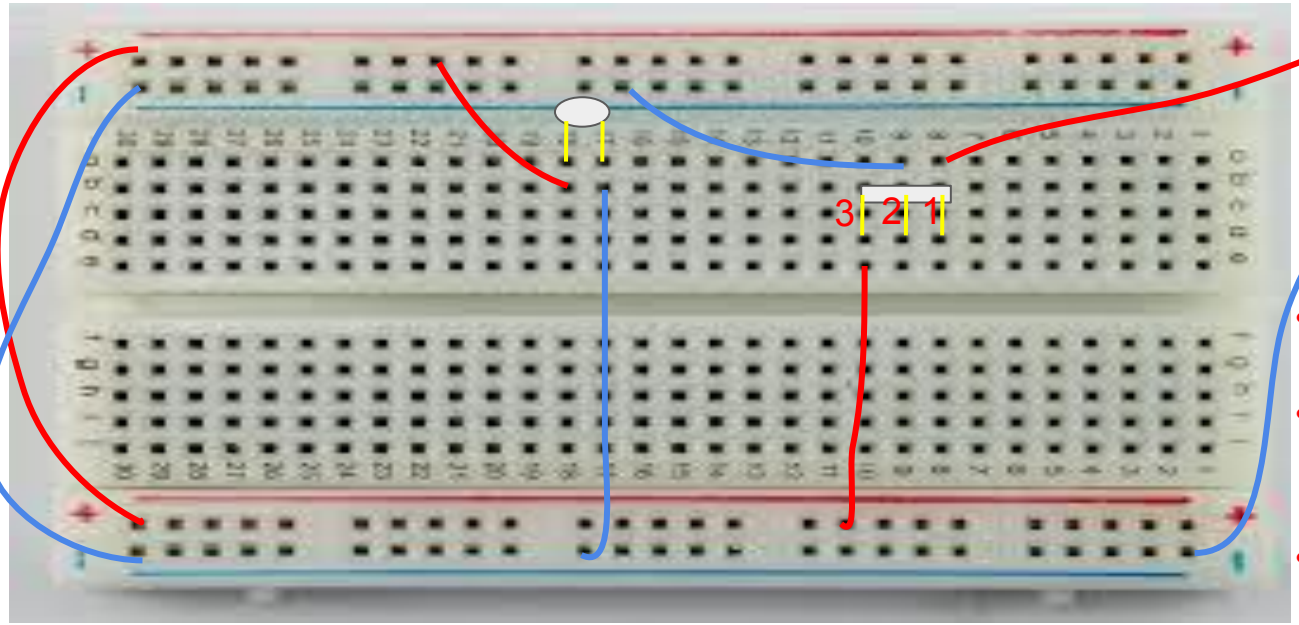
Capacitor

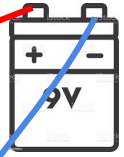
Regulator

- Conserve area
- Connect components to minimize use of jumpers to add unnecessary complexity
- **Connect the battery AFTER CONNECTING ALL THE DEVICES**
- Check if any unwanted heating in components

Layout on Breadboard

Wrong!





Capacitor

Regulator

- Connect components all around the breadboard
- Connecting components in a way that they are shorted on both terminals
- Connecting the battery while you are building the circuit

9V Battery Connector

Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

BS6I

Digi-Key Part Number	BS6I-ND
Manufacturer	MPD (Memory Protection Devices)
Manufacturer Product Number	BS6I
Supplier	MPD (Memory Protection Devices)
Description	BATT CONN SNAP 9V 1 CEL 6" LEADS
Manufacturer Standard Lead Time	12 Weeks
Detailed Description	Battery Connector, Snap 9V 1 Cell Wire Leads - 6" (152.4mm)
Customer Reference	Customer Reference
Datasheet	Datasheet

5V Regulator

Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

MC7805CT-BP

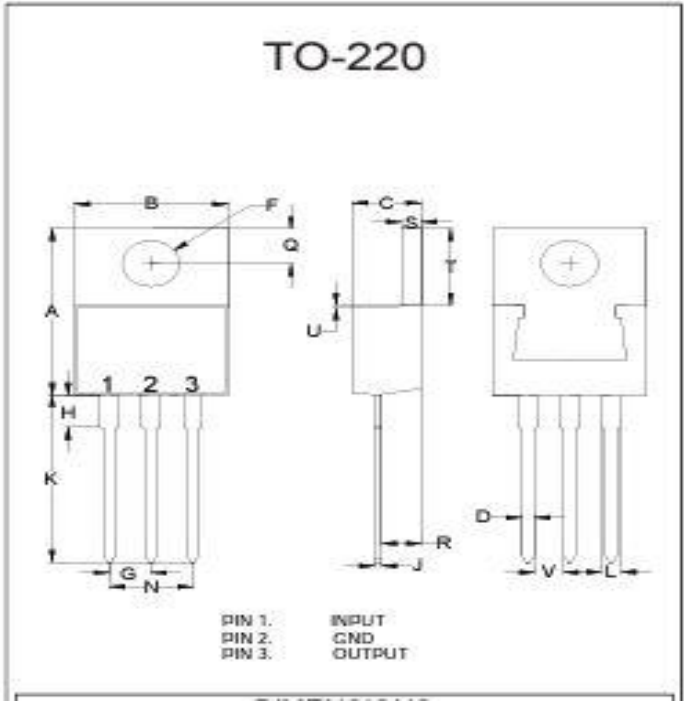
Digi-Key Part Number	MC7805CT-BPMS-ND
Manufacturer	Micro Commercial Co
Manufacturer Product Number	MC7805CT-BP
Supplier	Micro Commercial Co
Description	IC REG LINEAR 5V 1.5A TO220
Manufacturer Standard Lead Time	28 Weeks
Detailed Description	Linear Voltage Regulator IC Positive Fixed 1 Output 1.5A TO-220AB
Customer Reference	Customer Reference
Datasheet	Datasheet

MC7805CT-BP Datasheet

Maximum Ratings

Parameter	Symbol	Value	Unit
Input Voltage	V_I	35	V
Output Current	I_o	1.5	A
Power Dissipation	P_D	15	W
Operating Junction Temperature	T_{OPR}	-20~125	℃
Storage Temperature Range	T_{STG}	-55~125	℃

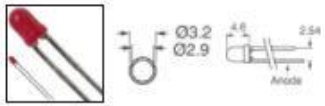
Notes:1.High Temperature Solder Exemption Applied, see EU Directive Annex 7a.



Pin 1 is to the left when you are directly facing the marking on the body of the Regulator

LED

Image shown is a representation only. Exact specifications should be obtained from the product data sheet.



SSL-LX3044ID-5V

Digi-Key Part Number	67-1068-ND
Manufacturer	Lumex Opto/Components Inc.
Manufacturer Product Number	SSL-LX3044ID-5V
Supplier	Lumex Opto/Components Inc.
Description	LED RED DIFFUSED T-1 T/H
Manufacturer Standard Lead Time	10 Weeks
Detailed Description	Red - LED Indication - Discrete 5V Radial
Customer Reference	Customer Reference
Datasheet	Datasheet

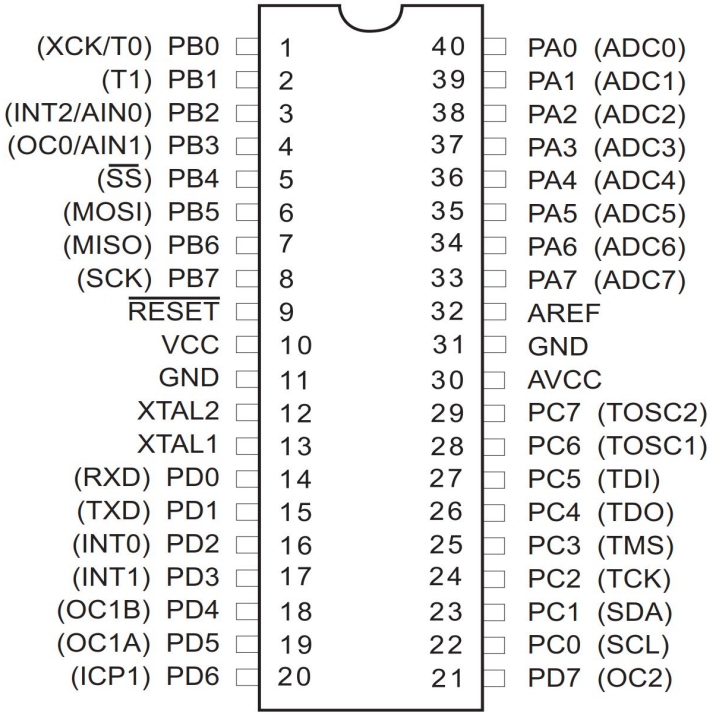
Capacitor

Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

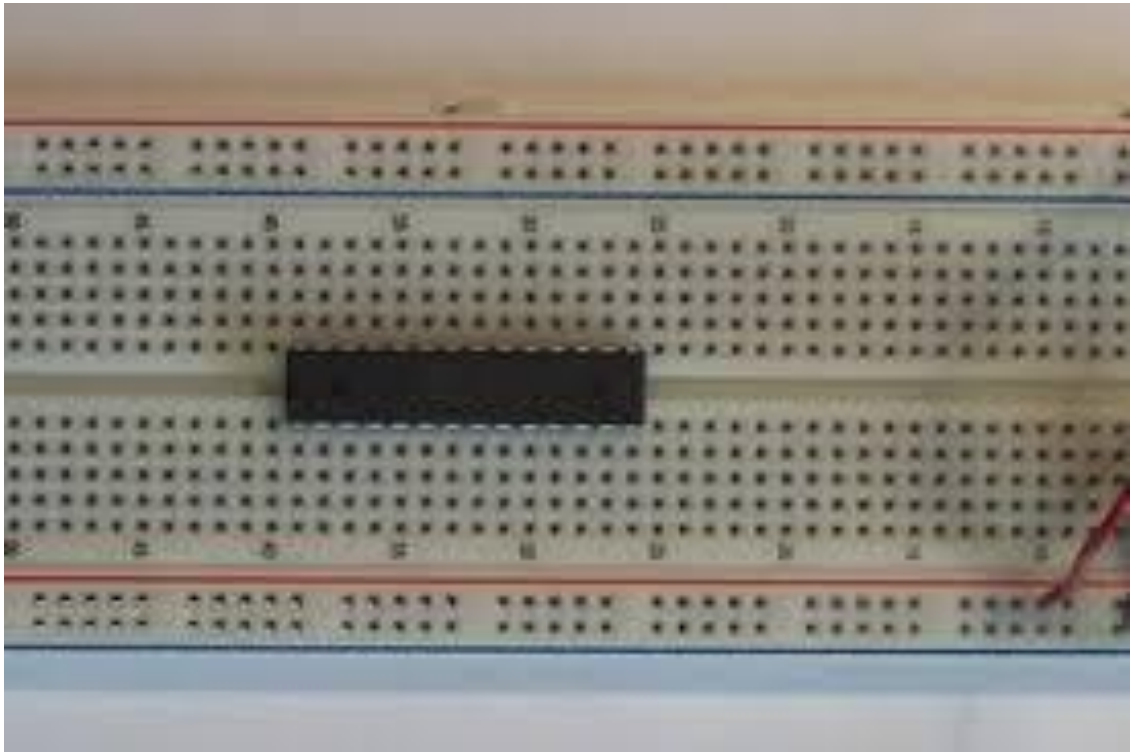
T350A104K035AT

Digi-Key Part Number	399-3526-ND
Manufacturer	KEMET
Manufacturer Product Number	T350A104K035AT
Supplier	KEMET
Description	CAP TANT 0.1UF 10% 35V RADIAL
Manufacturer Standard Lead Time	33 Weeks
Detailed Description	0.1 µF Conformal Coated Tantalum Capacitors 35 V Radial 26Ohm
Customer Reference	Customer Reference
Datasheet	Datasheet

Microcontroller Datasheet Example



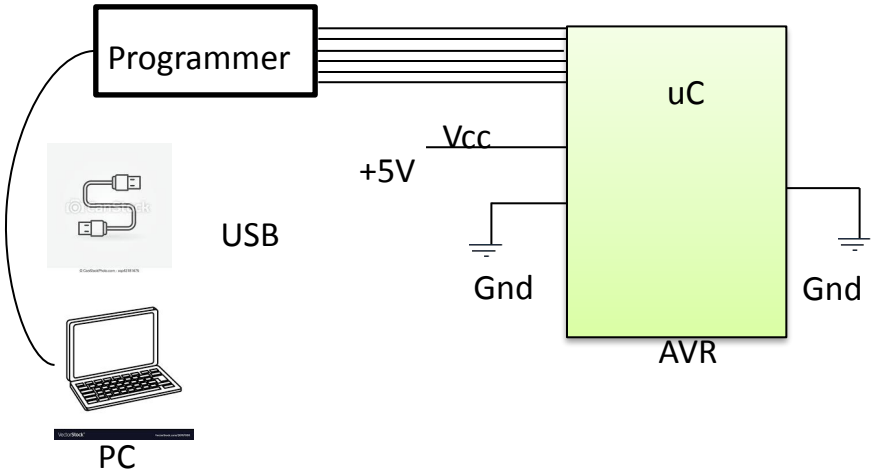
ATmega32 on Breadboard



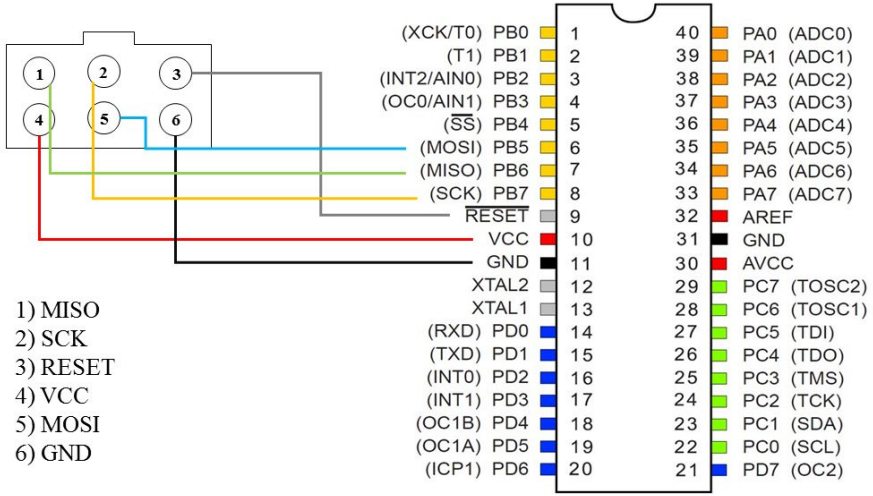
Programmer

Use the port labeled AVR

Connecting to ATmega32 Microcontroller



In-System Programming Interface (ISP)



1) MISO
2) SCK
3) RESET
4) VCC
5) MOSI
6) GND

https://caiobatista.com/uploads/courses/uci/s22/cs145/connector.png

See you next time :)

Q & A