Storage

Session 4

INST 346

Agenda

- Hard Disks

- Optical Disks

- Solid State Disks

- Magnetic Tape

"Rotating" Memory

- Fixed magnetic disk ("hard drive")
  - May be partitioned into multiple volumes
    - In Windows, referred to as C:, D:, E:, …
    - In Unix, referred to as /software, /homes, /mail, …
- Removable magnetic disk
  - Floppy disk, zip drives, …
- Removal optical disk
  - CDROM, DVD, CD-R, CD-RW, DVD+RW, …

Magnetic ("Hard") Disks

Step 1:
The circuit board controls the movement of the head actuator and a small motor.
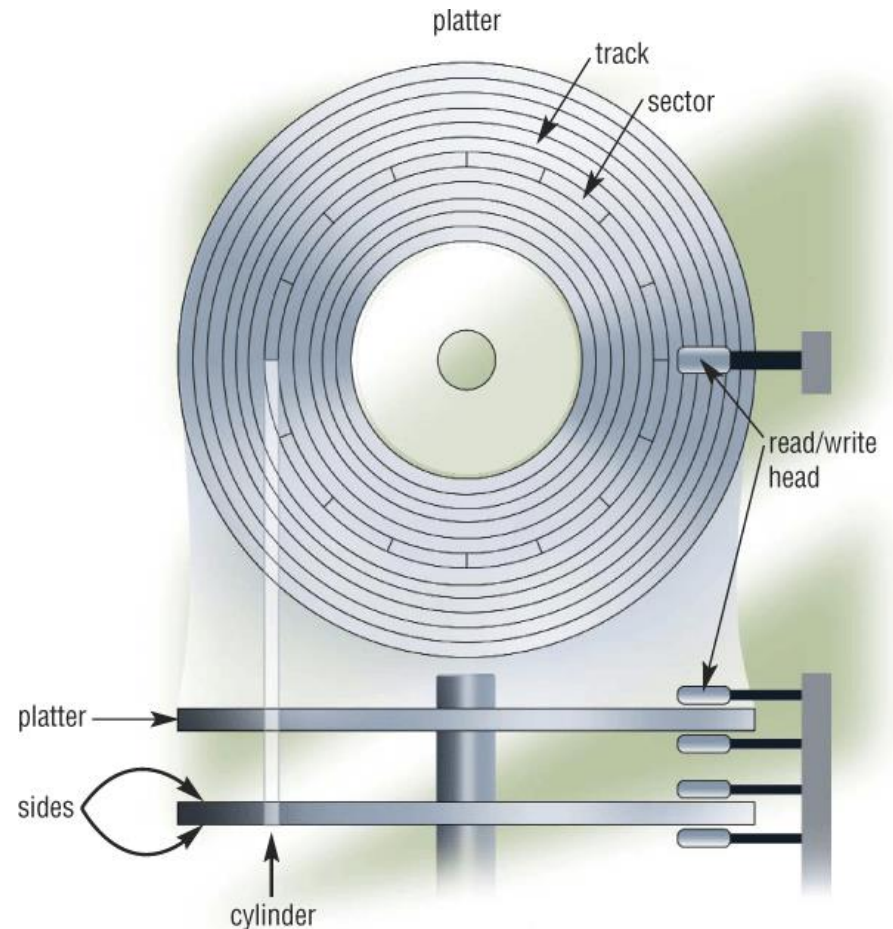
Step 2:
A small motor spins the platters while the computer is running.
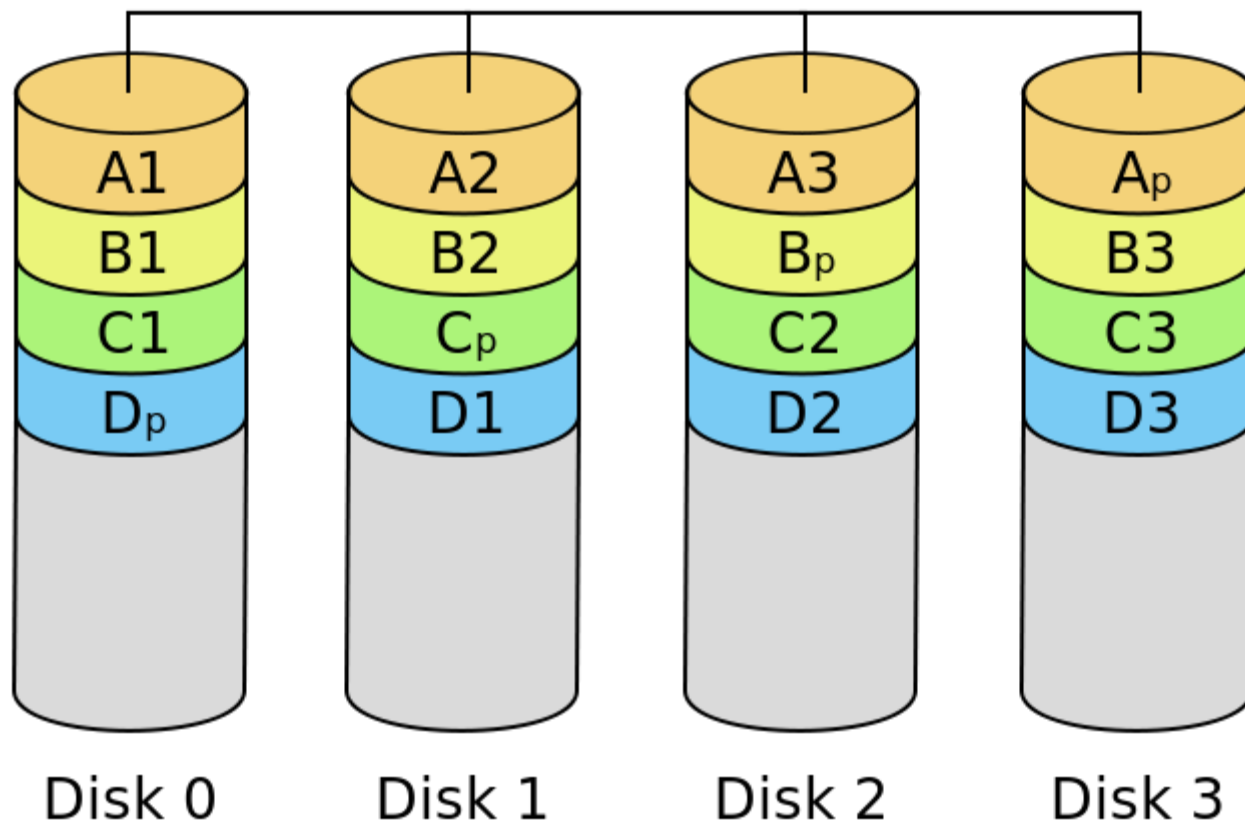
Step 3:
When software requests a disk access, the read/write heads determine the current or new location of the data.
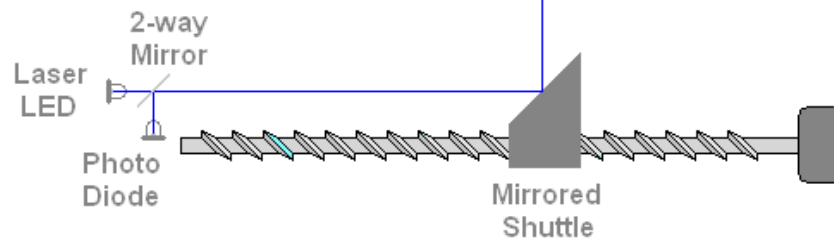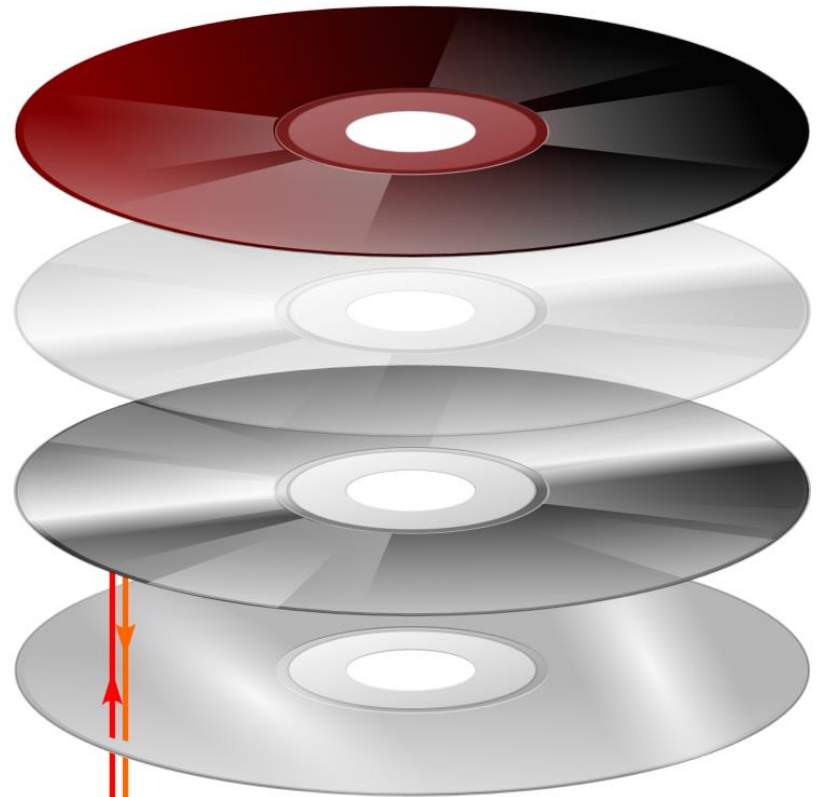
Step 4:
The head actuator positions the read/write head arms over the correct location on the platters to read or write data.

platter

track

sector

read/write head

platter

sides

cylinder

Extracted From Shelly Cashman Vermatt's Discovering Computers 2004

RAID 5

| Disk 0 | Disk 1 | Disk 2 | Disk 3 |

Optical Disc

Pits

Reflective Land   Non-reflective Pit

2-way Mirror

Laser LED

Photo Diode

Mirrored Shuttle
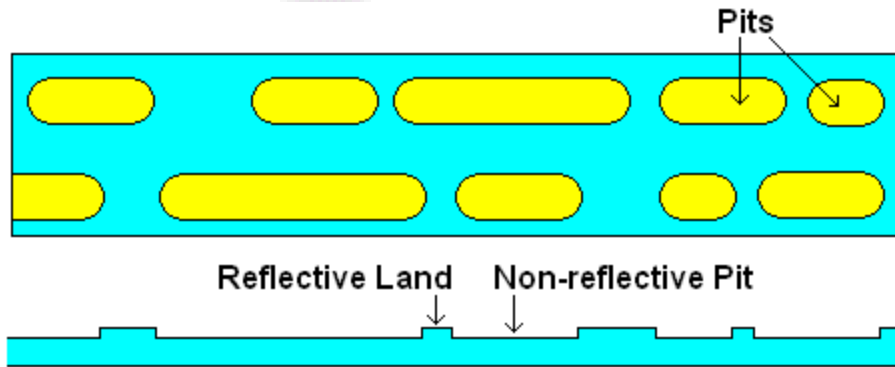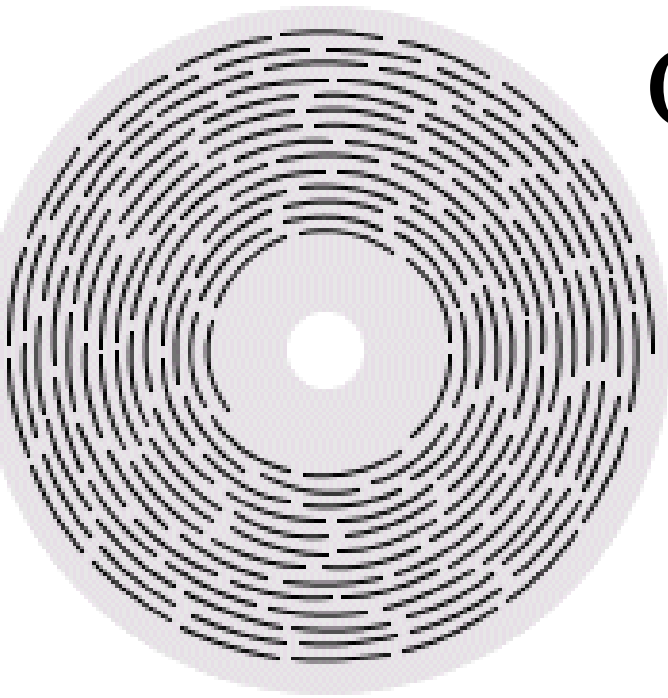
Optical Disk Technologies

Solid-State "Drives"

- "Flash memory"
  - Used in solid state drives and memory sticks
- <u>Much</u> faster "random access" than rotating disk
  - About 10,000 times faster
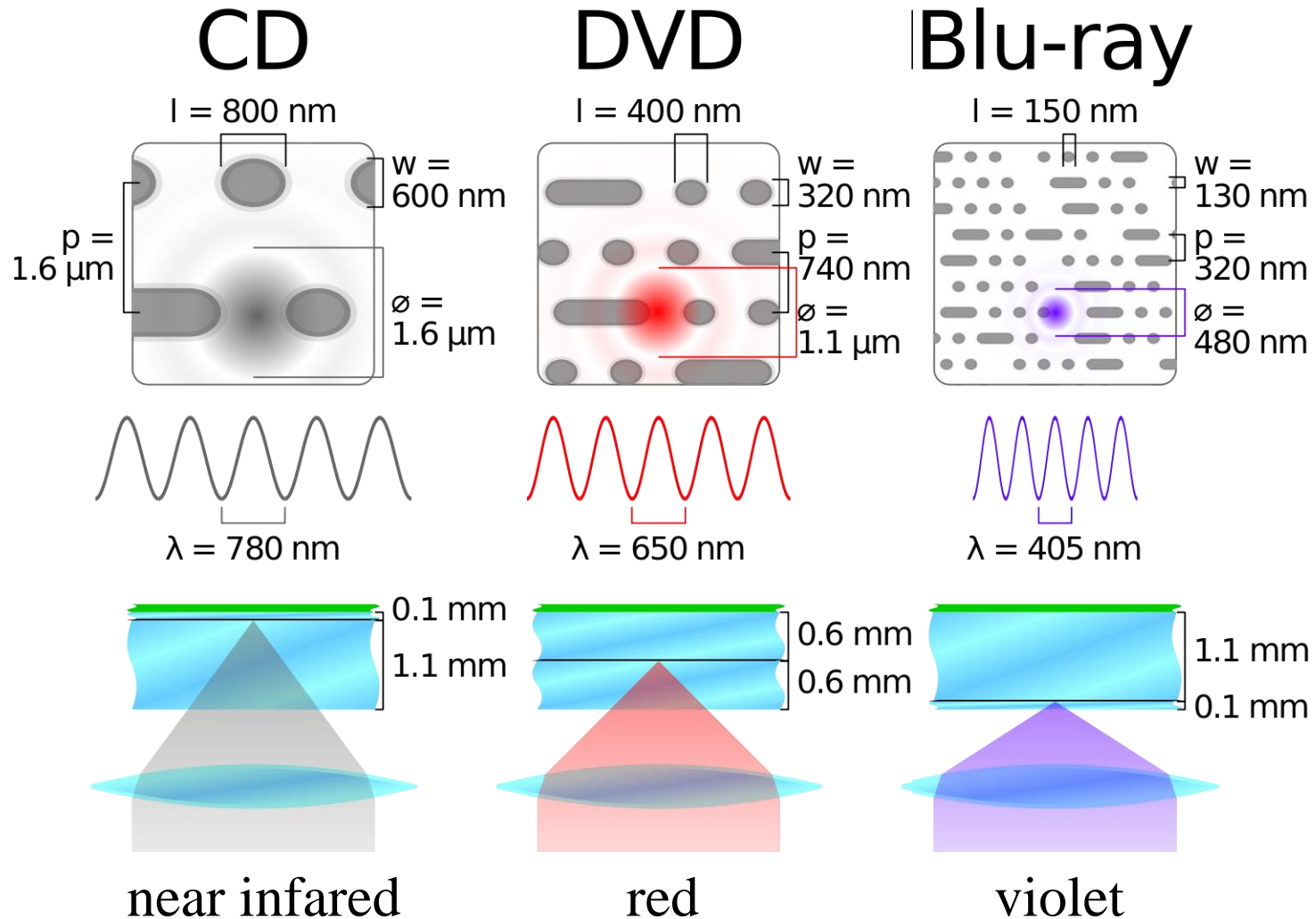- Substantially more expensive
  - About 5 times more per bit
- Limited data retention time
  - About 10 years (1-2 years for older drives)
- Limited number of lifetime write operations
  - About 5,000 writes per location
  - Seamless shuffling is used for "wear leveling"

Magnetic Tape

- Tapes store data sequentially
  - Fast transfer, but no practical "random access"

- Used only for low-use storage
  - Disaster recovery, offline storage

System Architecture

Keyboard

Mouse

Sound
Card

Video
Card

Input
Controller

System Bus

Front Side Bus

L2

L1

CPU

Cache

RAM

Hard
Drive

CD/
DVD

USB Port

Motherboard
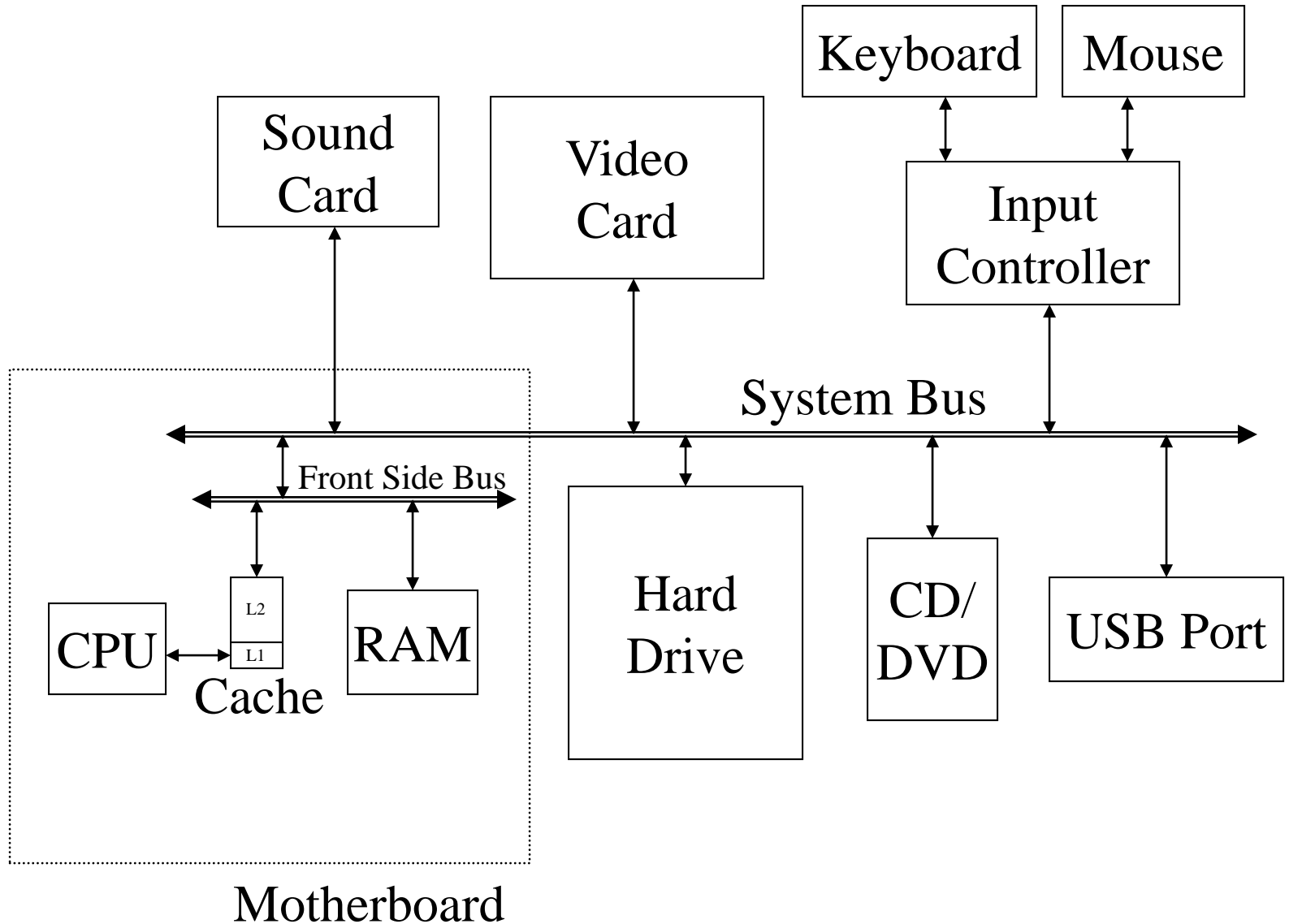
The Storage Hierarchy

Type	Speed	Size	Cost
Registers	~300 ps	256 B	Very expensive
Cache	~1 ns	4 MB	Expensive
RAM	~10 ns	1 GB	Cheap
Hard drive	~10 ms	100 GB	Very cheap

Frequency

Unit	Abbreviation	Cycles per second
hertz	Hz	1
kilohertz	KHz	$10^3 = 1,000$
megahertz	MHz	$10^6 = 1,000,000$
gigahertz	GHz	$10^9 = 1,000,000,000$

Time

Unit	Abbreviation	Duration (seconds)
second	sec/s	1
millisecond	ms	$10^{-3} = 1/1,000$
microsecond	μs	$10^{-6} = 1/1,000,000$
nanosecond	ns	$10^{-9} = 1/1,000,000,000$
picosecond	ps	$10^{-12} = 1/1,000,000,000,000$
femtosecond	fs	$10^{-15} = 1/1,000,000,000,000,000$

Units of Size

Unit	Abbreviation	Size (bytes)
bit	b	1/8
byte	B	1
kilobyte	KB	$2^{10} = 1024$
megabyte	MB	$2^{20} = 1,048,576$
gigabyte	GB	$2^{30} = 1,073,741,824$
terabyte	TB	$2^{40} = 1,099,511,627,776$
petabyte	PB	$2^{50} = 1,125,899,906,842,624$

Before You Go

On a sheet of paper, answer the following (ungraded) question (no names, please):

What was the muddiest point in today's class?