Basic Microcontroller Principles

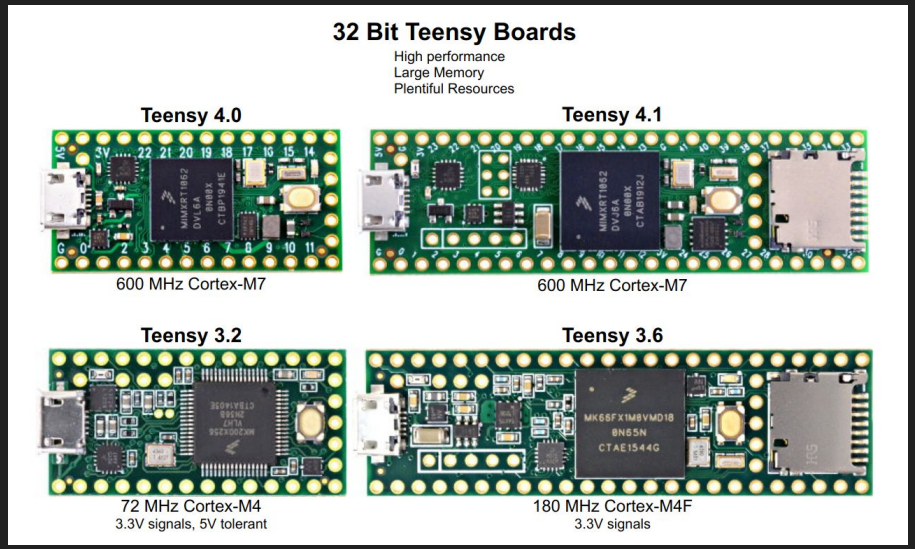
Made by Akash Harapanahalli for GTOR

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.

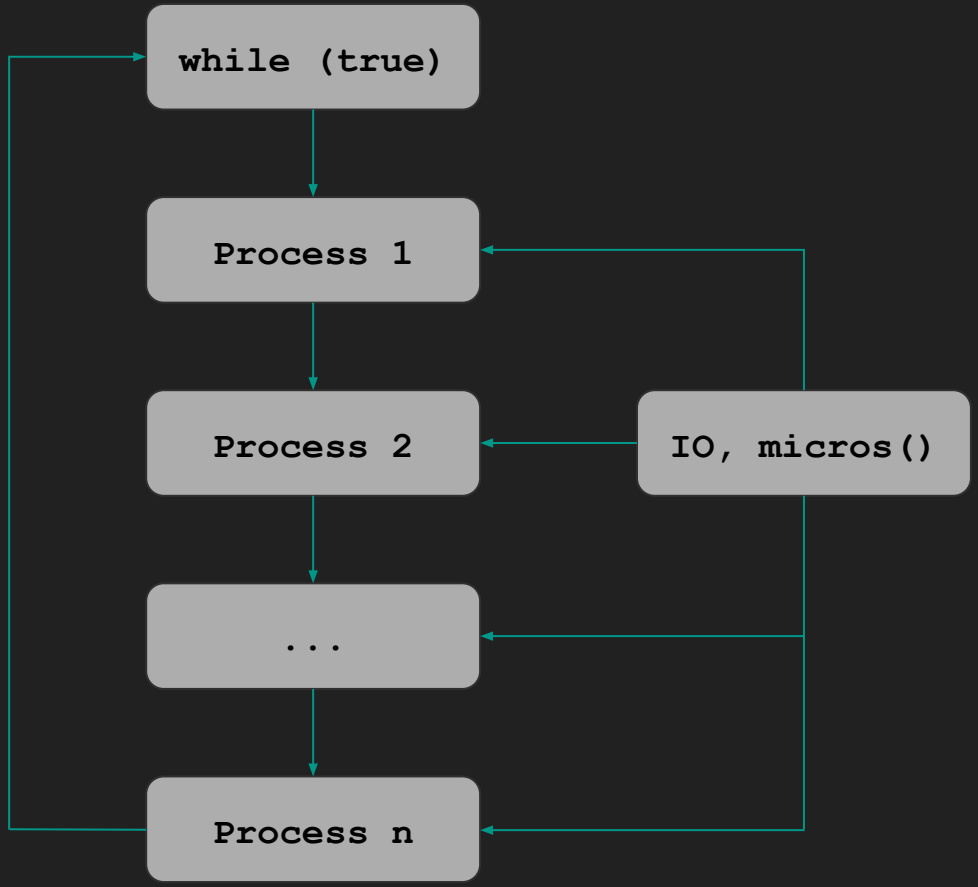
Teensy

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



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.


while (true)
Process 1
Process 2
IO, micros()
...
Process n

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!