Raspberry Pi Workshop Vol. 1

Welcome

Agenda

- 9:30 - Welcome Coffee
- 9:45 - Part I: Raspberry Pi Board, Processor and Peripherals
- 10:45 - Part II: Connecting Things and Making Electrons Flow
- 11:45 - Part III: The Operating System
- 12:30 - Lunch
- 13:45 - Part IV:
- 14:45 - Part V: Examples / Python / Node-RED
- 15:30 - Group projects
- 18:00 - Group presentations

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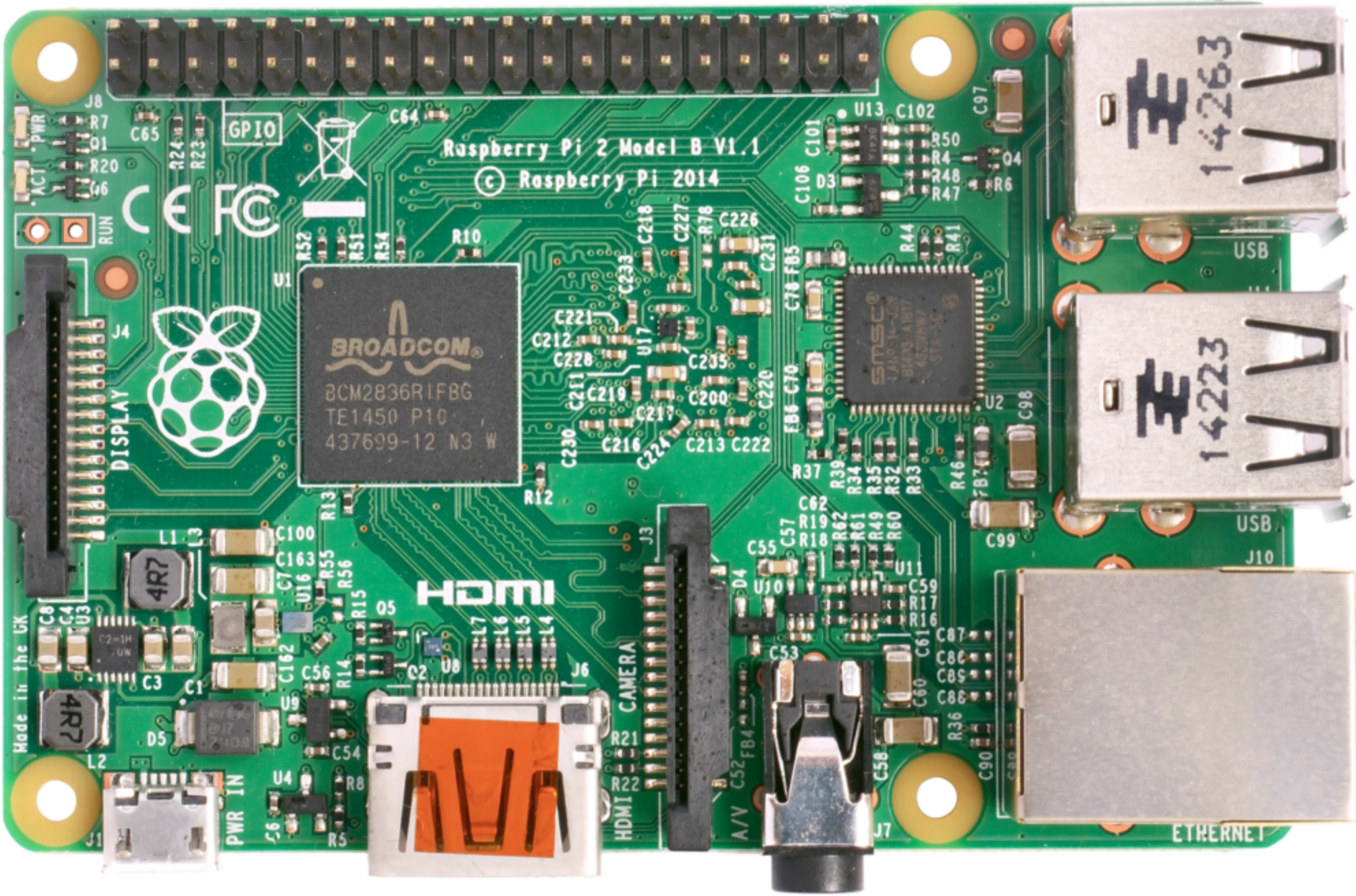
Learning Objectives

- Knowing the different ways to connect to the Raspberry Pi remotely and locally
- Knowing how to access wired and wireless networks
- Understand the basics of Raspian Linux and the its tools
- Understand how to connect a UART or USB device
- Understand how to use the GPIO pins as inputs or outputs

Part I

Raspberry Pi Board, Processor and Peripherals


GPIO
Raspberry Pi 2 Model B V1.1
© Raspberry Pi 2014
BROADCOM
BCM2836RIFBG
TE1450 P10
437699-12 N3 W
DISPLAY
RUN
PWR
ACT
HDMI
CAMERA
A/V
USB
USB
ETHERNET
PWR IN
Made in the UK

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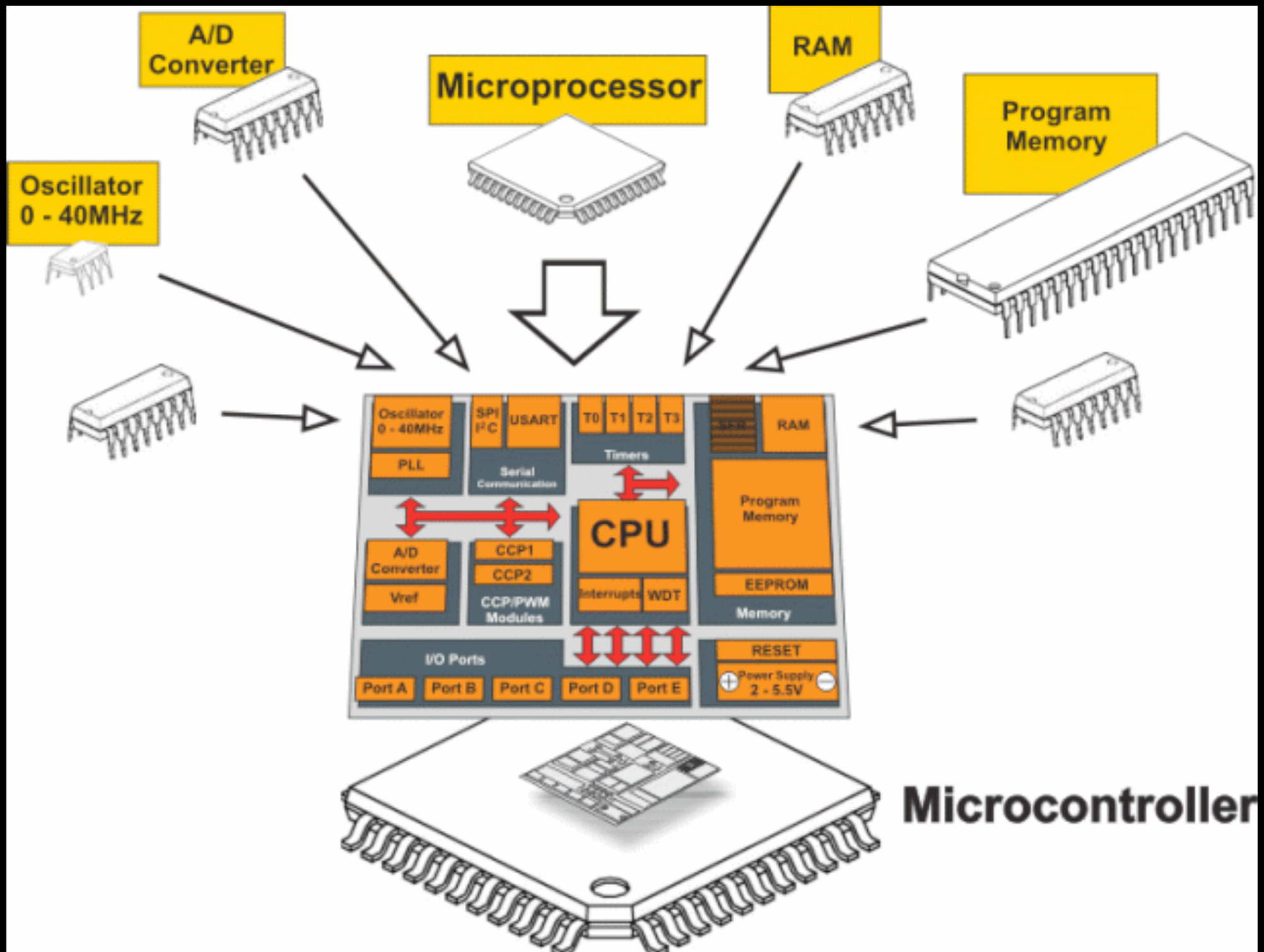
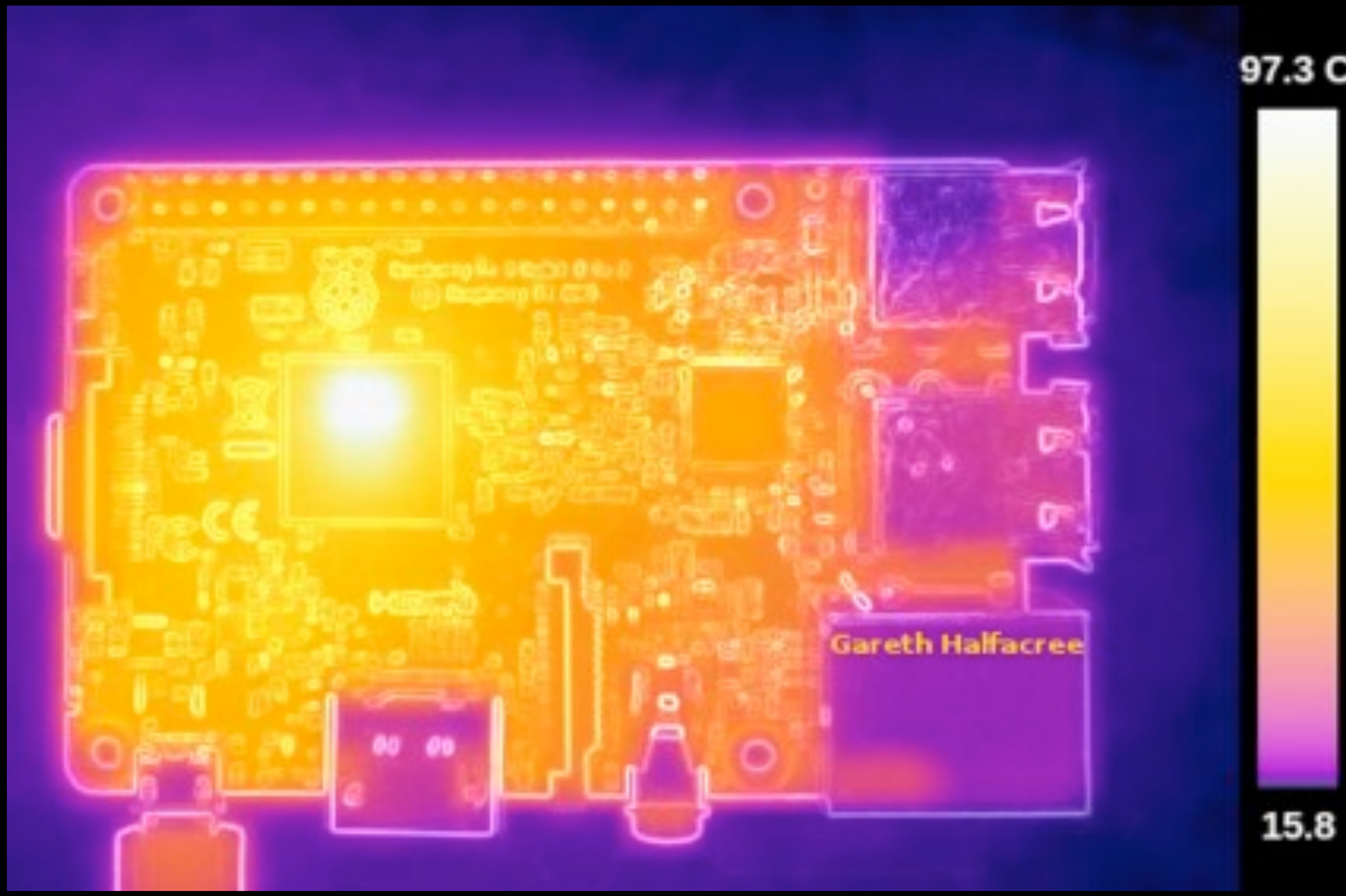
Specs

- A 1.2GHz 64-bit quad-core ARMv8 CPU
- 802.11n Wireless LAN
- Bluetooth 4.1 / Bluetooth Low Energy (BLE)
- 1GB RAM
- 4 USB ports / 40 GPIO pins / Full HDMI port / Ethernet port
- Combined 3.5mm audio jack and composite video
- Camera interface (CSI)
- Display interface (DSI)
- Micro SD card slot (now push-pull rather than push-push)
- VideoCore IV 3D graphics core

Raspberry Pi vs. Arduino



Hot!



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ESD

- The Shocking Truth: https://www.youtube.com/watch?v=hLOQ7zOWGAA

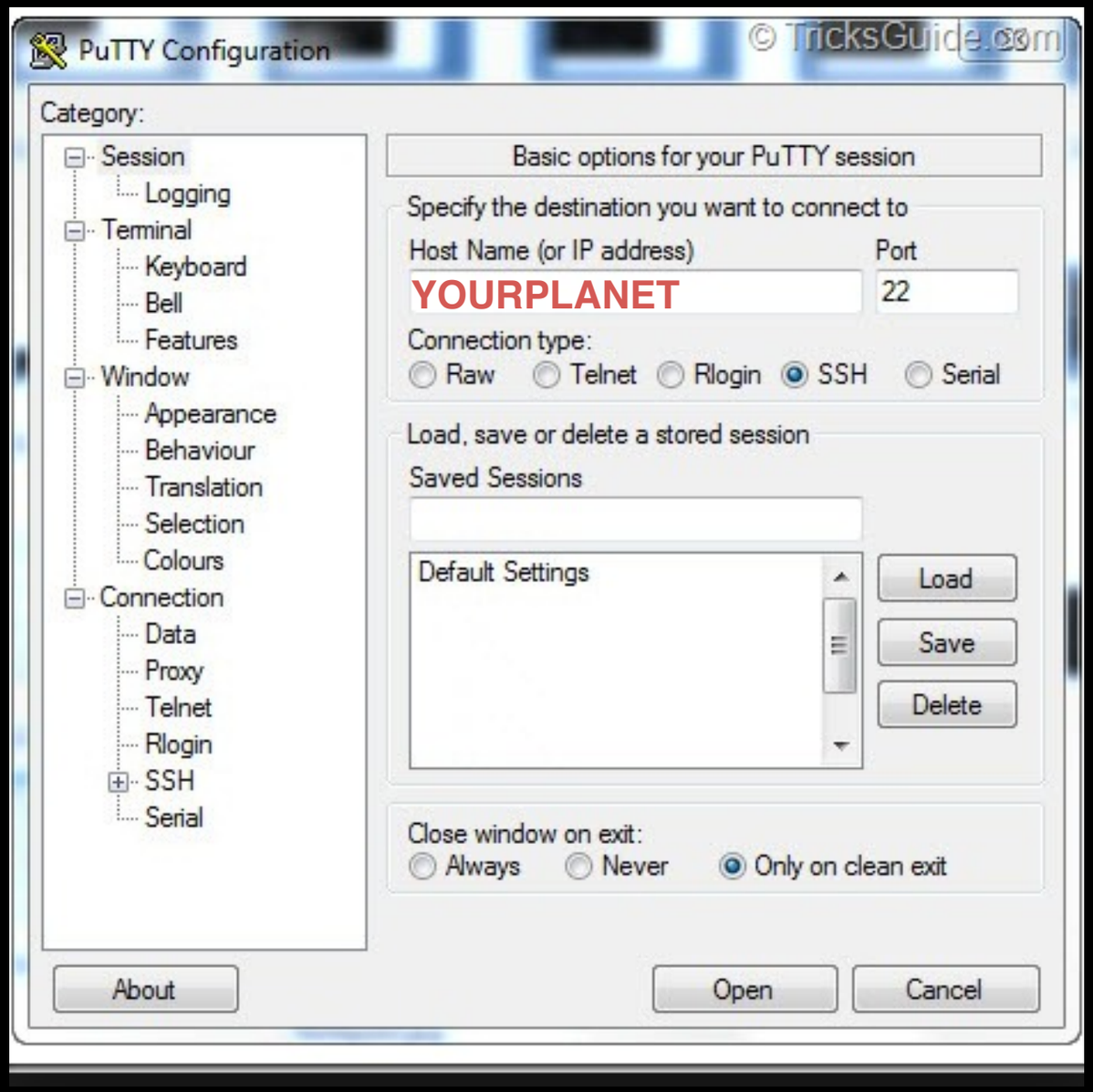
Exercise

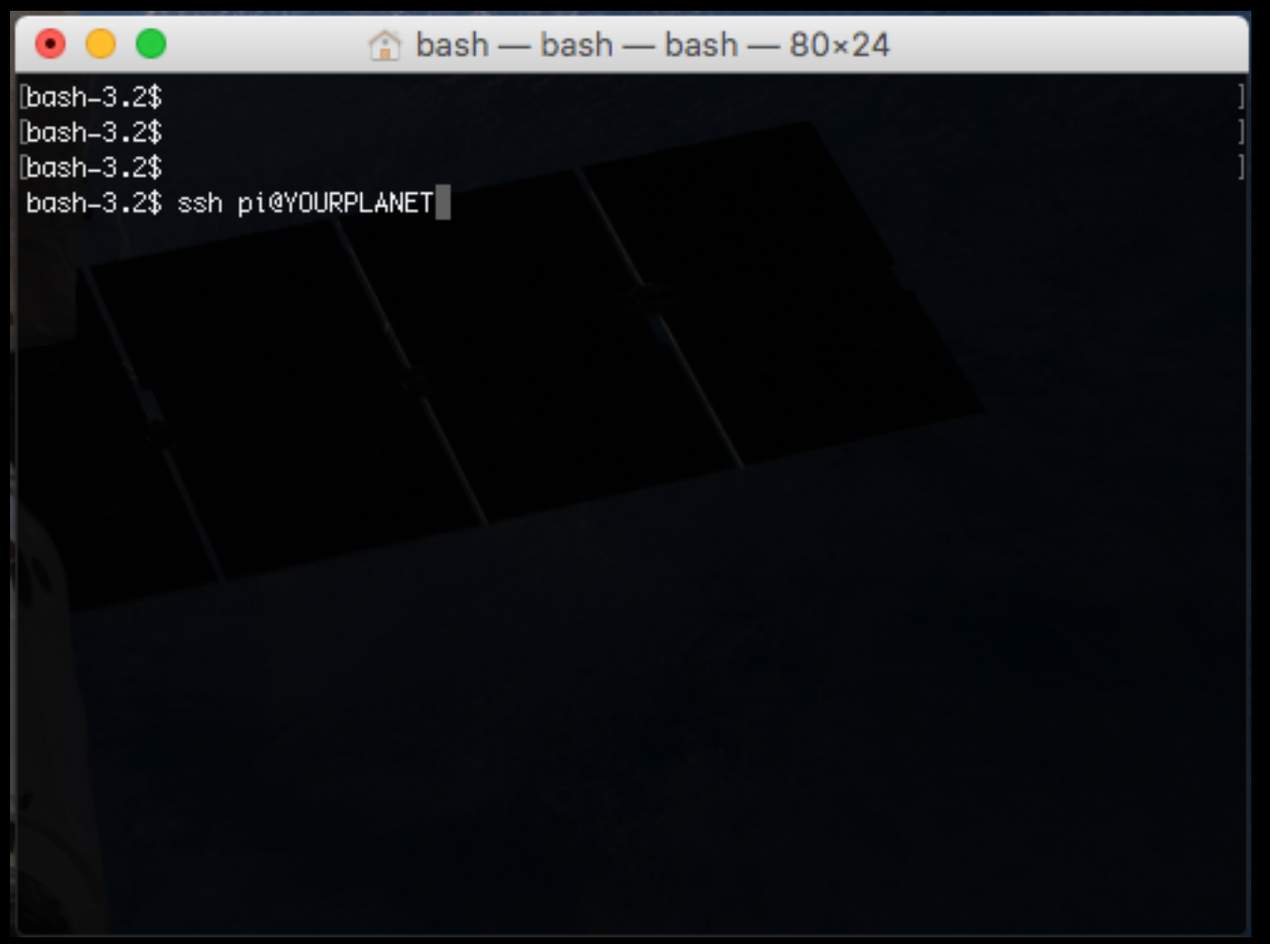
- Connect to Wifi:
  MASSCHALLENGE / innovation2016++

- On Windows:
  download Putty: www.putty.org

- On Mac OS X & Linux:
  open “Terminal”

Your Laptop





putty.org

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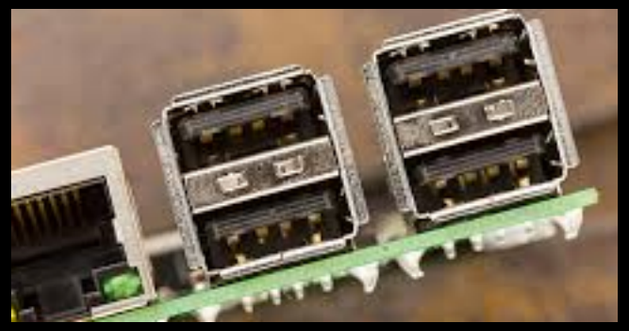
Part II

Connecting Things and Making Electrons Flow

USB



- Standard USB 2.0
- Power and data
- For webcams, 3d printers, spectrometers, usb sticks..

HDMI

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CSI


C217
C230
C216
C224
C213 C222
FB6
R37
R12
B-RPI32
RPI32
J3
C55
C57
D4
U10
L5
L4
C53
J6
CAMERA
R21
R22
FB4
C52
HDMI
A/V

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Ethernet

- For when you don’t have Wifi…

Audio / Video

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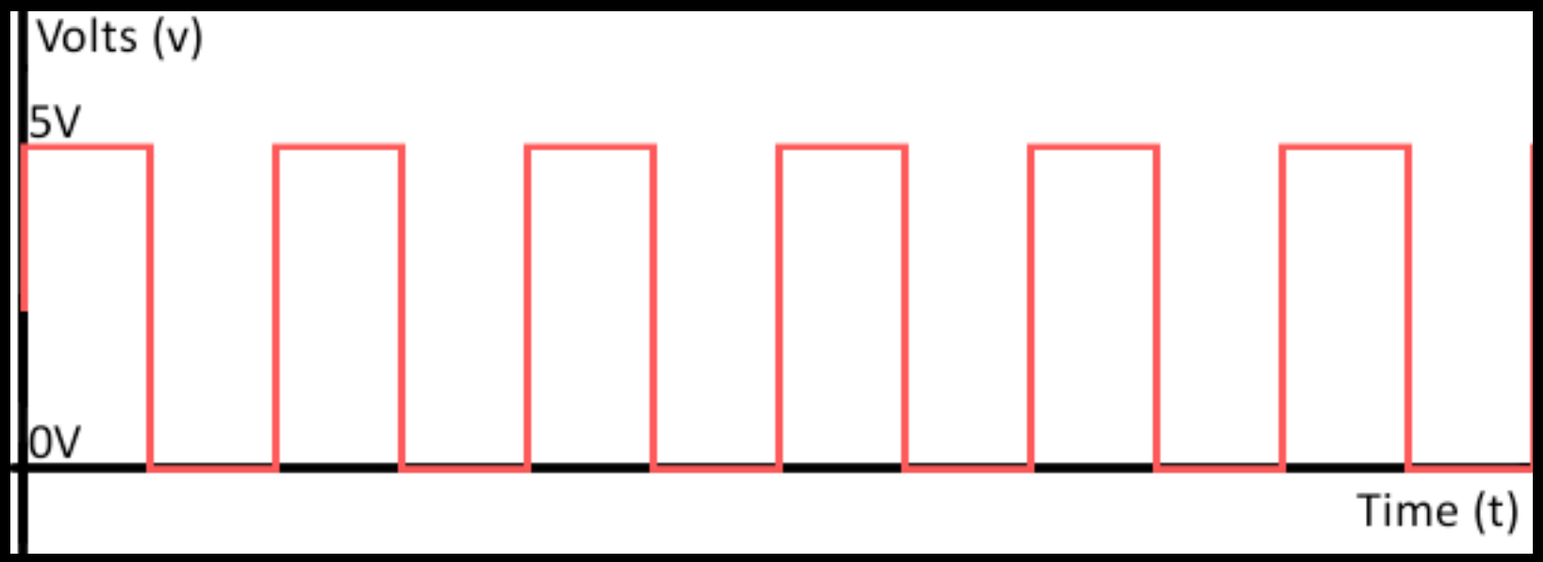
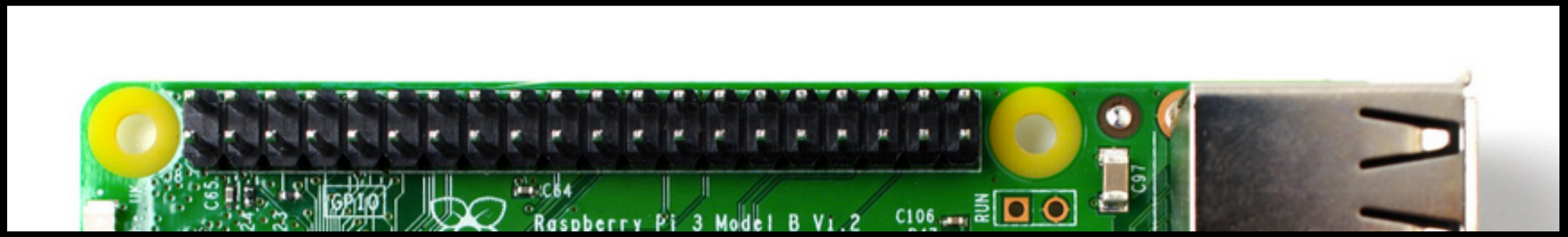
Digital Signals



- How does information travel from one computer to another?
- **Warning!** “3V logic”, “5V logic”

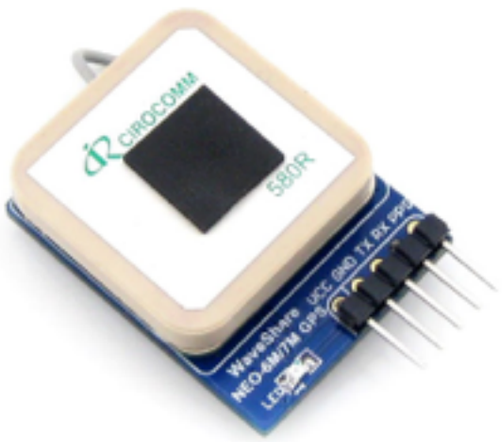
GPIO



- General Purpose Input/Output
- gpio utility: http://wiringpi.com/the-gpio-utility/

UART

"serial port"



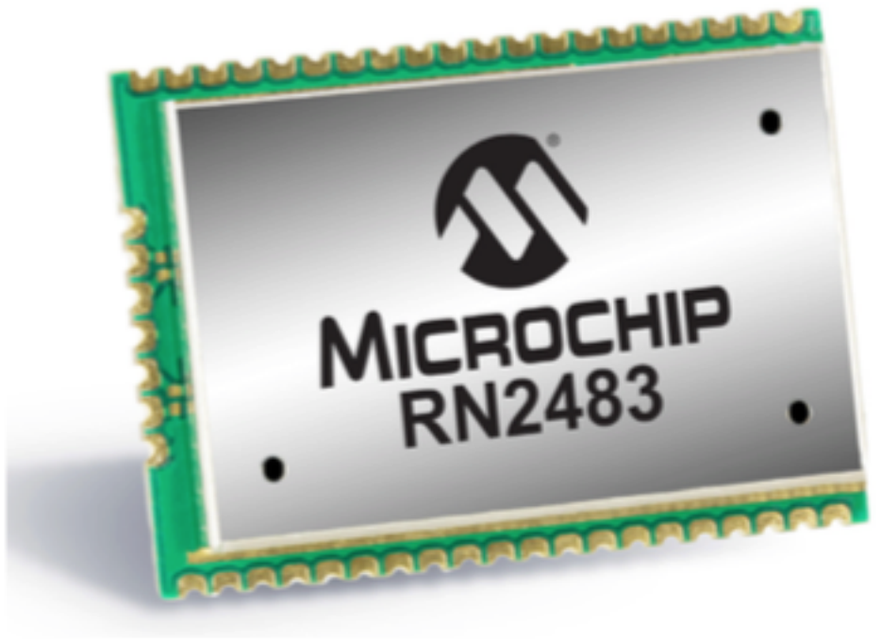
OCHIP

RN2483

Low-Power Long Range LoRa® Technology Transceiver Module

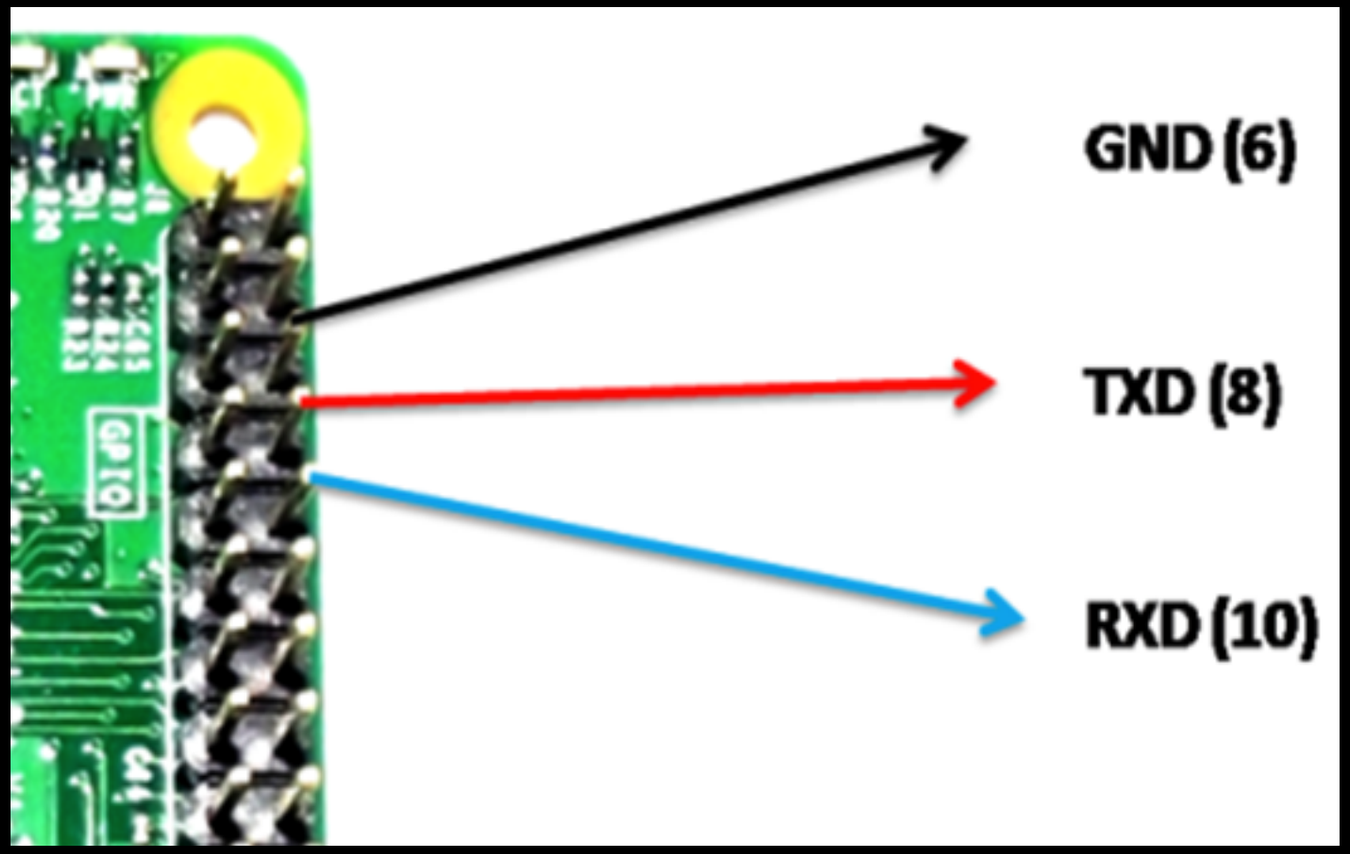
General Features

- On-board LoRaWAN™ protocol stack
- ASCII command interface over UART
- Compact form factor: 17.8 x 26.7 x 3.2 mm
- Castellated SMT pads for easy and reliable PCB mounting
- Environmentally friendly, RoHS compliant
- European R&TTE Directive Assessed Radio Module
- Device Firmware Upgrade (DFU) over UART, see *"RN2483 LoRa® Technology Module Command Reference User's Guide"* (DS40001784)



Operational

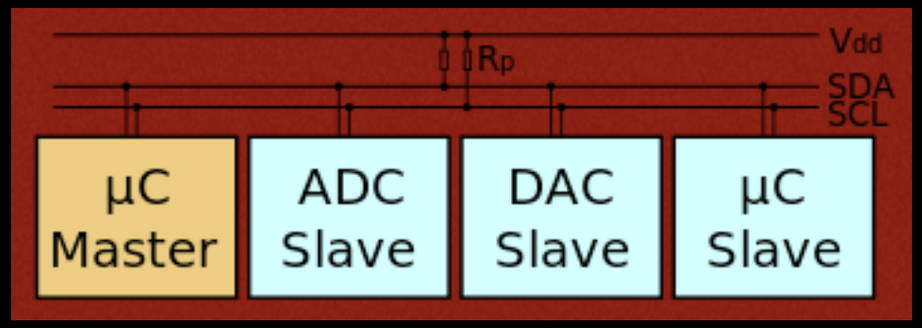
RX (receive)/TX (transmit)



- `screen /dev/ttyACM0 9600`

I2C

- Bus

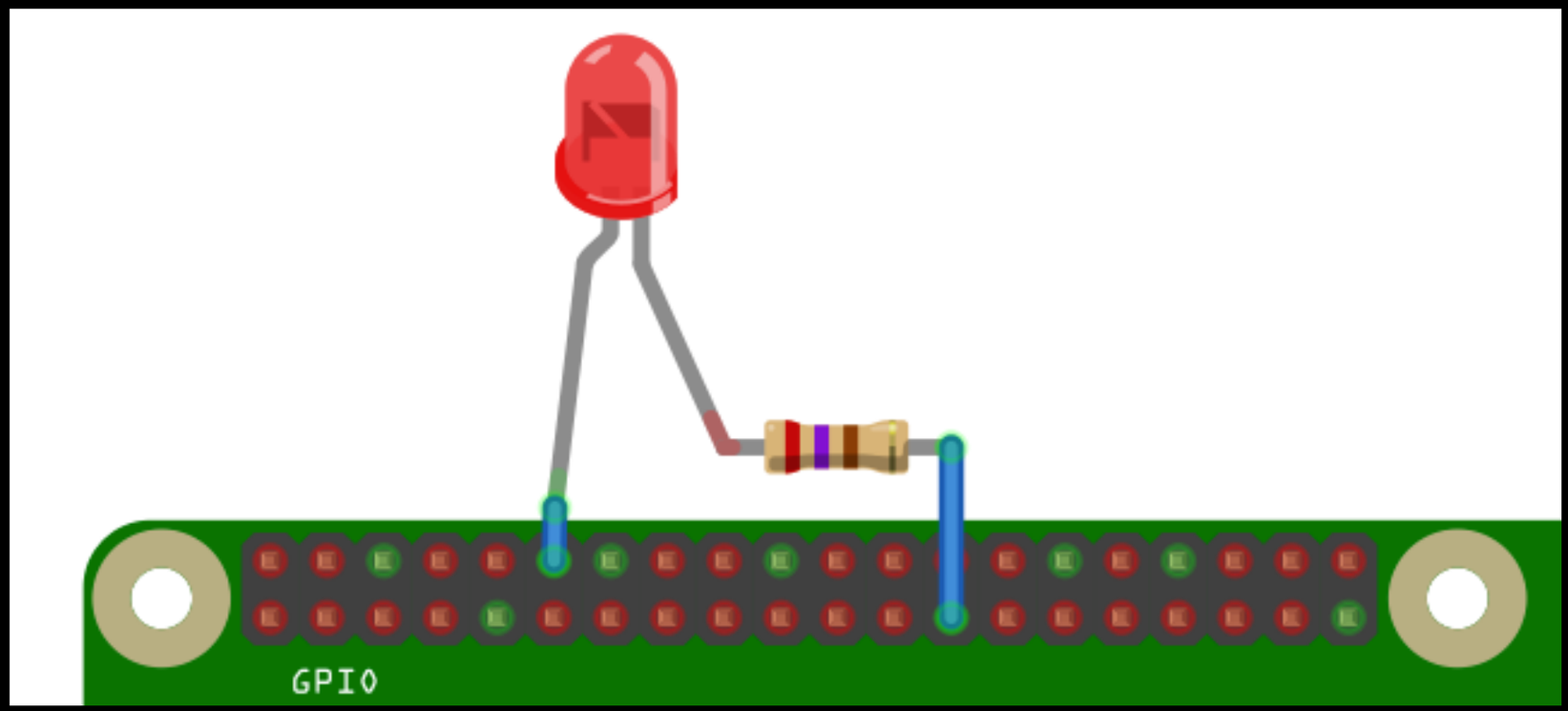


- Install `i2c-tools` and use `i2c-detect`

- For displays, sensors, motor controllers, etc.

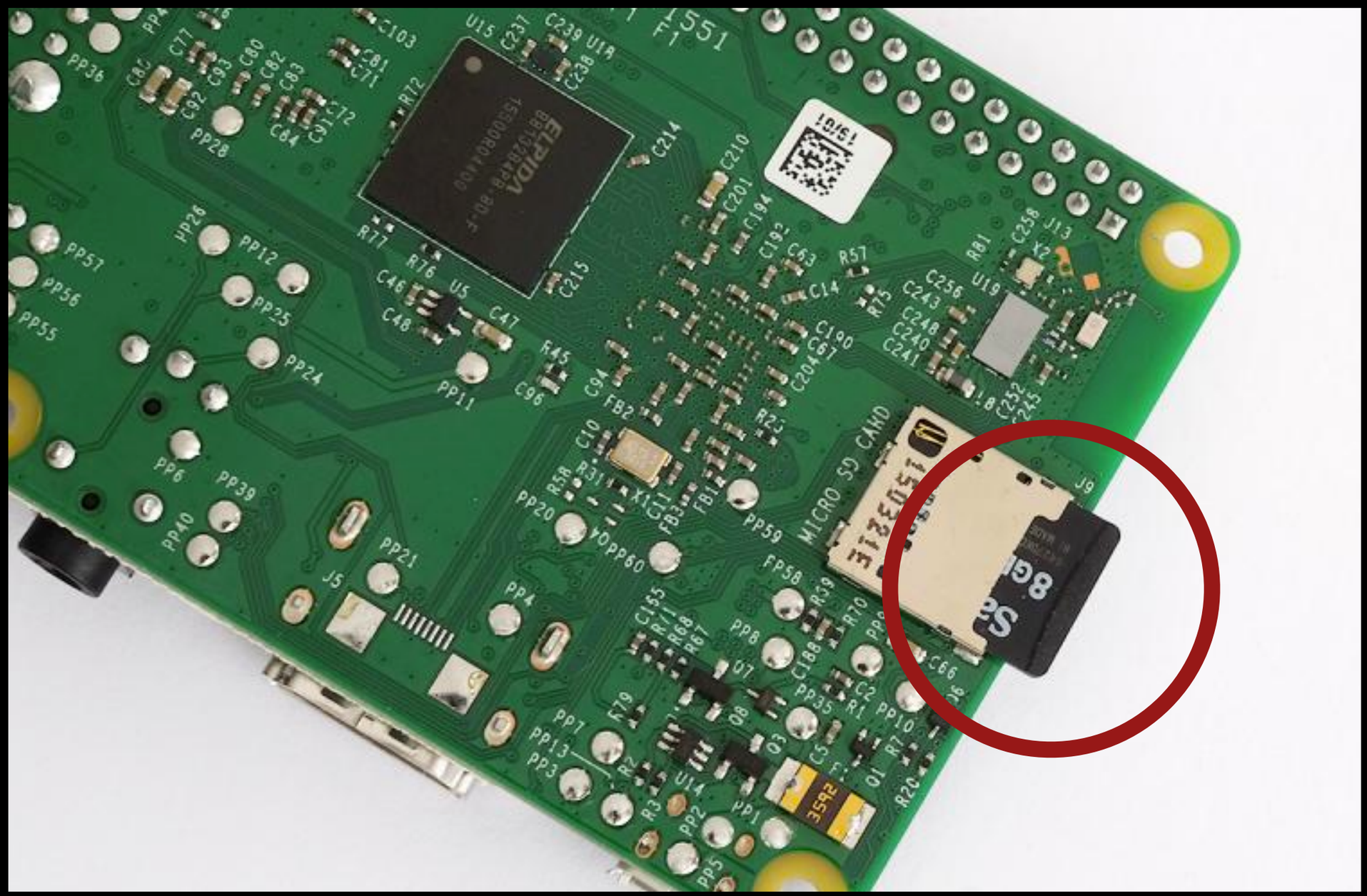
Exercise

- Connect a LED and turn it on using the «gpio utility».

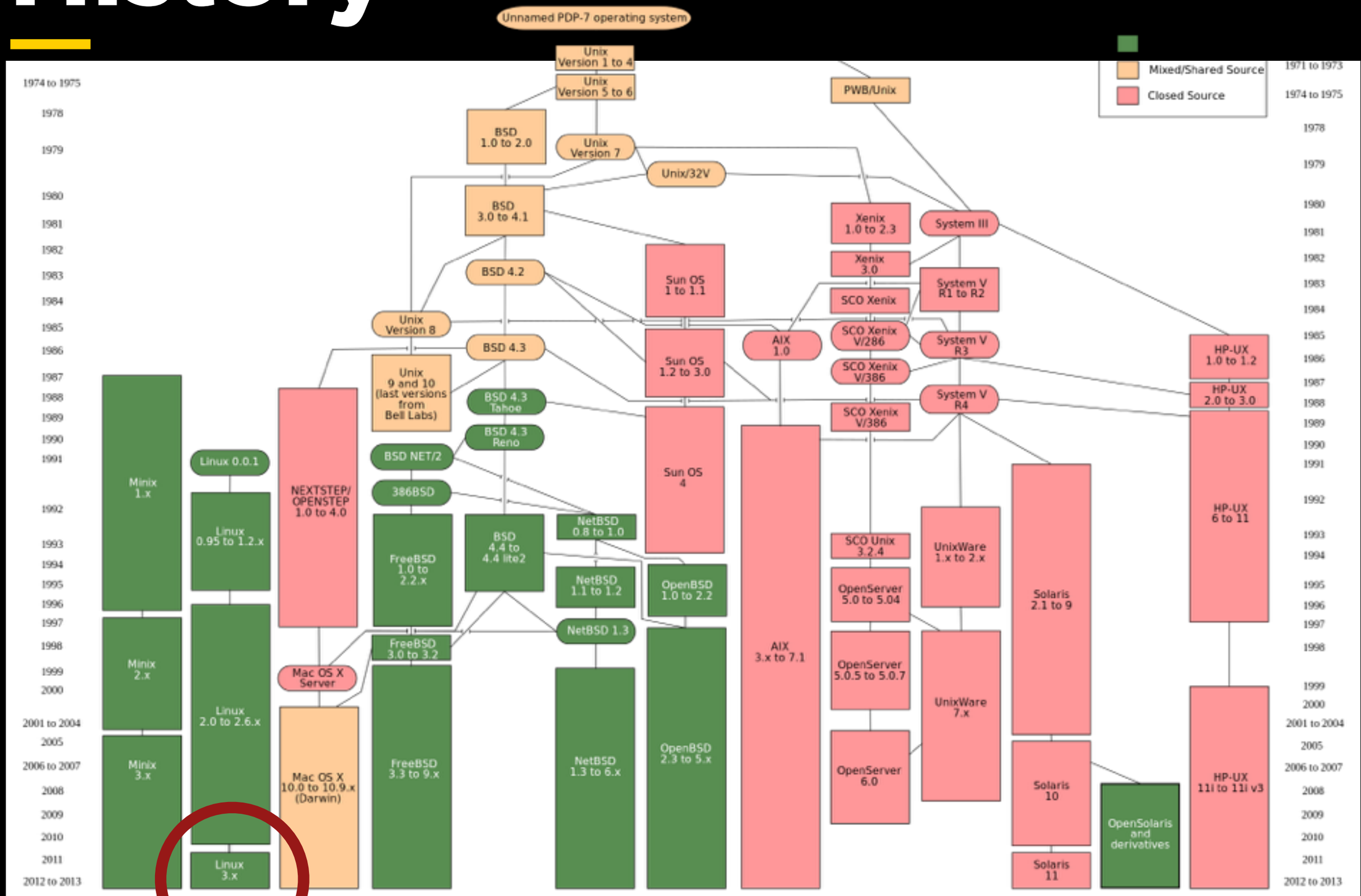


Part III

The Operating System


MICRO SD CARD
PP59
PP60
PP58
PP8
PP35
PP10
PP7
PP13
PP3
PP2
PP1
PP5
PP4
PP21
PP20
PP6
PP39
PP40
PP24
PP11
PP25
PP12
PP26
PP57
PP56
PP55
PP36
PP28
J5
J9
J13
X1
X2
U5
U7
U8
U14
U15
U19
U1A
C103
C81
C71
C72
C91
C64
C92
C93
C60
C82
C83
C77
C85
R72
R77
R76
C46
C48
C47
C214
C215
C210
C201
C194
C192
C63
R57
C14
C256
C243
C248
C240
C241
C190
C67
C204
C232
C245
R81
C258
R45
C96
C94
FB2
C10
R58
R31
C11
FB3
FB1
R25
R39
R10
C155
R71
R68
R67
C188
C66
C2
R1
R79
R2
R3
R7
R20
C5
3592
1551
F1
1510
8GB
octanis

History


Unnamed PDP-7 operating system
Unix Version 1 to 4
Unix Version 5 to 6
Unix Version 7
PWB/Unix
BSD 1.0 to 2.0
Unix/32V
BSD 3.0 to 4.1
Xenix 1.0 to 2.3
System III
Xenix 3.0
BSD 4.2
Sun OS 1 to 1.1
System V R1 to R2
SCO Xenix
Unix Version 8
BSD 4.3
AIX 1.0
SCO Xenix V/286
System V R3
HP-UX 1.0 to 1.2
Sun OS 1.2 to 3.0
SCO Xenix V/386
Unix 9 and 10 (last versions from Bell Labs)
BSD 4.3 Tahoe
System V R4
HP-UX 2.0 to 3.0
BSD 4.3 Reno
Sun OS 4
BSD NET/2
Minix 1.x
Linux 0.0.1
NEXTSTEP/ OPENSTEP 1.0 to 4.0
386BSD
Linux 0.95 to 1.2.x
FreeBSD 1.0 to 2.2.x
BSD 4.4 to 4.4 lite2
NetBSD 0.8 to 1.0
AIX 3.x to 7.1
SCO Unix 3.2.4
UnixWare 1.x to 2.x
HP-UX 6 to 11
OpenServer 5.0 to 5.04
Solaris 2.1 to 9
NetBSD 1.1 to 1.2
OpenBSD 1.0 to 2.2
NetBSD 1.3
OpenServer 5.0.5 to 5.0.7
UnixWare 7.x
Minix 2.x
Linux 2.0 to 2.6.x
FreeBSD 3.0 to 3.2
Mac OS X Server
OpenBSD 2.3 to 5.x
Minix 3.x
Mac OS X 10.0 to 10.9.x (Darwin)
FreeBSD 3.3 to 9.x
NetBSD 1.3 to 6.x
OpenServer 6.0
Solaris 10
OpenSolaris and derivatives
HP-UX 11i to 11i v3
Linux 3.x
Solaris 11
Mixed/Shared Source
Closed Source
1971 to 1973
1974 to 1975
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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1996
1997
1998
1999
2000
2001 to 2004
2005
2006 to 2007
2008
2009
2010
2011
2012 to 2013

Linux

- is not an operating system
- comes in flavors: Raspian
- robust, versatile, stable

Bash (Shell)

- Fundamental: Type something, press enter, view output.

- $

Tools

- pwd
- ls
- cd
- cat
- less
- tail
- sudo
- mkdir
- touch
- nano
- mv
- cp
- rm
- man
- df
- du
- free
- who
- uptime
- ifconfig
- reboot
- halt
- top
- ps
- grep

Filesystem

- /
  - /etc - nerve center of your system, config files
  - /var - logs, temp
  - /usr - shareable, read-only data
  - /home - users directories in here
  - /dev - “device files” (in Linux everything is a file or a directory)
- dot files «.test»

Installing Software

- sudo apt-get install *SomeRandomApplication*
- apt-cache search *That Thing I Can't Remember*

Bash cont.

- Examples:

```
cat /var/log/syslog | less
```

```
for i in {1..500}; do echo 'Hi!' $(($i % 2)); sleep 1; done
```

Bash scripting

- `nano myfirstscript`
- ```
  #!/bin/bash
  echo Hello!
  echo World?
  whoami
  ```
- `chmod +x myfirstcript`
- `./myfirstscript`
  ```

Warning!

- Do not unplug your Raspberry Pi without shutting down the operating system! The SD card could be corrupted.
- SD cards have limited write cycles.

Exercise

- Create a directory in your home and create an empty file called “myscript”
- Edit “myscript” and write a script that outputs “hello world”
- The script must also create a new directory “woz” and create a file “niak.txt” inside it
- **Bonus**: make your LED blink using the GPIO utility in just one line

Part IV

Networking and Remote Access

IP addresses, names, etc.

- What's a computer network?
- What's the internet?
- What's DHCP and DNS?
- How can I set a static IP ?

Wifi

- To change the wifi on your Pi, the easiest is to connect a screen, keyboard and mouse. Or use VNC!

- Wifi config: `/etc/wpa_supplicant/wpa_supplicant.conf`

- IP config: `/etc/network/interfaces`

Ethernet

- Connect to home “router” and let DHCP assign an IP.
- Look at web interface of “router” to see what IP your Pi got.
- Connect to your Pi!

SSH

- ssh pi@192.168.2.10
- `ssh pi@planetebleue.ch`
- Warning: Passwords vs. Keys

SFTP

- Drag and drop files onto the Pi from your computer

- cyberduck.io

VNC

- VNC DEMO
- Warning!

Exercise

- Install “tightvncserver”, run “vncserver :1” on Pi
- Download www.realvnc.com/download/viewer
- Connect to the Raspberry Pi with the VNC viewer
- Use SCP to copy your favorite cat picture into your home directory. Then, delete the cat picture using the terminal. Download www.cyberduck.io for Mac / Win

Part V

Examples & Programming (Python / Node Red)

Examples

- RFID reader: http://bit.ly/2bYJXwu
- LoRa utility: https://github.com/cheminfo/lora
- Servo motor control using PWM: http://razzpisampler.oreilly.com/ch05.html
- Weather station

Specific libraries

- pyserial - Python Serial Port Extension
- RPi.GPIO - A module to control Raspberry Pi GPIO channels

GPIO demo code

- ```
  import RPi.GPIO as GPIO
  GPIO.setmode(GPIO.BOARD)
  GPIO.setup(7, GPIO.OUT)
  GPIO.output(7,True)
  ```

- **Ref:** http://makezine.com/projects/tutorial-raspberry-pi-gpio-pins-and-python
  ```

Graphical programming:

Node-RED

- Browse to http://YOURPLANET:1880

Exercise

- `wget http://goo.gl/0ZDOdX -O intro.py`
- OR
- make your LED blink when a tweet comes in using Node-RED

Presentations