

Operating Systems Overview

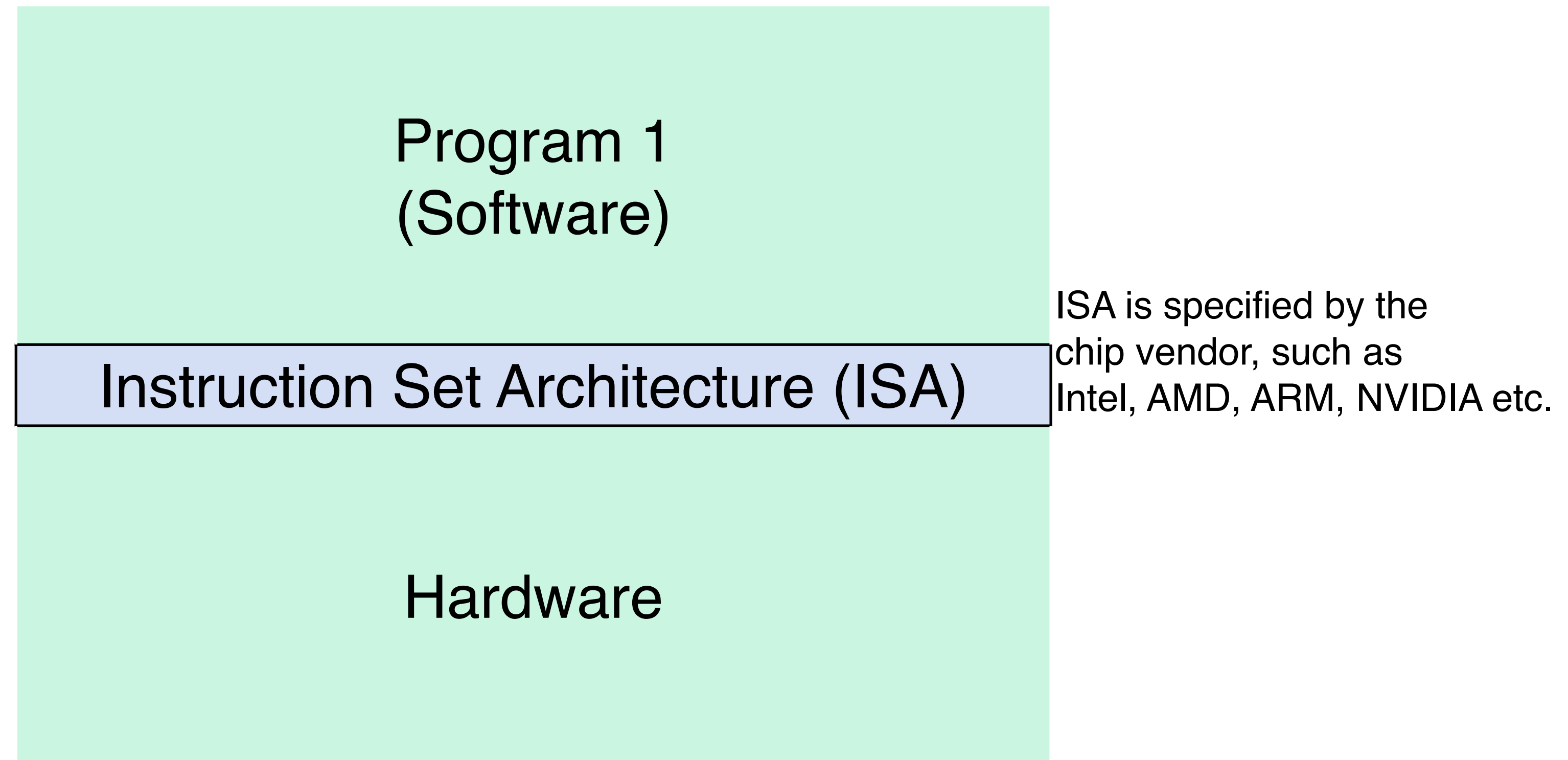
Prof. Kartik Gopalan

What is an Operating System?

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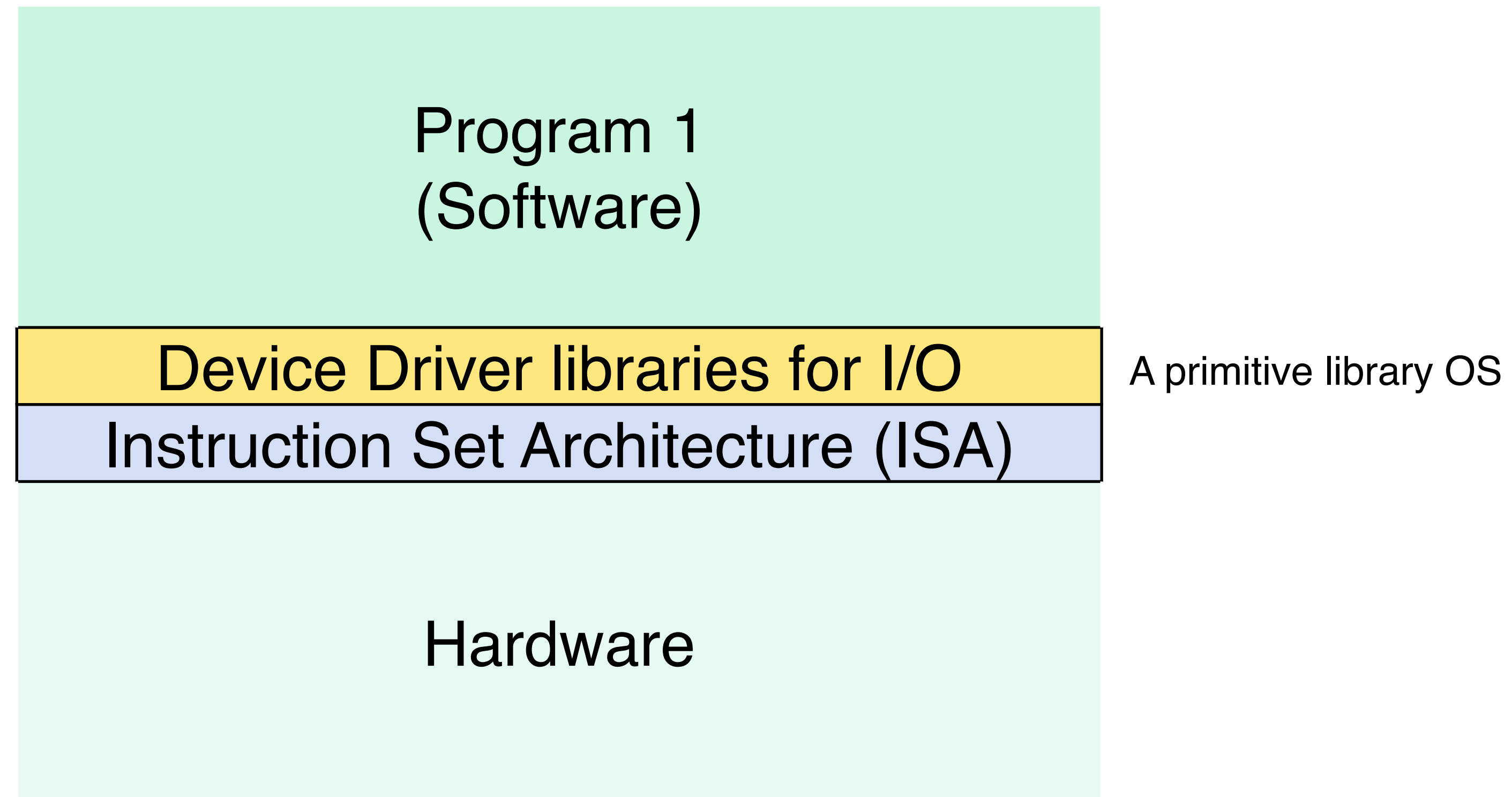
- A bunch of software and data residing somewhere in memory.
 - But its not just *any* software.
- OS is the most privileged software in a computer.
 - *Privileged* means that OS can do special things, like write to disk, talk over the network, control memory and CPU usage, etc.
- OS manages all system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

Why do we need an OS?



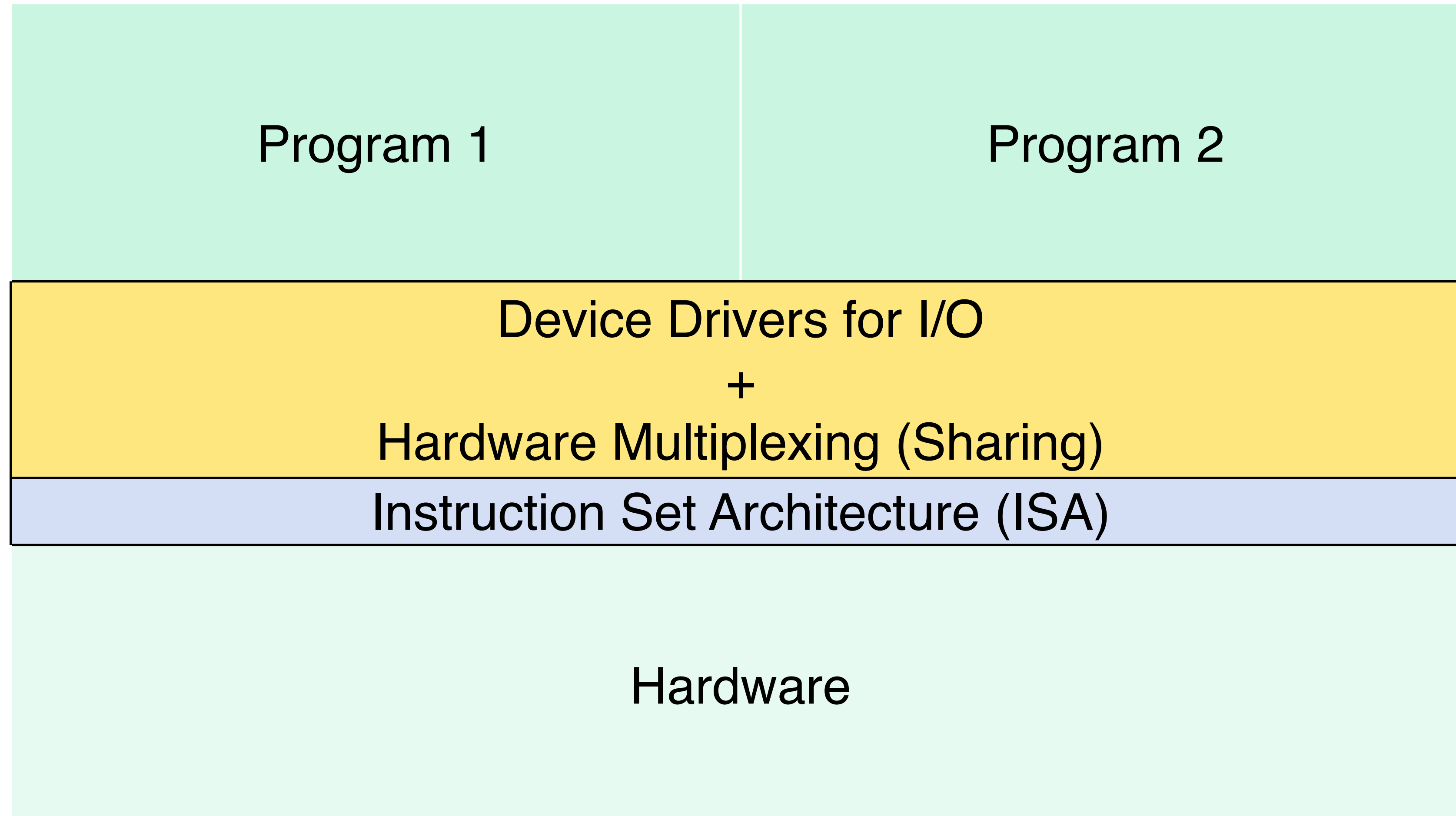
Why do we need an OS?

But the program doesn't know how to access hardware devices for input/output (I/O)



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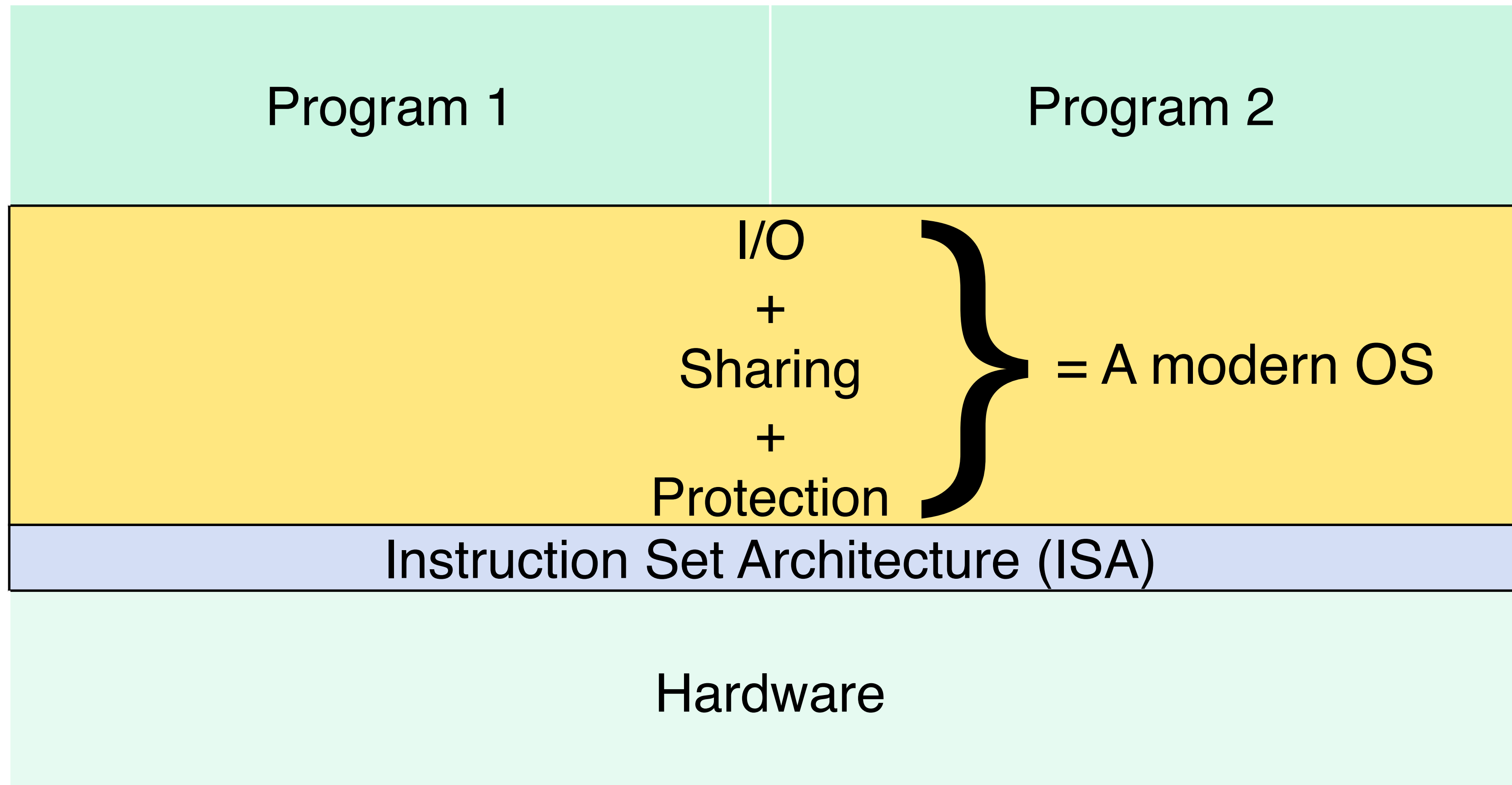
But what if two programs need to share the hardware?



Why do we need an OS?

But what if

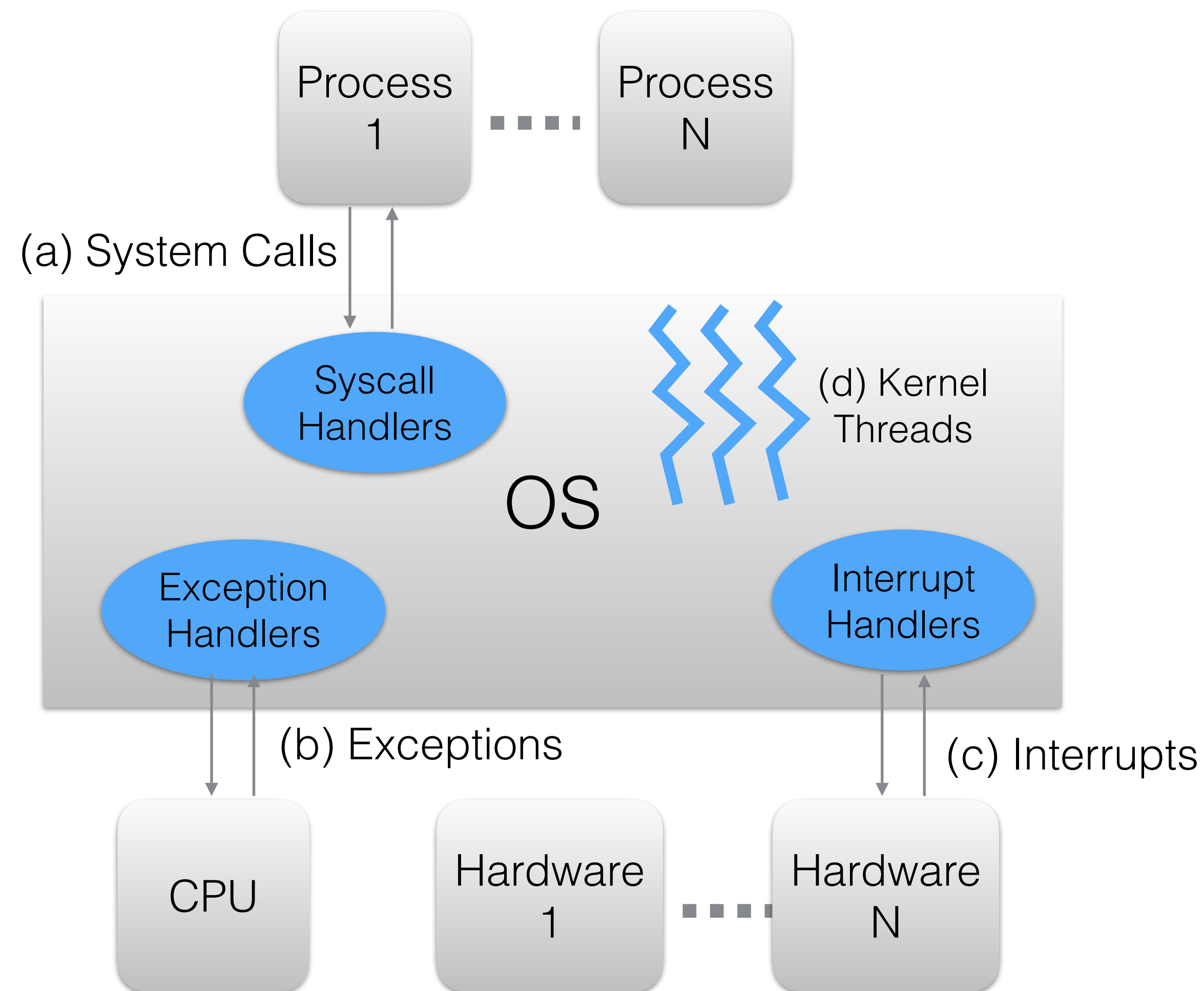
- two programs don't trust each other?
- OS doesn't trust programs?
- hardware doesn't trust programs?



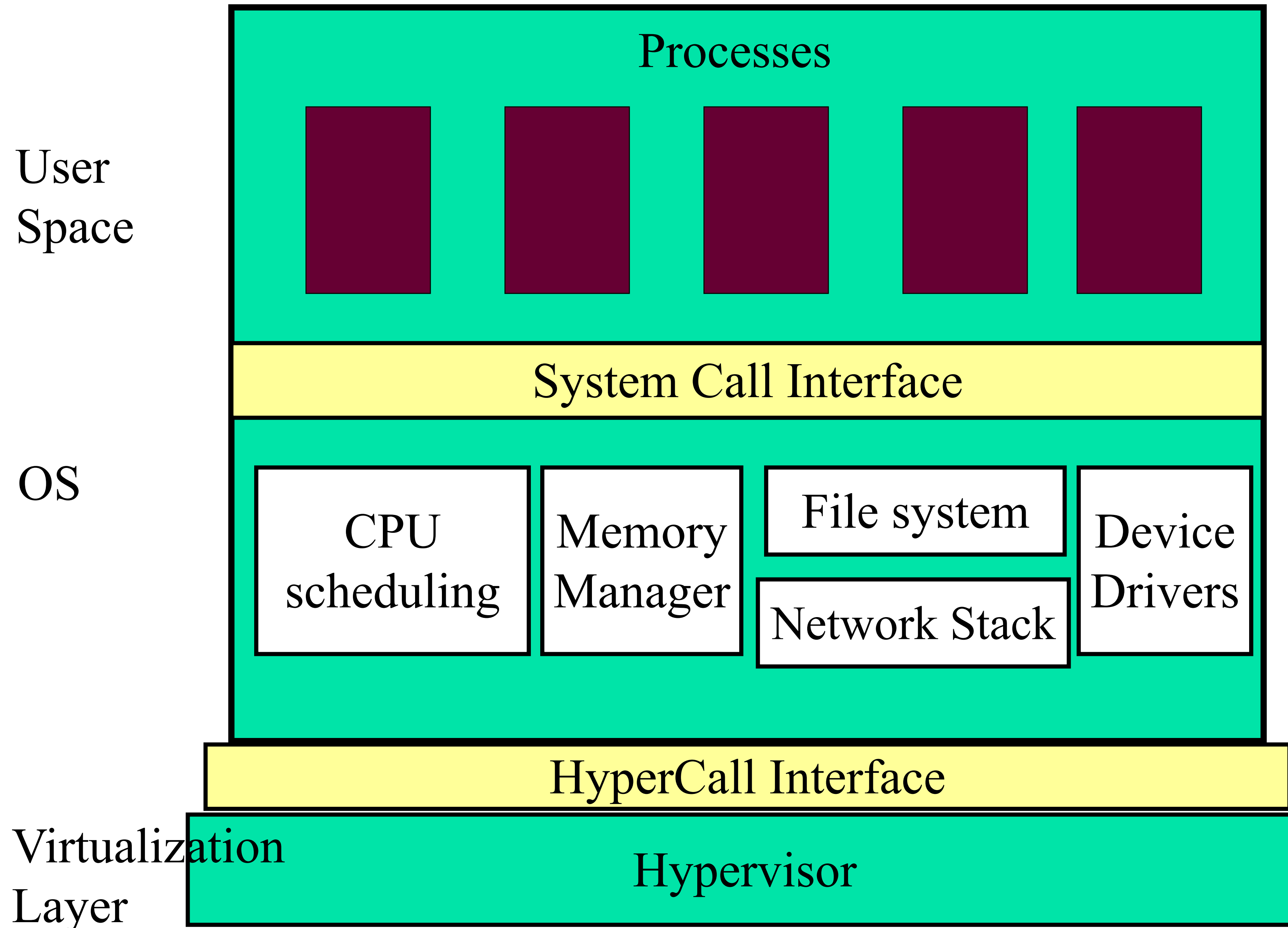
But when does the OS “run”?

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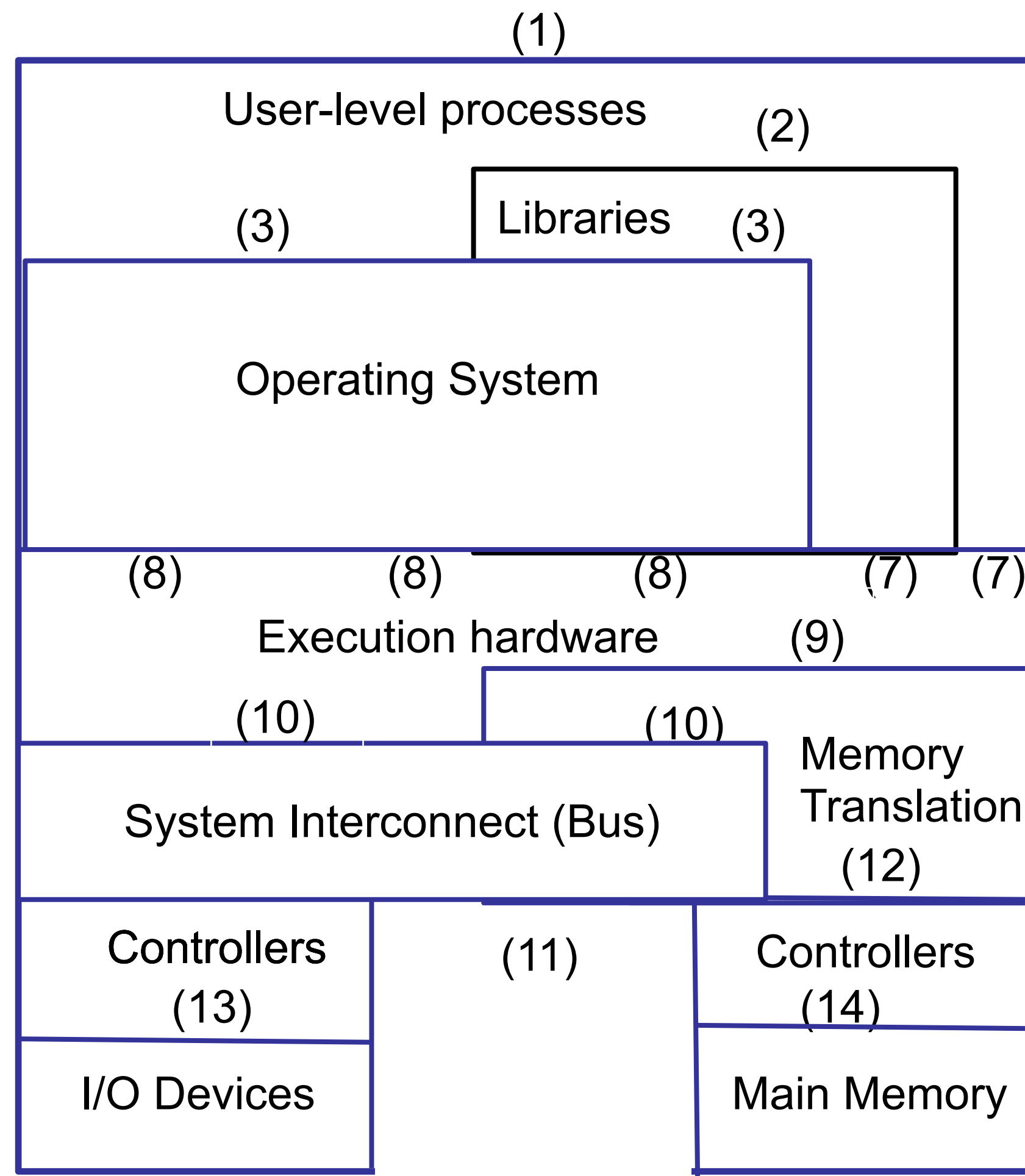
Four ways to invoke OS code



Layers of Software



Interfaces in a Computer System



- Instruction Set Architecture (ISA) = 7+8
- User ISA = 7
- System ISA = 8
- System calls = 3
- Application Binary Interface (ABI) = 3 + 7
- Application Programmer's Interface (API) = 2 + 7

Abstractions:

Processes, Threads, VMs, and Containers

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.
- 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.