Arduino Mega
What is an Arduino Mega?

• The Arduino Mega is a microcontroller development board designed for hobbyists and novices

• It has a custom coding interface (IDE) for creating, uploading, and troubleshooting code

• Multiple online tutorials are available for complex code and advanced development
What is a microcontroller?

• A microcontroller (MCU) is an integrated circuit that acts as a tiny computer

• It contains a processor that can send and receive input, memory to store information, and programmable input and output (I/O) pins for working with external devices such as sensors and switches
What is a development board?

• Commercially available printed circuit board (PCB) designed to make it easier to interface with a microcontroller
• Provides minimum hardware for connecting external devices such as a USB adaptor and integrated circuits for voltage regulation
• Provides basic logic for programming and interacting with the device
• Useful for small project design and development
Arduino Development Boards

Figure 3: Arduino Mega microcontroller

Figure 4: Arduino Nano microcontroller

Figure 5: Arduino Teensy microcontroller

Figure 6: Arduino Uno microcontroller
Other Development Boards

Figure 7: BeagleBone microcontroller

Figure 8: Raspberry Pi microcontroller

Figure 9: Basic Stamp microcontroller
# Arduino Mega Specifications

<table>
<thead>
<tr>
<th>Microcontroller</th>
<th>ATmega2560</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>7-12V</td>
</tr>
<tr>
<td>(recommended)</td>
<td></td>
</tr>
<tr>
<td>Input Voltage (limit)</td>
<td>6-20V</td>
</tr>
<tr>
<td>Digital I/O Pins</td>
<td>54 (of which 15 provide PWM output)</td>
</tr>
<tr>
<td>Analog Input Pins</td>
<td>16-channel 10-bit</td>
</tr>
<tr>
<td>DC Current per I/O Pin</td>
<td>20 mA</td>
</tr>
<tr>
<td>DC Current for 3.3V Pin</td>
<td>50 mA</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>256 KB of which 8 KB used by bootloader</td>
</tr>
<tr>
<td>SRAM</td>
<td>8 KB</td>
</tr>
<tr>
<td>EEPROM</td>
<td>4 KB</td>
</tr>
<tr>
<td>Clock Speed</td>
<td>16 MHz</td>
</tr>
<tr>
<td>LED_BUILTIN</td>
<td>13</td>
</tr>
<tr>
<td>Length</td>
<td>101.52 mm</td>
</tr>
<tr>
<td>Width</td>
<td>53.3 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>37 g</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to 85°C</td>
</tr>
</tbody>
</table>

Figure 10: Arduino Mega specifications

Figure 11: Arduino Mega microcontroller
Powering the Arduino

• The Mega can be powered via USB, battery or AC-to-DC wall adapter

• Recommended supply of 7-12 VDC

• Pin specific:
  – VIN: Provides power via an external supply
  – 5V: Provides a steady 5V supply through the voltage regulator
  – 3V3: Supplies 3.3 V with a maximum current draw of 50 mA
  – All of the I/O pins operate at 5 V and can provide or receive 20 mA (maximum 40 mA)
Memory

- The Mega offers 256 kB of self-programmable flash memory for storing code, with 8 kB dedicated to the bootloader
- It provides 8 kB of static random-access memory (SRAM) for storing variables
- There are 4 kB of electrically erasable programmable read-only memory (EEPROM) that can be used to read or write using the EEPROM library
Interfacing with the Arduino

• Communication with the Mega is achieved using stackable header pins that connect to the internal circuitry of the board.

• Header Pins provide easy access to:
  – Power Inputs/Outputs
  – Analog-to-Digital (ADC) Channels
  – Digital I/O Pins
  – Serial Channels

Figure 13: Arduino Mega microcontroller
ADC Channels

- The Mega provides sixteen 5V ADC channels for collecting information from external devices.
- Each of the channels can interpret most electric signals below 5V into a digital number called an ADC value.
- These values can be saved to variables on the Mega’s onboard memory.

Figure 14: Arduino Mega microcontroller
Digital Input/Output

• The Mega provides 54 digital input/output (I/O) channels
• These allow for digital communication with external devices such as LEDs or switches
• Some channels have dedicated functions such as serial communication, pulse-width modulation (PWM) output, and interrupts

Figure 15: Arduino Mega microcontroller
More Digital I/O Features

• For hardware serial (UART), there are 4 pairs of RX and TX pins to receive and transmit TTL serial data

• SPI is available for MISO, MOSI, SCK and CS using the SPI library

• TWI for SDA and SCL is available using the Wire library with a 5V I^2^C bus on pins 20 and 21

• The Mega includes 15 PWM pins which provide an 8-bit output using the analogWrite() function
Arduino Shields

• Shields are modular circuit boards designed to piggyback onto the Arduino in order to increase functionality of the microcontroller

• The MegaSat was designed as a shield to attach directly to the Arduino Mega

Figure 16: MegaSat prototype shield connected to an Arduino Mega
Prototyping with Arduino

• Arduino Playground is a great place to start
  – Sample code
  – Project ideas
  – Community forums to share and explore

• Visit https://playground.arduino.cc/
Troubleshooting

• **Power**
  – Supplying less than 7 V may cause the 5 V pins to drop too low which can create instability
  – Supplying over 12 V may damage the voltage regulator and cause the circuit to overheat

• **Connections**
  – Refer to datasheets to ensure proper wiring

• **Programming**
  – Ensure correct libraries, keywords, pin selection, syntax (more details provided in coding lecture)
References

- https://beagleboard.org/bone
- https://www.parallax.com/catalog/microcontrollers/basic-stamp
- https://store.arduino.cc/arduino-mega-2560-rev3
- https://www.digikey.com/product-detail/en/adafruit-industries-llc/3295/1528-1787-ND/6238007?WT.srch=1&gclid=Cj0KCQiA_s7fBRDrARIsAGEvF8QAFYj__yCsqkJJ1XszRI-9ANImmMkU4PB0q9k-ibkBj7K_eDMaAoA-EALw_wcB
- https://www.engineersgarage.com/blogs/comparison-between-serial-communication-protocols-spi-i2c-uartusrt-0
- www.circuitstoday.com
- https://learn.sparkfun.com/tutorials/arduino-shields/all