

HPC & Parallel Programming

Overview

Kun Suo

Computer Science, Kennesaw State University

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

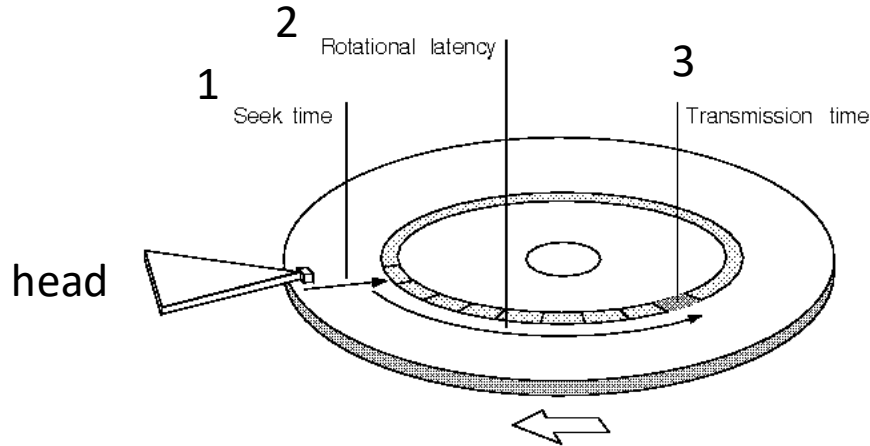
Disk



- 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



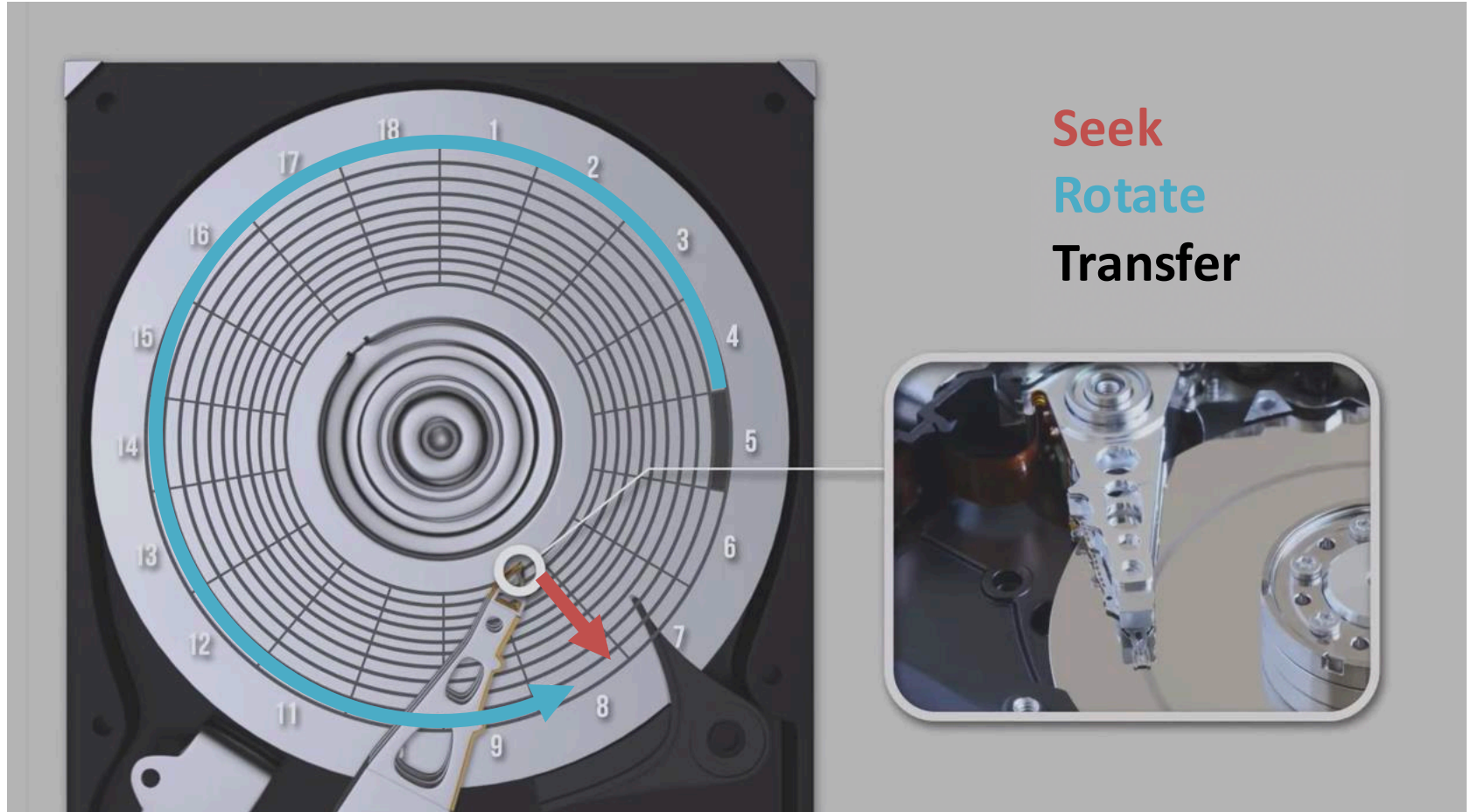
Disk



- 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

The image shows a terminal window with the command `sudo hdparm -Tt /dev/sda` and its output. Four callouts are present: two blue boxes pointing to the first two lines of output, and two red boxes pointing to the last two lines of output.

```
administrator@ubuntuvm-14 ~> 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
409600000 bytes (410 MB, 391 MiB) copied, 25.1254 s, 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)

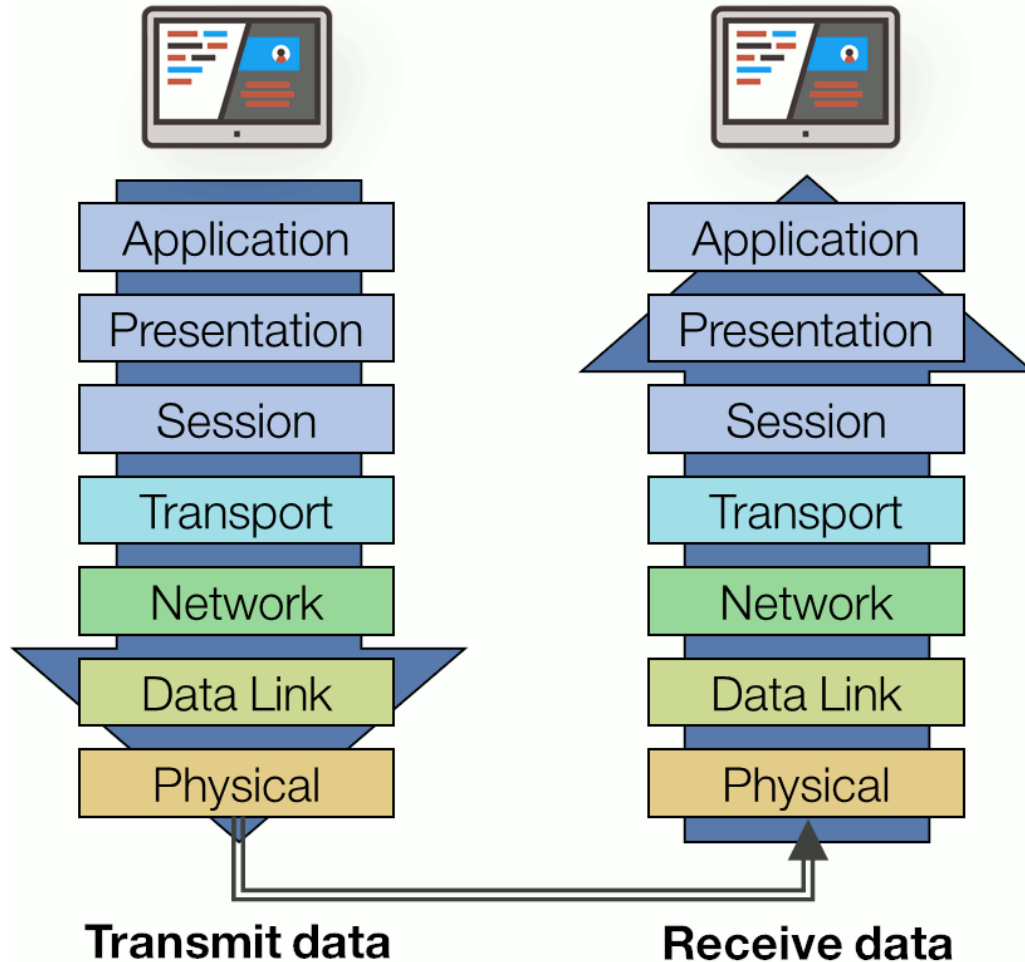
```
administrator@ubuntuvm-1604 ~>  
sudo dd if=/dev/sda of=/dev/null bs=4k count=100000  
100000+0 records in  
100000+0 records out  
409600000 bytes (410 MB, 391 MiB) copied, 2.08187 s, 197 MB/s
```

Block size 4k

Block number
100000



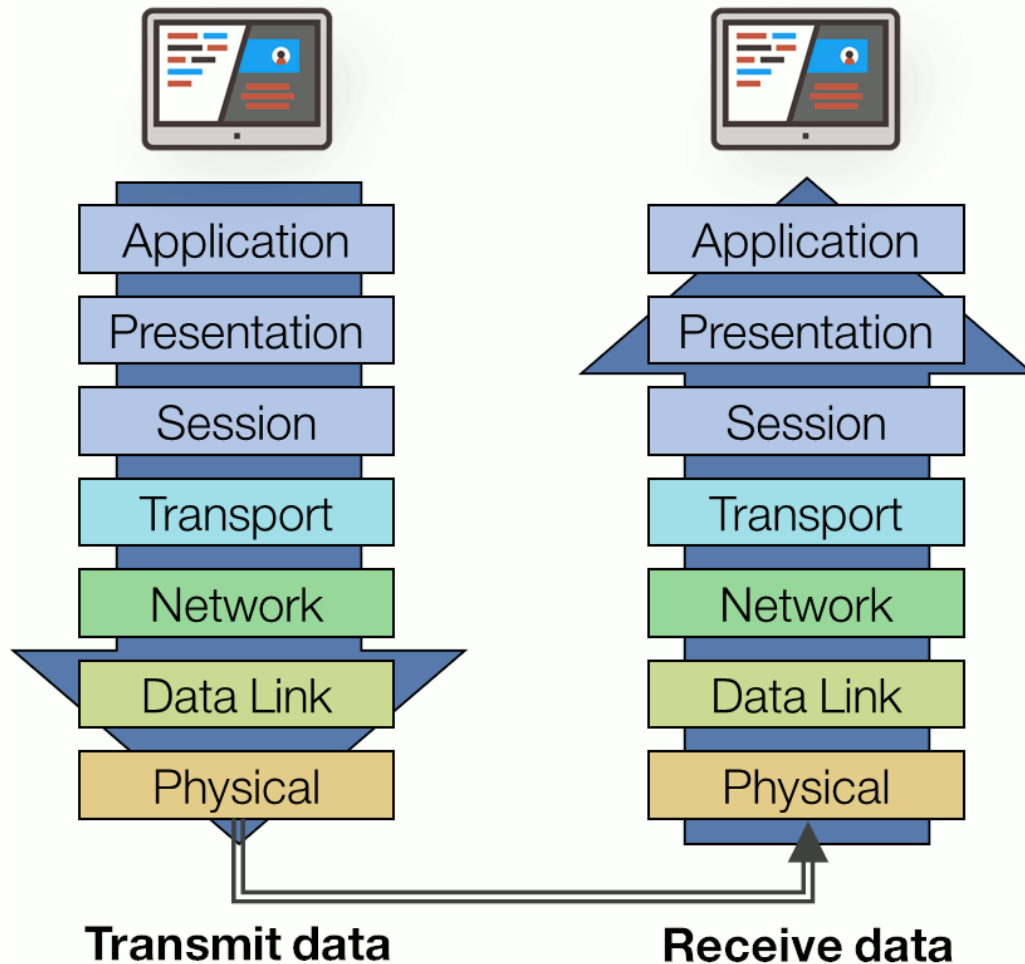
Networking



- 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.



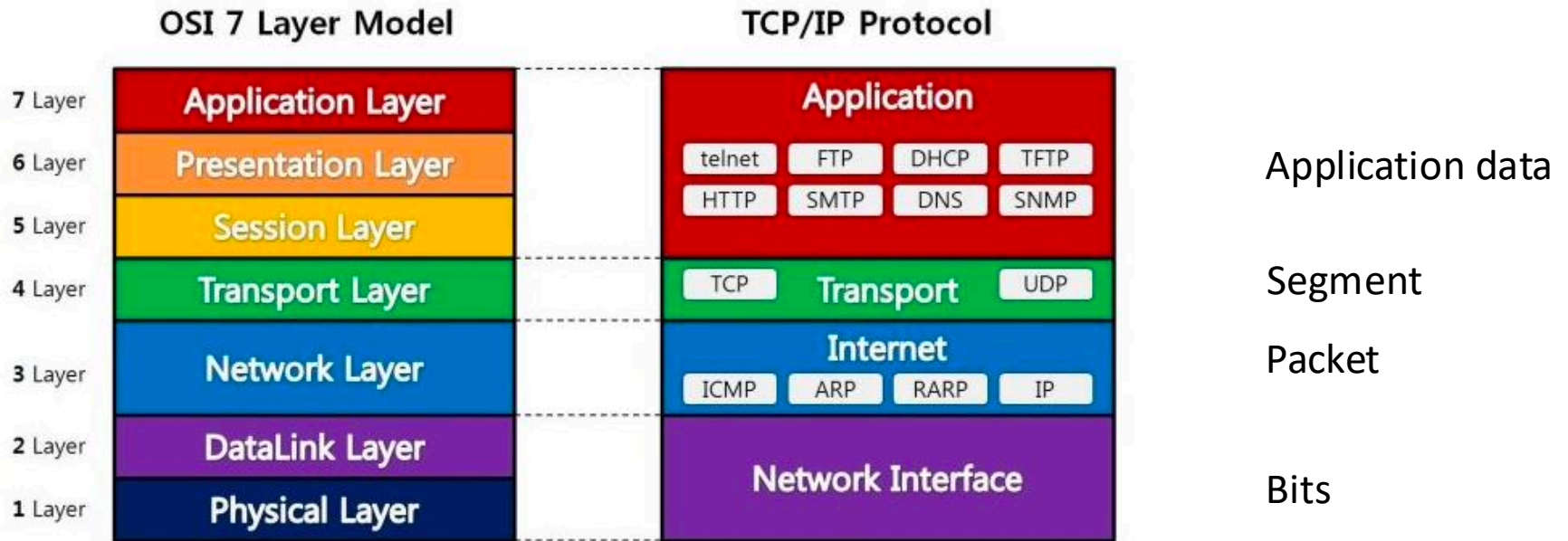
Networking



- 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 X
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>



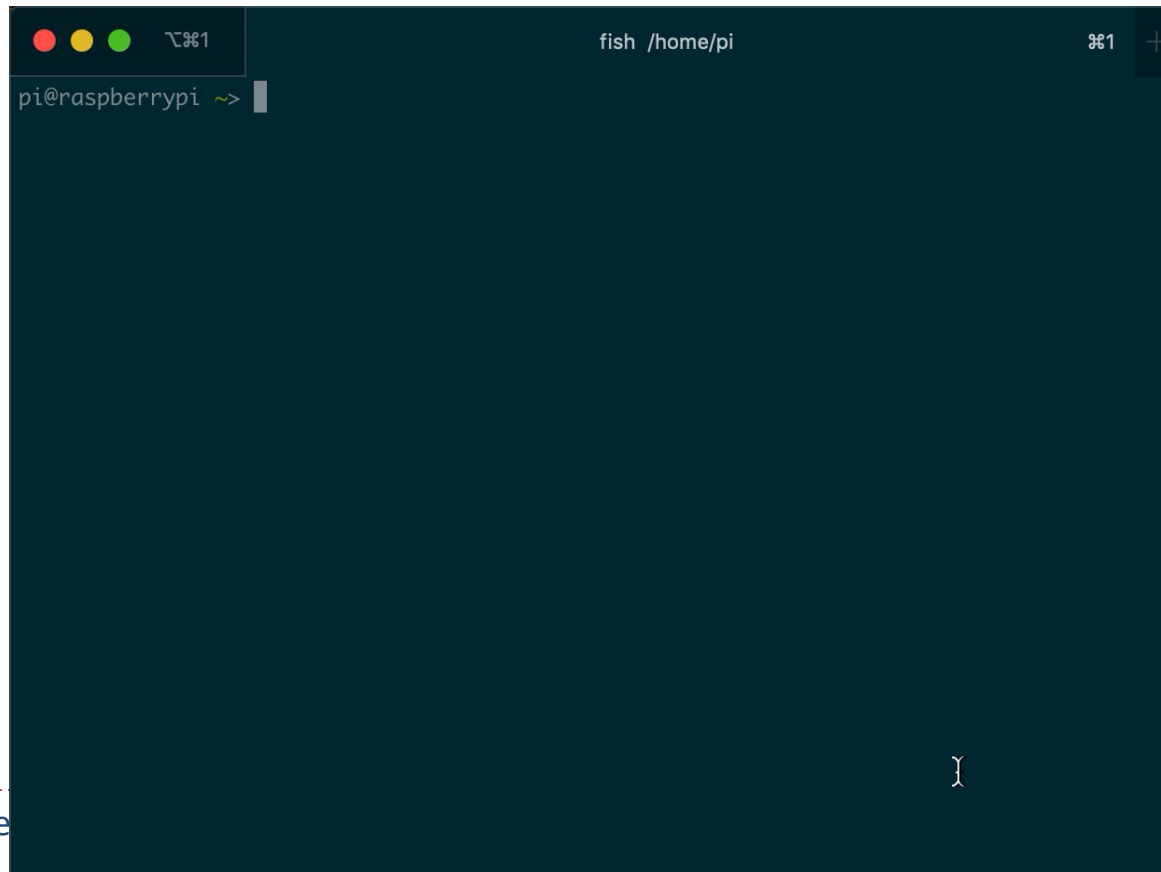
Test: Your VM hardware specs?

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



How to get my machine spec?

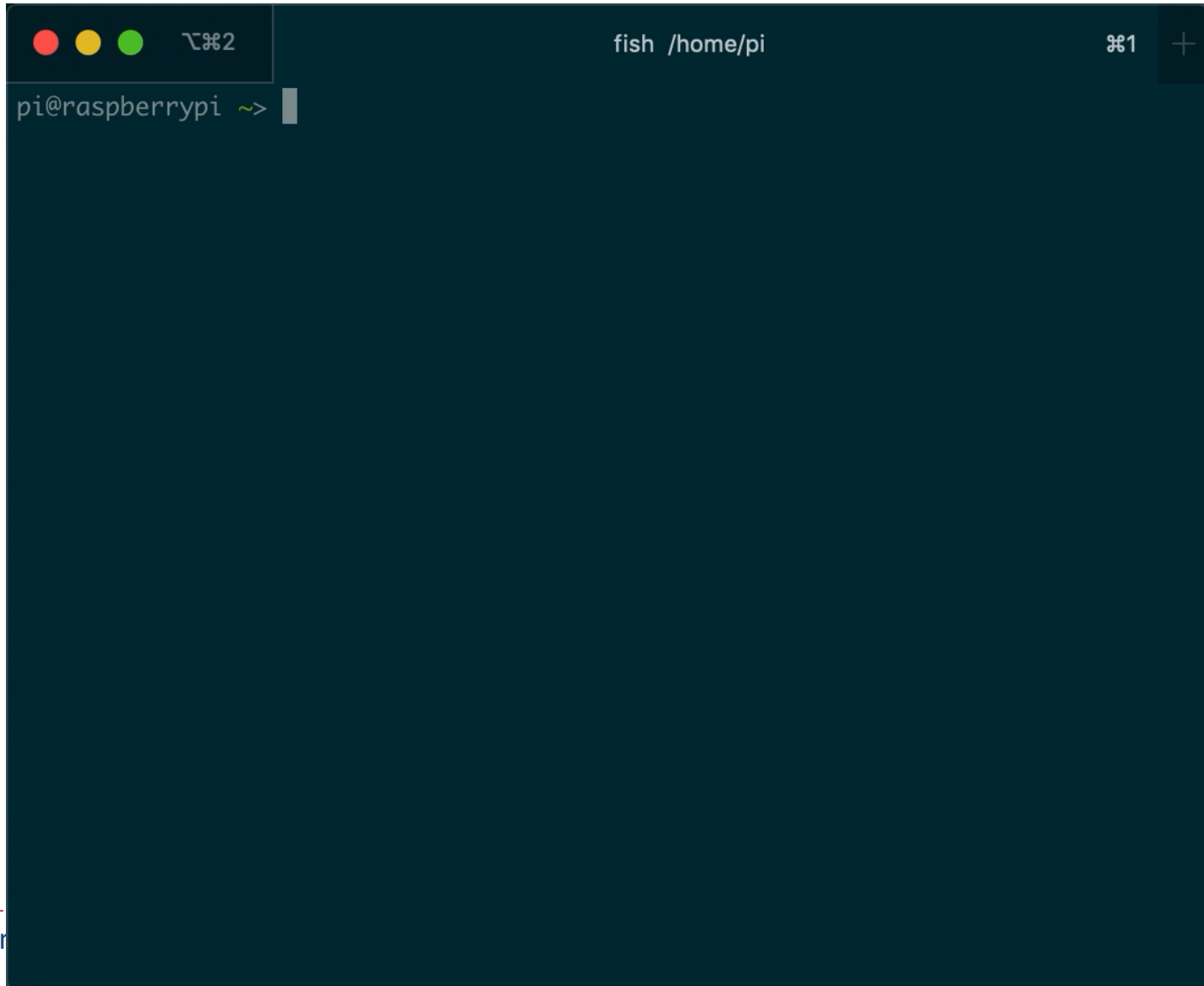
- Inxi: <https://www.tecmint.com/inxi-command-to-find-linux-system-information/>



A terminal window with a dark blue background. The title bar shows three colored circles (red, yellow, green) and the text "fish /home/pi". The terminal content shows the prompt "pi@raspberrypi ~>" followed by the command "inxi" which has been executed, resulting in a blank line. A cursor is visible at the end of the command line.



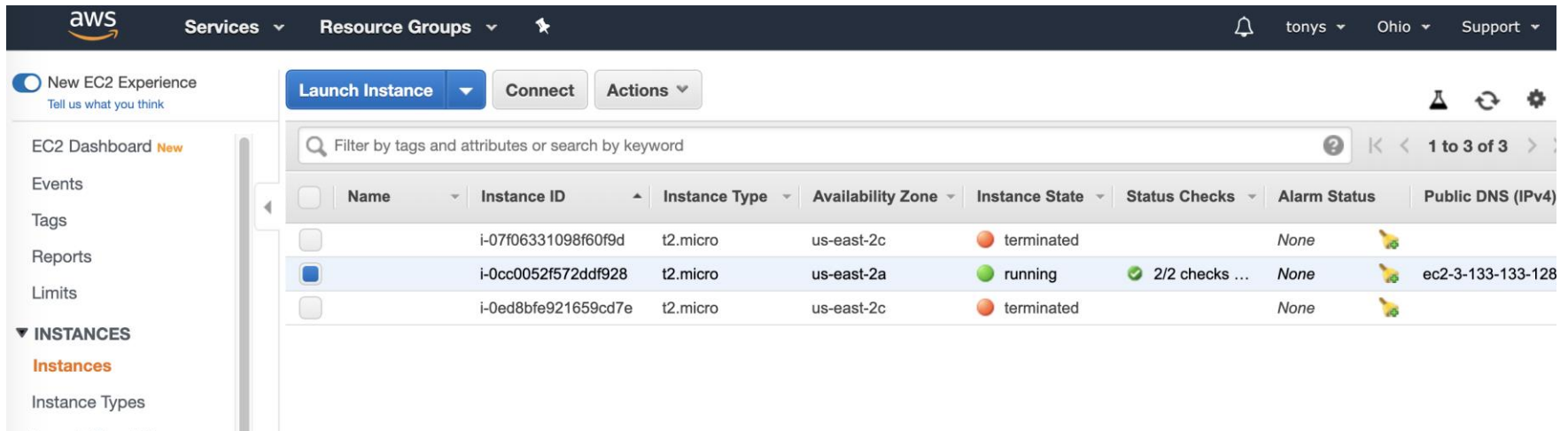
How to get my machine spec? One command for All!



Con

Test 1: Amazon Web Service VM

- `ssh -i "osclass.pem" ubuntu@ec2-3-133-133-128.us-east-2.compute.amazonaws.com`



The screenshot shows the AWS Management Console interface for EC2 instances. The top navigation bar includes the AWS logo, 'Services', 'Resource Groups', and user information. The left sidebar shows the 'EC2 Dashboard' and a list of navigation links including 'Events', 'Tags', 'Reports', 'Limits', and 'INSTANCES'. The main content area displays a table of EC2 instances with columns for Name, Instance ID, Instance Type, Availability Zone, Instance State, Status Checks, Alarm Status, and Public DNS (IPv4). Three instances are listed: two 'terminated' and one 'running'. The 'running' instance is highlighted with a blue selection box.

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



Test 2: Microsoft Azure VM

- `ssh ksu@13.90.101.24`

The screenshot displays the Microsoft Azure portal interface. On the left, a sidebar contains navigation links for Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Settings, Networking, Disks, Size, Security, Extensions, Continuous delivery (Preview), Availability + scaling, Configuration, Identity, and Properties. The main area shows the details of a virtual machine named 'test'. The 'Connect' button is highlighted, and a dialog box titled 'Connect to virtual machine' is open on the right. This dialog box has tabs for RDP, SSH, and BASTION. The SSH tab is selected, showing instructions to connect via SSH and a form to enter the IP address (set to 'Public IP address (13.90.101.24)'), port number (set to '22'), and login command (set to 'ssh ksu@13.90.101.24'). Below the dialog box, there are links for 'Having trouble connecting to this VM?' including 'Diagnose and solve problems', 'Troubleshoot connection', 'Serial console', and 'Reset password'.

Microsoft Azure

Search resources, services, and docs (G+)

ksuo@kennesaw.edu
KENNESAW STATE UNIVERSITY

Home > All resources > test

test
Virtual machine

Search (Cmd+/)

Connect Start Restart Stop Capture Delete Refresh

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

Azure Spot

Public IP address

Private IP address

Public IP address

Private IP address

Virtual network

DNS name

Scale Set

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

CPU (average)

6%
5%
4%
3%
2%

Network (total)

4MB
3MB
2MB

Connect to virtual machine

test

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 ksu@13.90.101.24

Having trouble connecting to this VM?

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

