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COMP140/GAM160

Lecture 8 – Hardware Interfaces

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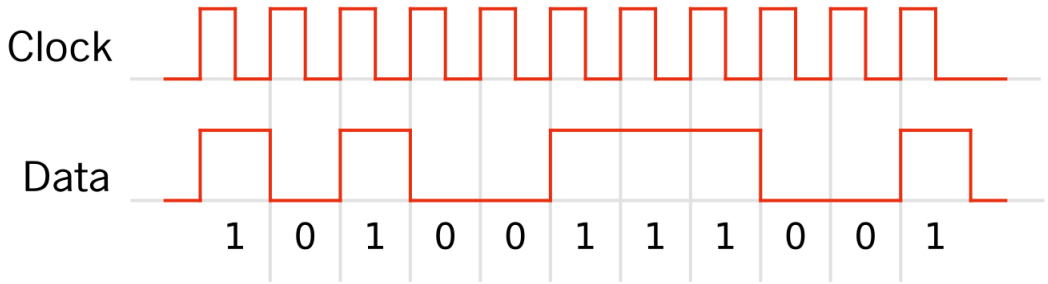
1/4/2019

THIS LECTURE

- Look at different types of interfaces for hardware
- Take a close look at the MPU-6050 accelerometer/gyroscope

TIMING

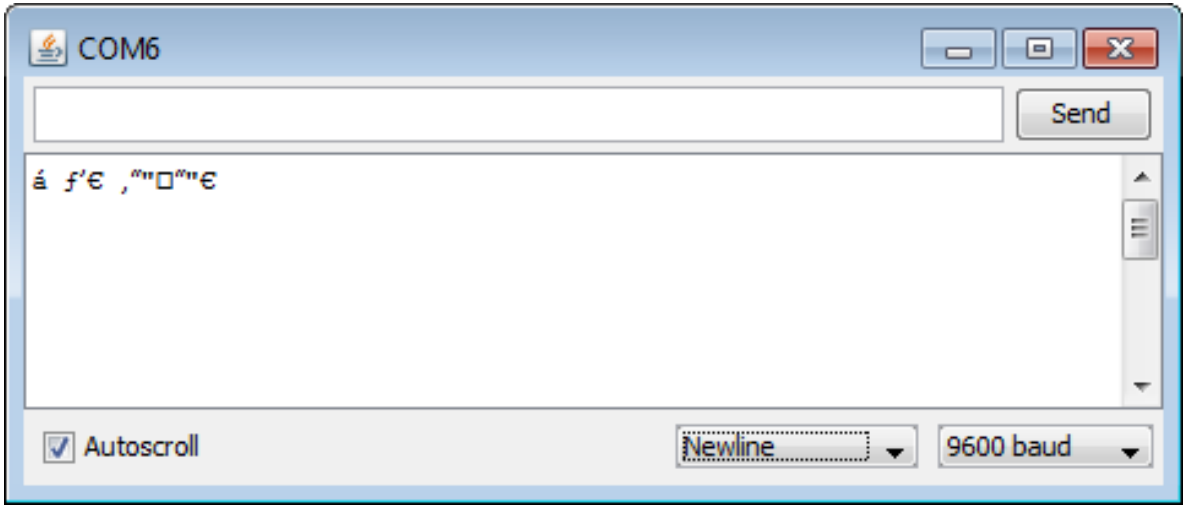
- Interfaces either use a clock line to signify a new bit is available for the host to read, or asynchronous interfaces use an agreed upon frequency (‘baud rate’)



SERIAL/UART

- This is how an Arduino talks to a computer (via a UART to USB converter on board)
- Uses an agreed baud rate (defined in your code)
  - Serial.begin(9600)
- Two communication lines – RX (receive) and TX (transmit)
- TX connects to RX, RX to TX
- Used by some peripherals such as Bluetooth modules

WHEN TIMING GOES WRONG



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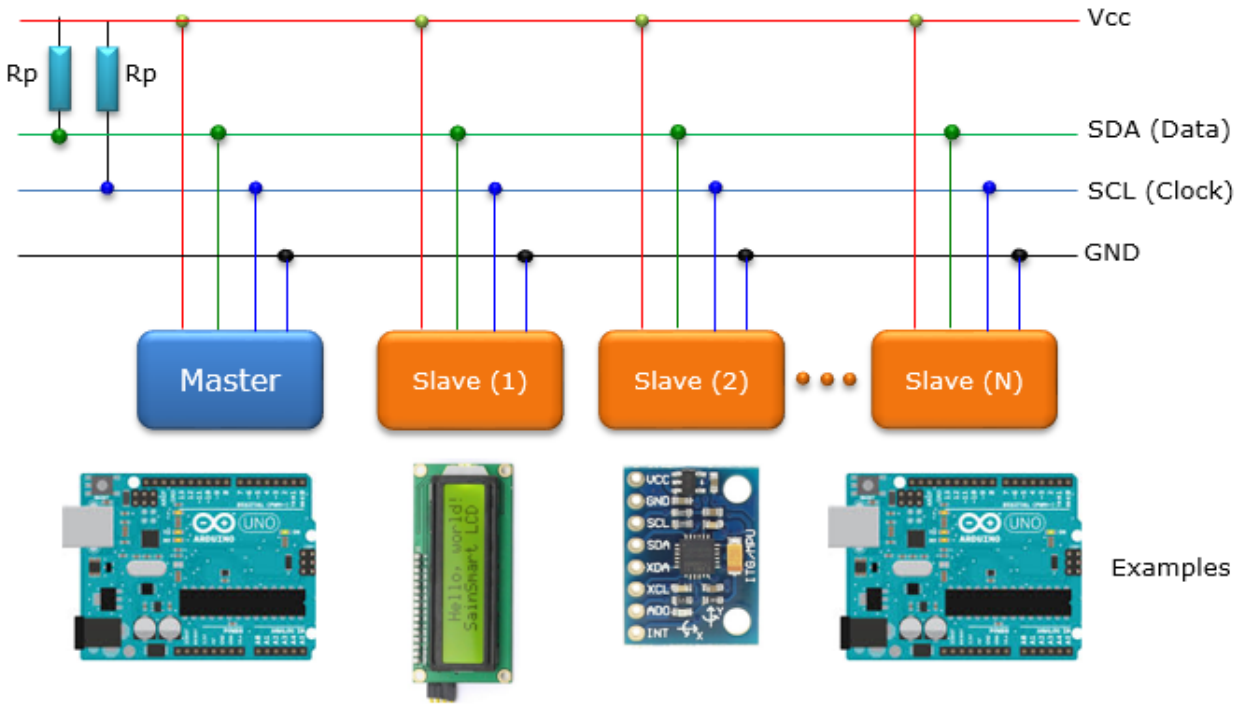
I^2C

INTER-INTEGRATED CIRCUIT (PRONOUNCED I SQUARE C)

- Uses a clock signal – the transmitting device sets the speed of data transmission
- Two communication lines – SDA (data) and SCL (clock)
- Multiple I^2C devices can communicate on the same data lines (bussed)
- Slave devices have an address (e.g. 0x68)

I2C BUS EXAMPLE



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WIRE LIBRARY

- I^2C library for Arduino
- Arduino can be either a host or a slave
- Particularly useful for wired Arduino-to-Arduino communication

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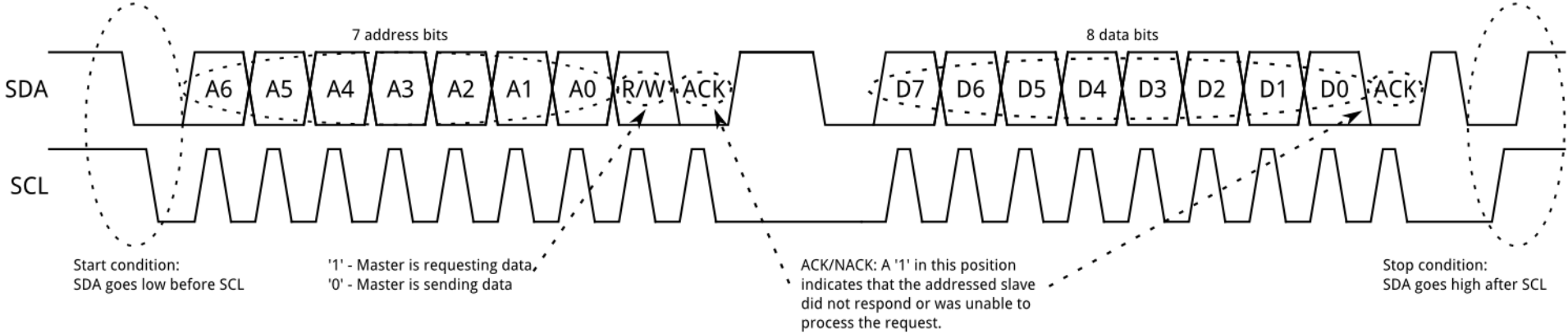
I2C COMMUNICATION EXAMPLE



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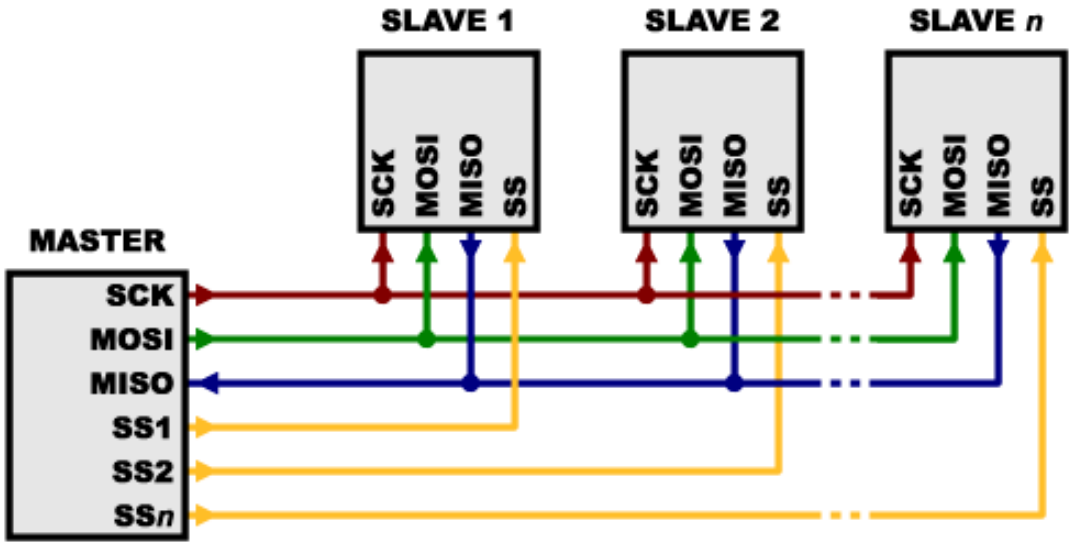
SPI

SERIAL PERIPHERAL INTERFACE

- Uses a clock signal
- 4 lines used
  - MISO – master in slave out
  - MOSI – master out slave in
  - SCK – serial clock
  - CS – chip select
- Lots of wires
- Not addressed – each slave device requires a discrete chip select line. Can be an advantage when using many of the same device.

SPI BUS EXAMPLE



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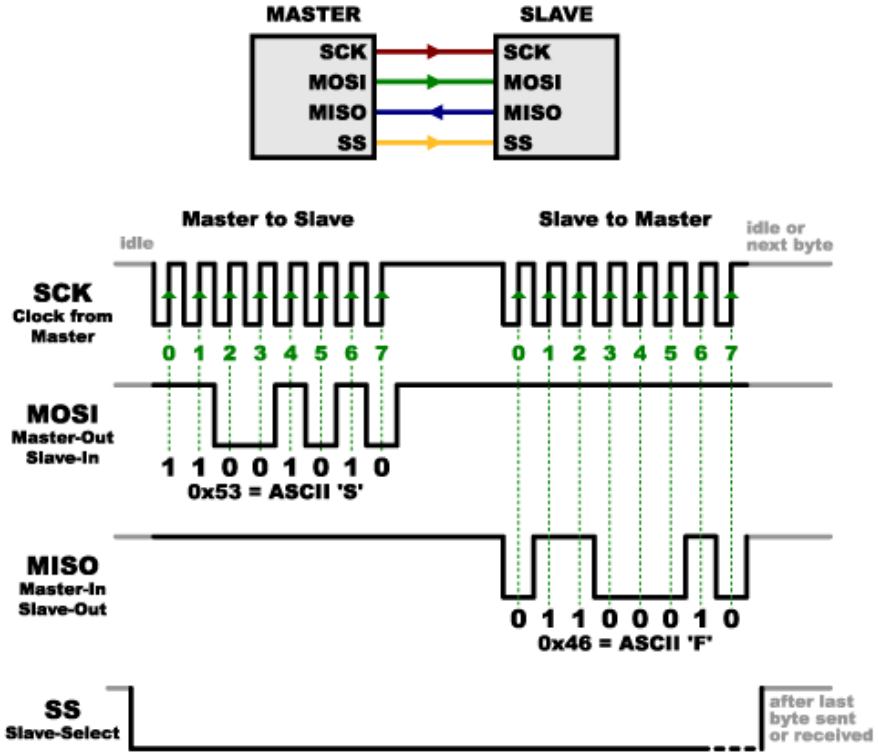
SPI COMMUNICATION EXAMPLE



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DEBUGGING INTERFACES

- Not doing what you expect? Spy on them!
- Logic analysers are the digital equivalent of an oscilloscope

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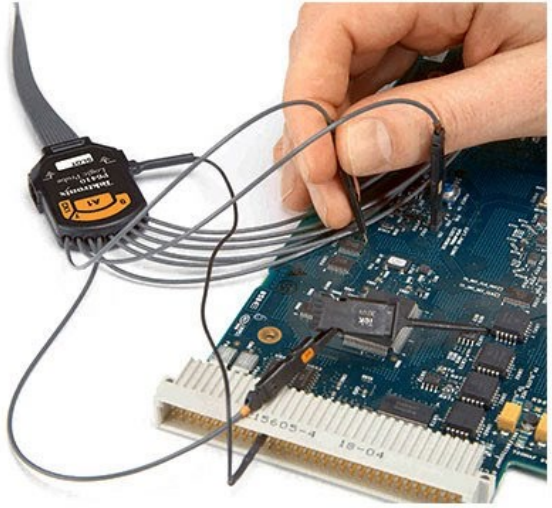
LOGIC ANALYSERS

- Typically have up to 8 signal capture lines for capturing digital logic (HIGH or LOW)
- Easy to connect to an existing circuit
- Connects to a computer via USB to capture data
- We have a couple in the Games Academy



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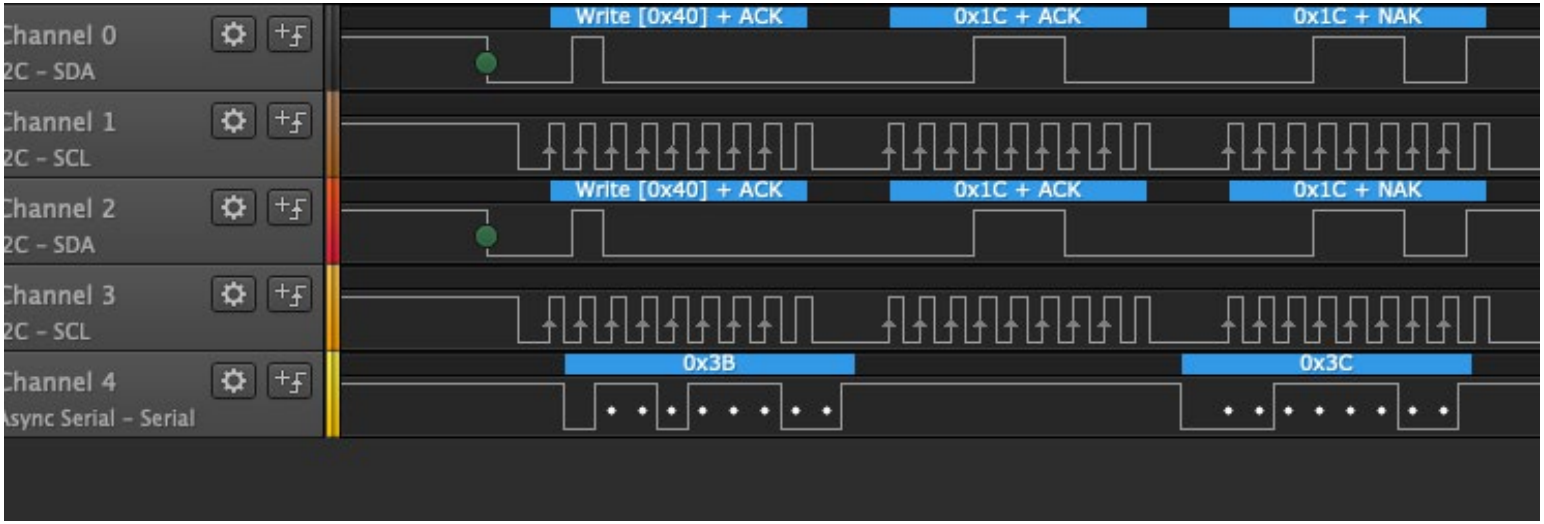
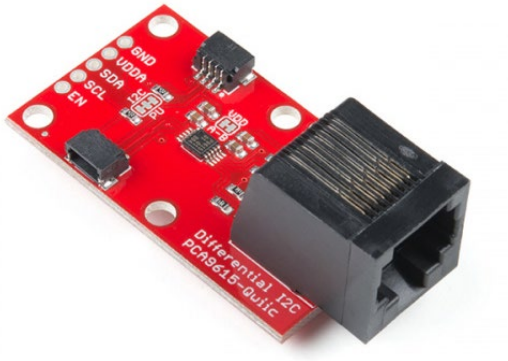
LOGIC ANALYSER SOFTWARE



SENDING DATA OVER LONG DISTANCES

- Low voltage signals (e.g. 5v/3.3v) are susceptible to noise and voltage drop over long distances (typically over 30cm)
- Noise can turn your digital 1 into a 0. This is bad.
- Differential signalling can help
- PCA9615 chip converts I^2C to a differential signal that can run over ethernet cable up to 30m!



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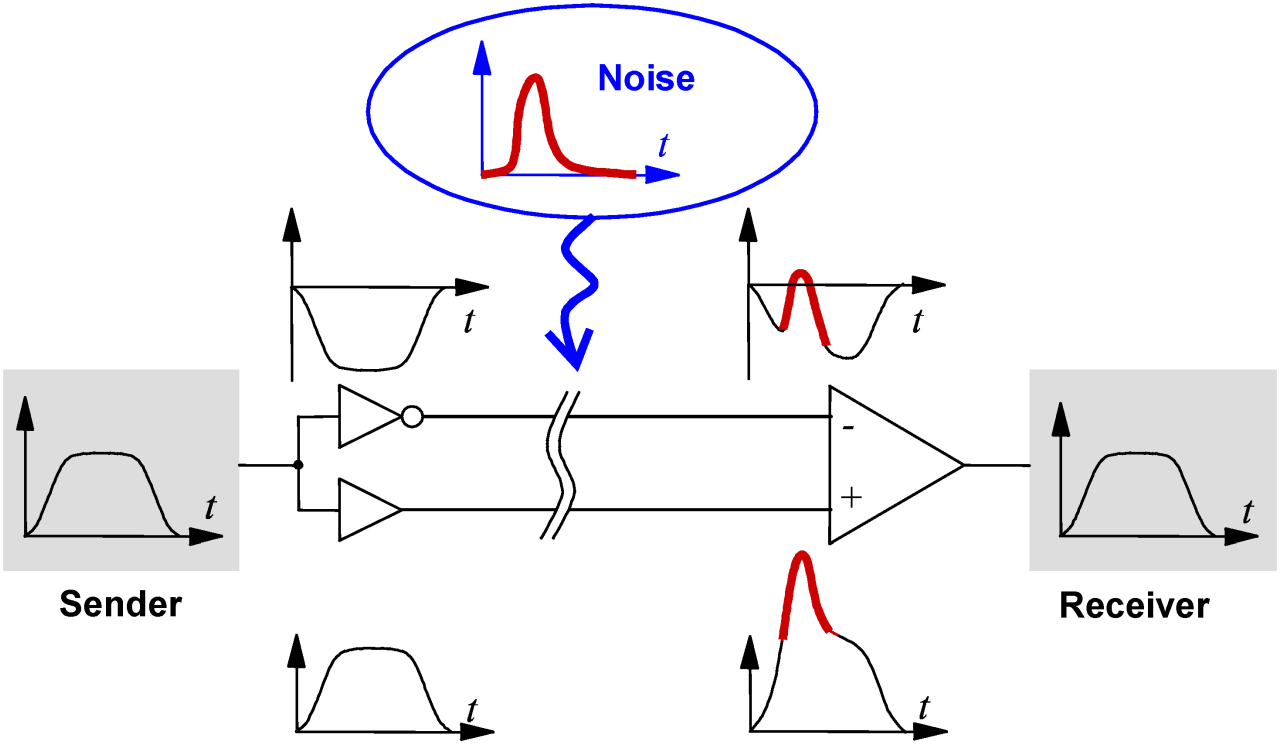
DIFFERENTIAL SIGNALLING

- Used by USB and in professional audio (‘balanced signal’ – usually an XLR plug)
- Two lines carry the same signal, but one is inverted
- The two lines cancel each other out, which just leaves the noise – this can then be cancelled out!



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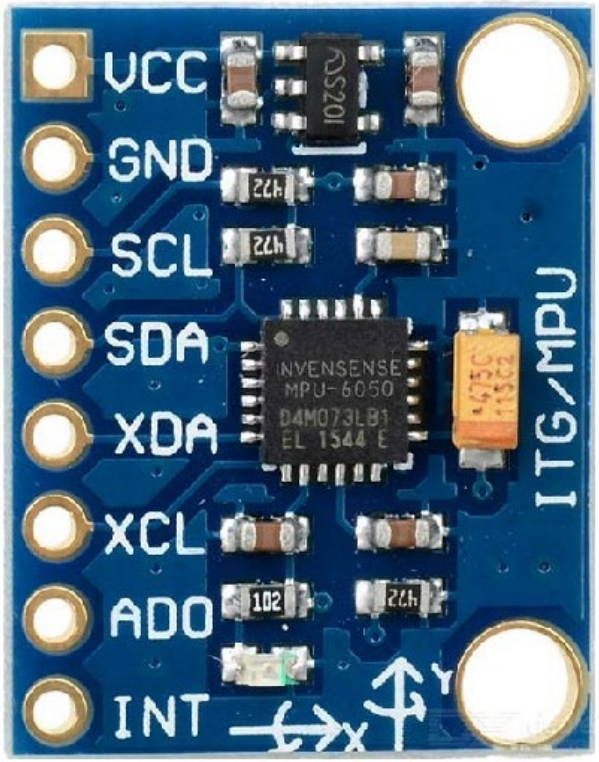
MPU-6050

- Cheap and easily available
- Gyroscope (senses rotation in 3 axis)
- Accelerometer (senses acceleration in 3 axis)
- Temperature sensor



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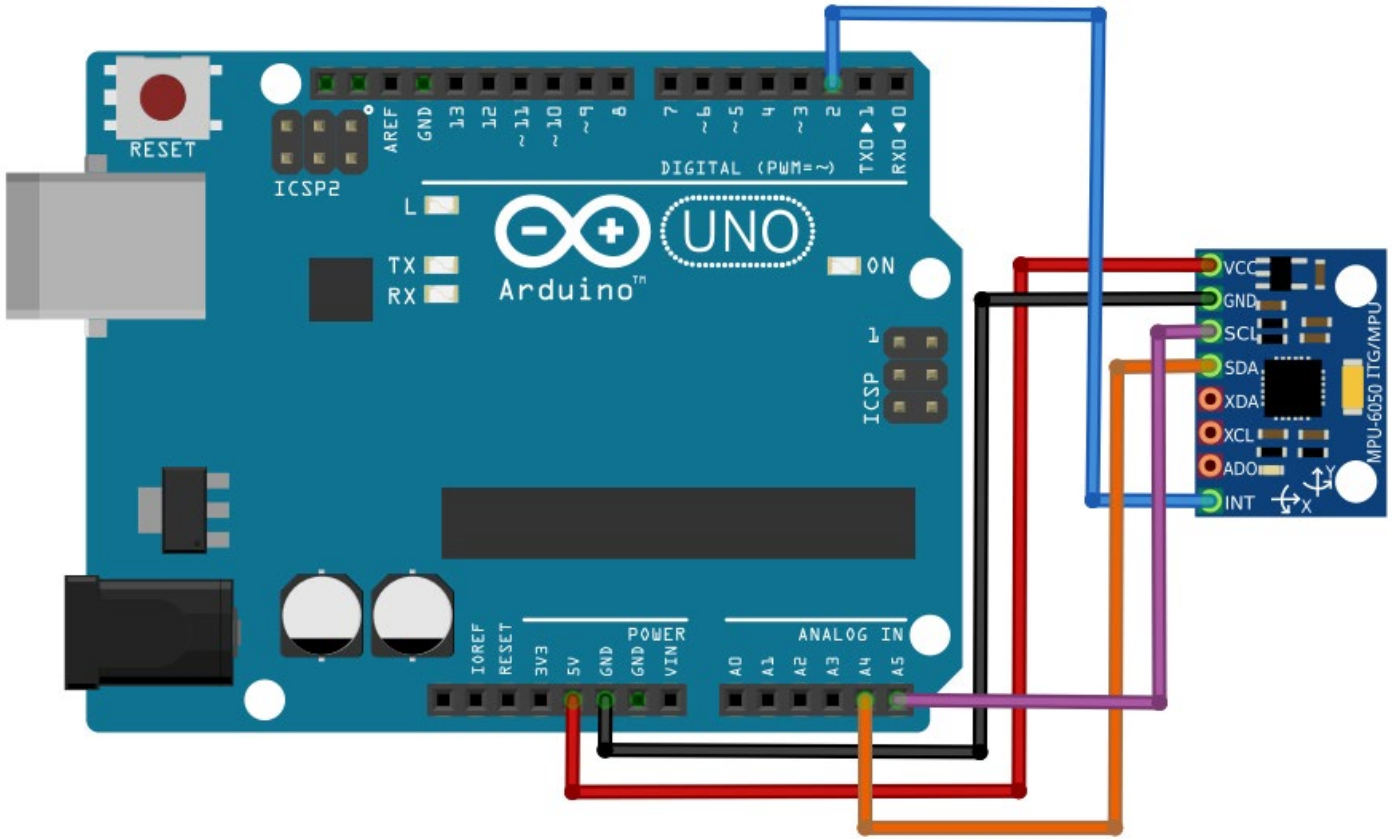

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MPU-6050 LIBRARY

- https://github.com/jarzebski/Arduino-MPU6050
- Abstracts all communication into a simple to use class
- Uses the motion processing features of the chip to output easy to use data in degrees and metres per second

TL;DR

- Google the peripheral you're using
- Find a library and/or example
- …
- Profit

WORKSHOP THIS AFTERNOON

- Project support workshop
- Please bring your hardware!

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