Summer Bootcamp - 2022

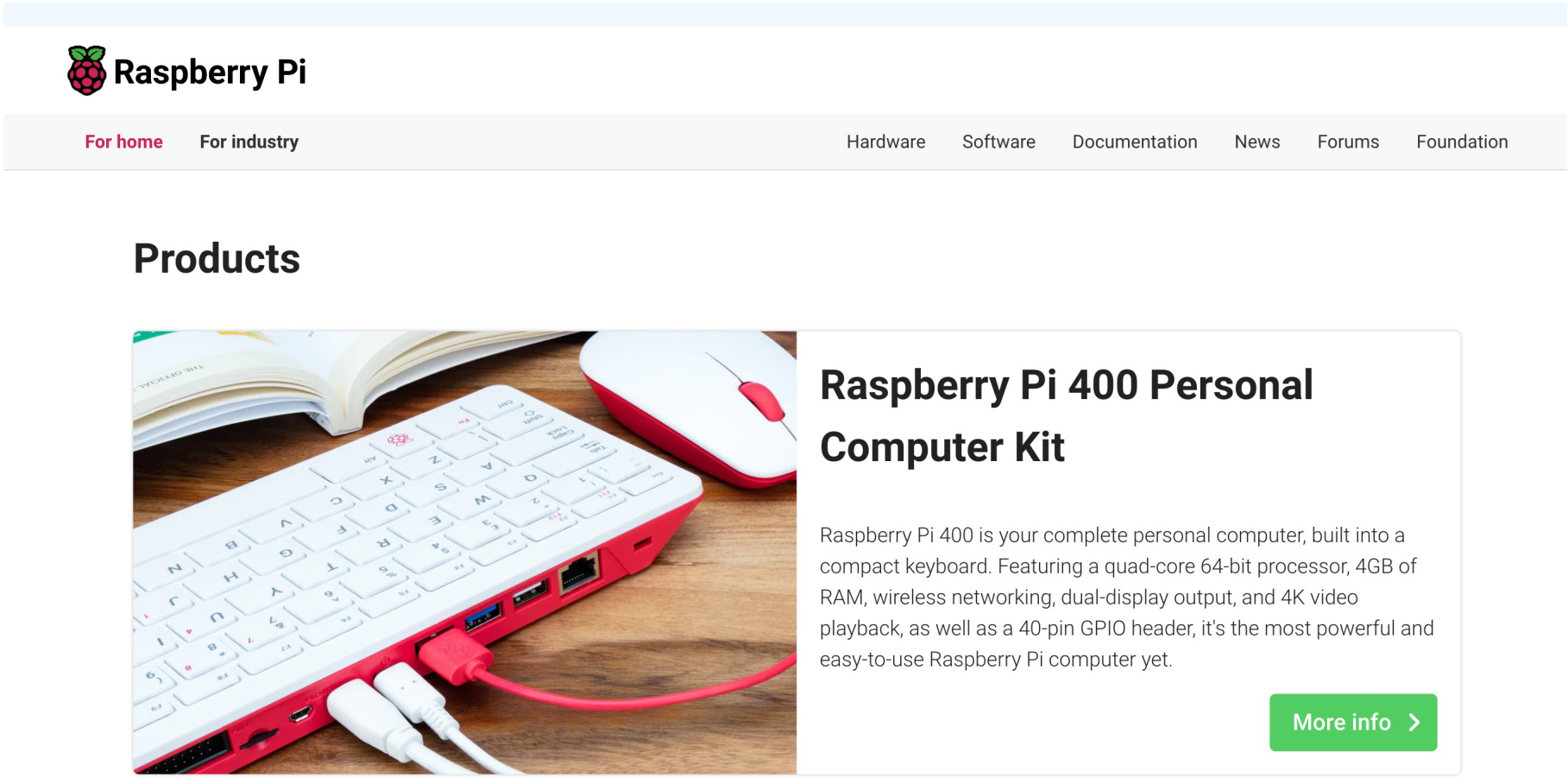
Network Coding

Workshop

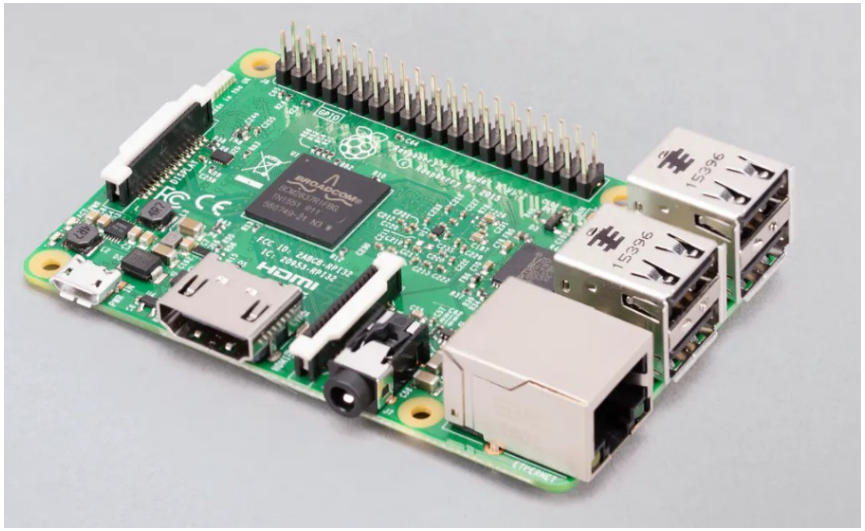
Workshop Day 1

- Raspberry Pi
  - Installation & Configuration
  - Connectivity: VNC and SSH (Raspberry Pi Configuration)
  - Static IP
- Connectivity
  - Network Connection
  - Remote Access (VNC, SSH, VSC, Putty, …etc)
- Unix Command
  - ls, rm, mkdir, del, cd, pwd
- Editing - vi
- Write a Hello World on raspberry pi

Raspberry Pi – official website

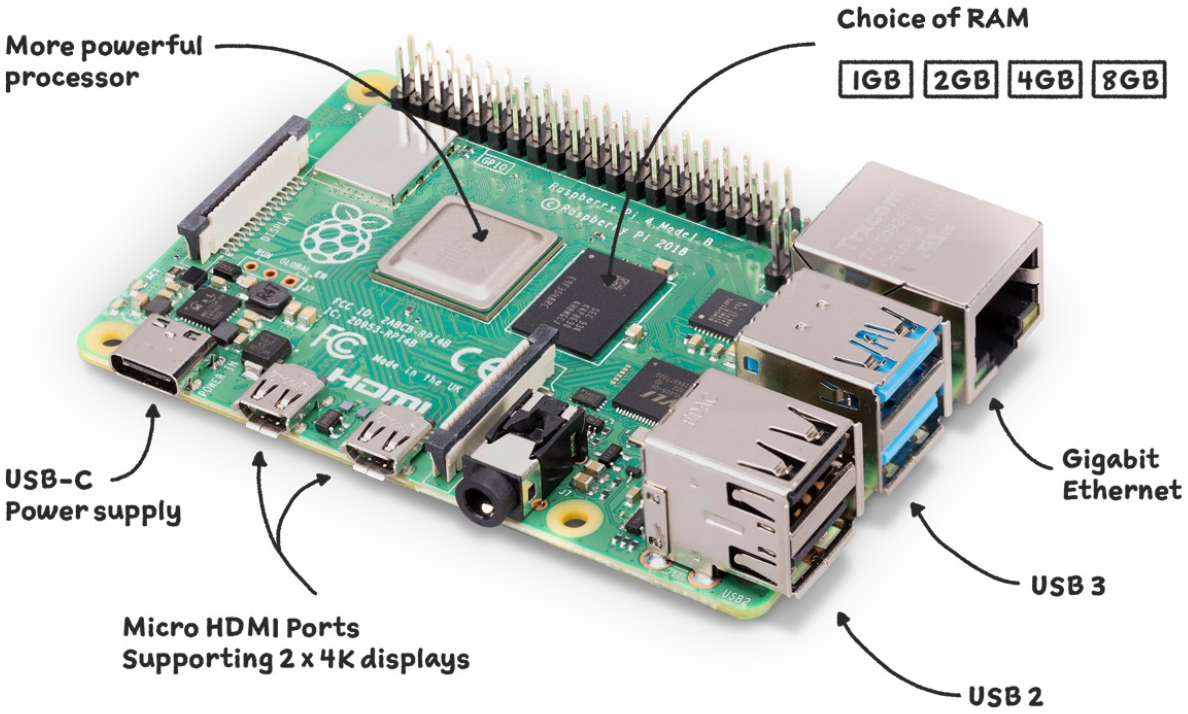


Raspberry Pi – 3rd Generation Model B

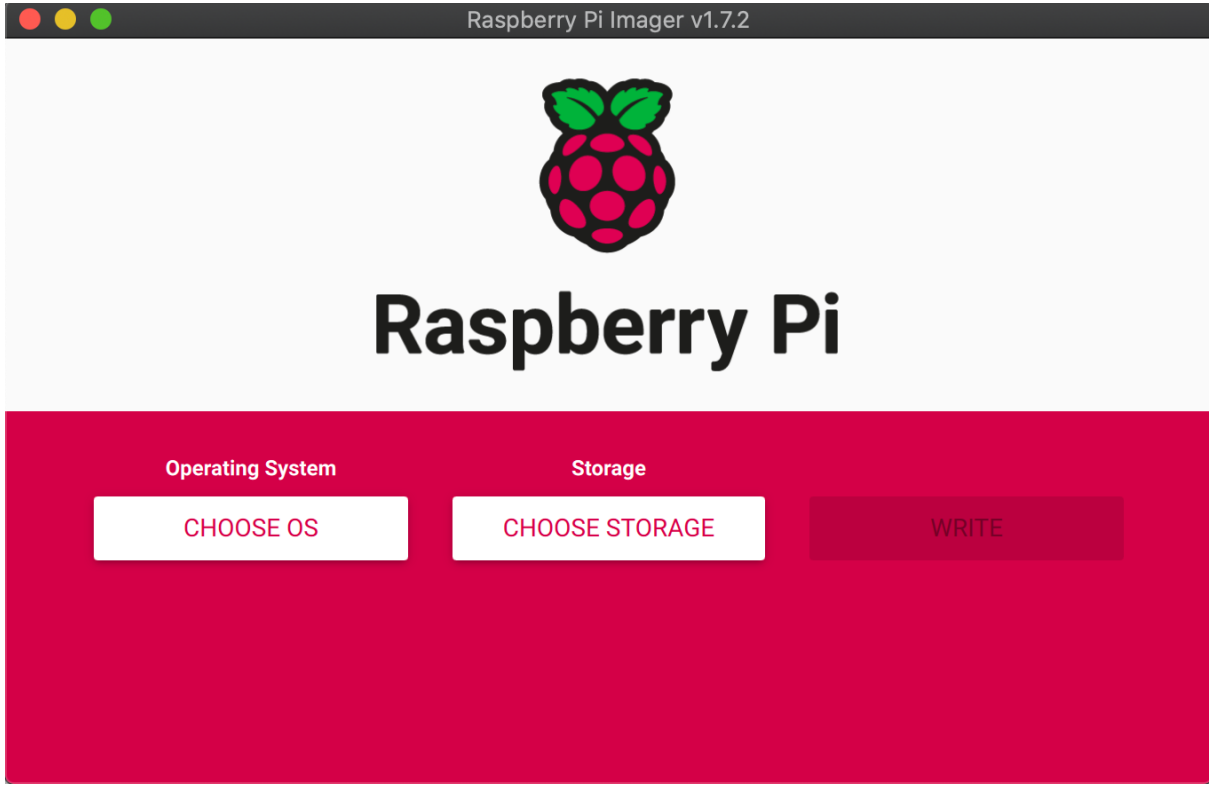


Quad Core 1.2GHz Broadcom BCM2837 64bit CPU
1GB RAM
BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
100 Base Ethernet
40-pin extended GPIO
4 USB 2 ports
4 Pole stereo output and composite video port
Full size HDMI
CSI camera port for connecting a Raspberry Pi camera
DSI display port for connecting a Raspberry Pi touchscreen display
Micro SD port for loading your operating system and storing data
Upgraded switched Micro USB power source up to 2.5A

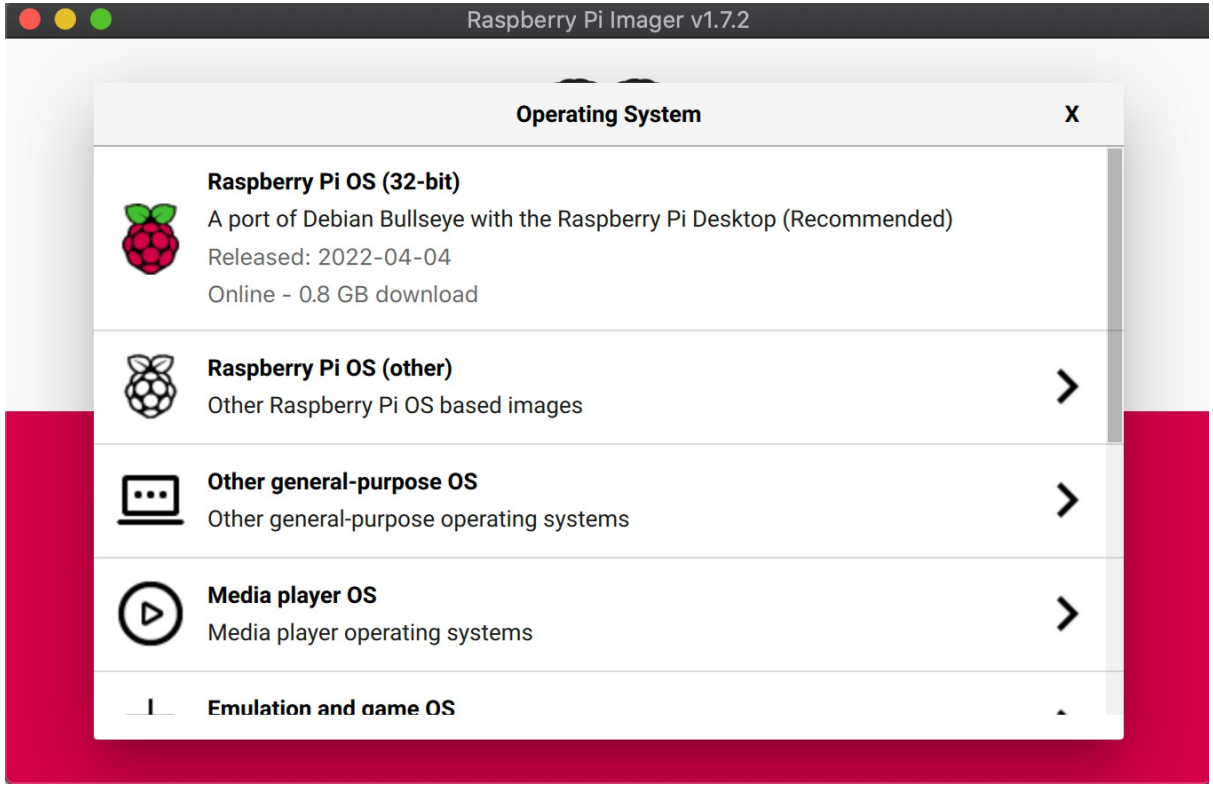
Raspberry Pi – Model 4 (latest)



Installation & Configuration

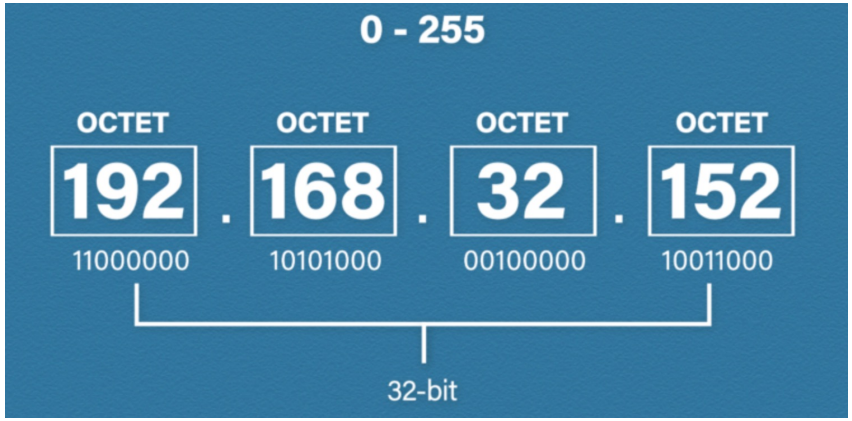


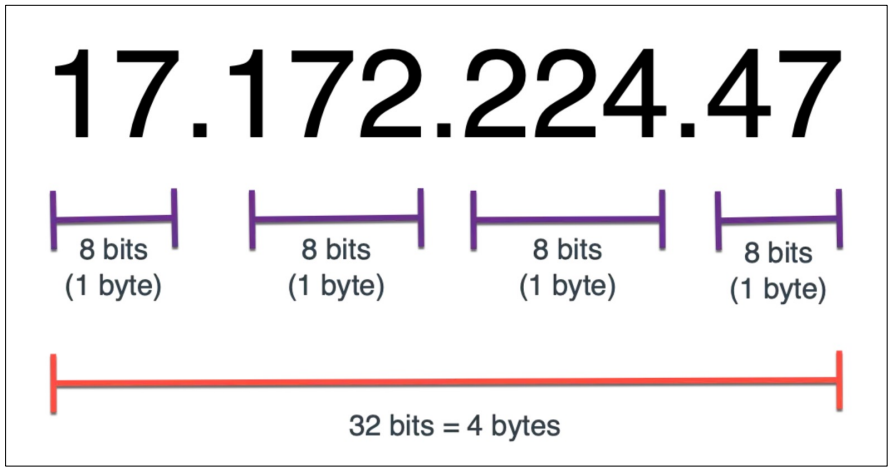
Choose OS – Desktop, Non-Desktop, general



Network Address – IP4 (Quick Overview)

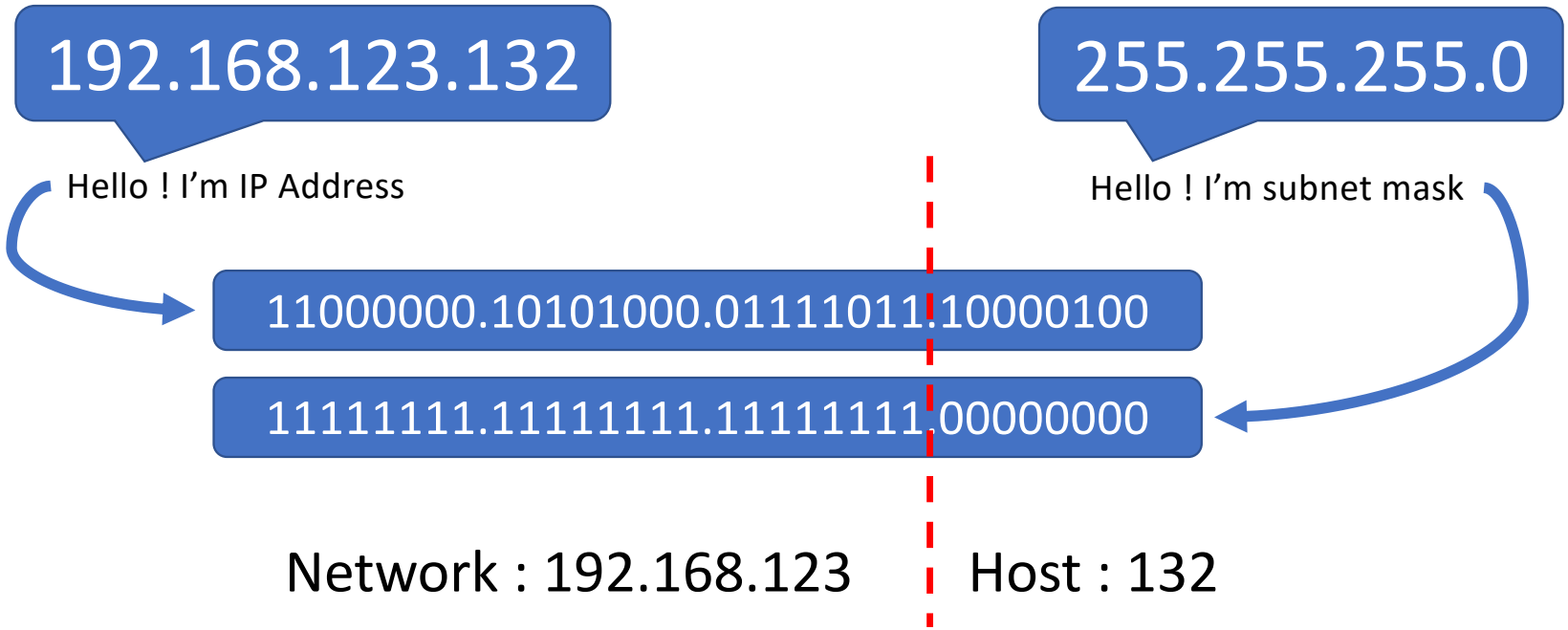
- Address Format
- Subnet Mask (1's)
- Network ID
- Host ID
- Address Allocation
  - Dynamic vs Static
- Types
  - Public vs Private





Subnetting

- Subnetting is the process to divide the larger network into smaller sub-networks (subnets)

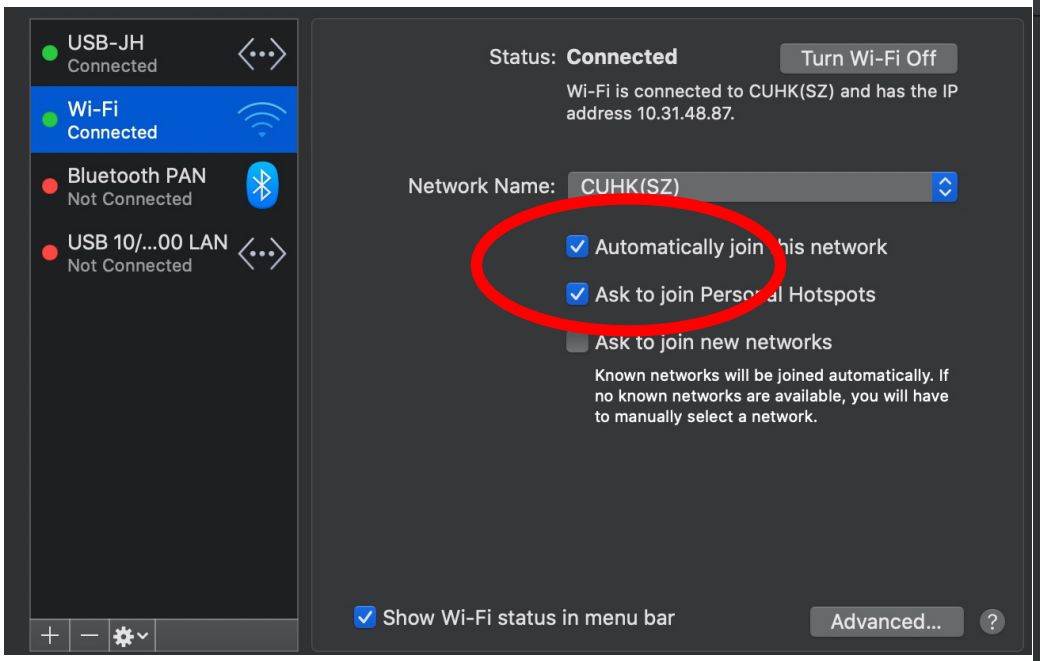


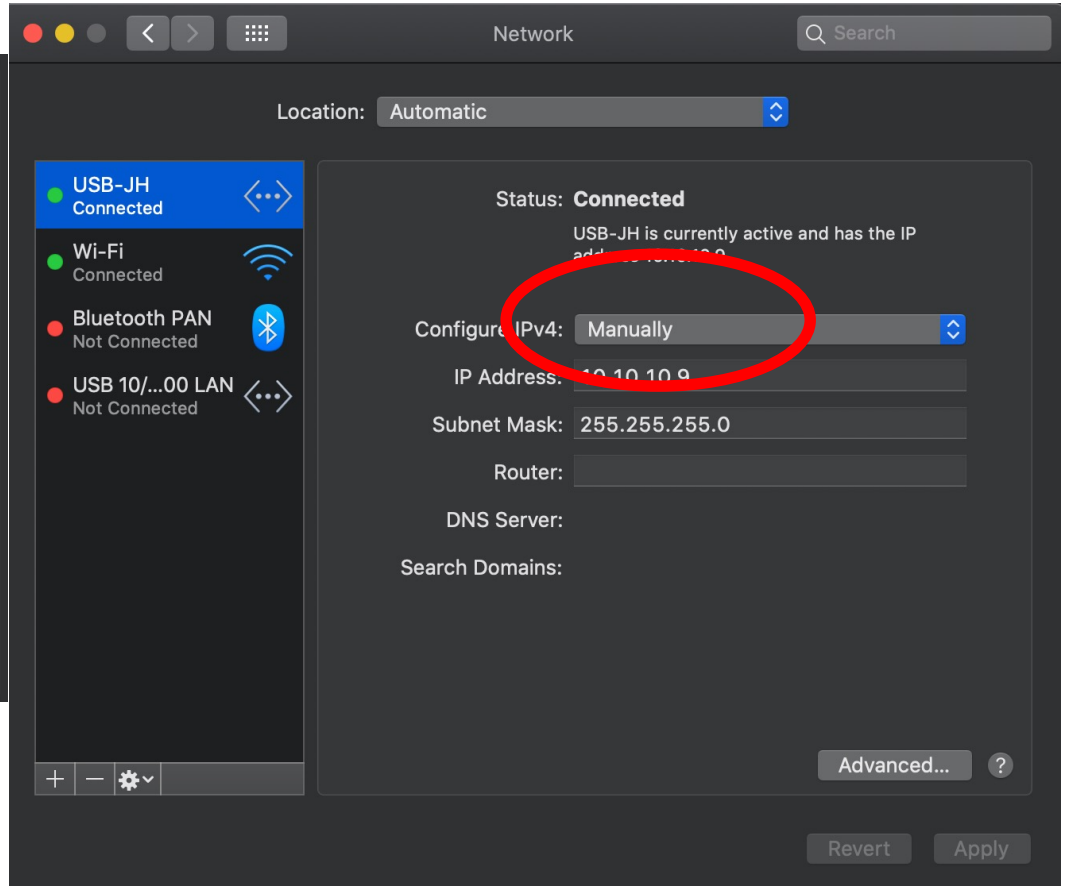
Public vs Private IP (Public vs Private network)

- Class A: 10.0.0.0 — 10.255.255.255
- Class B: 172.16.0.0 — 172.31.255.255
- Class C: 192.168.0.0 — 192.168.255.255

Public IP address	Private IP address
External (global) reach	Internal (local) reach
Used for communicating outside your private network, over the internet	Used for communicating within your private network, with other devices in your home or office
A unique numeric code never reused by other devices	A non-unique numeric code that may be reused by other devices in other private networks
Found by Googling: "What is my IP address?"	Found via your device's internal settings
Assigned and controlled by your internet service provider	Assigned to your specific device within a private network
Not free	Free
Any number not included in the reserved private IP address range Example: 8.8.8.8.	10.0.0.0 — 10.255.255.255; 172.16.0.0 — 172.31.255.255; 192.168.0.0 — 192.168.255.255 Example: 10.11.12.13

Auto vs Manual IP





IP Classes

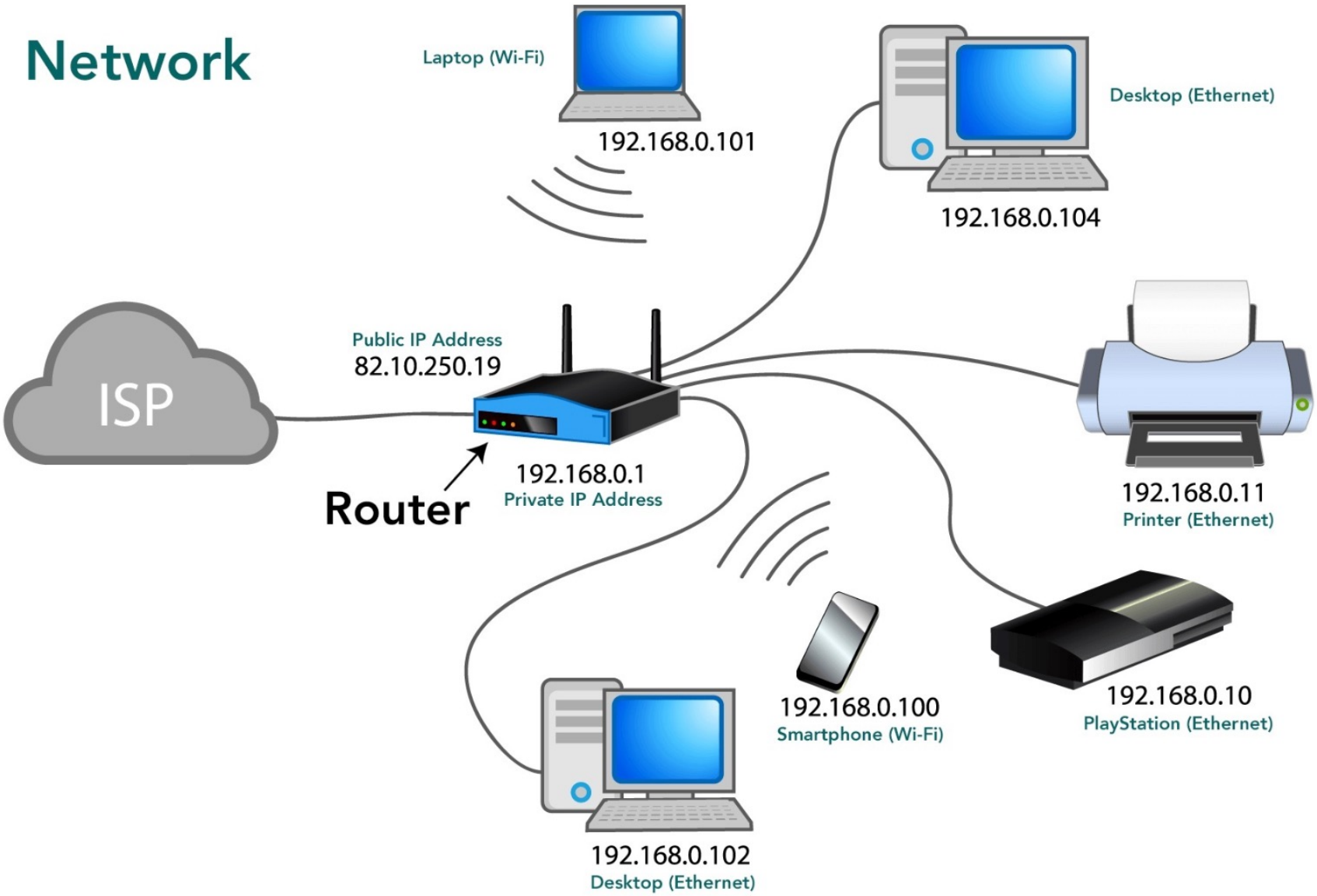
Class	IP Address Range (Theoretical)	Start-Bits	Application / Used for
A	0.0.0.0 to 127.255.255.255	0	Very large networks
B	128.0.0.0 to 191.255.255.255	10	Medium networks
C	192.0.0.0 to 223.255.255.255	110	Small networks
D	224.0.0.0 to 239.255.255.255	1110	Multicast
E	240.0.0.0 to 247.255.255.255	1111	Experimental

Cable Categories

Category	Max. Data Rate	Bandwidth	Max. Distance	Usage
Category 1	1 Mbps	0.4 MHz		Telephone and modem lines
Category 2	4 Mbps	4 MHz		LocalTalk & Telephone
Category 3	10 Mbps	16 MHz	100 m (328 ft.)	10BaseT Ethernet
Category 4	16 Mbps	20 MHz	100 m (328 ft.)	Token Ring
Category 5	100 Mbps	100 MHz	100 m (328 ft.)	100BaseT Ethernet
Category 5e	1 Gbps	100 MHz	100 m (328 ft.)	100BaseT Ethernet, residential homes
Category 6	1 Gbps	250 MHz	100 m (328 ft.) 10Gb at 37 m (121 ft.)	Gigabit Ethernet, commercial buildings
Category 6a	10 Gbps	500 MHz	100 m (328 ft.)	Gigabit Ethernet in data centers and commercial buildings
Category 7	10 Gbps	600 MHz	100 m (328 ft.)	10 Gbps Core Infrastructure
Category 7a	10 Gbps	1000 MHz	100 m (328 ft.) 40Gb at 50 m (164 ft.)	10 Gbps Core Infrastructure
Category 8	25 Gbps (Cat8.1) 40 Gbps (Cat8.2)	2000 MHz	30 m (98 ft.)	25 Gbps/40 Gbps Core Infrastructure

Gateway

- A network gateway joins two networks so the devices on one network can communicate with the devices on another network.
- Without gateways, you wouldn't be able to access the internet, communicate and send data back and forth.


Network
Laptop (Wi-Fi)
192.168.0.101
Desktop (Ethernet)
192.168.0.104
ISP
Public IP Address
82.10.250.19
192.168.0.1
Private IP Address
Router
192.168.0.11
Printer (Ethernet)
192.168.0.100
Smartphone (Wi-Fi)
192.168.0.10
PlayStation (Ethernet)
192.168.0.102
Desktop (Ethernet)

Routing Table

- route

```
root@raspberrypi:~# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         10.20.12.254    0.0.0.0         UG    303    0        0 wlan0
10.10.10.0      10.10.10.5      255.255.255.0   UG    0      0        0 eth0
10.20.12.0      0.0.0.0         255.255.255.0   U     303    0        0 wlan0
root@raspberrypi:~#
```

- route -n

```
root@raspberrypi:~# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.20.12.254    0.0.0.0         UG    303    0        0 wlan0
10.10.10.0      10.10.10.5      255.255.255.0   UG    0      0        0 eth0
10.20.12.0      0.0.0.0         255.255.255.0   U     303    0        0 wlan0
root@raspberrypi:~#
```

Remote Access - Unix

- SSH – Secure Shell (Remote Login, separate UNIX session)
- VNC – Virtual Network Computing, a deskop sharing system that allows you remotely control another computer, by transmitting all your keyboard and mouse movements from your computer.
- VSC – Visual Studio Code (SSH extension)
- Putty – SSH and Telnet client (GUI Based)

IP4 Commands

- ifconfig
- ip route get <ip>
- ping <ip>
- route -n
- traceroute

Route – Adding a new route

- route add

```
/sbin/route add -net 10.10.10.0/24 gw 10.10.10.5 dev eth0
```

- reboot machine !!!

Route – persisting route

- /etc/dhcpcd.exit-hook

```
dhcp/                dhcpcd.conf        dhcpcd.exit-hook
root@raspberrypi:/etc# vi dhcpcd.exit-hook
root@raspberrypi:/etc#
```

```
/sbin/route add -net 10.10.10.0/24 gw 10.10.10.5 dev eth0
~
~
~
~
~
~
~
```

Unix Command – Cheat Sheet

ls	To list the directory.
pwd	To show the current directory.
mkdir folder	To create a new directory with the name *folder*
cp f1 f2	To copy file f1 to file f2
mv f1 f2	To move file f1 to file f2 if there exists a file named f2
rm f1	To delete a file named f1
rm –r file	To remove a file forcefully
rm –r dir	To delete a directory named *dir*
rm –rf dir	To forcefully remove a directory named dir
rm –f f1	To forcefully remove a file named f1
touch file	To create or update a file
more file	To print the contents of a file as output
head file	To print the contents of the first 10 lines of the file as output
tail file	To print the contents of the last 10 lines of the file as output

PROCESS COMMANDS	
ps	To display all the currently active processes in the OS
kill pid	To kill the process with the mentioned process id as pid
fg	To bring the recently running job to foreground
bg	To list all the current background running processes or jobs
top	To display all the running processes.

NETWORK	
ifconfig	To list down all the network related details such as all the assigned IP addresses IPv4 and IPv6, network interfaces etc.,
netstat	To list down all the ongoing connections in the local system and the details of ports being listened to and the services those are waiting for requests.
nslookup	To query the DNS lookup and find the related details.
hostname	To know the details of the hostname and IP address mapped.

SEARCHING	
find	To search the files in the directory specified.
grep	To search the selected lines in all the files that match the given pattern.
grep <pattern> <files>	To search for the pattern in given lines.
grep –rn <pattern> <dir>	To search the pattern recursively for the pattern in a given directory including the line number.
grep –r <pattern> <dir>	To search the pattern recursively for the pattern in given directory.
command | grep <pattern>	To search for the pattern in the given output of the command.
Locate file	To find all the instances of the file using an index-based system of the database that is built of updated command.
Find file	To find all the occurrences of a file in the real system file directory.

vi

Vi

- Mode
  - Command (esc) vs Input
- Input
  - a,i,o,O
- Show Mode
- Move Command
  - hjkl (left, up, down, right)
  - ^$ (beginning, end)
  - w,b (word)
- Delete & Undo (dd, u, dw)
- Yank & Copy (Y, p, P, “aY, “aP)
- File Command (:q, :w, :wq, q!)
- Search (start,end/search)

vi Editor "Cheat Sheet"

Invoking vi: vi *filename*
Format of vi commands: *[count][command]* (count repeats the effect of the command)

Command mode versus input mode

Vi starts in command mode. The positioning commands operate only while vi is in command mode. You switch vi to input mode by entering any one of several vi input commands. (See next section.) Once in input mode, any character you type is taken to be text and is added to the file. You cannot execute any commands until you exit input mode. To exit input mode, press the escape (**Esc**) key.

Input commands (end with Esc)

a	Append after cursor
i	Insert before cursor
o	Open line below
O	Open line above
:r *file*	Insert *file* after current line

Any of these commands leaves vi in input mode until you press **Esc**. Pressing the **RETURN** key will not take you out of input mode.

Change commands (Input mode)

cw	Change word (Esc)
cc	Change line (Esc) - blanks line
c$	Change to end of line
r*c*	Replace character with *c*
R	Replace (Esc) - typeover
s	Substitute (Esc) - 1 char with string
S	Substitute (Esc) - Rest of line with text
.	Repeat last change

Changes during insert mode

<ctrl>h	Back one character
<ctrl>w	Back one word
<ctrl>u	Back to beginning of insert

File management commands

:w *name*	Write edit buffer to file *name*
:wq	Write to file and quit
:q!	Quit without saving changes
ZZ	Same as :wq
:sh	Execute shell commands (<ctrl>d)

Window motions

<ctrl>d	Scroll down (half a screen)
<ctrl>u	Scroll up (half a screen)
<ctrl>f	Page forward
<ctrl>b	Page backward
/string	Search forward
?string	Search backward
<ctrl>l	Redraw screen
<ctrl>g	Display current line number and file information
n	Repeat search
N	Repeat search reverse
G	Go to last line
*n*G	Go to line *n*
:*n*	Go to line *n*
z<CR>	Reposition window: cursor at top
z.	Reposition window: cursor in middle
z-	Reposition window: cursor at bottom

Cursor motions

H	Upper left corner (home)
M	Middle line
L	Lower left corner
h	Back a character
j	Down a line
k	Up a line
^	Beginning of line
$	End of line
l	Forward a character
w	One word forward
b	Back one word
f*c*	Find *c*
;	Repeat find (find next *c*)

Deletion commands

dd or *n*dd	Delete *n* lines to general buffer
dw	Delete word to general buffer
d*n*w	Delete *n* words
d)	Delete to end of sentence
db	Delete previous word
D	Delete to end of line
x	Delete character

Recovering deletions

p	Put general buffer after cursor
P	Put general buffer before cursor

Undo commands

u	Undo last change
U	Undo all changes on line

Rearrangement commands

yy or Y	Yank (copy) line to general buffer
"*z*6yy	Yank 6 lines to buffer *z*
yw	Yank word to general buffer
"*a*9dd	Delete 9 lines to buffer *a*
"*A*9dd	Delete 9 lines; Append to buffer *a*
"*a*p	Put text from buffer *a* after cursor
p	Put general buffer after cursor
P	Put general buffer before cursor
J	Join lines

Parameters

:set list	Show invisible characters
:set nolist	Don't show invisible characters
:set number	Show line numbers
:set nonumber	Don't show line numbers
:set autoindent	Indent after carriage return
:set noautoindent	Turn off autoindent
:set showmatch	Show matching sets of parentheses as they are typed
:set noshowmatch	Turn off showmatch
:set showmode	Display mode on last line of screen
:set noshowmode	Turn off showmode
:set all	Show values of all possible parameters

Move text from file *old* to file *new*

vi *old*	
"*a*10yy	yank 10 lines to buffer *a*
:w	write work buffer
:e *new*	edit new file
"*a*p	put text from *a* after cursor
:30,60w *new*	Write lines 30 to 60 in file *new*

Regular expressions (search strings)

^	Matches beginning of line
$	Matches end of line
.	Matches any single character
*	Matches any previous character
.*	Matches any character

Search and replace commands

Syntax:

```
:[address]s/old_text/new_text/
```

Address components:

.	Current line
n	Line number n
.+m	Current line plus m lines
$	Last line
/string/	A line that contains "string"
%	Entire file
[addr1],[addr2]	Specifies a range

Examples:

The following example replaces only the **first** occurrence of Banana with Kumquat in each of 11 lines starting with the current line (.) and continuing for the 10 that follow (.+10).

```
:.,.+10s/Banana/Kumquat
```

The following example replaces **every** occurrence (caused by the `g` at the end of the command) of `apple` with `pear`.

```
:%s/apple/pear/g
```

The following example removes the last character from every line in the file. Use it if every line in the file ends with `^M` as the result of a file transfer. Execute it when the cursor is on the first line of the file.

```
:%s/.$//
```

The End