Using the GPIO interface on the Raspberry Pi

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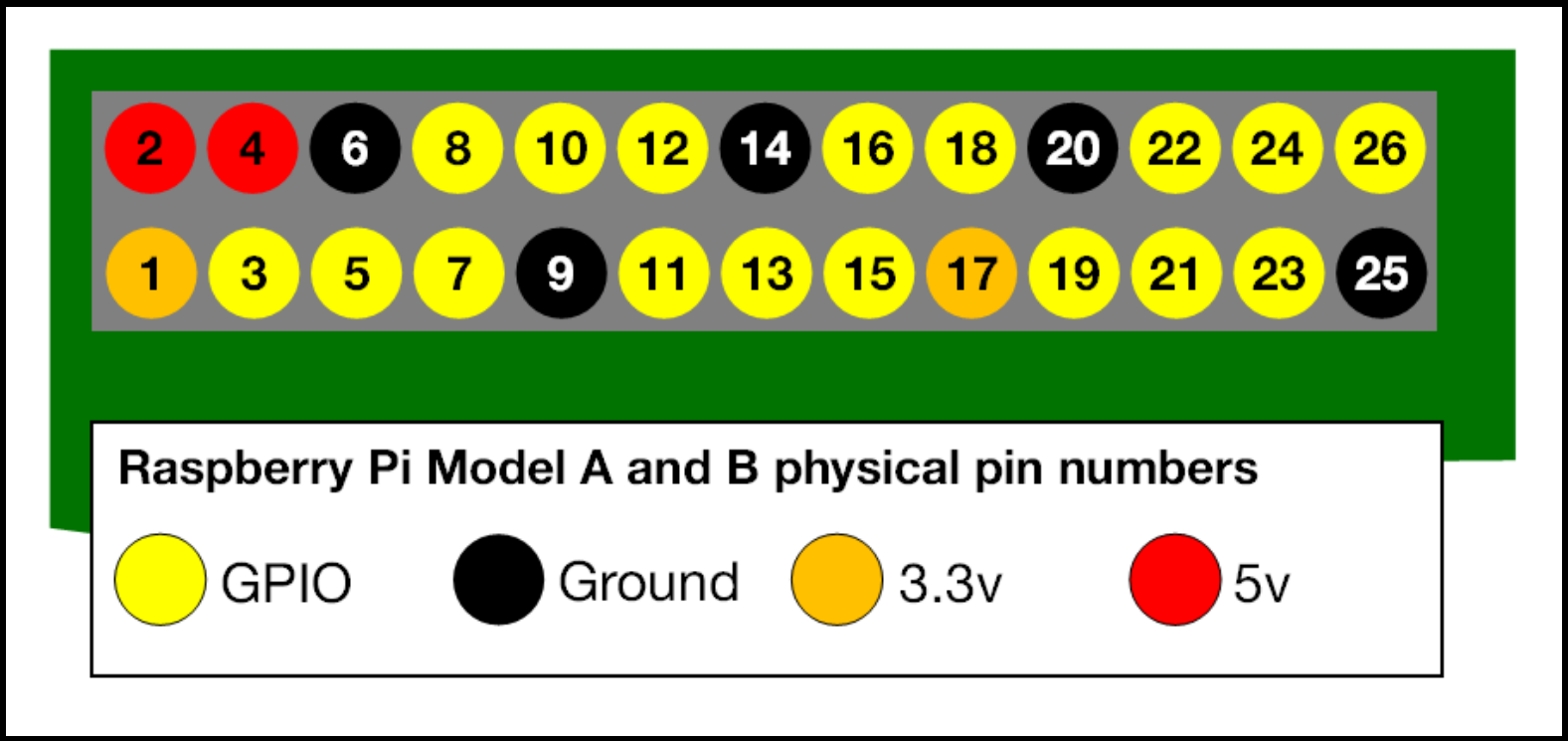
Introduction

- Raspberry Pi has many interfaces
- Some we are already familiar with
- Today we'll look at P1 (GPIO Interface)
- Its basic usage and pointers to more detail

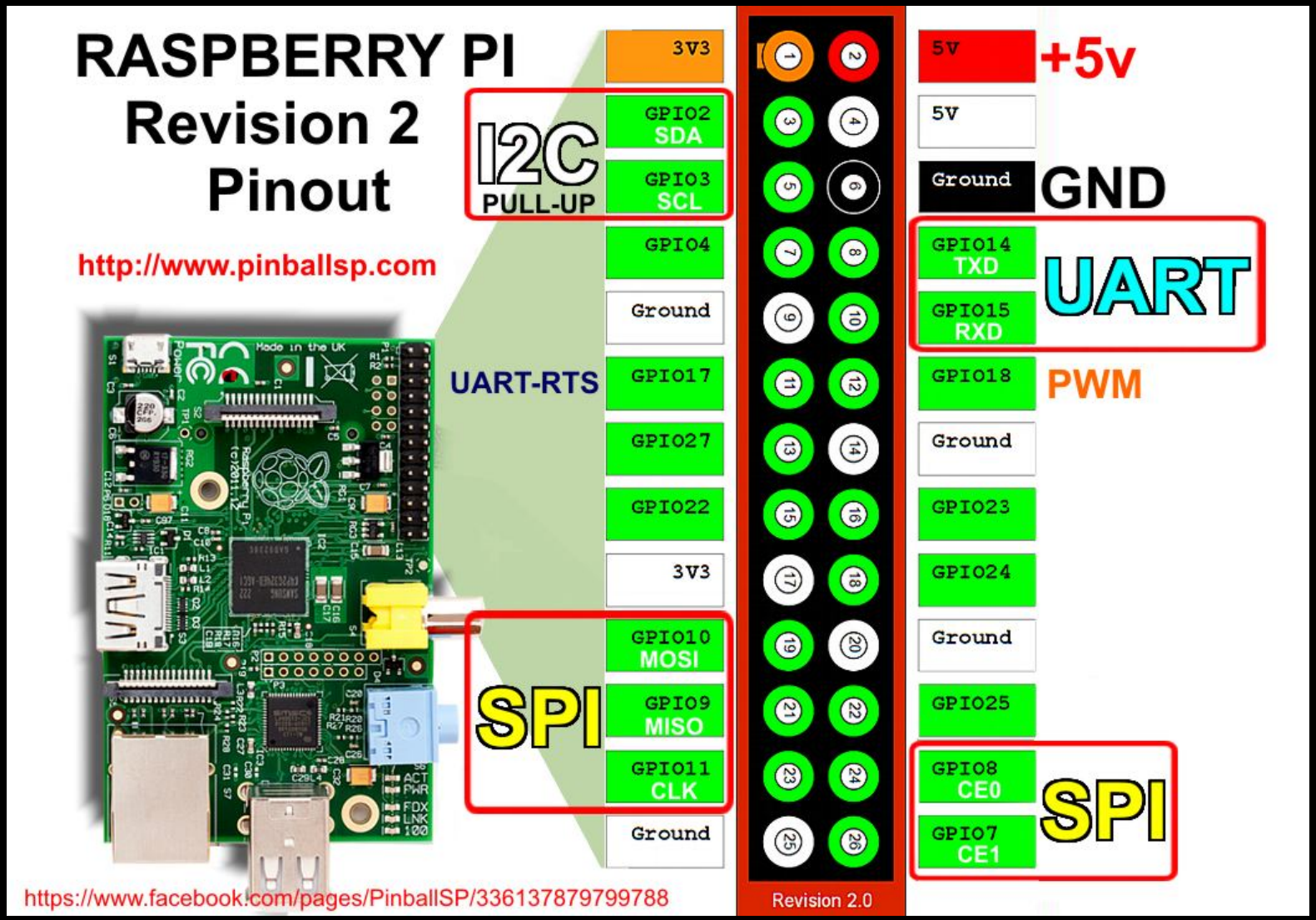
GPIO Pinouts I

- Each pin has a purpose
- Power and Ground
- I/O Pins
- PWM
- I^2C
- SPI
- No analog inputs
- No analog outputs*

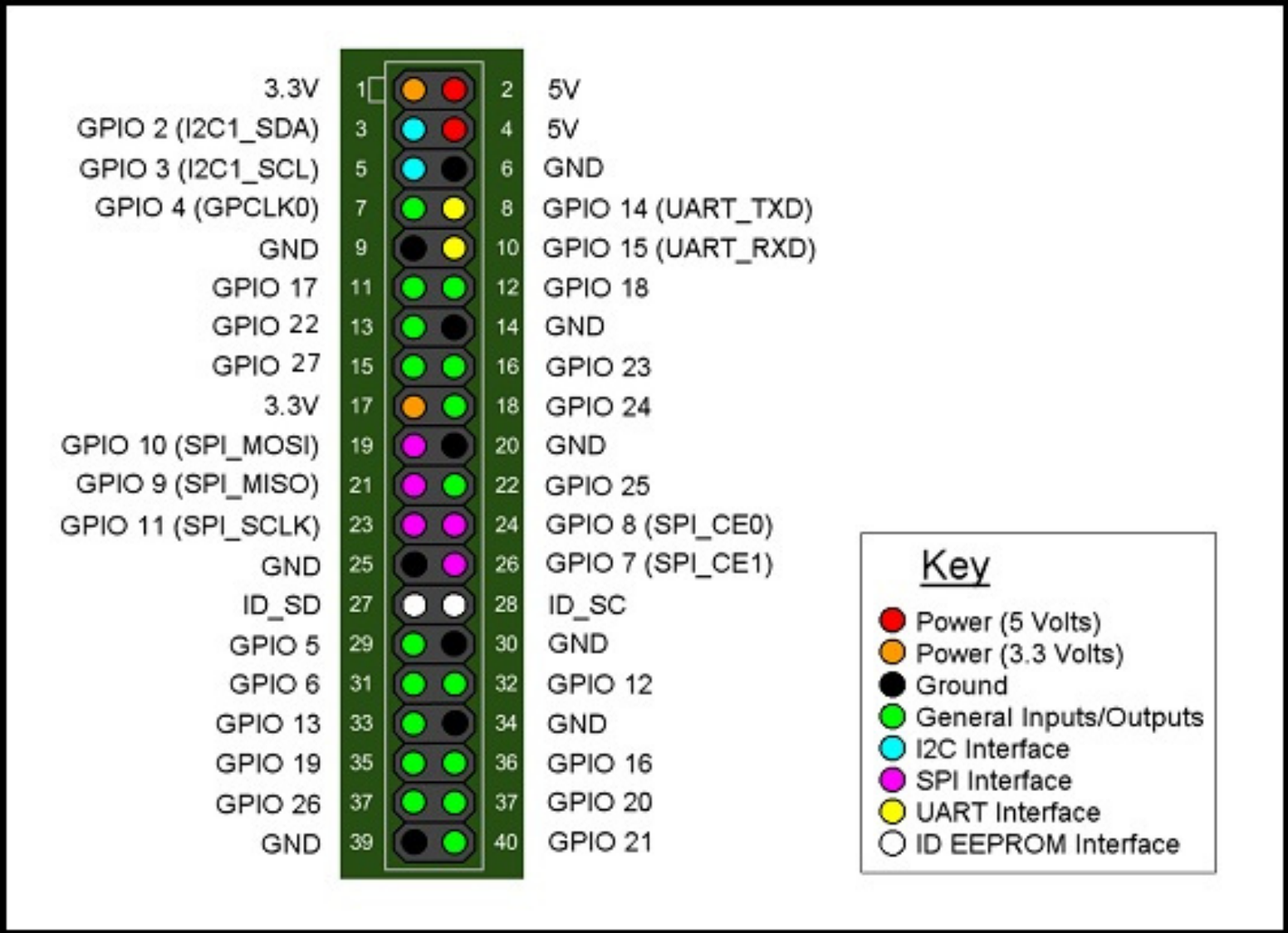
GPIO Pinouts II



GPIO Pinouts III



GPIO Pinouts IV



Simple Output I

- Simple outputs
  - 3.3V if set to 1
  - 0.0V if set to 0
- Easiest to program
- Can use Scratch, Python or C
- Example

Simple Output II

```
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)

ledpin = 18
GPIO.setup(ledpin, GPIO.OUT)

GPIO.output(ledpin, 1)
GPIO.cleanup()
```

Simple Input I

- 3.3V = 1
- 0.0V = 0
- Use with buttons and other digital devices
- Built-in pull up/down resistors
- Example code

Simple Input II

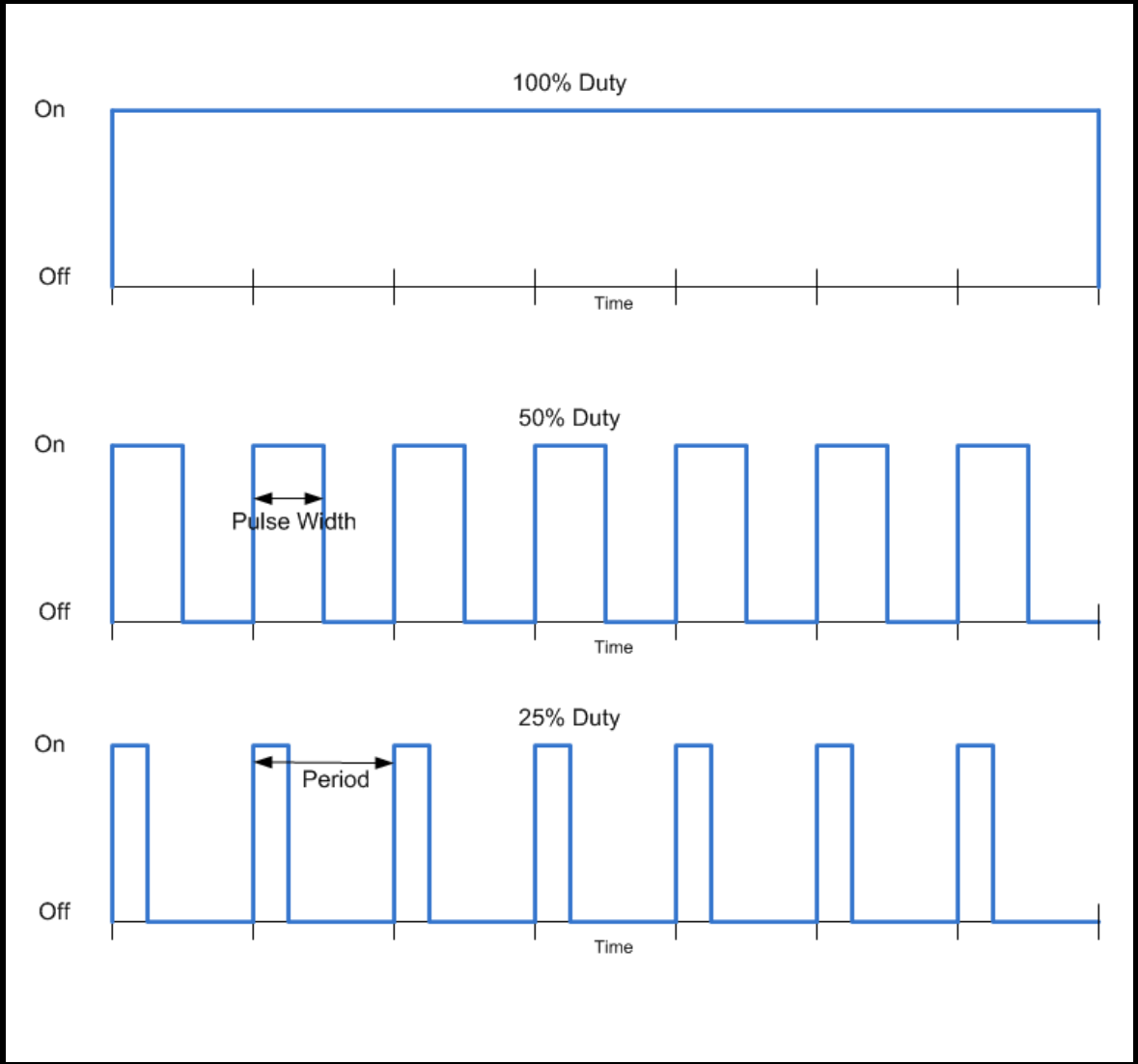
```
btnpin = 18
GPIO.setup(btnpin, GPIO.IN,
           pull_up_down=GPIO.PUD_DOWN)

while True:
    button = GPIO.input(btnpin)
    if button:
        print('Button pressed')
        time.sleep(0.2) # Debounce
GPIO.cleanup()
```

- Debounce switches either in hardware or software using loops

Pulse-Width Modulation (PWM) I

- PWM creates a pulse of varying widths

Pulse-Width Modulation (PWM) II



Pulse-Width Modulation (PWM) III

- Dim LED/Lights
- Control RGB LEDs
- Contorl motor speed
- Control servo motors
- Use as a timing signal
- Use to broadcast radio signals (PiFM)
- Example code

Pulse-Width Modulation (PWM) IV

```
ledpin = 18
freq = 50 # Hz
GPIO.setup(ledpin, GPIO.OUT)
pwm = GPIO.PWM(ledpin, freq)
pwm.start(25) # duty cycle
time.sleep(5)
pwm.ChangeDutyCycle(75)
time.sleep(5)
GPIO.cleanup()
```

Serial Communications I

- Standard via UART (Pins 8 and 10)
- By default, kernel messages and getty are running
- Update grub configuration and inittab to disable defaults
- To connect RS-232 devices use a MAX3232 to adjust voltages
- Other different interfaces exist
  - Serial Peripheral Interface (SPI)
  - Inter-Integrated Circuit (I^2C)
- Many peripherals use SPI or I^2C such as, LCD Screens and other devices

What to do when you're running out of pins!

- Multiplexing
- Specialized hardware drivers (i.e. LED Matrix drivers)
- Daisy-chaining
- Add-on boards (Guzunty, Gert, ...)

Questions?