

# HPC & Parallel Programming

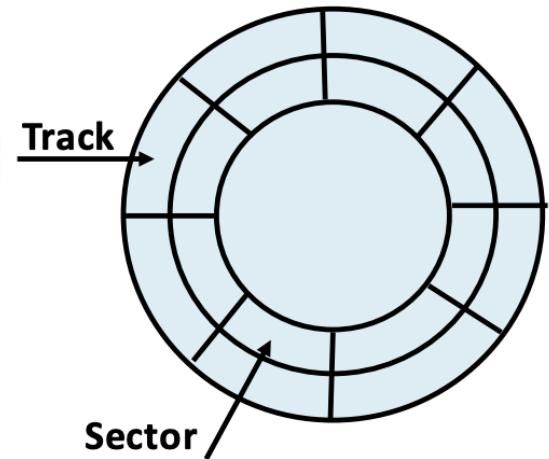
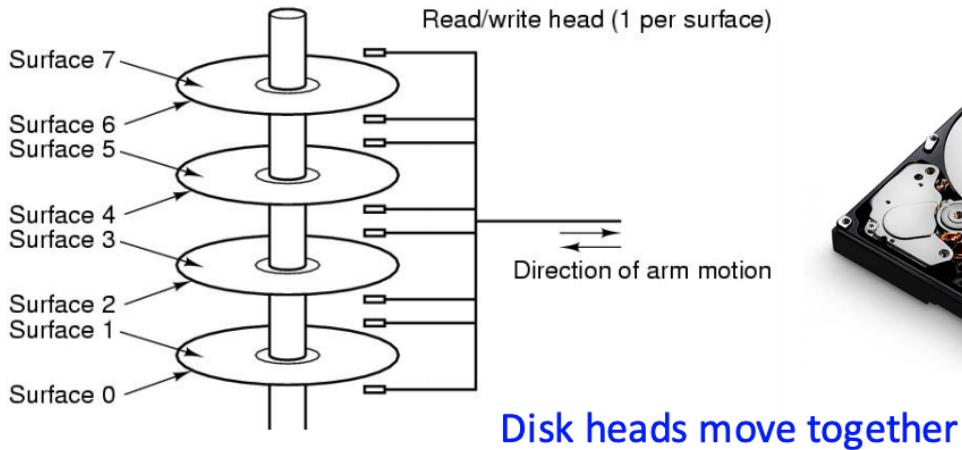
## Overview

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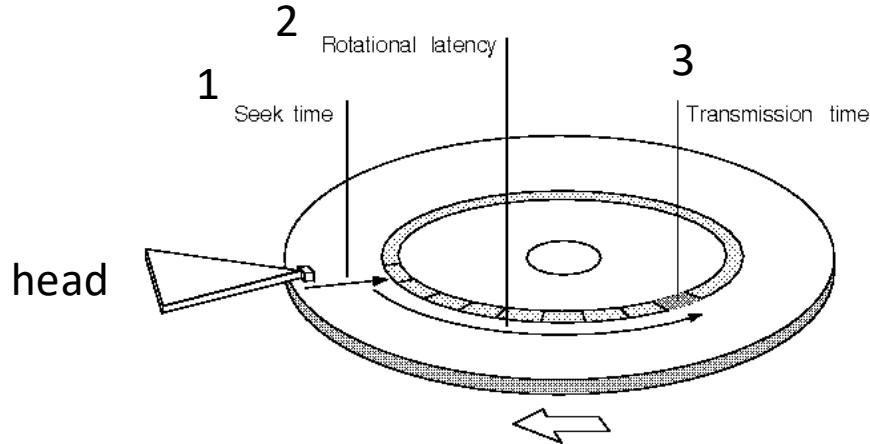
<https://kevinsuo.github.io/>

# Disk



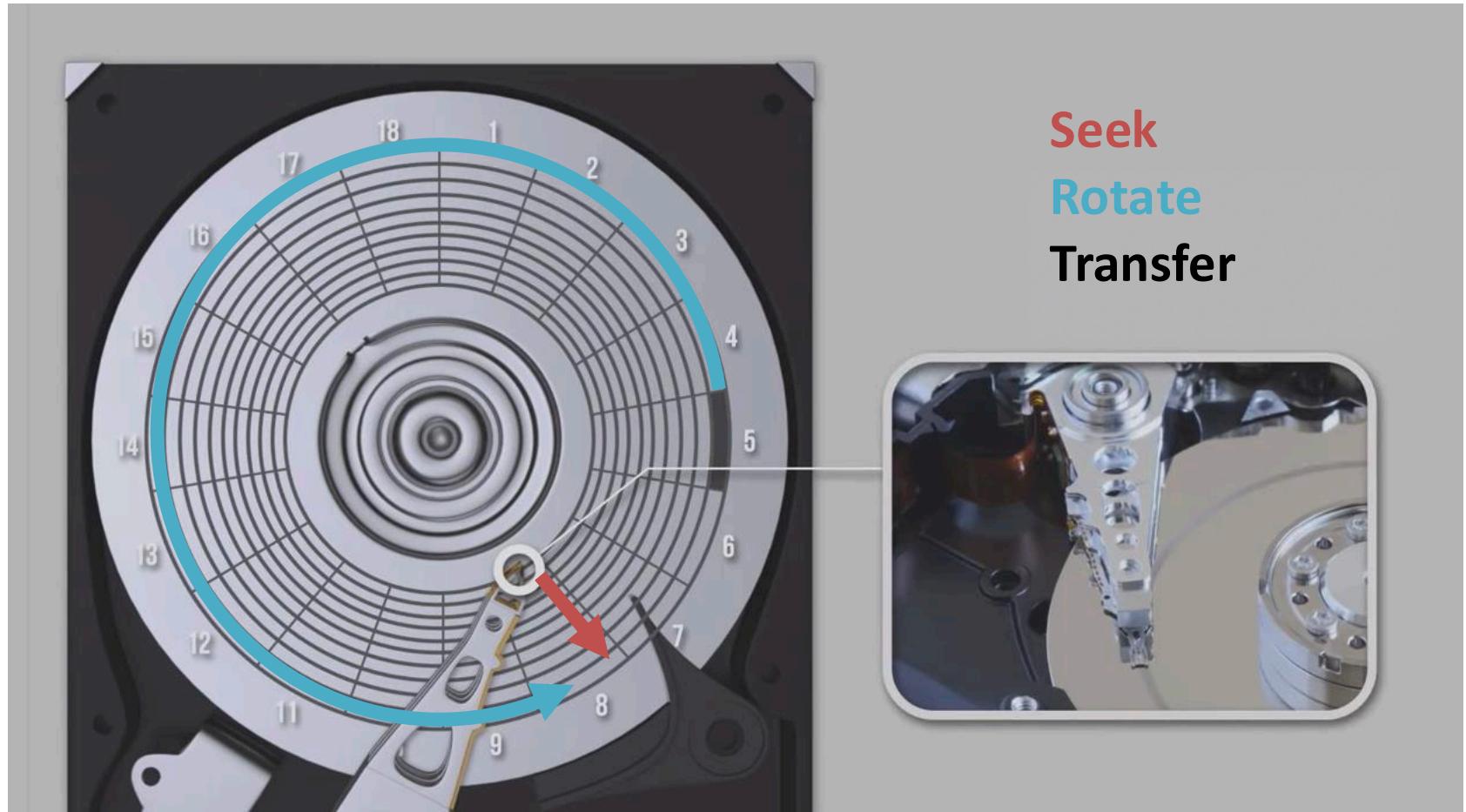
- A stack of platters, a surface with a magnetic coating
- Typical numbers (depending on the disk size):
  - 500 to 2,000 tracks per surface
  - 32 to 128 sectors per track
    - ▶ A sector is the smallest unit that can be read or written
- Originally, all tracks have the same number of sectors

# 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
```

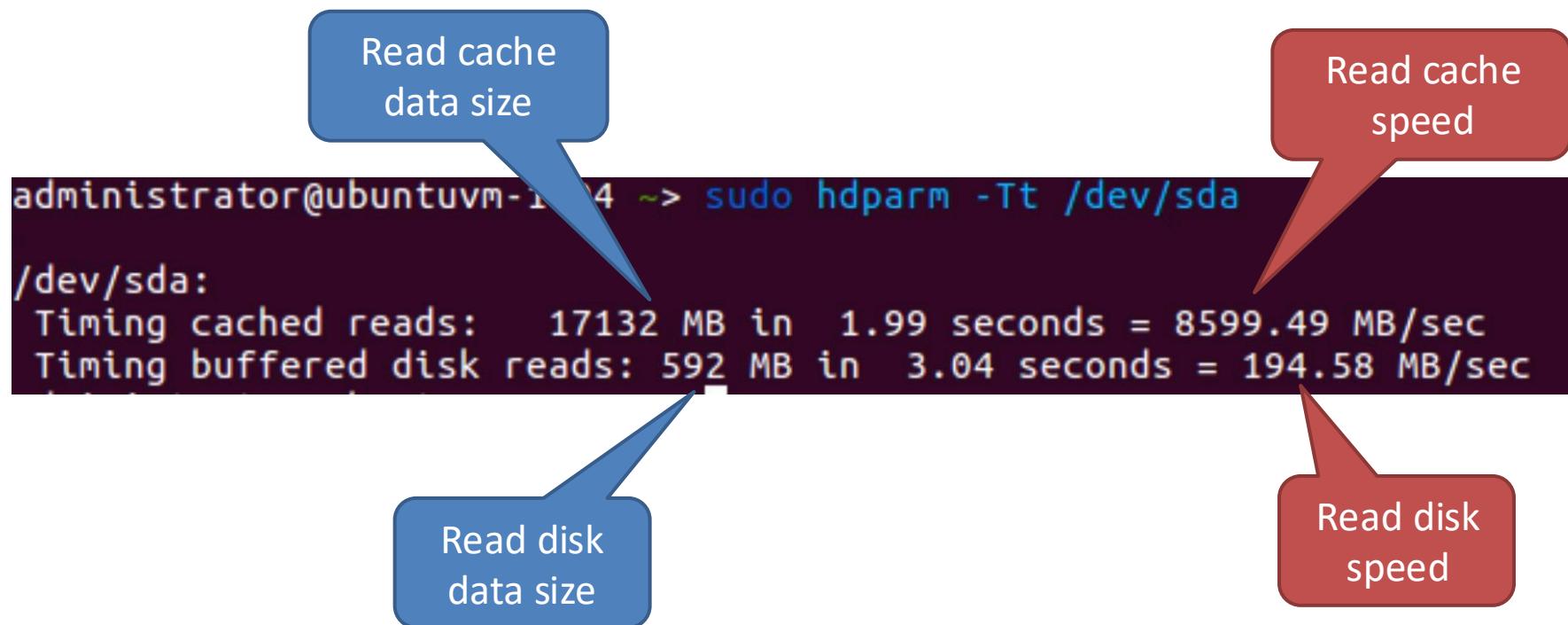


# Disk R/W Process



# Disk R/W Speed

- \$ sudo hdparm -Tt /dev/sda



```
administrator@ubuntuvm-104 ~> sudo hdparm -Tt /dev/sda
/dev/sda:
Timing cached reads: 17132 MB in 1.99 seconds = 8599.49 MB/sec
Timing buffered disk reads: 592 MB in 3.04 seconds = 194.58 MB/sec
```

Read cache data size

Read cache speed

Read disk data size

Read disk speed

# dd: Disk Write Speed

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

/dev/zero: generate null string stream

Write into this file

```
sudo dd if=/dev/zero of=/testw.dbf bs=4k count=100000 oflag=direct
100000+0 records in
100000+0 records out
4096000000 bytes (410 MB, 391 MiB) copied, 25.1254 , 16.3 MB/s
```

Block size 4k

Block number 100000



# dd: Disk Read Speed

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

/dev/zero: the source file

Write into this file (it is an empty file)

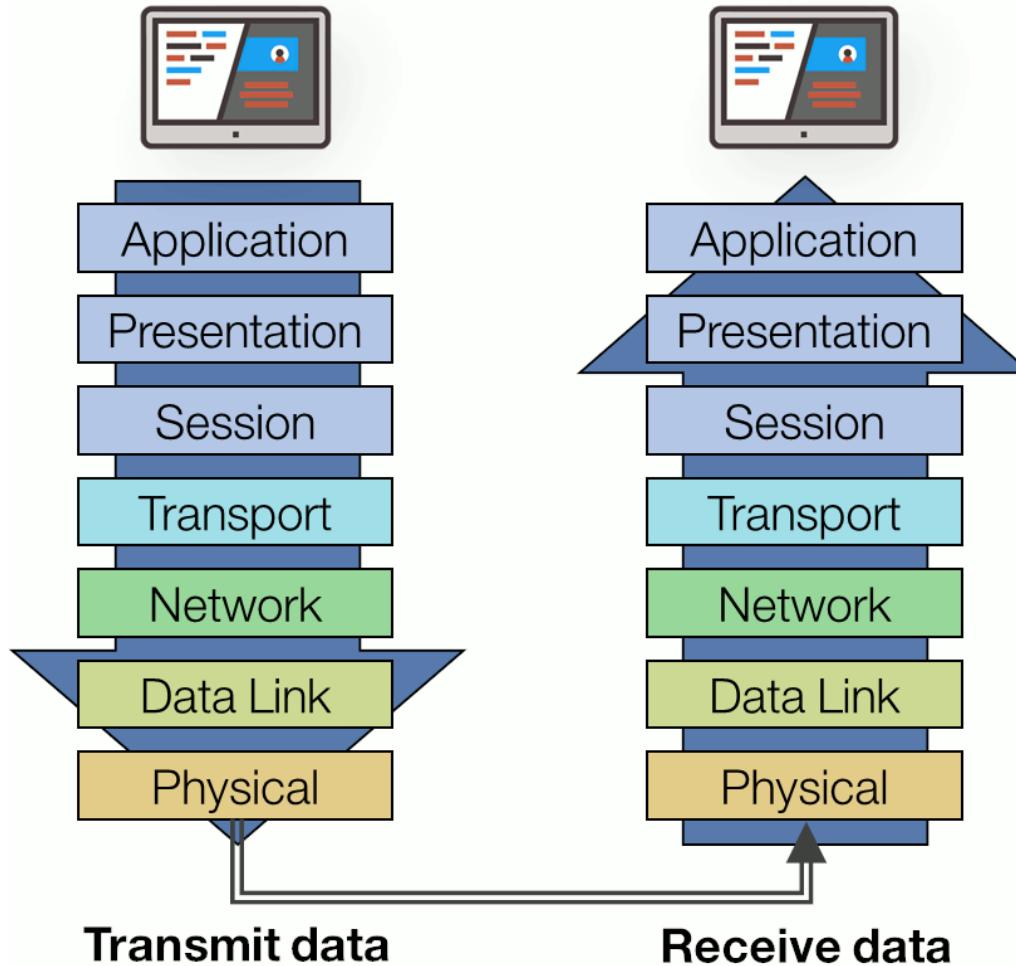
```
administrator@ubuntuvm-1604 ~>
sudo dd if=/dev/sda of=/dev/null bs=4k count=100000
100000+0 records in
100000+0 records out
4096000000 bytes (410 MB, 391 MiB) copied, 2.03887 s, 197 MB/s
```

Block size 4k

Block number 100000

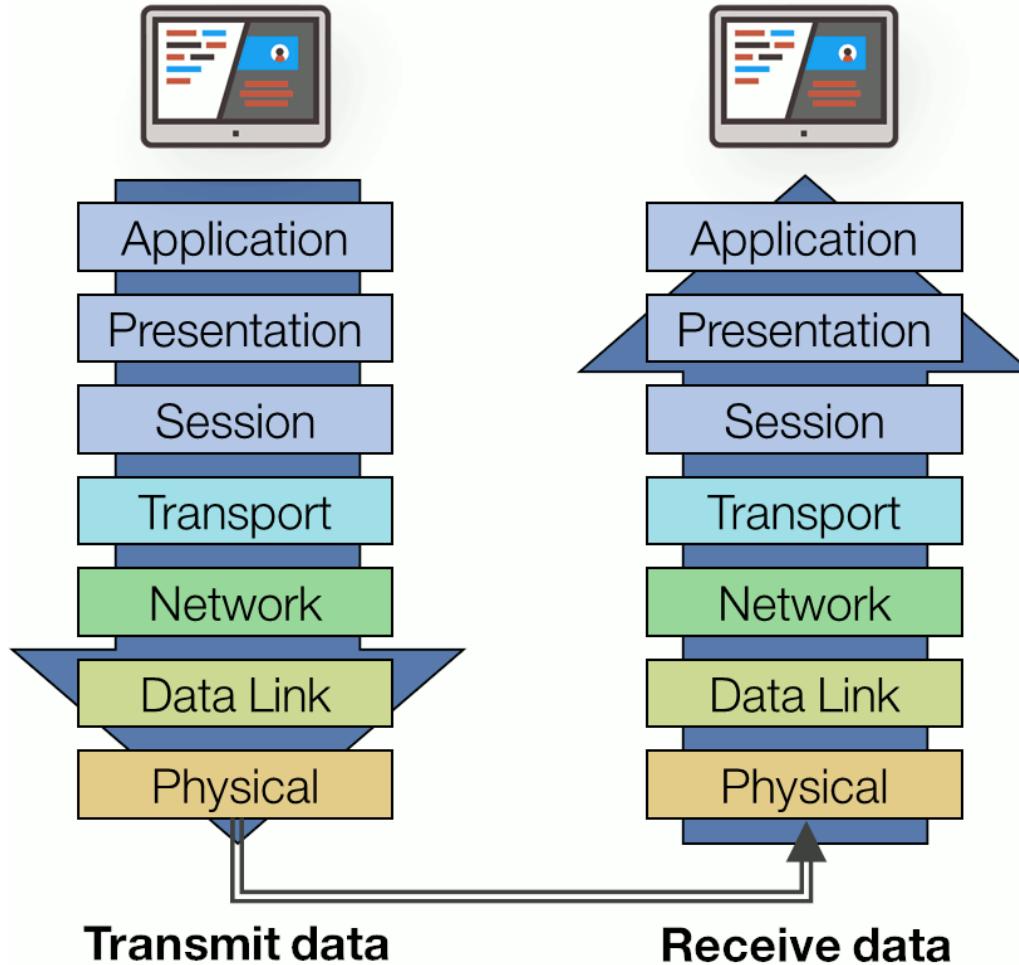


# Networking



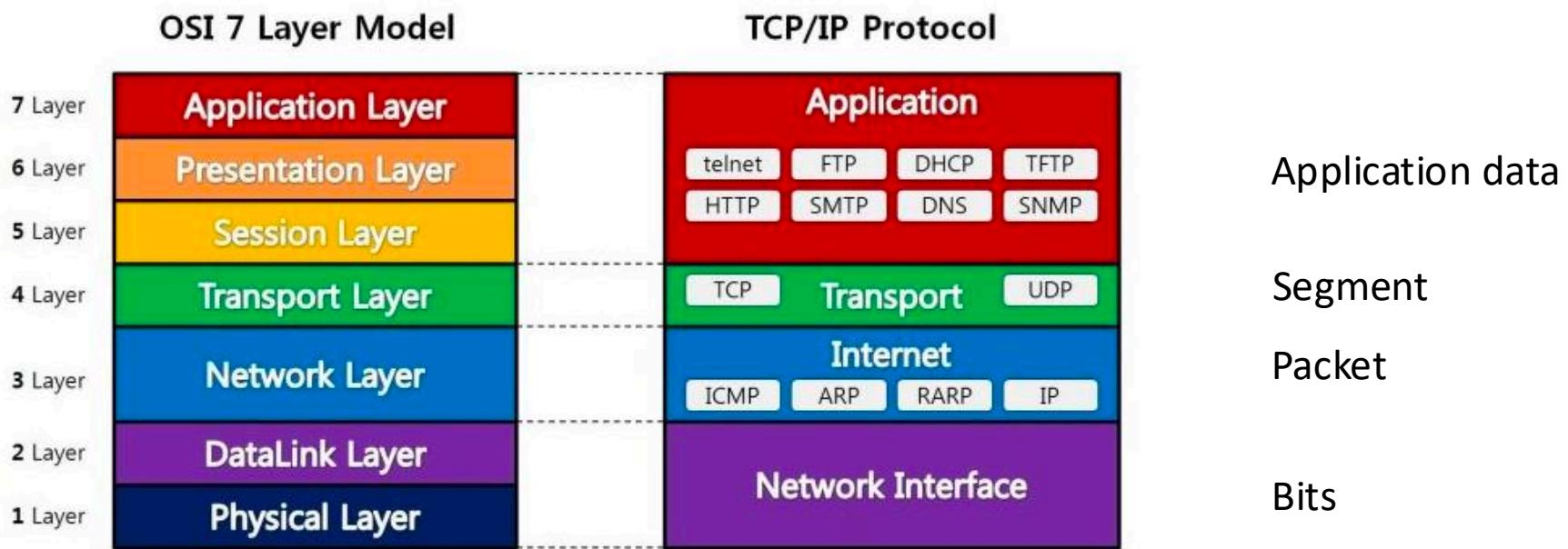
- Physical: represents the electrical and physical representation of the system
- Data link: provides node-to-node data transfer and handles error correction
- Network: router function, packet forwarding, etc.

# 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



# Networking connection: ping

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

```
administrator@ubuntuvm-1604 ~> ping www.google.com
PING www.google.com (216.58.194.228) 56(84) bytes of data.
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=1 ttl=116 time=2.70 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=2 ttl=116 time=3.11 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=3 ttl=116 time=2.81 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=4 ttl=116 time=3.14 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=5 ttl=116 time=3.01 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=6 ttl=116 time=3.07 ms
64 bytes from atl14s63-in-f4.1e100.net (216.58.194.228): icmp_seq=7 ttl=116 time=3.03 ms
^C
```



# 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

# Computer Parts!



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



# Test: Your VM hardware specs?

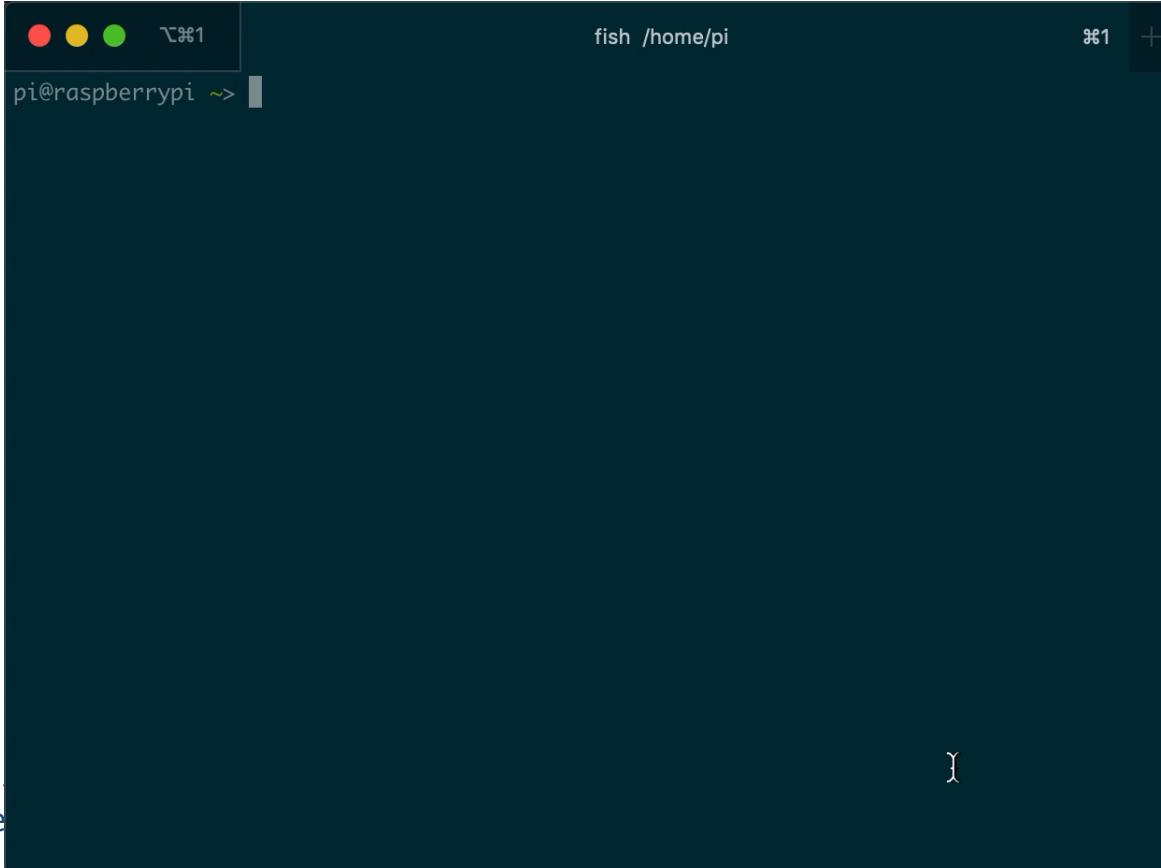
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- CPU? → How many cores? Frequency? Topology?
- Cache? → Size?
- Memory? → Size? Speed?
- Disk? → Size?
- Network? → Latency? Bandwidth?

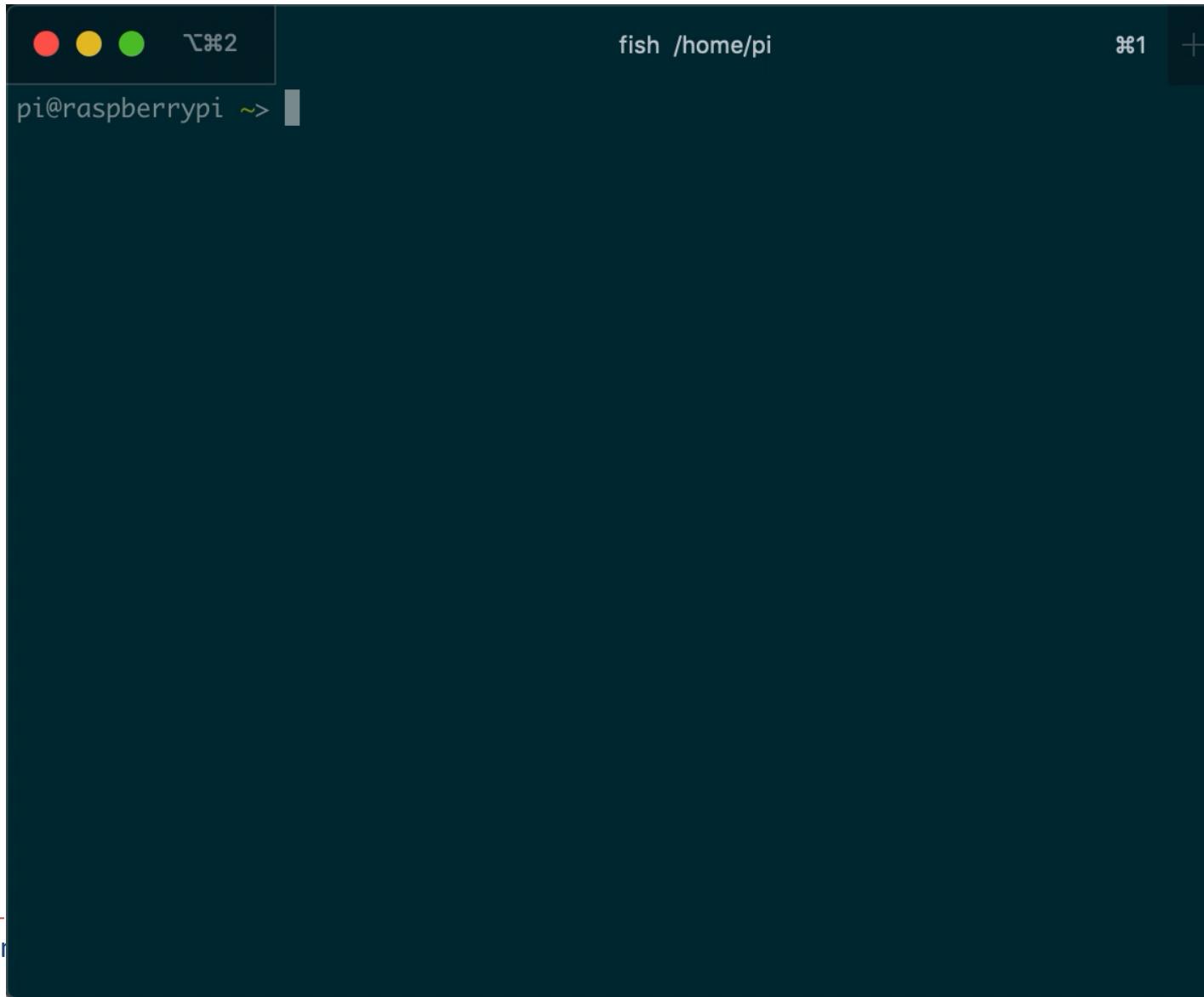


# How to get my machine spec?

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



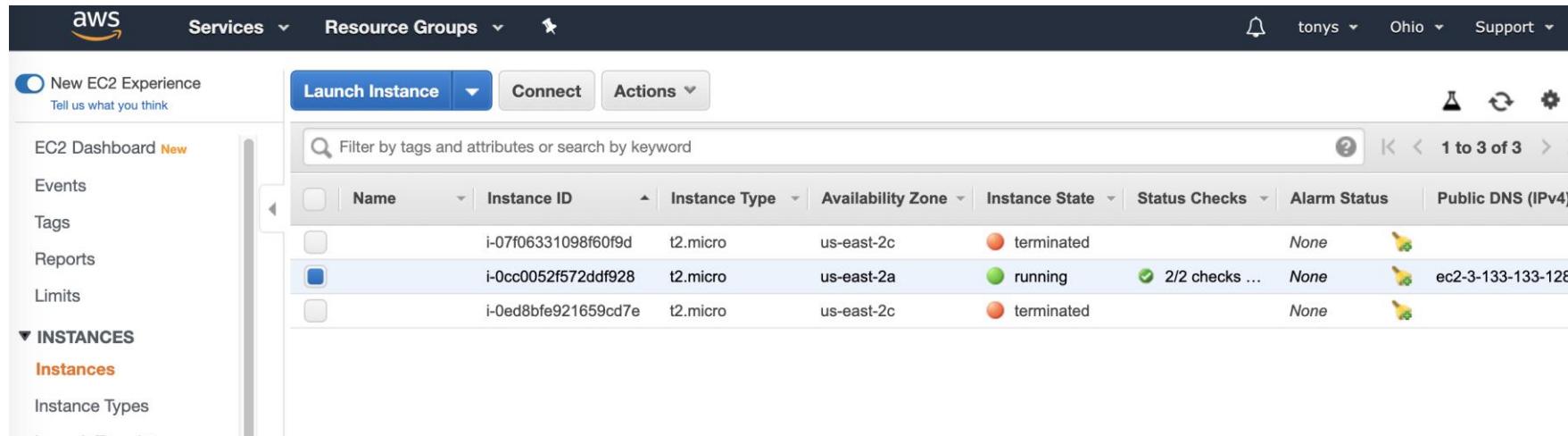
# How to get my machine spec? One command for All!



A screenshot of a terminal window on a Raspberry Pi. The window has a dark background with a light blue header bar. In the top-left corner of the header bar, there are three colored circles (red, yellow, green) and a small icon. The top-right corner shows the text "fish /home/pi" and "⌘1". Below the header bar, the text "pi@raspberrypi ~>" is visible, followed by a light blue command line input field. The main body of the terminal is a large, empty dark area. At the bottom of the slide, there is a red dashed line with a red triangle pointing right, and the word "Cont" is partially visible.

# 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



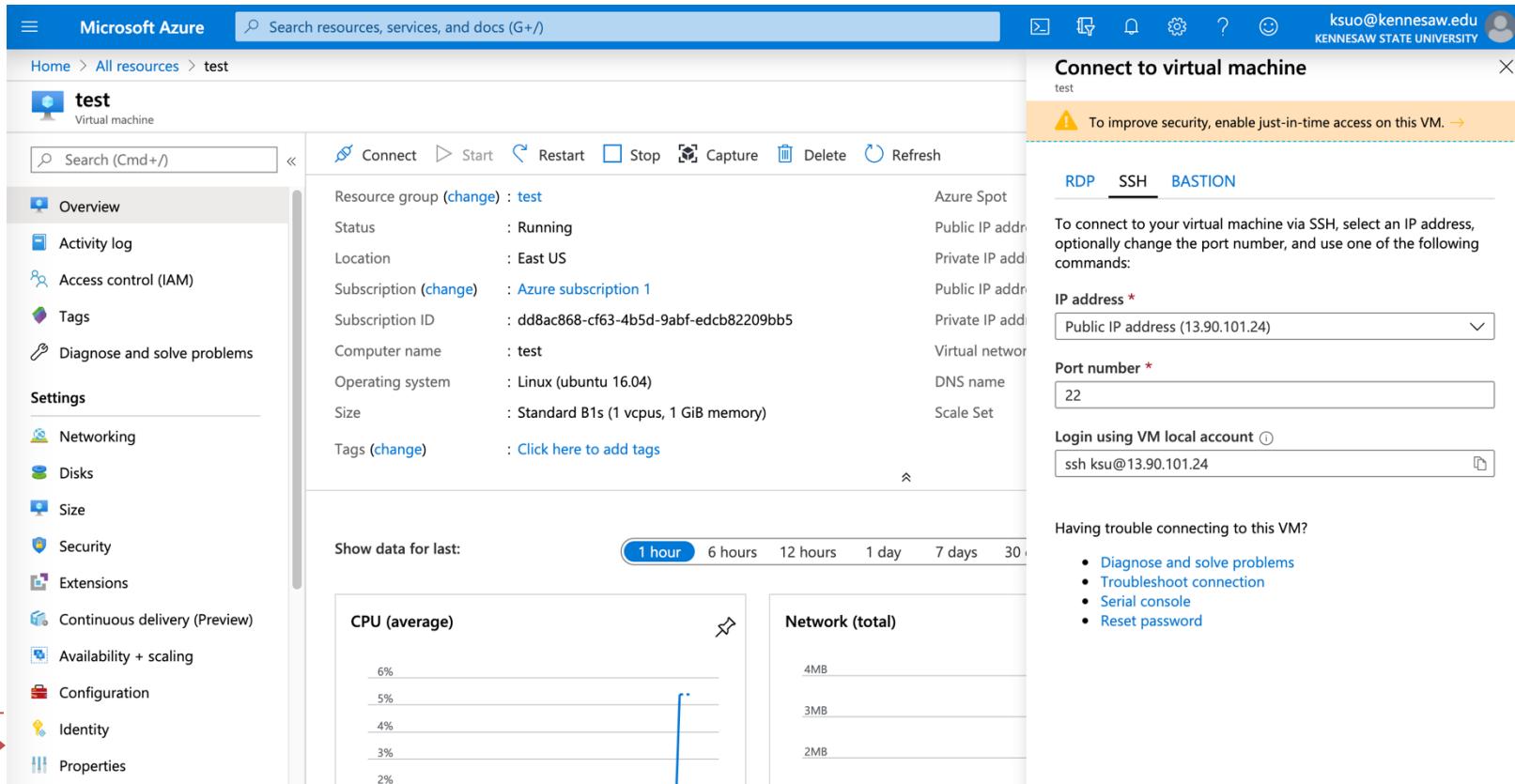
The screenshot shows the AWS EC2 Dashboard. The top navigation bar includes the AWS logo, Services, Resource Groups, a search bar, and user information (tonys, Ohio, Support). The left sidebar has links for New EC2 Experience, EC2 Dashboard, Events, Tags, Reports, Limits, and INSTANCES (with sub-links for Instances and Instance Types). The main content area has tabs for Launch Instance, Connect, and Actions. A search bar is at the top of the instance list. The table below shows three instances:

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)
	i-07f06331098f60f9d	t2.micro	us-east-2c	terminated		None	
■	i-0cc0052f572ddf928	t2.micro	us-east-2a	running	2/2 checks ...	None	ec2-3-133-133-128
	i-0ed8bfe921659cd7e	t2.micro	us-east-2c	terminated		None	



# 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 ksuo@13.90.101.24



Microsoft Azure Search resources, services, and docs (G/)

Home > All resources > test

**test** Virtual machine

Resource group (change) : test

Status : Running

Location : East US

Subscription (change) : Azure subscription 1

Subscription ID : dd8ac868-cf63-4b5d-9abf-edcb82209bb5

Computer name : test

Operating system : Linux (ubuntu 16.04)

Size : Standard B1s (1 vcpus, 1 GiB memory)

Tags (change) : Click here to add tags

Show data for last: 1 hour 6 hours 12 hours 1 day 7 days 30 days

**CPU (average)**

**Network (total)**

Connect to virtual machine

To improve security, enable just-in-time access on this VM.

**RDP** **SSH** **BASTION**

To connect to your virtual machine via SSH, select an IP address, optionally change the port number, and use one of the following commands:

**IP address \*** Public IP address (13.90.101.24)

**Port number \*** 22

**Login using VM local account** ssh ksuo@13.90.101.24

Having trouble connecting to this VM?

- Diagnose and solve problems
- Troubleshoot connection
- Serial console
- Reset password