# HPC & Parallel Programming

## Overview

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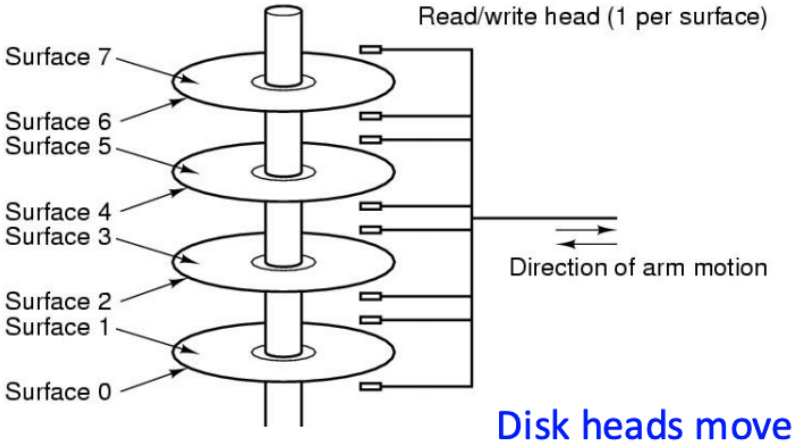
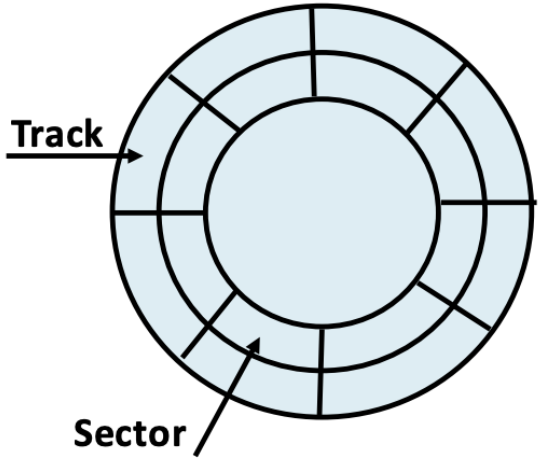
https://kevinsuo.github.io/

# Disk

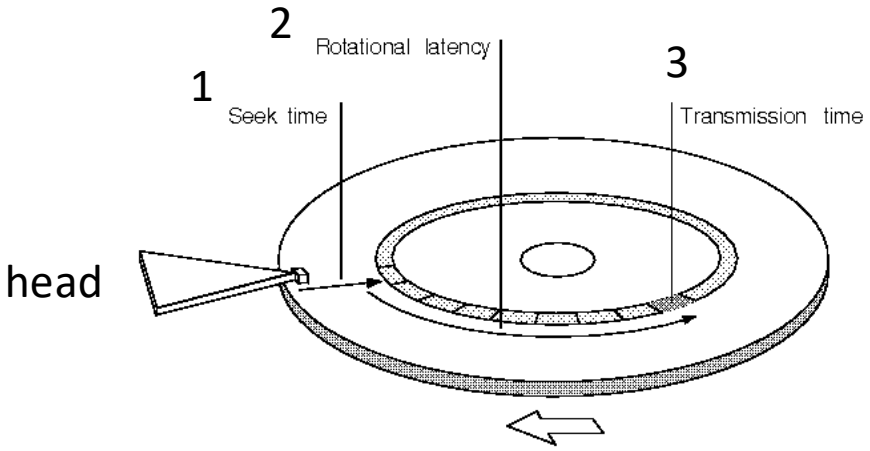



Disk heads move together



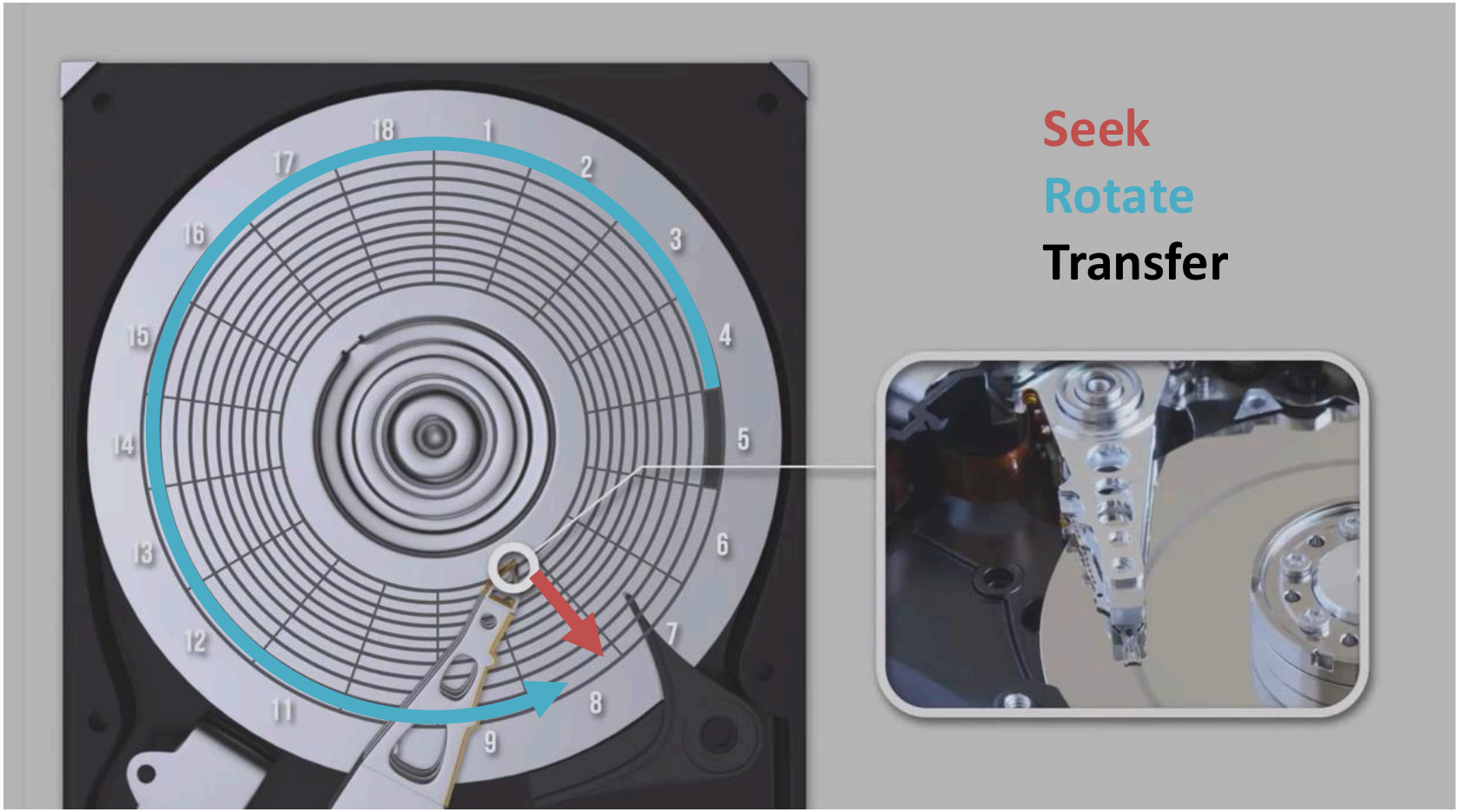

- A stack of platters, a surface with a magnetic coating
- Typical numbers (depending on the disk size):
  - 500 to 2,000 tracks per surface
  - 32 to 128 sectors per track
    - A sector is the smallest unit that can be read or written
- Originally, all tracks have the same number of sectors

# Disk




- Disk head: each side of a platter has separate disk head
- Read/write data is a three-stage process:
  - Seek time: position the arm over the proper track
  - Rotational latency: wait for the desired sector to rotate under the read/write head
  - Transfer time: transfer a block of bits (sector) under the read-write head
- Average seek time as reported by the industry:
  - Typically in the range of 8 ms to 15 ms

# Disk



# Disk information

- lsblk
  - Lists out all the storage blocks, which includes disk partitions and optical drives. Details include the total size of the partition/block and the mount point if any.

```
administrator@ubuntuvm-1604 ~> lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sr0     11:0    1  1.5G  0 rom  /media/administrator/Ubuntu 16.04.5 LTS amd64
sda      8:0    0   40G  0 disk
├─sda2   8:2    0    1K  0 part
├─sda5   8:5    0  975M  0 part [SWAP]
└─sda1   8:1    0   39G  0 part /
```

# Disk information

- df
  - prints out details about only mounted file systems. The list generated by df even includes file systems that are not real disk partitions.

```
administrator@ubuntuvm-1604 ~> df
Filesystem     1K-blocks    Used Available Use% Mounted on
udev             4054632       0   4054632   0% /dev
tmpfs             816876   42148    774728   6% /run
/dev/sda1       40168028 7350596  30753972  20% /
tmpfs            4084376    1044   4083332   1% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs            4084376       0   4084376   0% /sys/fs/cgroup
/dev/sr0         1610928 1610928         0 100% /media/administrator/Ubuntu 16.04.5 LTS amd64
tmpfs             816876      56    816820   1% /run/user/1000
```

# Disk information

- fdisk
  - display the partitions and details like file system type

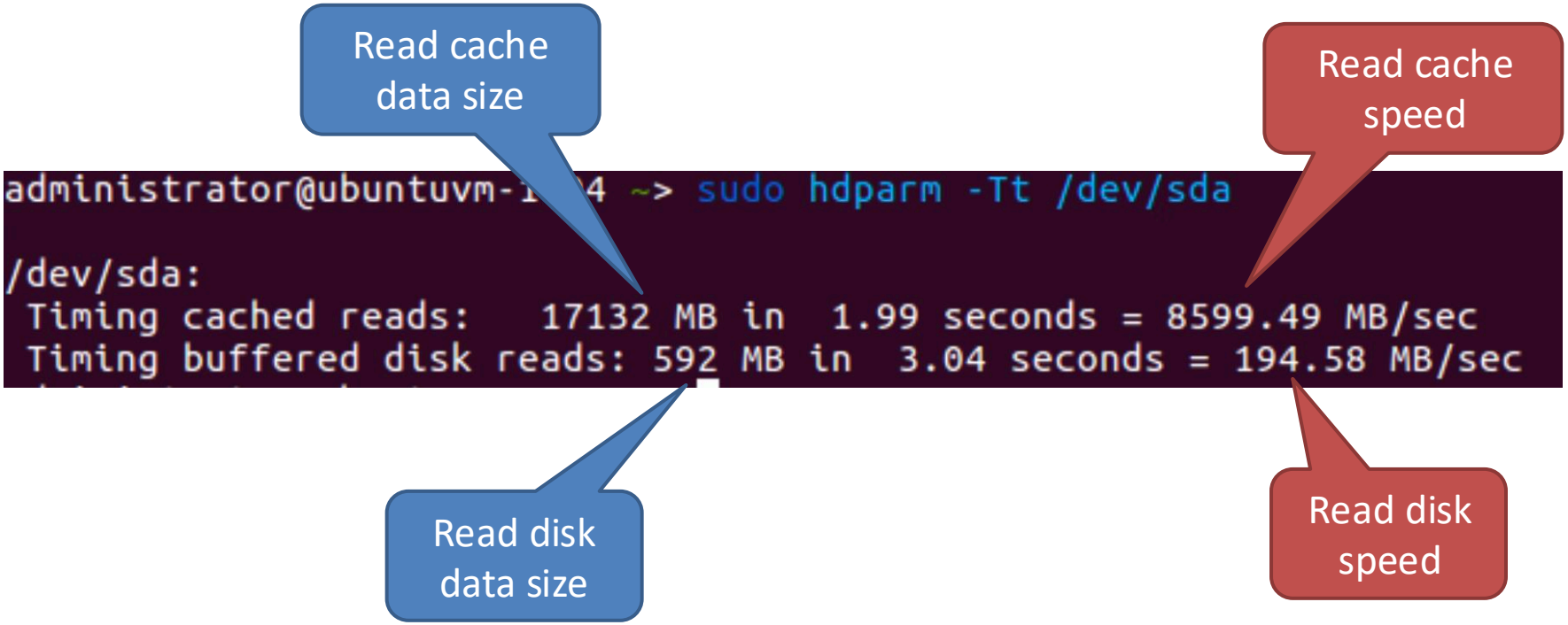
```
administrator@ubuntuvm-1604 ~> sudo fdisk -l
[sudo] password for administrator:
Disk /dev/sda: 40 GiB, 42949672960 bytes, 83886080 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x6e6dc012

Device     Boot    Start      End  Sectors  Size Id Type
/dev/sda1  *        2048 81885183 81883136   39G 83 Linux
/dev/sda2       81887230 83884031  1996802  975M  5 Extended
/dev/sda5       81887232 83884031  1996800  975M 82 Linux swap / Solaris
```

# Disk R/W Process

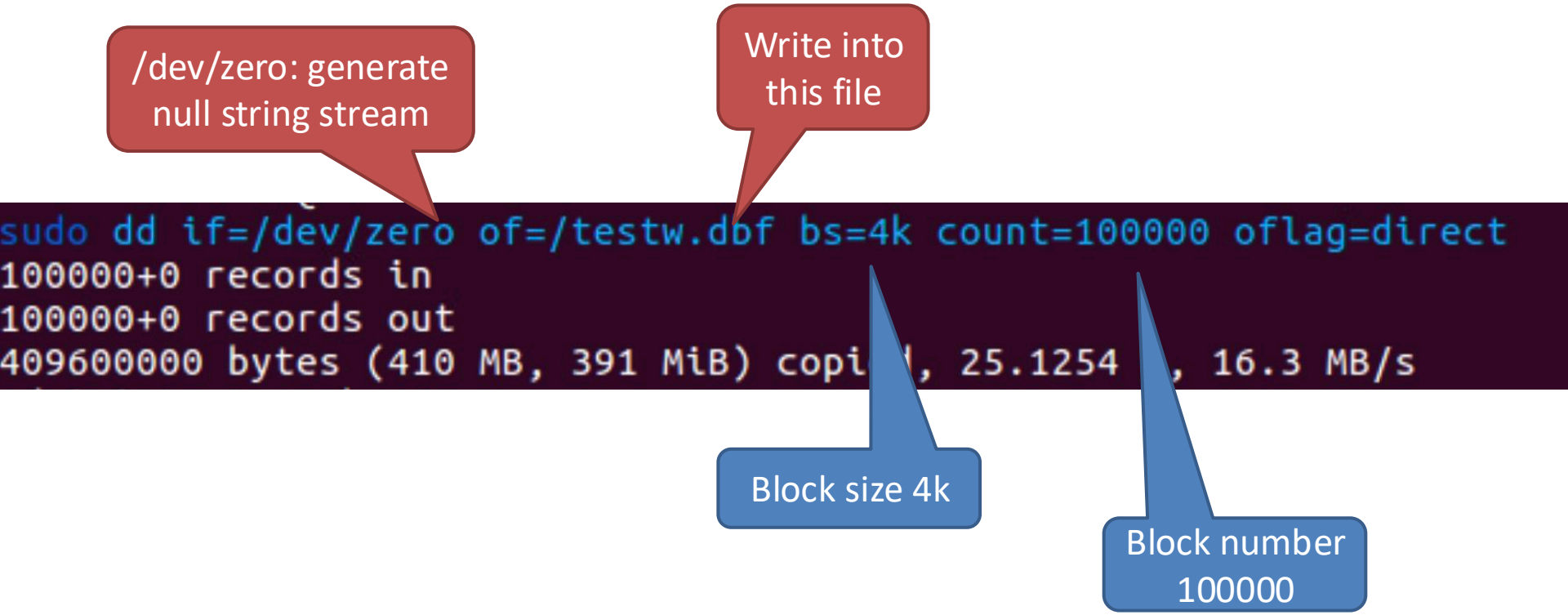
# Disk R/W Speed

- $ sudo hdparm -Tt /dev/sda



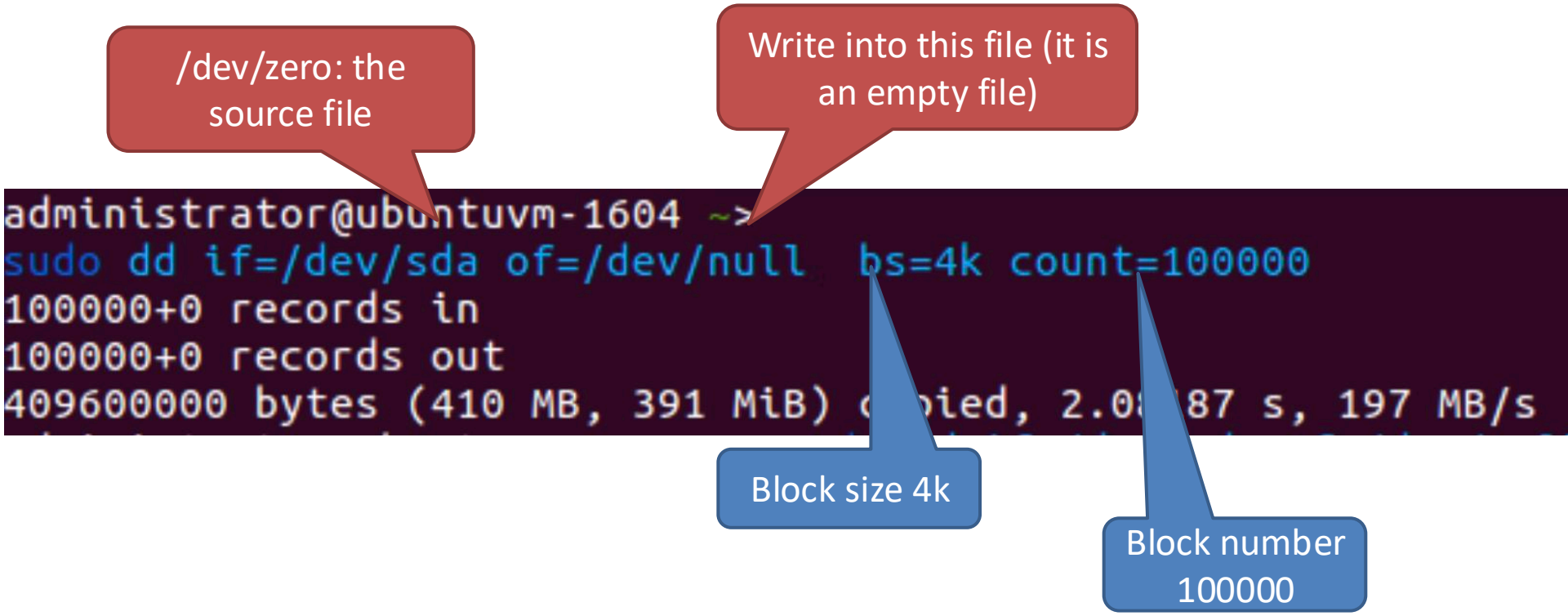
# dd: Disk Write Speed

- $ dd if=/dev/zero of=/testw.dbf bs=4k count=100000 oflag=direct

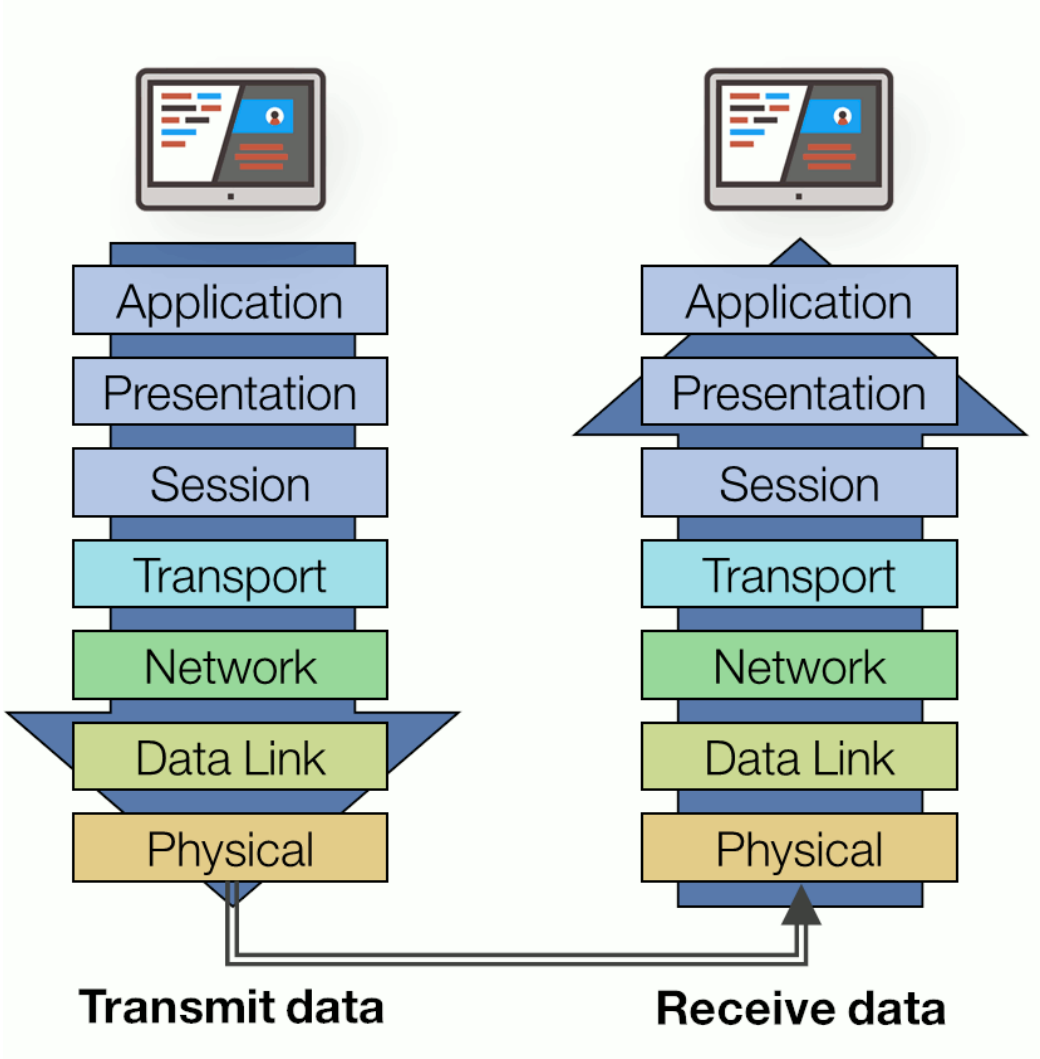


# dd: Disk Read Speed

- $ dd if=/dev/sdb of=/dev/null bs=4k count=100000

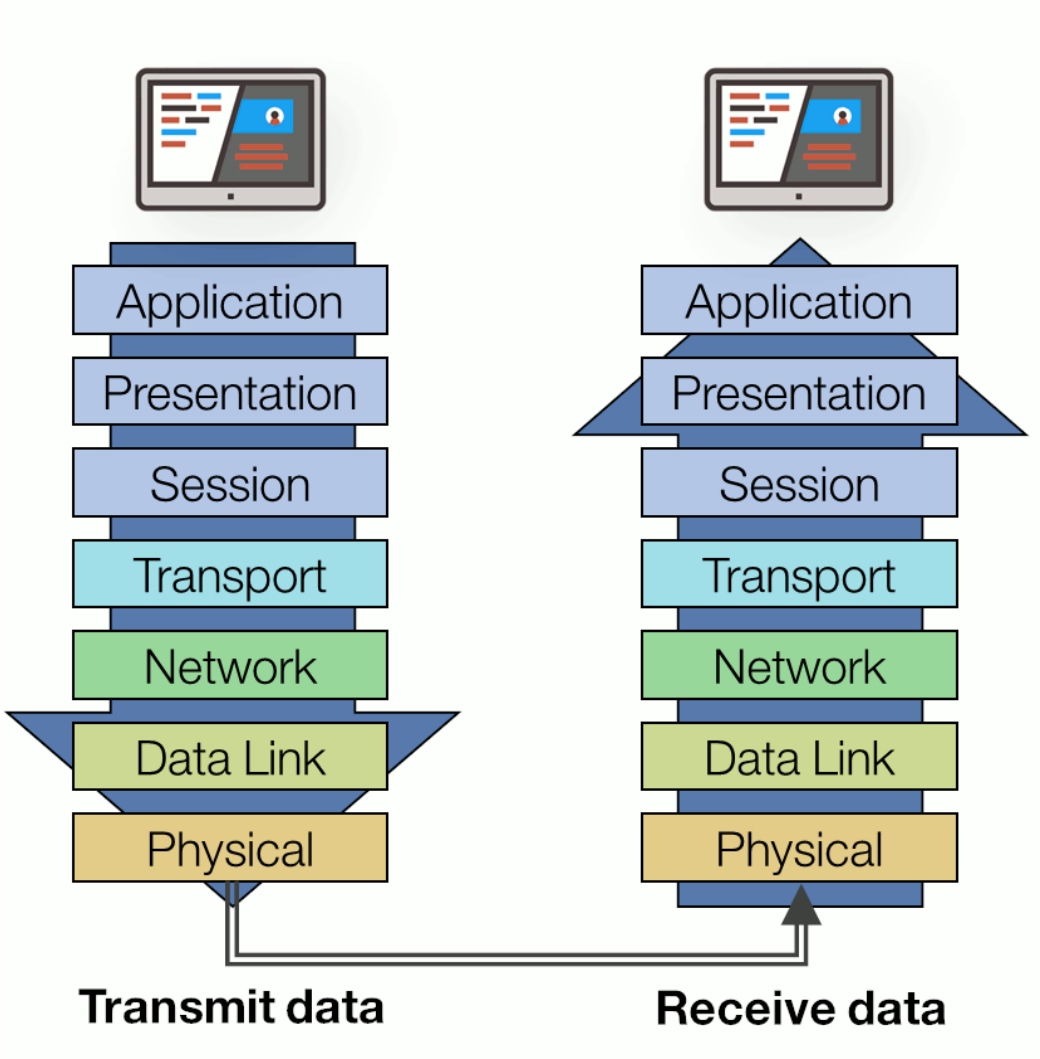


# Networking



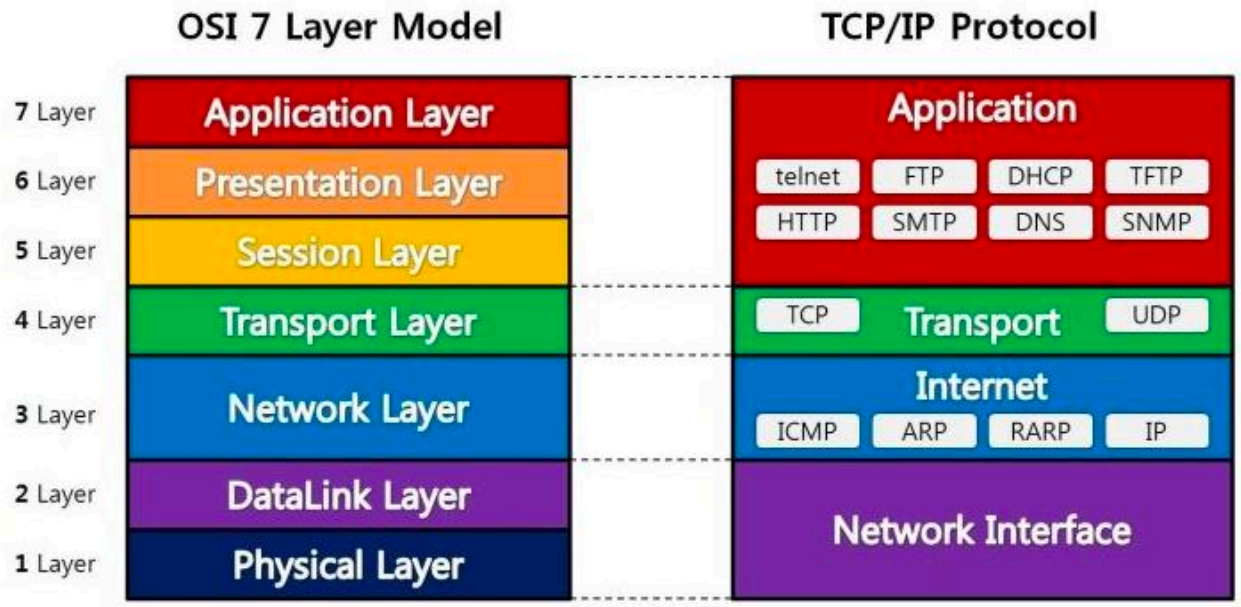

- Physical: represents the electrical and physical representation of the system
- Data link: provides node-to-node data transfer and handles error correction
- Network: router function, packet forwarding, etc.

# Networking




- Transport: coordination of the data transfer between end systems and hosts. How much data to send, at what rate, where it goes, etc.
- Session/Presentation/Application: interaction with the user level application

# Networking




Application data

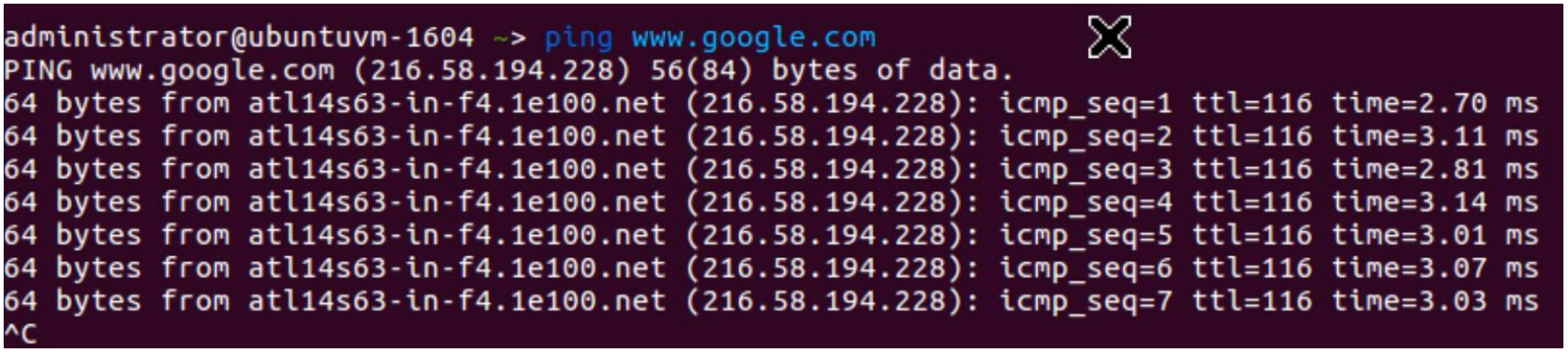
Segment

Packet

Bits

# Networking connection: ping

- Ping is a computer network administration software utility used to test the reachability of a host on an Internet Protocol network.



# Networking throughput: speedtest-cli

- $ wget https://github.com/sivel/speedtest-cli/archive/master.zip
- $ unzip master.zip
- $ cd speedtest-cli-master/
- ./speedtest.py

```
administrator@ubuntu1804vm ~/speedtest-cli-master> ./speedtest.py
Retrieving speedtest.net configuration...
Testing from PeachNet (168.28.186.189)...
Retrieving speedtest.net server list...
Selecting best server based on ping...
Hosted by Nitel (Atlanta, GA) [27.97 km]: 5.091 ms
Testing download speed................................................
.....................
Download: 1596.49 Mbit/s
Testing upload speed..................................................
.................................
Upload: 1035.54 Mbit/s
```

# An interesting video introducing hardware

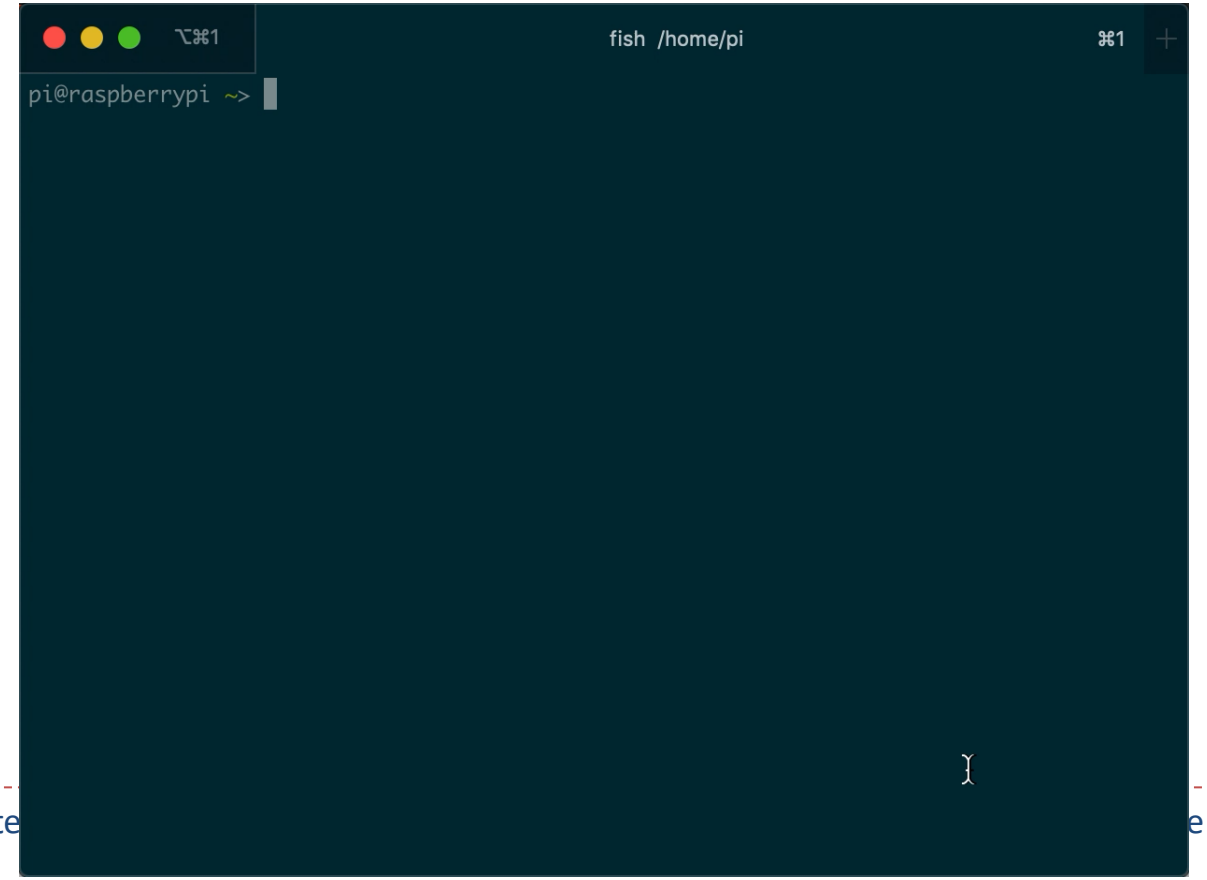

https://www.youtube.com/watch?v=ExxFxD4OSZ0

# Test: Your VM hardware specs?

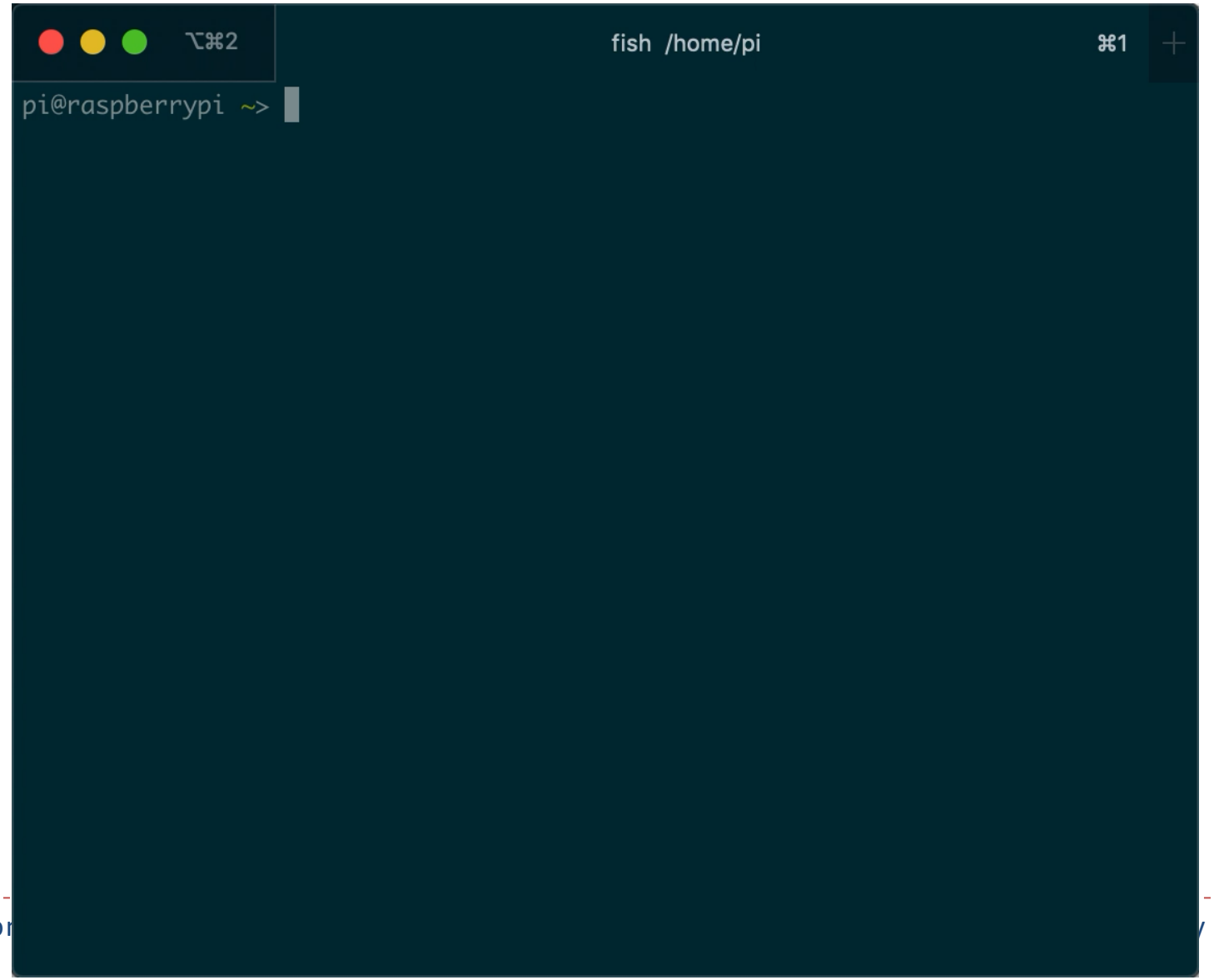
- CPU? → How many cores? Frequency? Topology?
- Cache? → Size?
- Memory? → Size? Speed?
- Disk? → Size?
- Network? → Latency? Bandwidth?

# How to get my machine spec?

- Inxi: https://www.tecmint.com/inxi-command-to-find-linux-system-information/

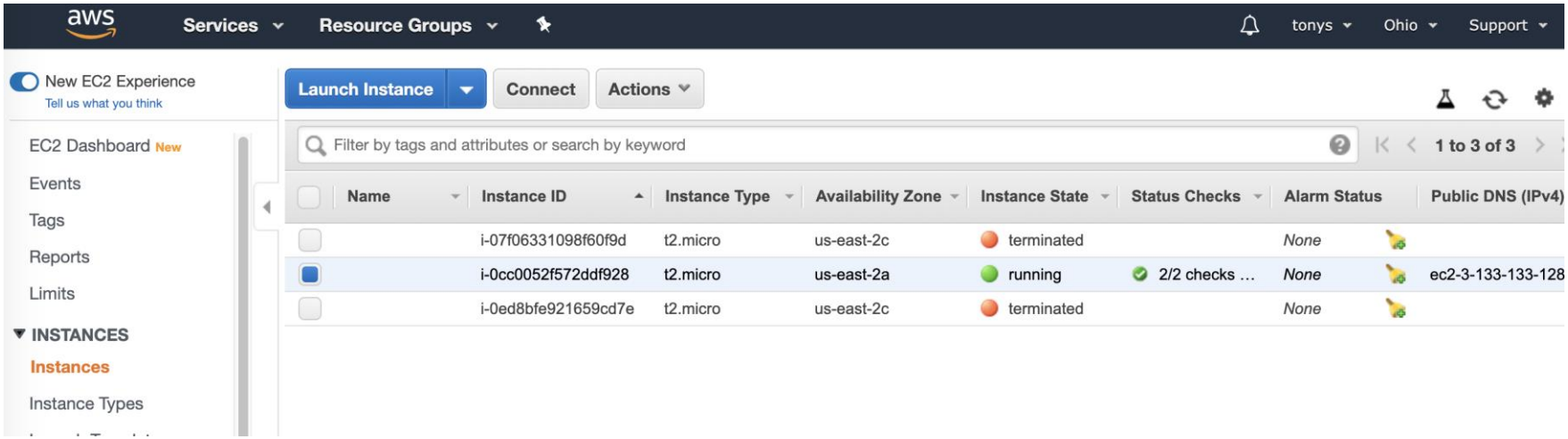


# How to get my machine spec? One command for All!



# Test 1: Try to create Amazon Web Service VM and test its hardware

- AWS Free Tier: https://aws.amazon.com/free/
- https://aws.amazon.com/education/awseducate/
- ssh -i "osclass.pem" ubuntu@ec2-3-133-133-128.us-east-2.compute.amazonaws.com



# Test 2: Try to create Microsoft Azure VM and test its hardware

- Azure for Students for free: https://azure.microsoft.com/en-us/free/students
- ssh ksu@13.90.101.24