

# Basic Microcontroller Principles

Made by Akash Harapanahalli for GTOR

# Why use microcontrollers?

- Small processors with built in RAM/ROM/IO.
- Unlike CPU/microprocessors, microcontrollers are built for **one use**....Cannot be changed in usage.
- Everything is easier digitally :')
- Perfect for our usage.



# Teensy

- 32 bit microcontrollers made by PJRC, aka Paul Stoffregen.
- USB for easy interfacing.
- Small profile, low energy consumption.

## 32 Bit Teensy Boards

High performance  
Large Memory  
Plentiful Resources

Teensy 4.0



600 MHz Cortex-M7

Teensy 4.1



600 MHz Cortex-M7

Teensy 3.2



72 MHz Cortex-M4  
3.3V signals, 5V tolerant

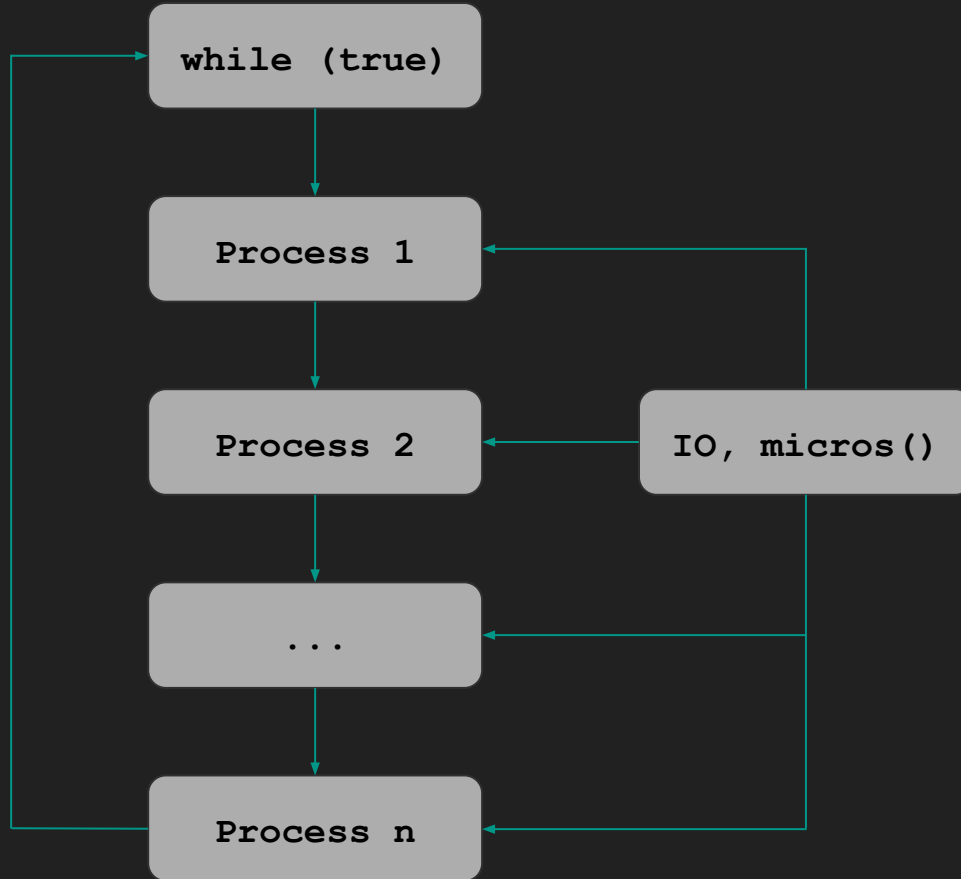
Teensy 3.6



180 MHz Cortex-M4F  
3.3V signals

# Programming for microcontrollers

- Single thread, continuously running.
- How to read sensors, write ports, communicate over serial etc, all simultaneously?
- Abuse high clock speed and built in timers to emulate thread-locking behavior.



# Code Example

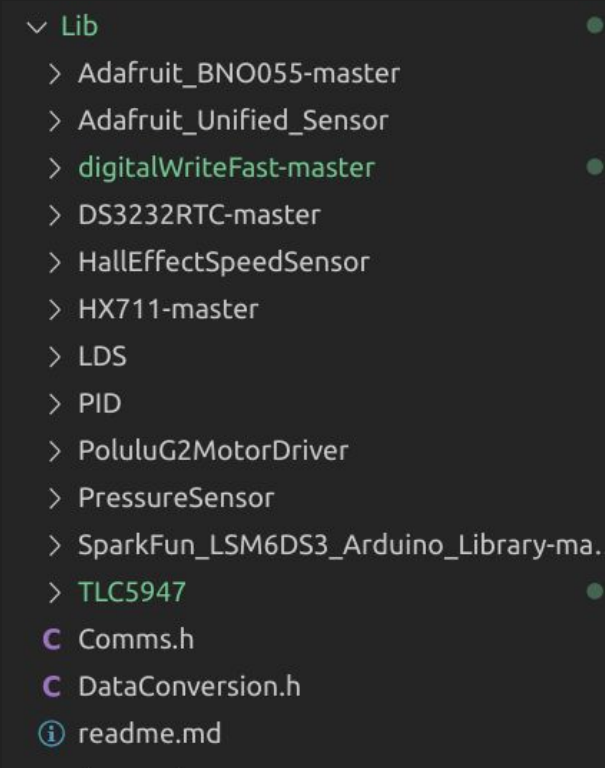
```
// Example of thread-locking code to:  
// 1) blink an LED, and  
// 2) read an analog sensor  
while(true){  
    digitalWrite(LED, HIGH)  
    delay(2000);  
    digitalWrite(LED, LOW);  
    delay(2000);  
    analogRead(...); // Only executes every 4 seconds!  
}
```

# Code Example, Improved

```
// Example of not thread-locking code to:  
// 1) blink an LED, and  
// 2) read an analog sensor  
uint8_t led_state = 0;  
uint32_t prev_write = 0;  
while(true){  
    if(abs(micros() - prev_write) >= 2000000){  
        led_state = !led_state; // Switches state LOW <--> HIGH  
        digitalWrite(LED, led_state);  
        prev_write = micros();  
    }  
    analogRead(...); // Executes every 1 microsecond!  
    delayMicroseconds(1);  
}
```

# Big programming focuses

- Readability
- Reusability
- Expandability
- C++ is king!



```
Lib
  > Adafruit_BNO055-master
  > Adafruit_Unified_Sensor
  > digitalWriteFast-master
  > DS3232RTC-master
  > HallEffectSpeedSensor
  > HX711-master
  > LDS
  > PID
  > PoluluG2MotorDriver
  > PressureSensor
  > SparkFun_LSM6DS3_Arduino_Library-ma..
  > TLC5947
  C Comms.h
  C DataConversion.h
  i readme.md
```