The machine that is everywhere hailed as the very incarnation of *the new* had revealed itself to be **not so new after all**, but a series of **skins**, *layer on layer*, winding around the **messy**, **evolving idea** of the **computing machine**.

Ellen Ullman, Life in Code, 1998

Why are we here?

CSC 360 Operating Systems…

THE GRAND ILLUSION

Jan 2020

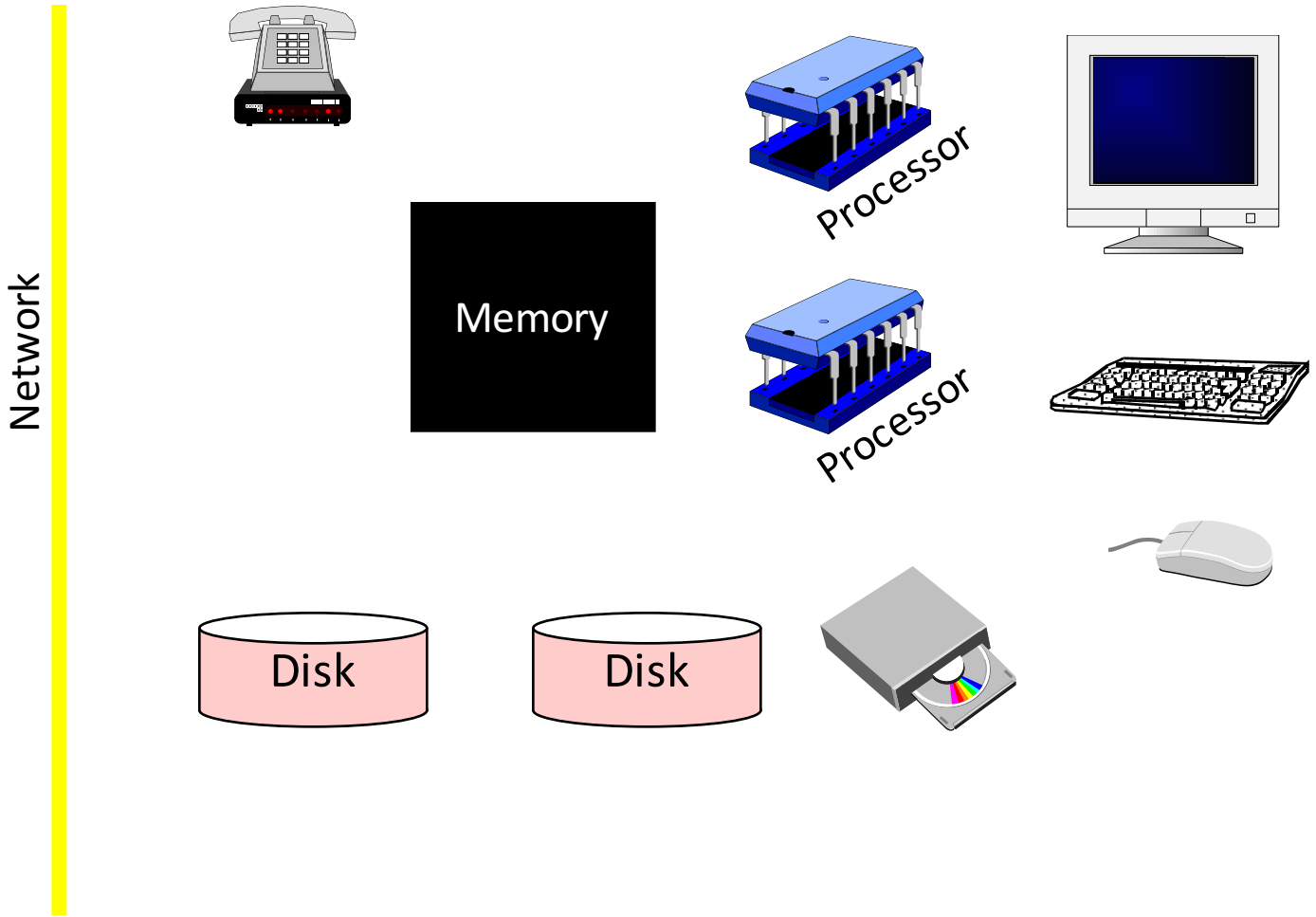
Why do you have to take this course

- ?

- What do you want to get out of it?!

- Take a few minutes, talk to someone YOU DON'T KNOW…
  - we will do this a few times
  - try to find someone who is in the same tutorial session as you!

hardware… what a mess!



Need policy and strategy for managing resources…

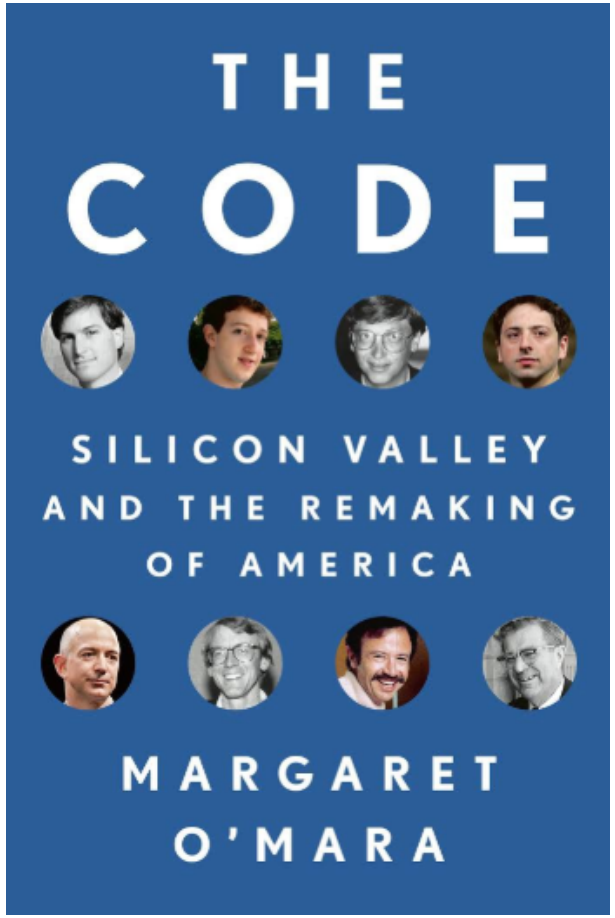
what is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware

- Operating system goals:
  - Execute user programs and make solving user problems easier
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner

We have an *exciting* history!

More global than this…
But you get the idea!



The machine that is everywhere hailed as the very incarnation of the new had revealed itself to be not so new after all, but a series of skins, layer on layer, winding around the messy, evolving idea of the computing machine.

Ellen Ullman,
Life in Code, 1998[3]

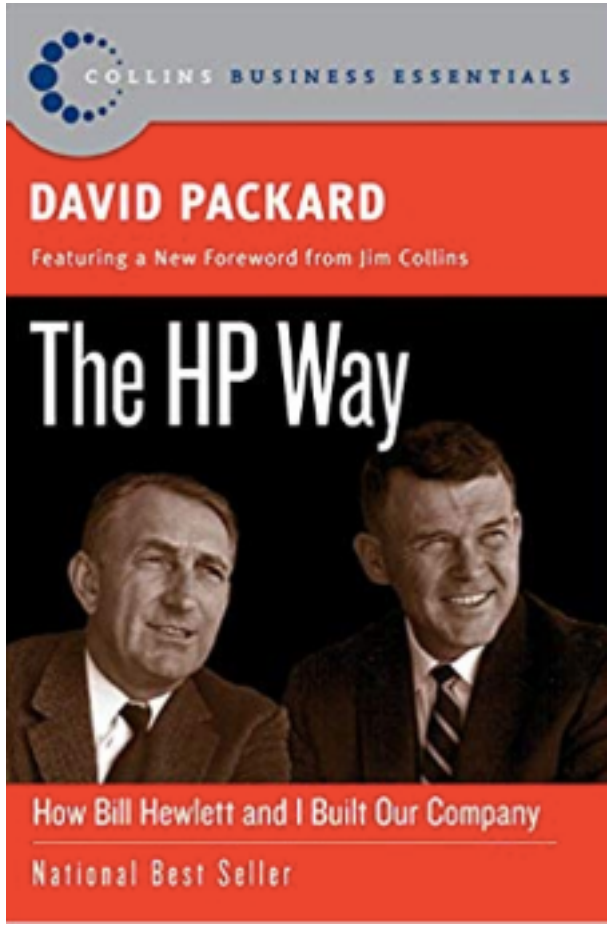
The start of an *economic* revolution?

1950s

1952

Entrepreneurs?

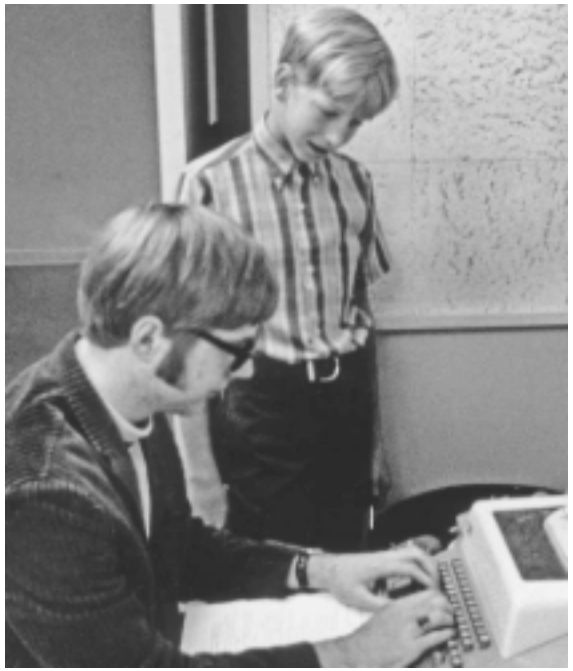
- Ann Hardy
  - IBM, Tymeshare, wrote an OS!
  - Became VP, turned entrepreneur…
- Hewlett and Packard
  - “Much more personal than standard corporate histories, David Packard's The HP Way provides insights into managing and motivating people and inspiration for would–be entrepreneurs. ”



Group work!

mid 60s

GOOD for children! (Paul Allan, Bill Gates)



1970s(?)

1983

Marketing?!

1980

Apple DOS

Apple computer running a Hello World program

Developer	Apple Computer
Written in	Assembly[1]
OS family	Apple DOS
Working state	Discontinued
Source model	Closed source
Initial release	1978; 42 years ago
Latest release	3.3 / 1980; 40 years ago
Kernel type	Monolithic kernel
License	Apple Software License Agreement

Synergy---Note not the only DOS!

1992

Sun Microsystems, ”the computer is the network”

An example of the Microsoft MS-DOS command-line interface, showing that the current directory is the root of drive C

Developer	Microsoft
Written in	x86 assembly,[1] later versions also used C
OS family	DOS
Working state	Preserved pieces exist in 32-bit Windows
Source model	Closed source; open source for select versions since 2018[2]
Initial release	August 12, 1981; 38 years ago[3]
Final release	8.0 (Windows Me) / September 16, 2000; 19 years ago
Repository	github.com/microsoft/ms-dos
Update method	Re-installation
Package manager	None
Platforms	x86
Kernel type	Monolithic
Default user interface	Command-line, text
License	Proprietary MIT License (v1.25 & v2.0)[2]
Succeeded by	Windows NT (as of Windows XP)
Official website	MS-DOS overview

Support status

MS-DOS 6.0 unsupported as of December 31, 2001[4]

Getting personal…

https://www.youtube.com/watch?v=0eEG5LVXdKo

Microsoft was shipping a browser, IE, with the OS.

Killed Netscape! (Came back as firefox!)

May 1998, Department of Justice filed **antitrust charges** against **Microsoft**

“He kills for code, man!”

Antitrust movie, 2001

Assignment 1!

- A "shell"
  - Command line interpreter!
  - USER meets OS head on! ☺

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All from wikipedia!

Linux

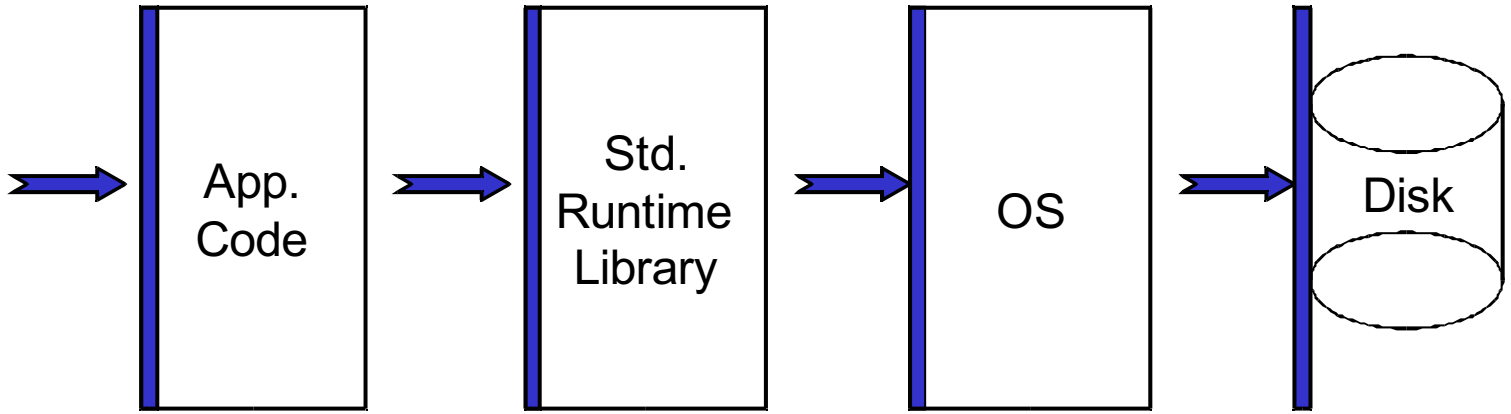
Tux the penguin, mascot of Linux[1]

Developer	Community Linus Torvalds
Written in	C, assembler
OS family	Unix-like
Working state	Current
Source model	Open source
Initial release	September 17, 1991; 28 years ago
Marketing target	Cloud computing, embedded devices, mainframe computers, mobile devices, personal computers, servers, supercomputers
Available in	Multilingual
Platforms	Alpha, ARC, ARM, C6x, H8/300, Hexagon, Itanium, m68k, Microblaze, MIPS, NDS32, Nios II, OpenRISC, PA-RISC, PowerPC, RISC-V, s390, SuperH, SPARC, Unicore32, x86, XBurst, Xtensa
Kernel type	Monolithic
Userland	GNU[a]
Default user interface	Unix shell
License	GPLv2[7] and others (the name "Linux" is a trademark[b])
Official website	www.linuxfoundation.org

User Operating System Interface

- Command Line Interface (CLI) or **command interpreter** allows direct command entry
  - Sometimes implemented in kernel, sometimes by systems program
  - Sometimes multiple flavors implemented – **shells**
  - Primarily reads in a command from user and executes it
    - Sometimes commands built-in, sometimes just names of programs
      - If the latter, adding new features doesn't require shell modification

Interface Layers



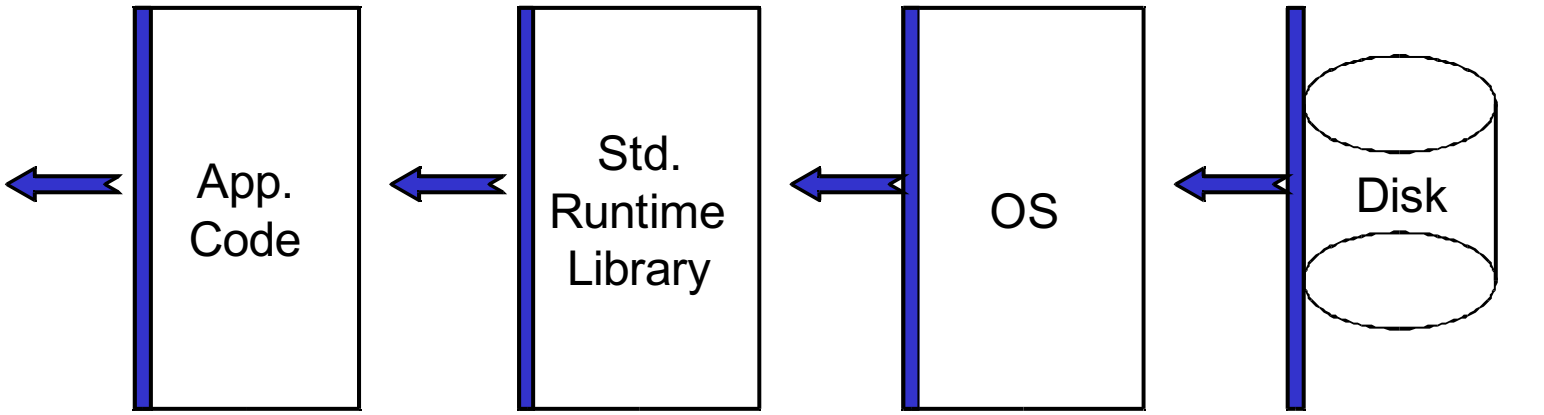
Whatever…

Procedure
Calls

Syscalls

Device-type
Dependent Commands

Exported Abstractions

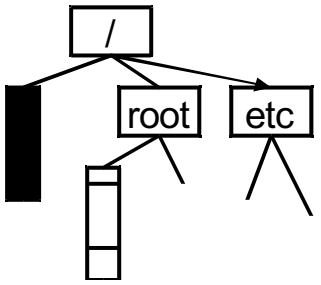


Note application is also a file (or many!)

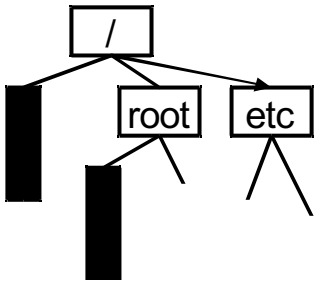
Whatever

.xls

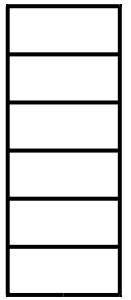
OS +
a tiny bit of
file type / structure



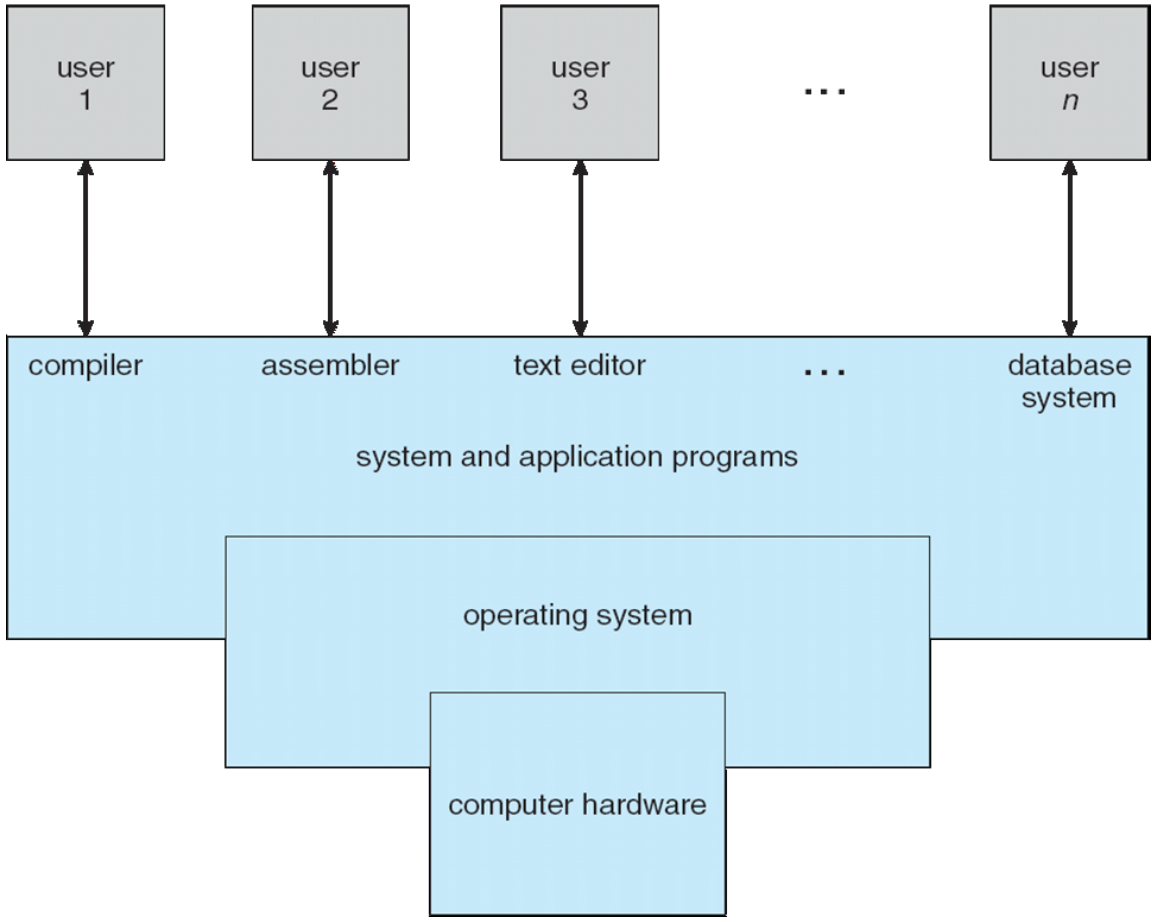
Directories,
Directory Entries,
Files,…



Array of Blocks

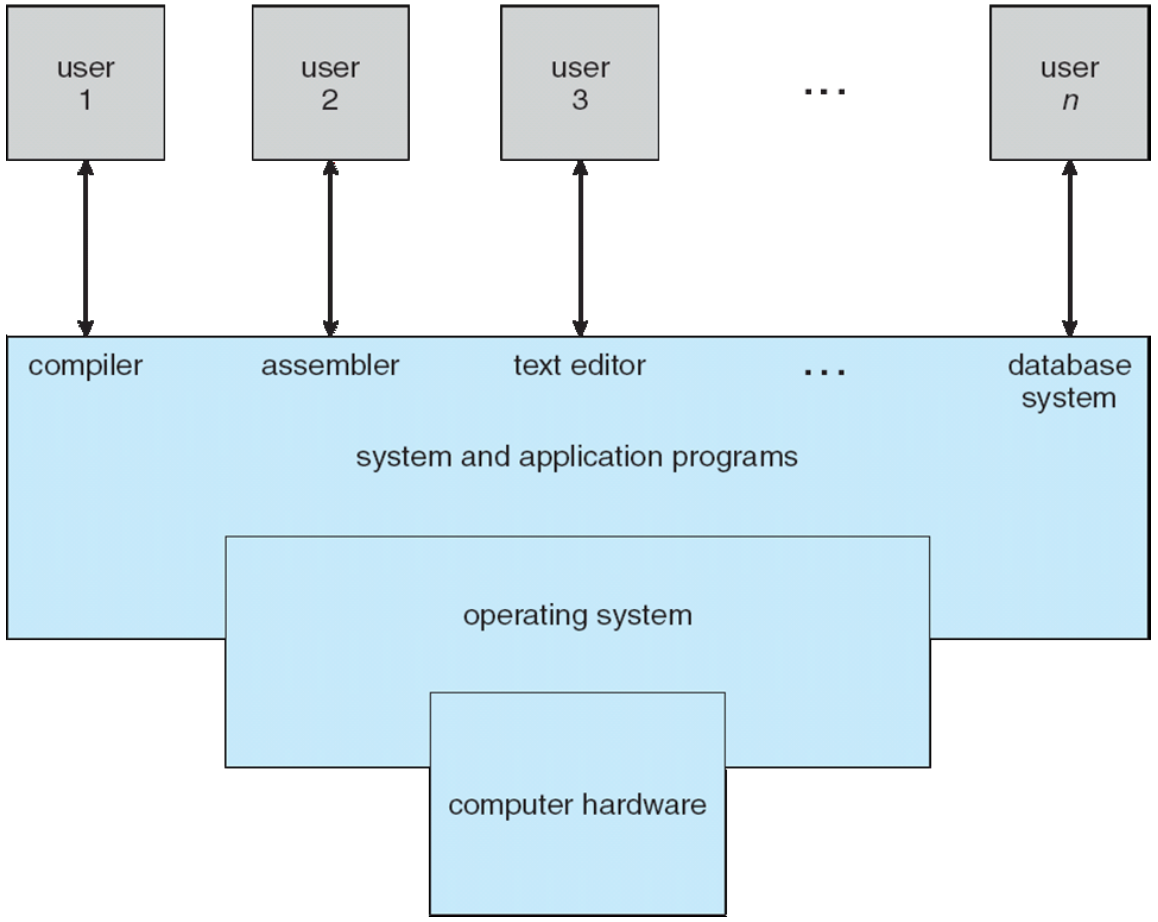


Four Components of a Computer System



Four Components of a Computer System

Do you see
a lot of multi-user
systems these days?



And more recently…

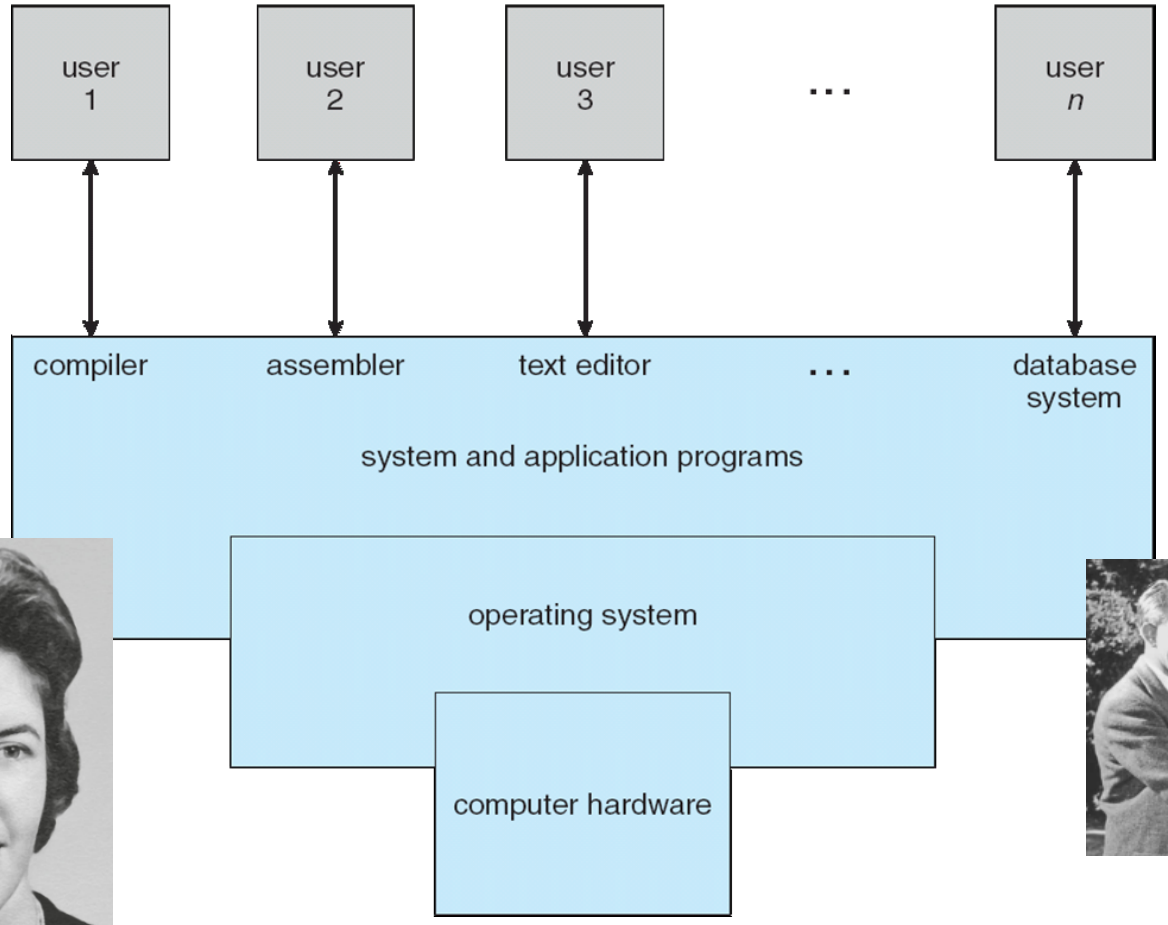
Google's Sergey Brin, Larry Page and Eric Schmidt 2001

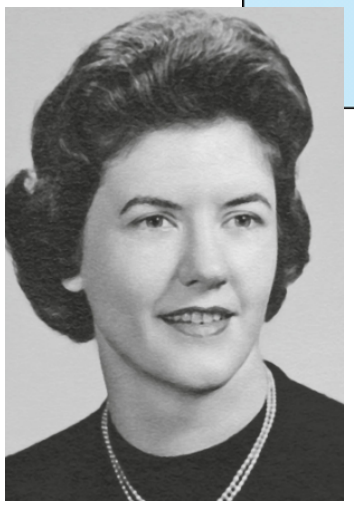
Amazon's Jeff Bezos 2004

Mark Zuckerberg 2010

LET'S BACK THAT QUESTION UP A LITTLE?!?!?

Do you see
a lot of multi-user
systems these days?

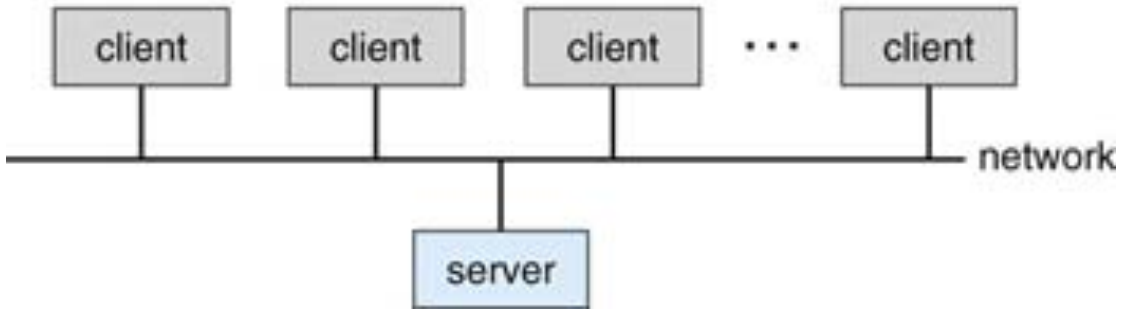




So where do we go from here?!

- Are you going to develop OSes?

- Maybe you want to be a Magician?!? ☺
  - Take a whole bunch of hardware and SHARE it between users of the system in such a way that they don't get in each other's way…
  - It's like they are the ONLY person (program?) on the system?!



Course Load in a Nutshell

Term Schedule

Dates are a guideline and are subject to change.

Assignment/Exam	Weight	Due Date
Tutorials	10%	1% each
Assignment 1	8%	January 31
Term Test 1	12%	February 3
Assignment 2	15%	February 28
Term Test 2	12%	March 2
Assignment 3	18%	April 3
Final Exam	25%	To be scheduled

Text: readings and forum questions (will be part of assignments!)

Silberschatz, Galvin, and Gagne 7th edition or later…

Tutorials

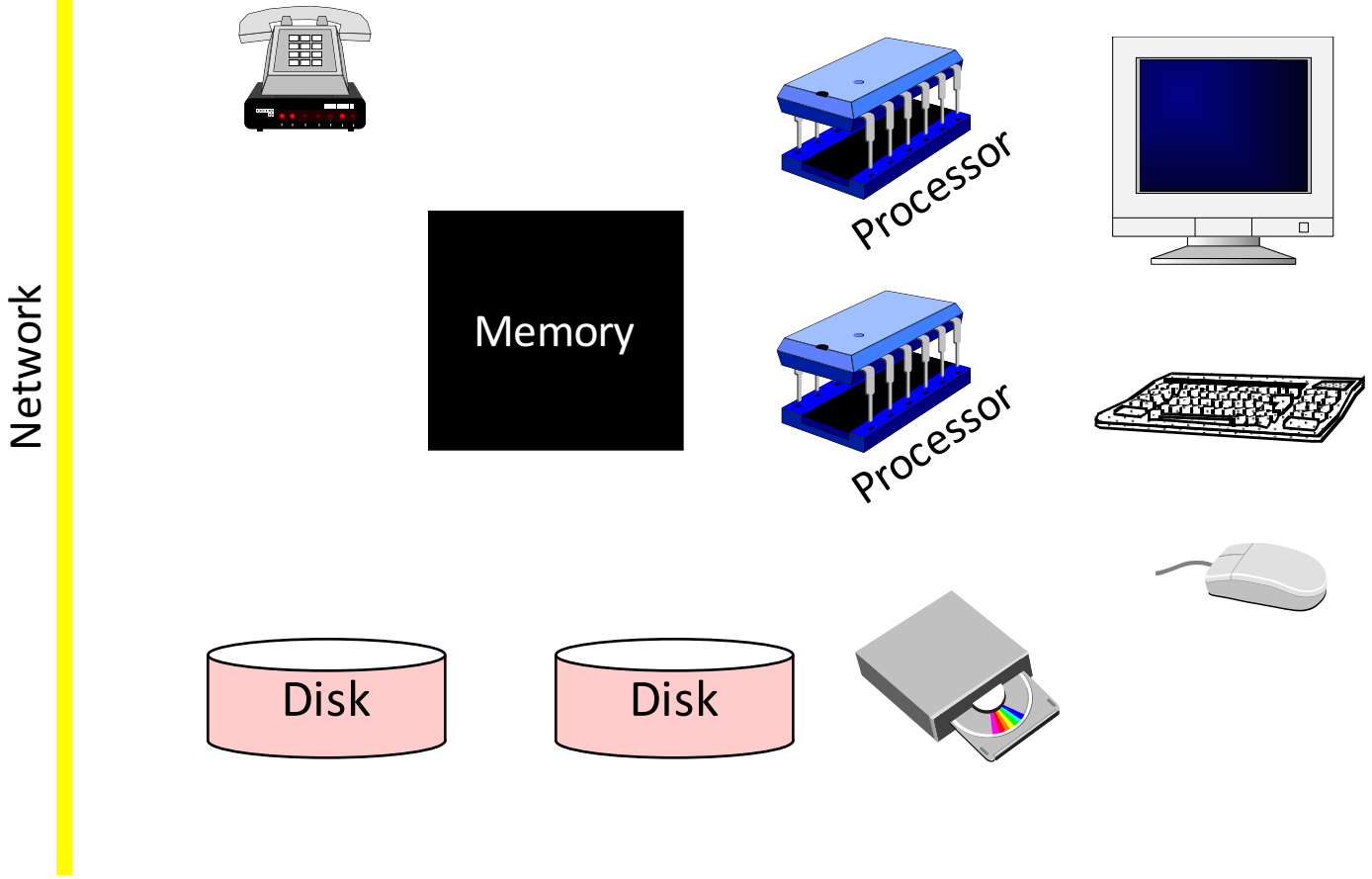
YES!!!! THEY ARE WORTH GOING TO!!! 1% of your mark each, good practice for tests/exam

T01	ELL 061	2020-01-13	2020-04-03	W	10:30-11:20
T02	ECS 108	2020-01-13	2020-04-03	W	13:30-14:20
T03	DSB C116	2020-01-13	2020-04-03	R	14:30-15:20

In the Beginning …

- There was hardware
  - processor
  - storage
  - card reader
  - tape drive
  - drum
- And not much else
  - no operating system
  - no libraries
  - no compilers

Hardware

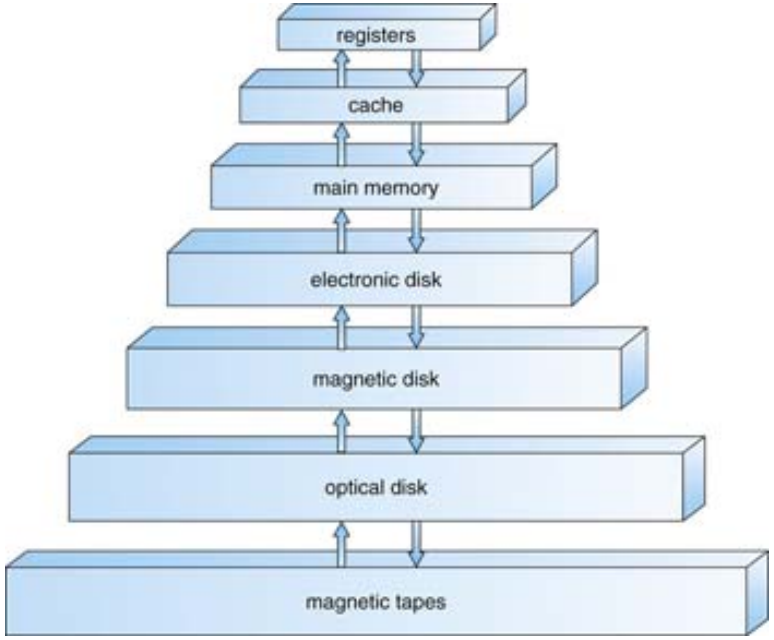


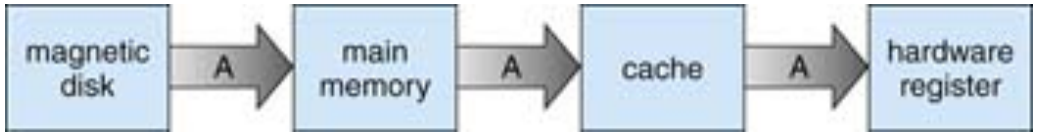
MAGICAL *Abstractions*

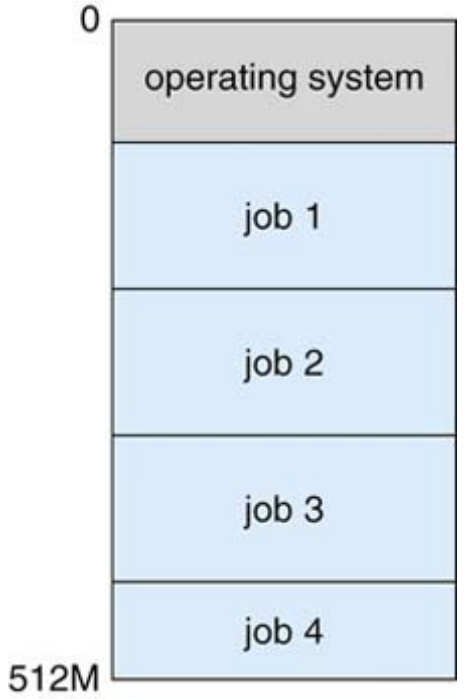
- Hardware
  - disks
  - memory
  - processors
  - network
  - monitor
  - keyboard
  - mouse
- Operating system
  - files
  - programs
  - threads of control
  - communication
  - windows, graphics
  - input
  - locator

Memory?

Memory

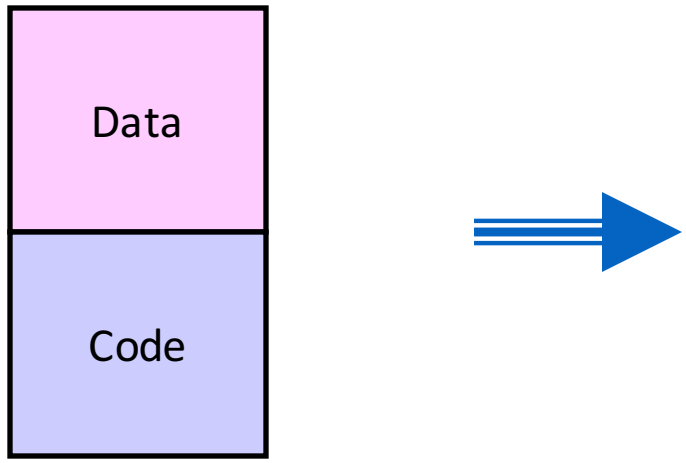


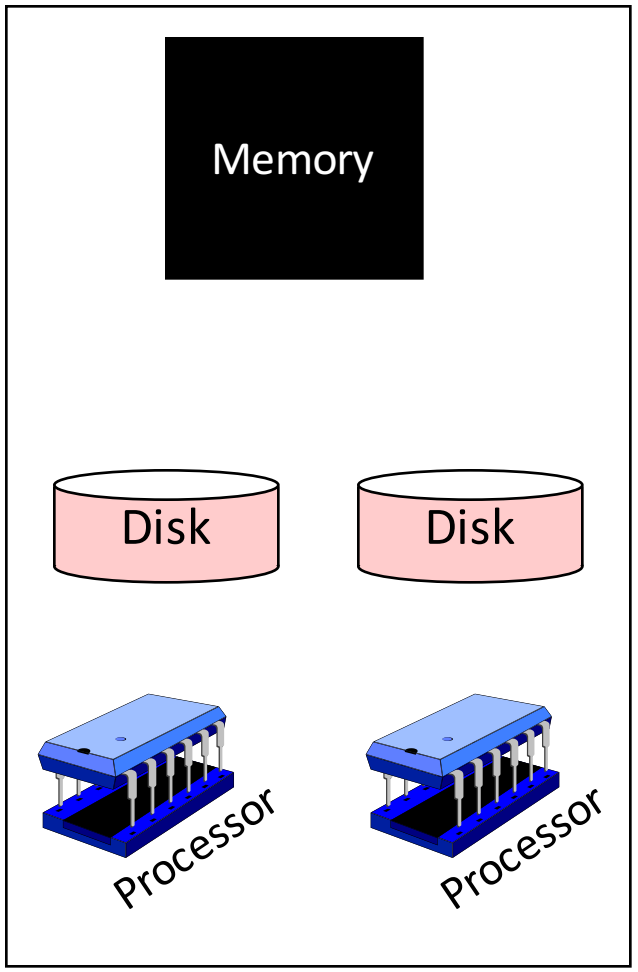




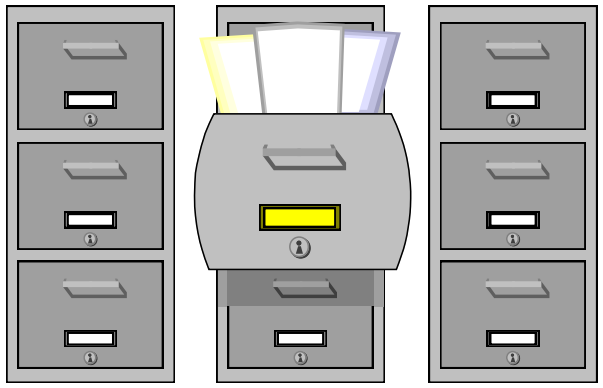
Level	1	2	3	4
Name	registers	cache	main memory	disk storage
Typical size	< 1 KB	< 16 MB	< 64 GB	> 100 GB
Implementation technology	custom memory with multiple ports, CMOS	on-chip or off-[illegible] SRAM	[illegible] DRAM	magnetic disk
Access time (ns)	0.25– 0.5	0.5– 25	80– 250	5,000.000
Bandwidth (MB/sec)	20,000– 100,000	5000– 10,000	1000– 5000	20– 150
Managed by	compiler	hardware	operating system	operating sys
Backed by	cache	main memory	disk	CD or tape

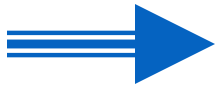
Programs (Assignment 2)

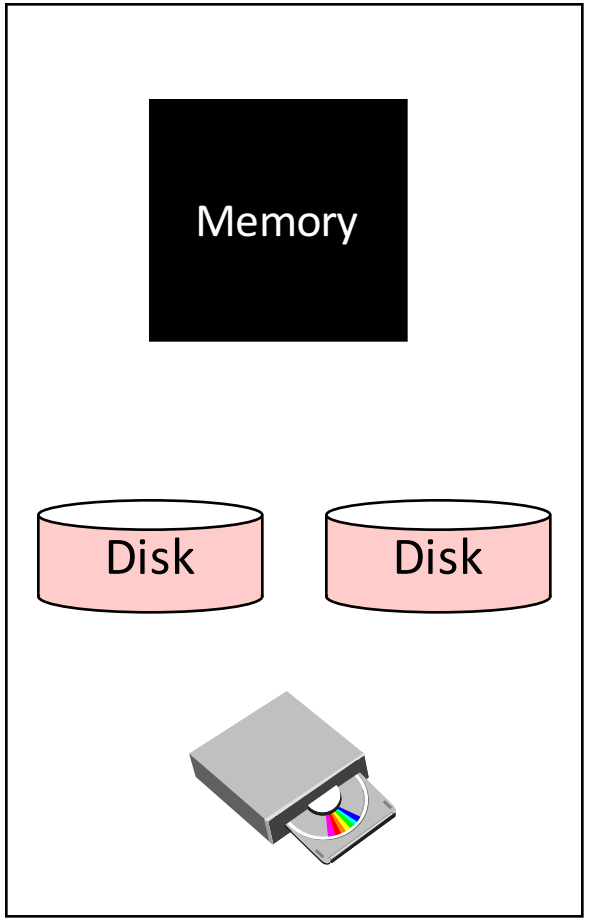




Files (Assignment 3)



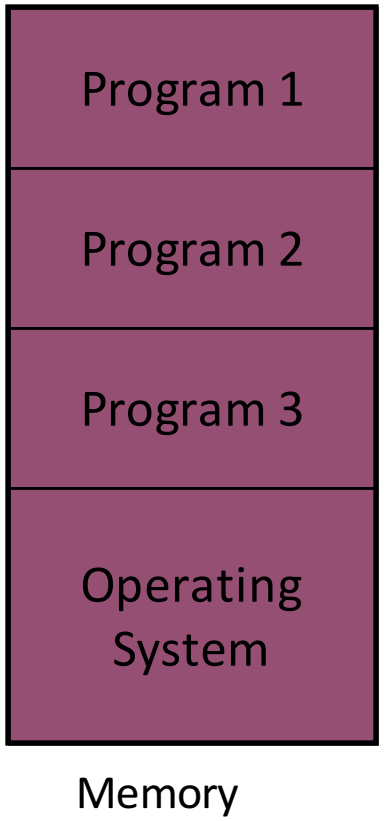




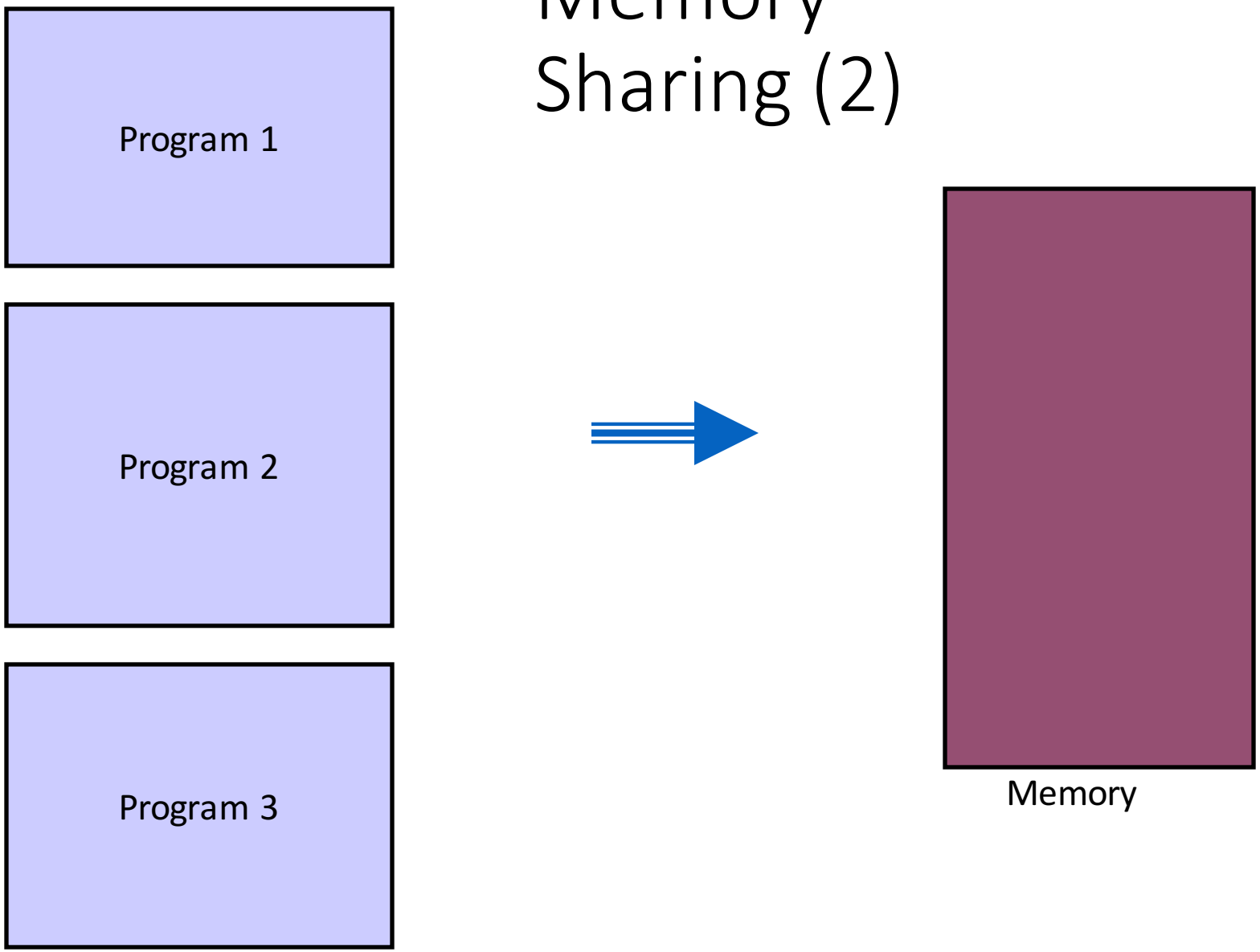
Issues

- Naming
- Allocating space on disk (permanent storage)
  - organized for fast access
  - minimize waste
- Shuffling data between disk and memory (high-speed temporary storage)
- Coping with crashes

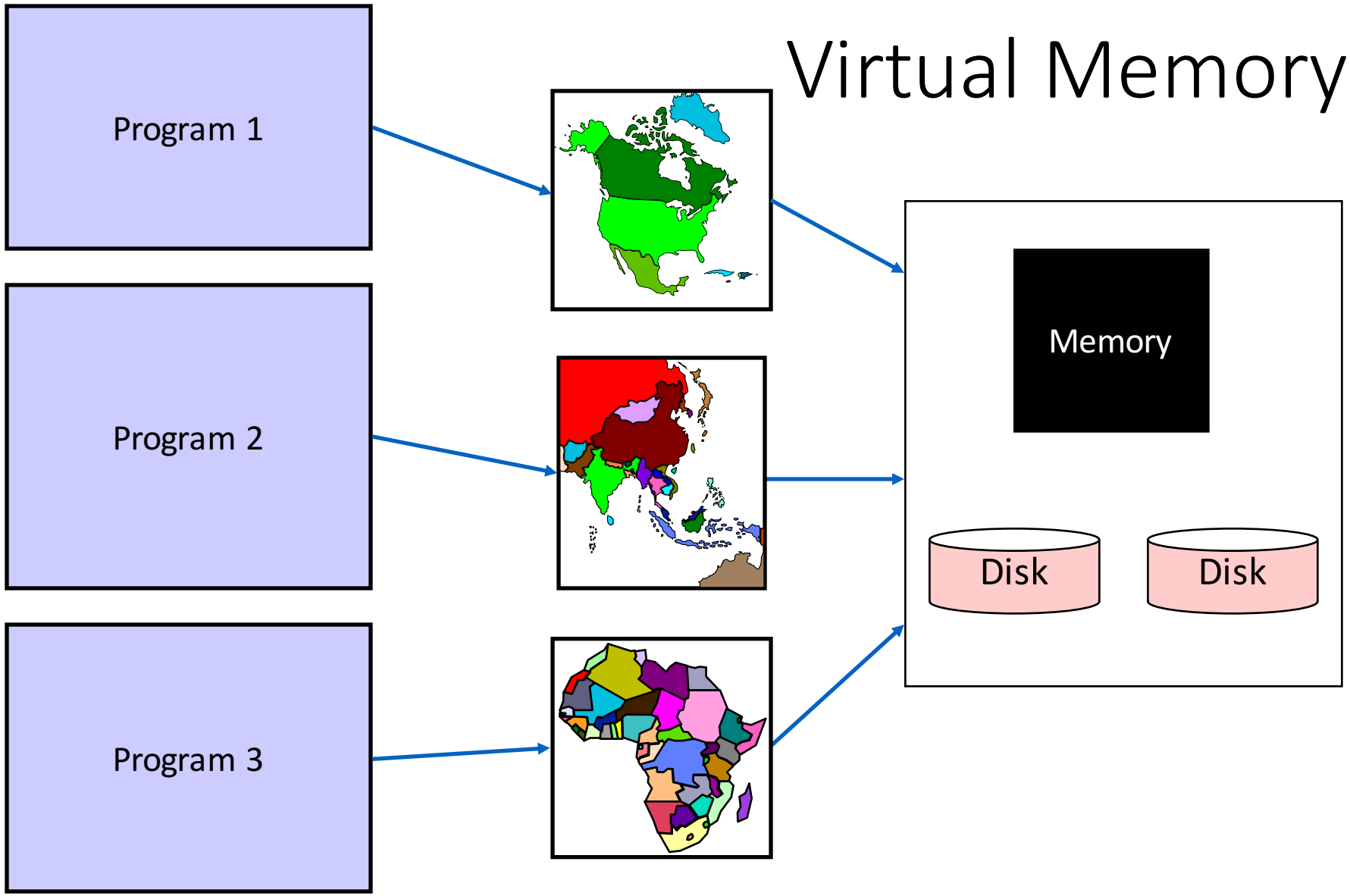
Memory Sharing (1)



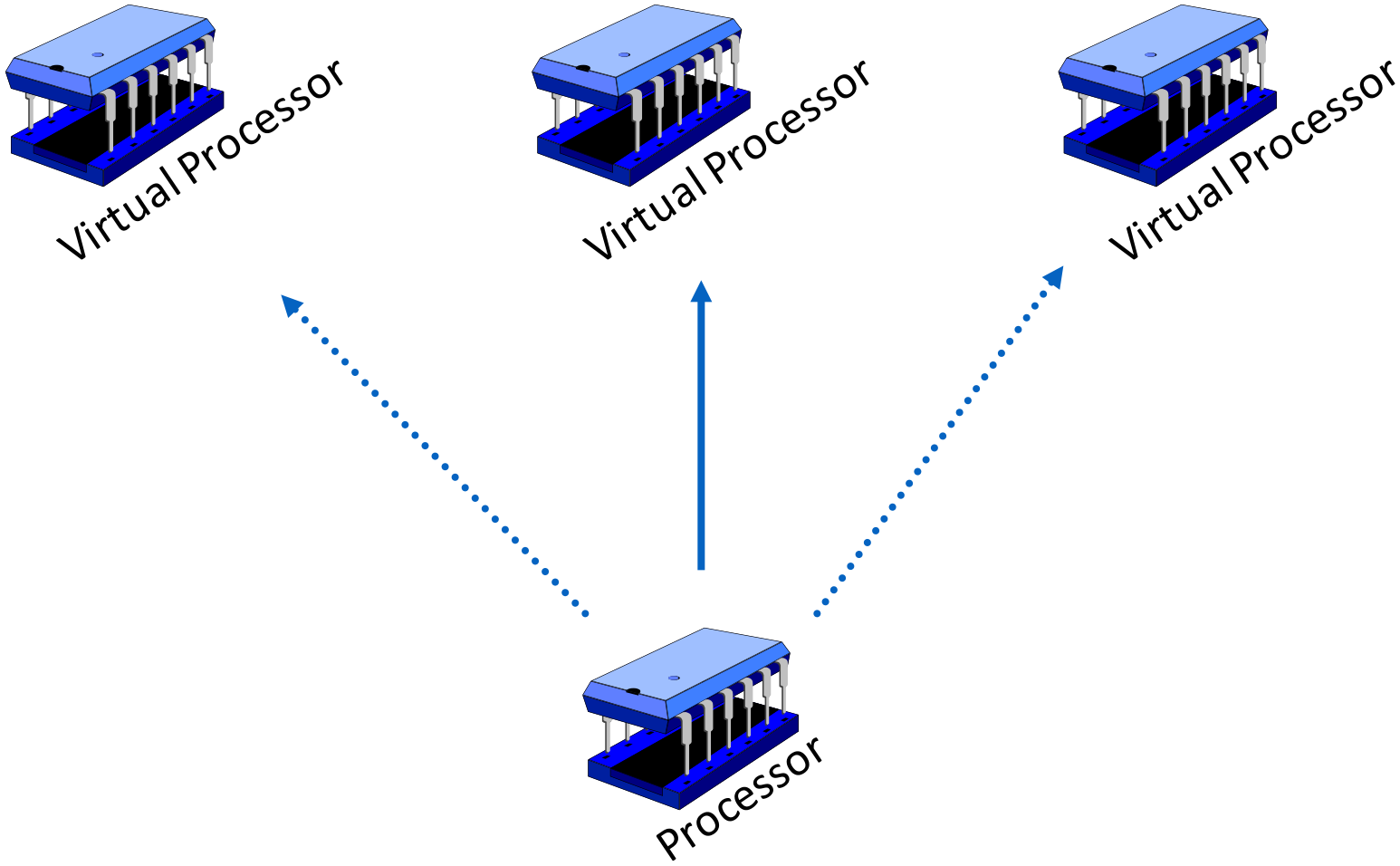
Memory Sharing (2)



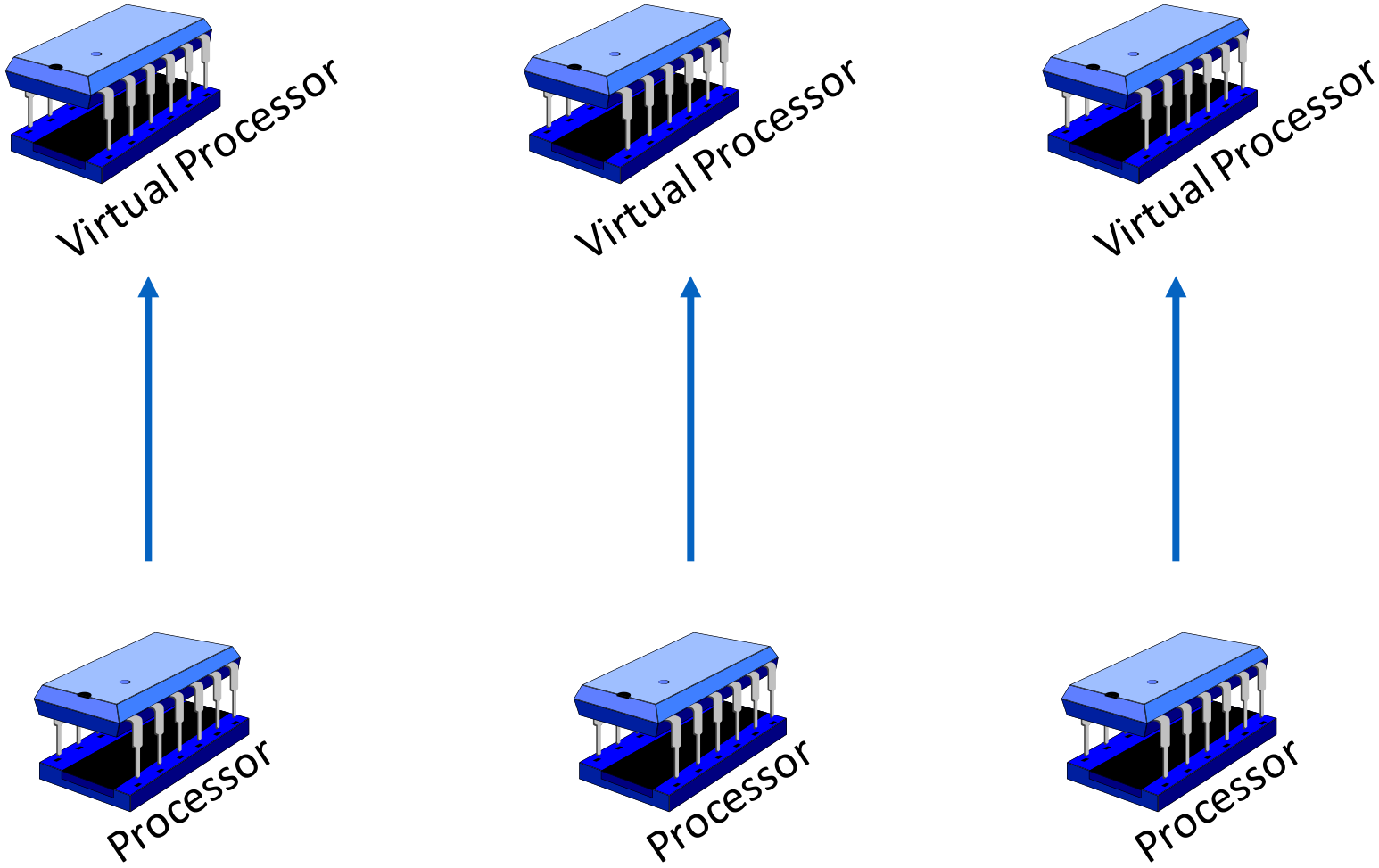
Virtual Memory



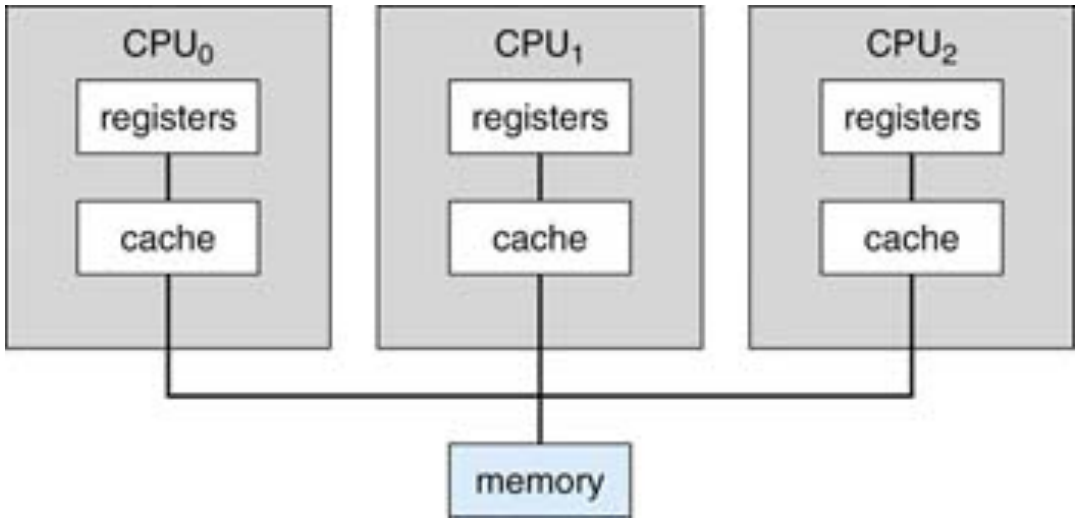
Concurrency (more in Assignment 2)

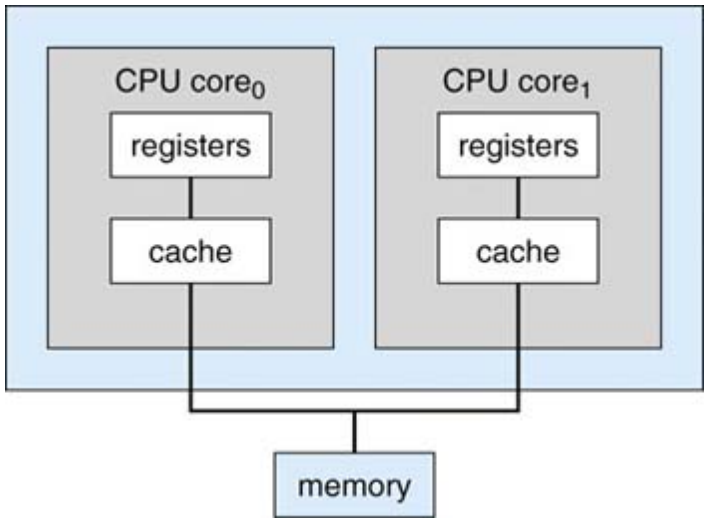


Parallelism



Processors and cores! (Assignment 2)





TO DO!!!!

- Be sure you're on CSC 360 CourseSpaces and upload your "picture"
  - You should have received email by now!
- Please keep up with **the programming**!
- Forum (reading/questions) is posted on the web **now**
  - Due as part of Assignment 1
  - https://www.g2.com/categories/operating-system
- Assignment 0 ("warmup") is posted on the web **now**
  - Will be discussed on Thursday
  - Tutorial question next week!