

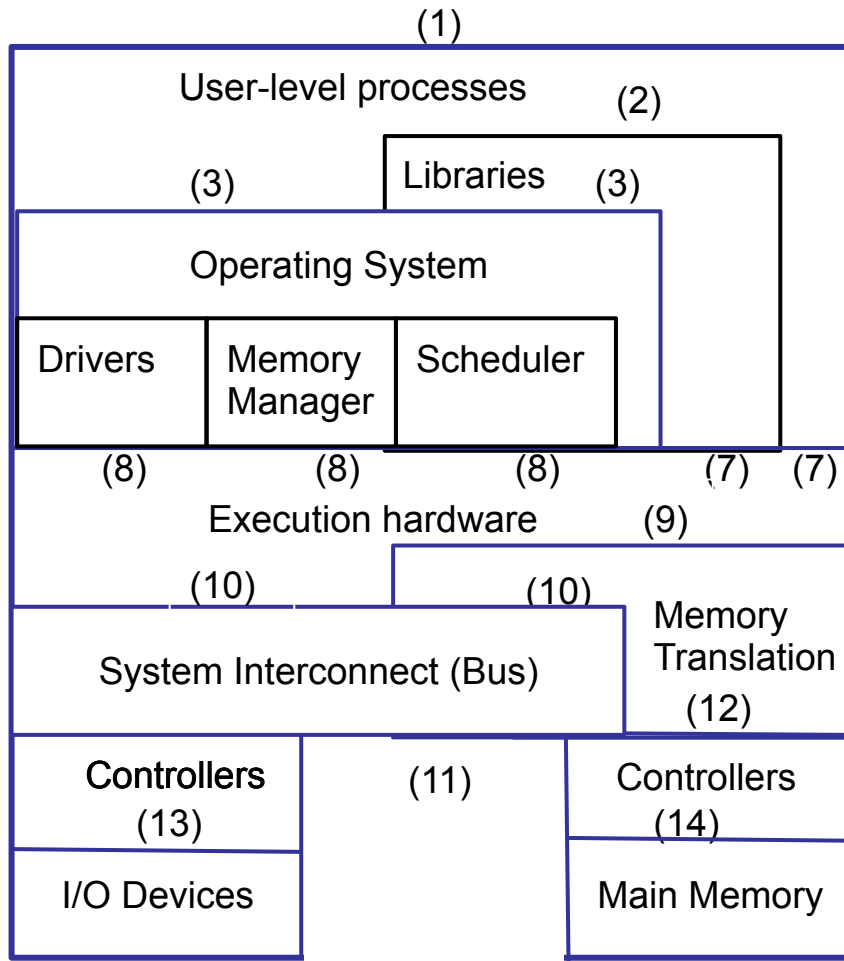
Operating Systems Overview

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Class website:

<http://oscourse.github.io>

Interfaces in a Computer System



User ISA : 7
 System ISA : 8
 Syscalls : 3
 ABI : 3, 7
 API : 2, 7

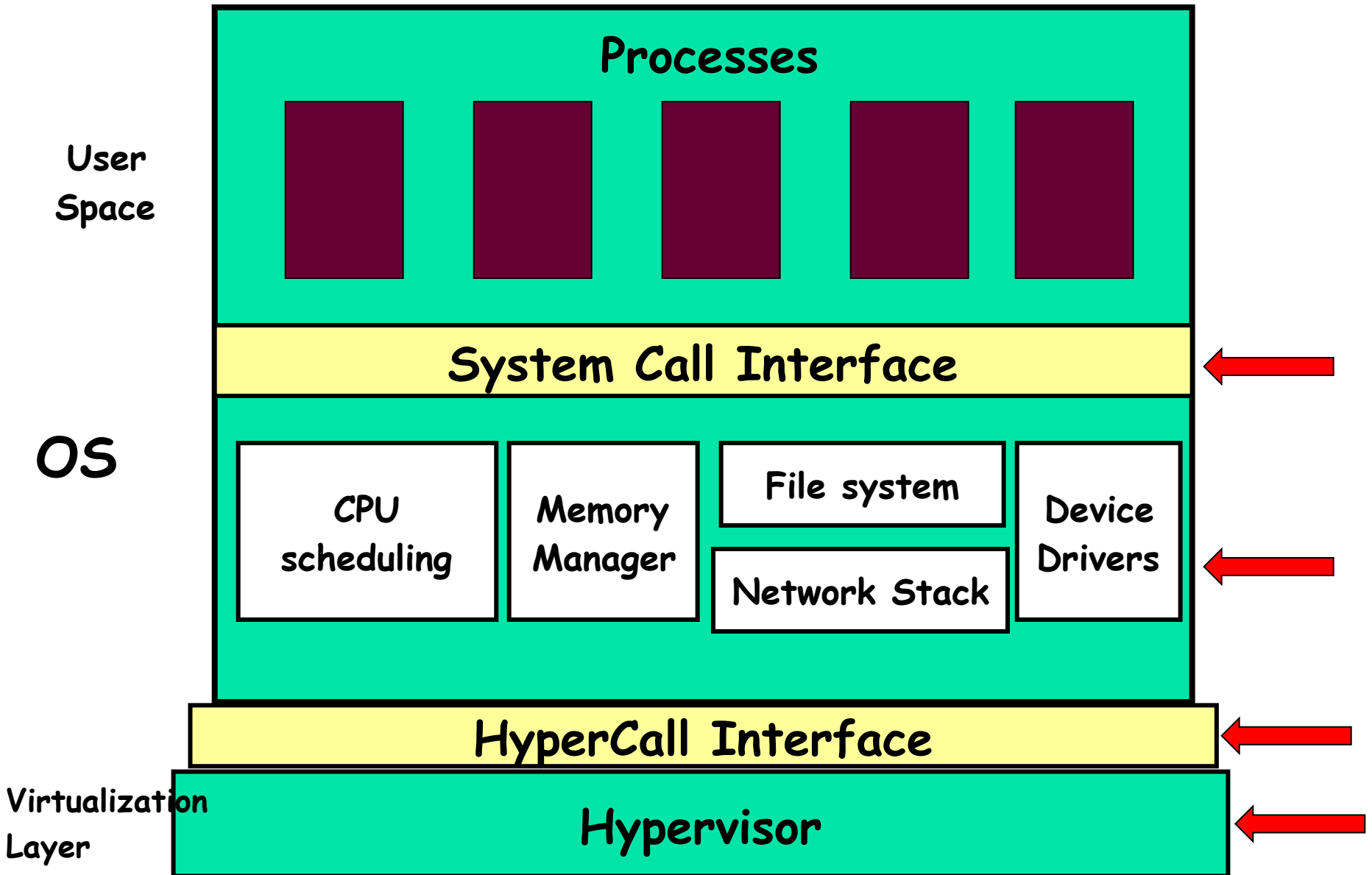
ISA = Instruction Set Architecture
 ABI = Application Binary Interface
 API = Application Programming Interface

What is an OS?

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- A bunch of software and data residing somewhere in memory.
 - But its not just *any* software.
- OS is the most privileged software in a computer.
 - *Privileged* means that OS can do special things, like write to disk, talk over the network, control memory and CPU usage, etc.
- OS manages all system resources
 - CPU, Memory, and I/O devices

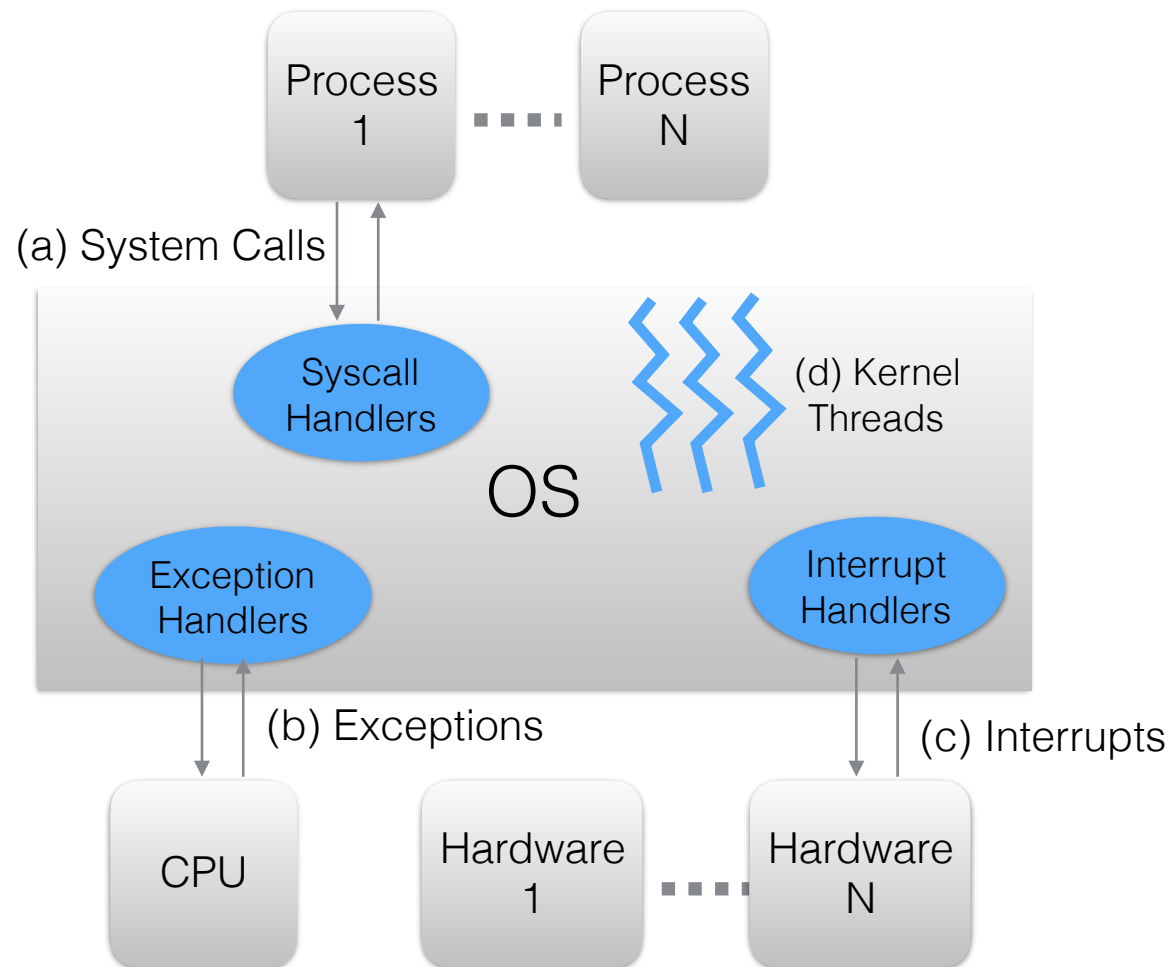
Layers of Software



But when does the OS “run”?

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Four ways to invoke OS code



Three major tasks of OS

1. Virtualization
2. Concurrency
3. Persistence

Virtualization

- Making a physical resource look like something else (virtual).
- Why virtualize?
 - To make the computer easier to use and program.
- Examples
 - Make one physical CPU look like multiple virtual CPUs
 - One or more virtual CPUs per process
 - Make physical memory (RAM) and look like multiple virtual memory spaces
 - One or more virtual memory spaces per process
 - Make physical disk look like a file system
 - Physical disk = raw bytes.
 - File system = user's view of data on disk.

Concurrency

- Juggling many tasks together
- Examples
 - One physical CPU runs many processes
 - One process runs many threads
 - One OS juggles process execution, system calls, interrupts, exceptions, CPU scheduling, memory management, etc.
- There's a LOT of concurrency in modern computer systems.
- And its the source of most of the system complexity.

Persistence

- Storing data “forever”
 - On hard disks, SSDs, CDs, floppy disks, tapes, phono discs, paper!
- But its not enough to just store raw bytes
- Users want to
 - Organize data (via file systems)
 - Share data (via network or cloud)
 - Access data easily
 - ...and recover data when lost.
 - Protect data from being stolen.

History of OS

- 1950s and 1960s: Early operating systems were simple batch processing systems
 - Users provided their own “OS” as libraries.
- 1960s and 1970s: Multi-programming on mainframes
 - Concurrency, memory protection, Kernel mode, system calls, hardware privilege levels, trap handling
 - Earliest Multics hardware and OS on IBM mainframes
 - Which led to the first UNIX OS which pioneered file systems, shell, pipes, and the C language.
- 1980s: Personal computing era
 - MacOS, IBM PC and its DOS, Windows, and so forth.
 - Unfortunately, many lessons from earlier multi-programming era were forgotten and had to be re-learned (painfully).
- 1980s also saw the fragmentation of UNIX
 - Each big company had its own version (IBM, Apple, HP, SUN, SGI, NCR, AT&T....)
 - LOT of legal wrangling over IP and copyrights
- 1990s: Then came BSD and Linux
 - Open source.
 - Led the way to modern OSes and cloud platforms
- 1990s also saw wider adoption of threads and parallelism
- 2000 and beyond: Mobile device OS and hypervisors
 - Android, iOS
 - VMWare ESX, Xen, Linux/KVM etc.