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# CS:3620 Operating Systems

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Introduction to OS

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# What is an operating system?

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“

*An operating system (OS) is system software that manages computer hardware and software resources and provides common services for computer programs.*

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”

(Wikipedia)

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# What is an operating system?

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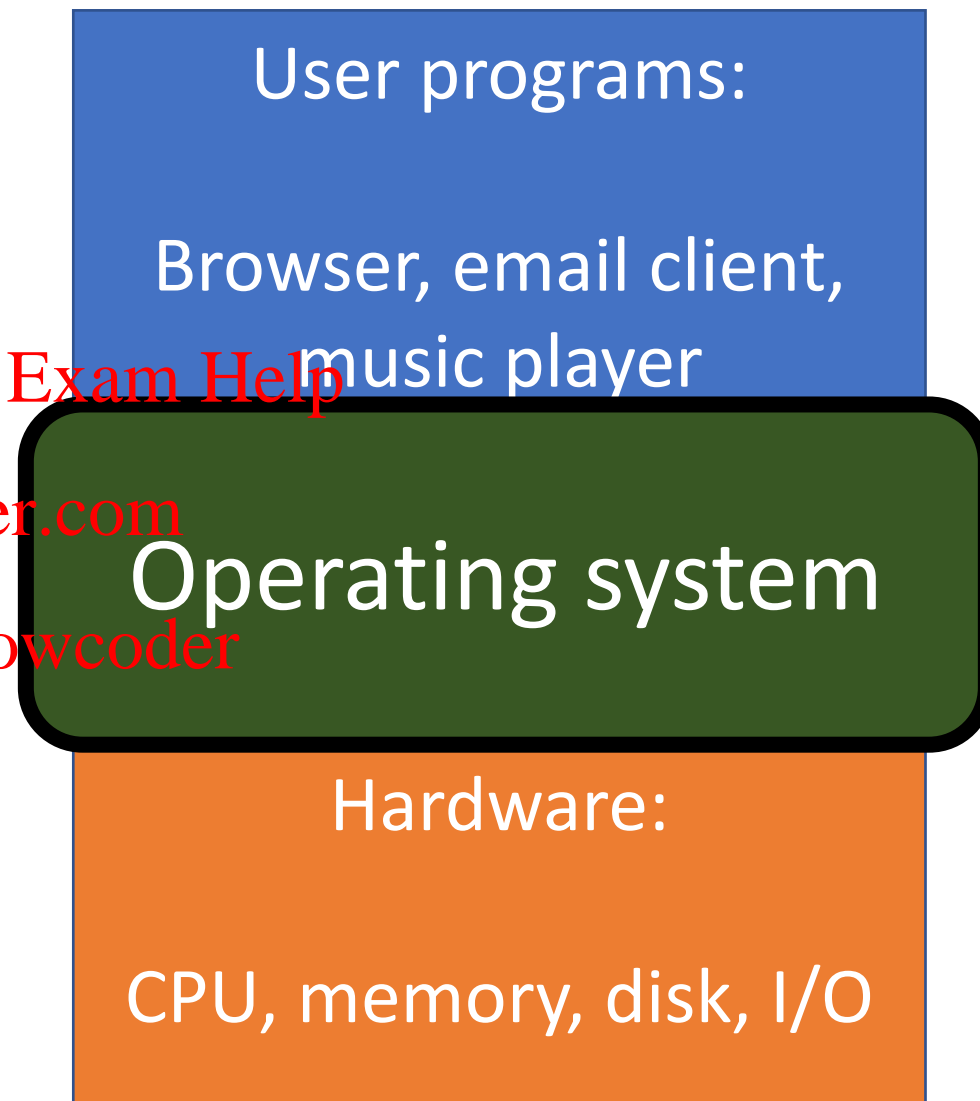
- Middleware between user programs and system hardware

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- Manages hardware: CPU, main memory, I/O devices (disk, network card, mouse, keyboard etc.)

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# What happens when you run a program?

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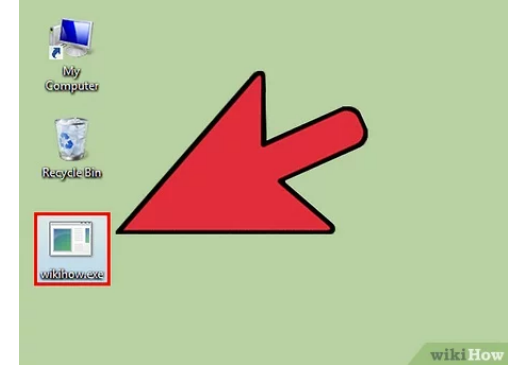
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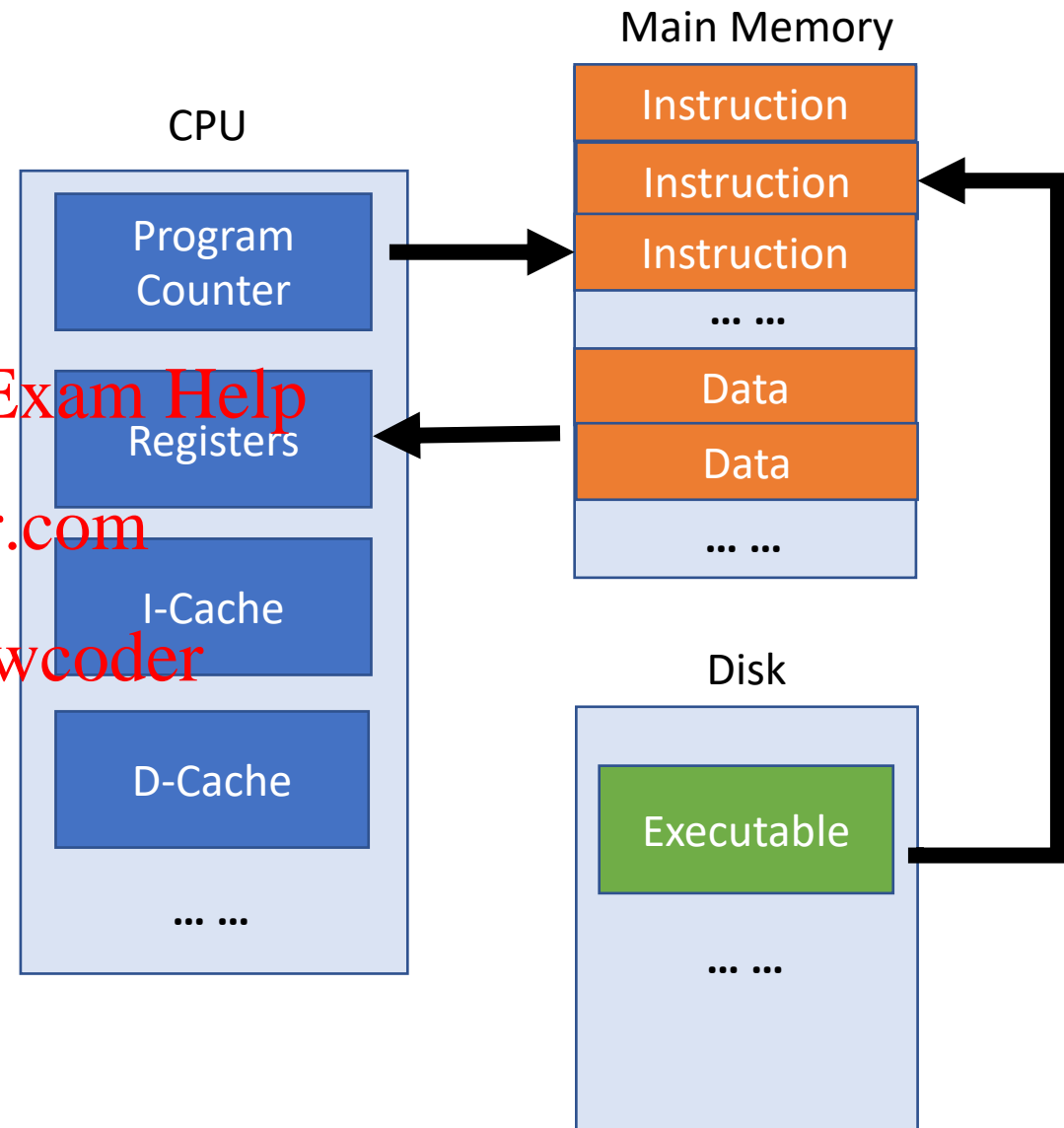
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- A compiler translates high-level programs into an executable (".c" to ".exe")
- The exe contains instructions that the CPU can understand, and data of the program
- Instructions run on CPU: hardware implements an instruction set architecture (ISA)
- CPU also consists of a few registers, e.g.,
  - Pointer to current instruction (program counter or PC)
  - Operands of instructions, memory addresses



# What happens when you run a program?

- To run an exe, CPU
  - Fetches instructions pointed by PC from memory
  - Loads data required by the instructions into registers
  - Decodes and executes the instruction
  - Store results to memory
- Most recently used instructions and data are in CPU caches for faster access



# What does the OS do?

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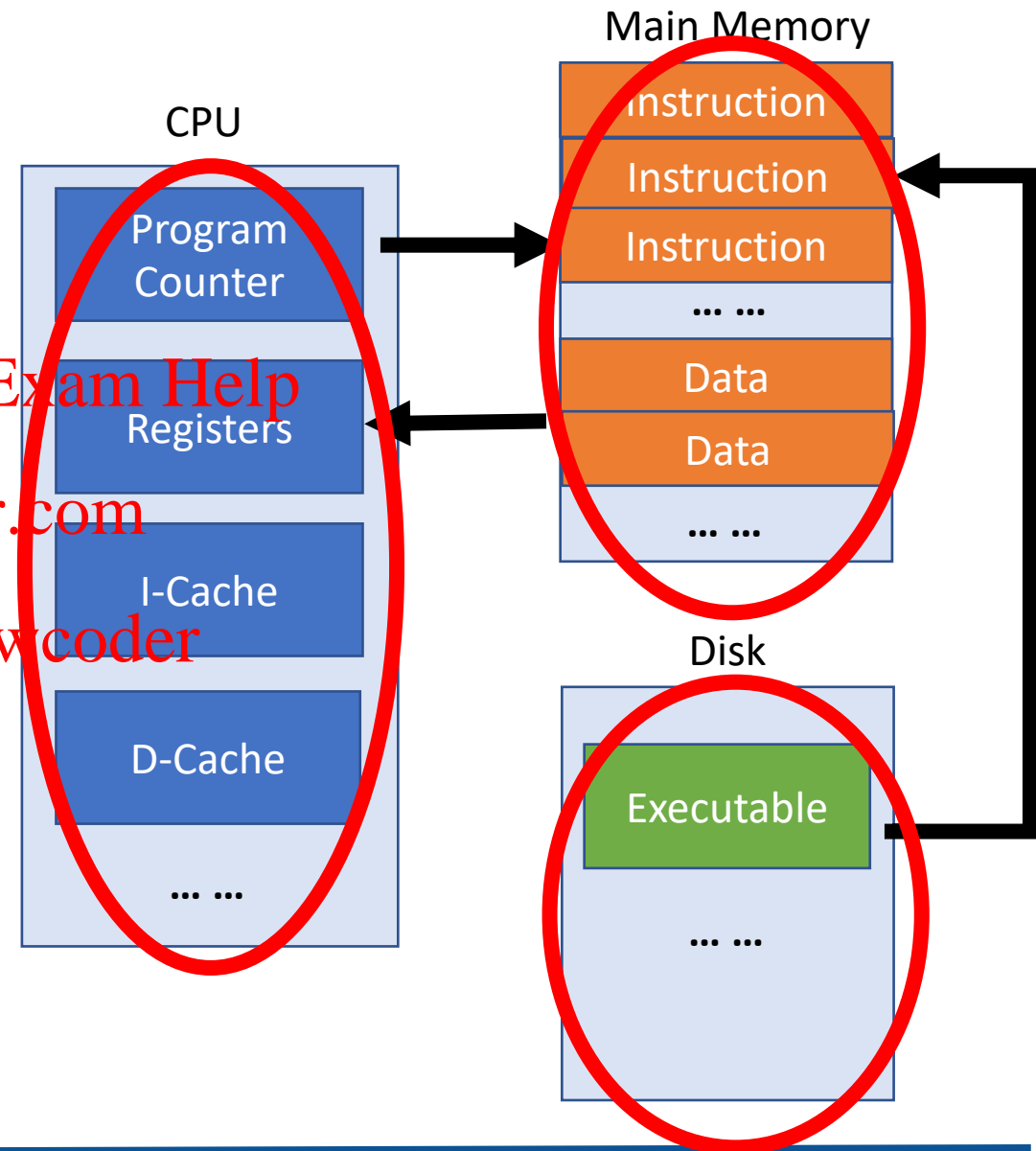
- OS manages program memory
  - Loads program executable from disk to memory
- OS manages CPU
  - Initializes program counter (PC) and other registers to begin execution
- OS manages external devices
  - Read/write files from disks

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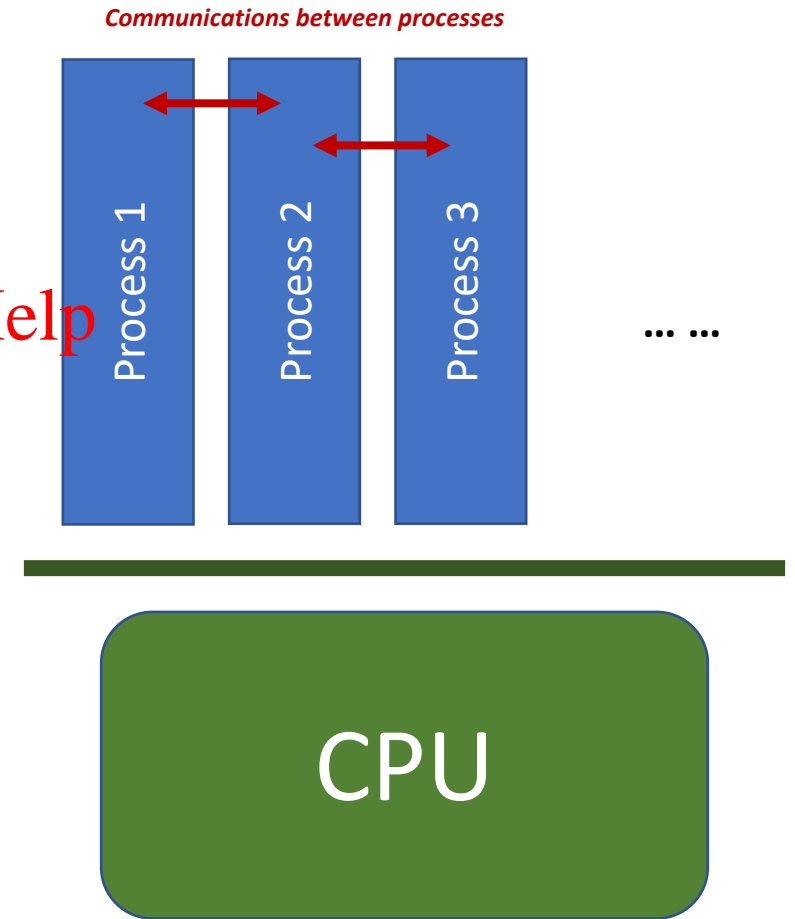
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- OS provides the process abstraction
  - Process: a running program
  - OS creates and manages processes
- Each process has the illusion of having the complete CPU, i.e., OS virtualizes CPU
- Timeshares CPU between processes
- Enables coordination between processes

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- My laptop has 2 physical cores (With HyperThreading: 2 threads per core)
- I can execute multiple programs at the same time
- Demo

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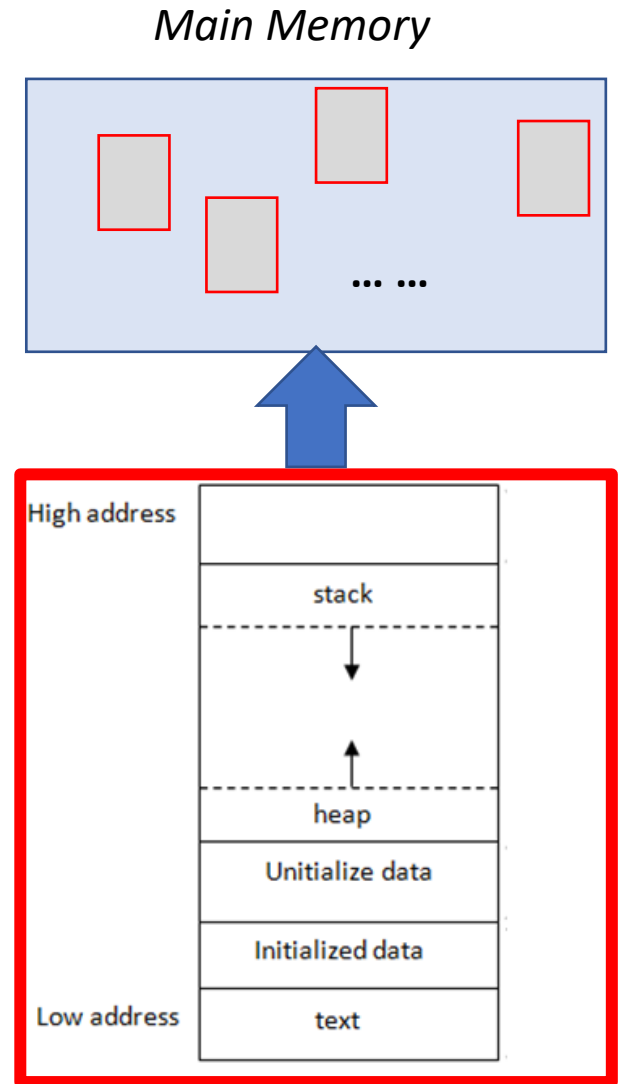
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- OS manages the memory of the process: code, data, stack, heap etc
- Each process thinks it has a dedicated memory space for itself, code and data starting from 0 (virtual addresses)
- OS abstracts out the details of the actual placement in memory, translates from virtual addresses to actual physical addresses

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*Process view of its memory space*

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- OS has code to manage disk, network card, and other external devices: device drivers
- Device driver talks the language of the hardware devices
- Issues instructions to devices (fetch data from a file)
- Responds to interrupt events from devices (user has pressed a key on keyboard)
- Persistent data organized as a filesystem on disk

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# Many Operating Systems

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FreeBSD



Chrome OS



Mac OS



# Which OS?

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- A laptop Add WeChat powcoder, MacOS, Chrome OS, Linux, (\*BSD, ...)
- A Web Server Linux, Windows, FreeBSD
- A Smartphone Assignment Project Exam Help  
Android, iOS, (Windows mobile)  
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- A home router Linux Add WeChat powcoder
- PlayStation 4 FreeBSD
- Nintendo Switch FreeBSD

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- Convenience, abstraction of hardware resources for user programs
- Efficiency of usage of CPU, memory, etc.
- Isolation between multiple processes

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- Started out as a library to provide common functionality across programs
- Later, evolved from procedure call to system call:  
what's the difference?  
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- When a system call is made to run OS code, the CPU executes at a higher privilege level  
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- Evolved from running a single program to multiple processes concurrently

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- Poll

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- *These lecture slides are based on a slide set by Youjip Won (Hanyang University) and Mythili Vutukuru (IIT Bombay)*

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