Introduction

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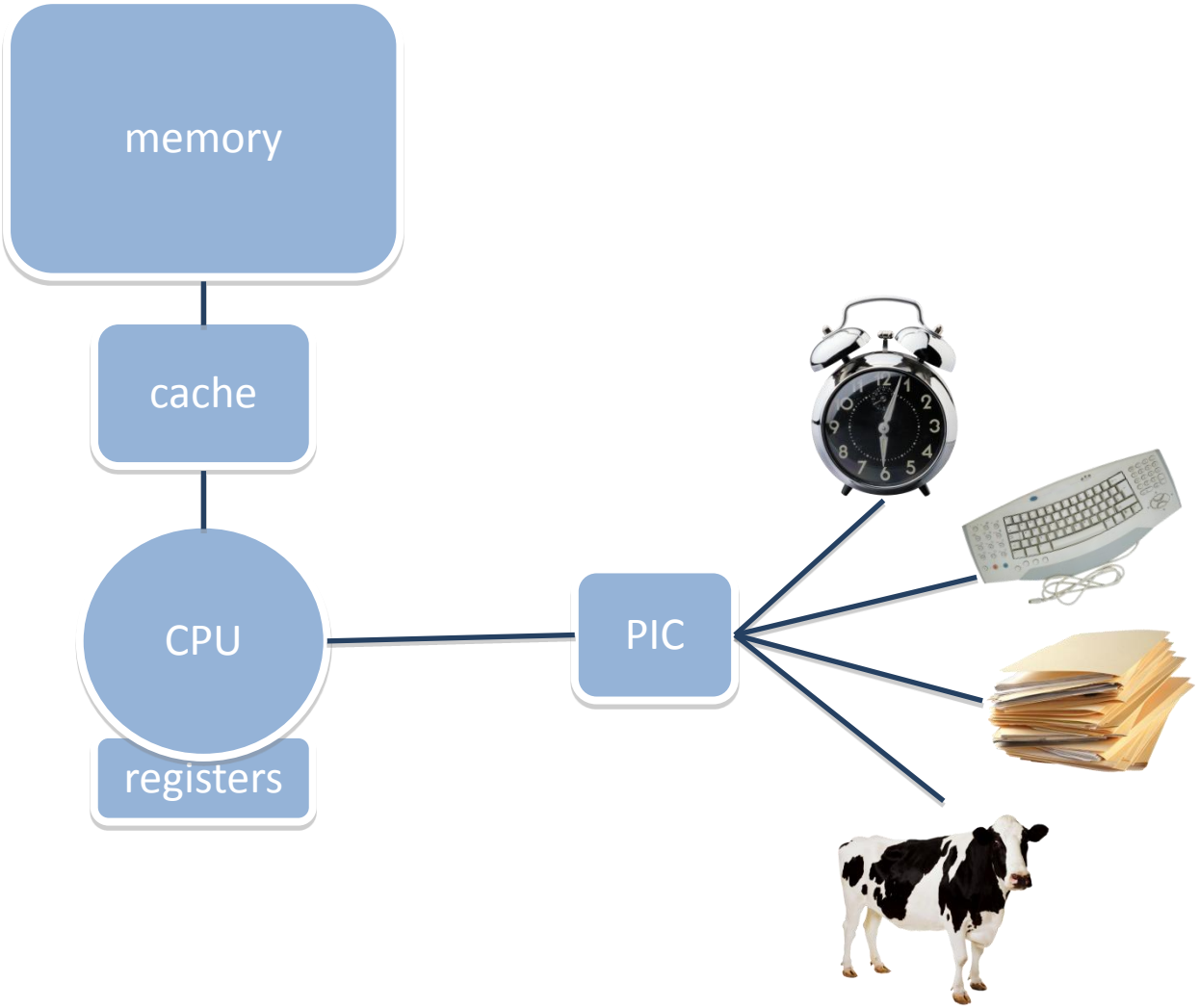
Content

- Previous concepts
  - Architecture
  - Operating Systems
- System Initialization
  - Boot Process
    - Power ON
    - BIOS
    - Bootloader
    - System Initialization
  - Example: Linux & Windows

Architecture



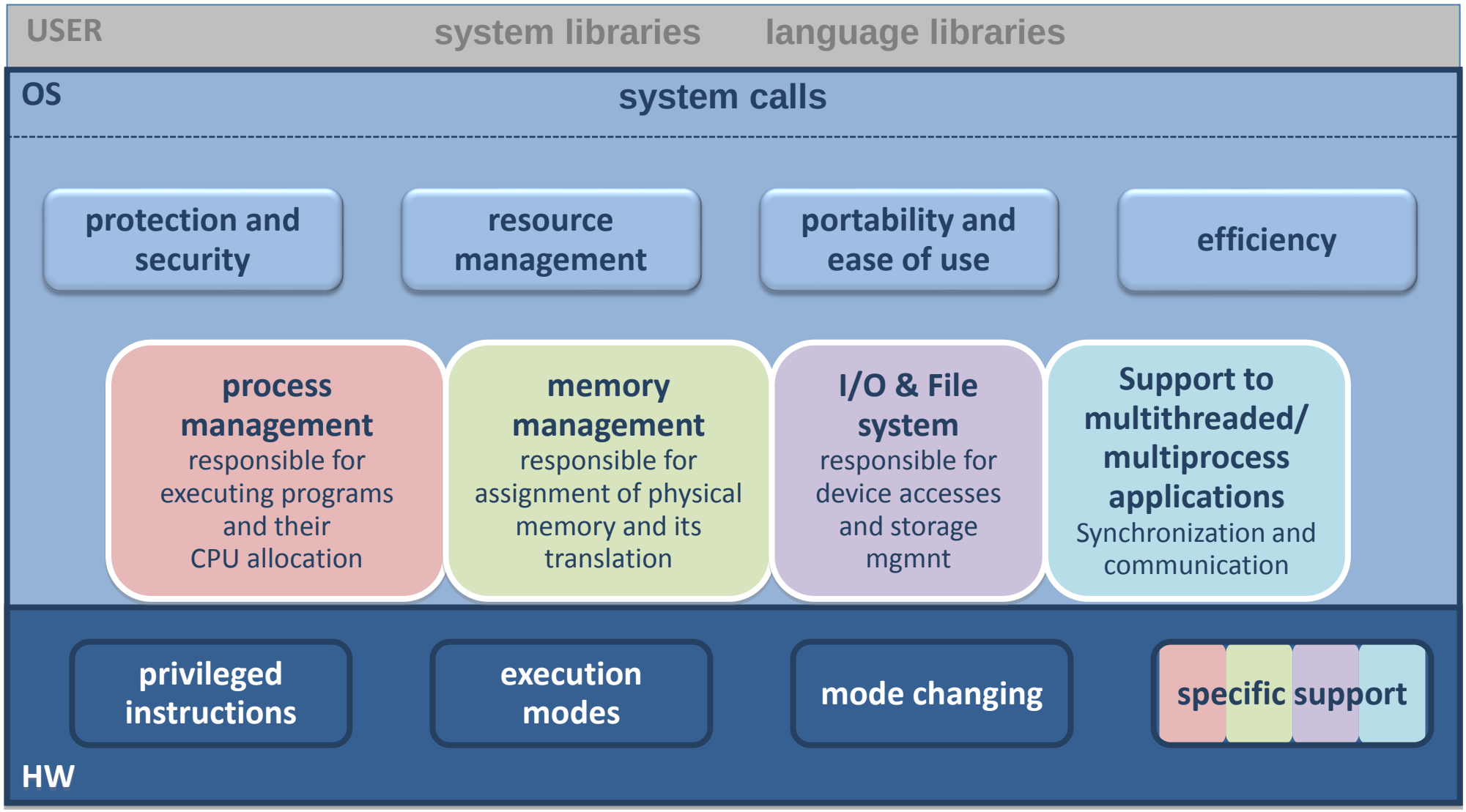
x86 processor

- Registers
- Operations:
  - Arithmetic
  - Logic
  - Memory
  - Other

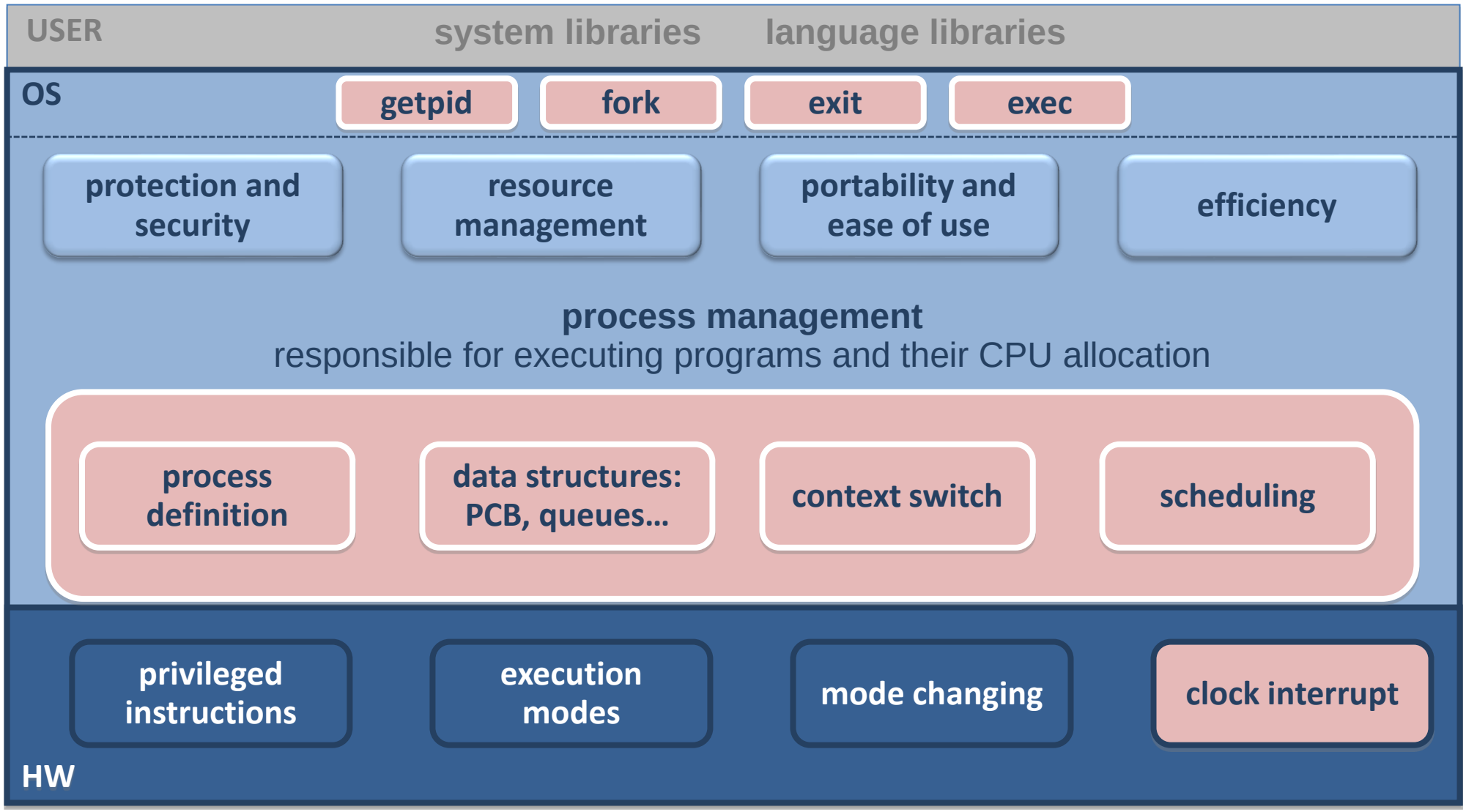
Operating System

- Software between user and HW
- Manages:
  - Processes
  - Memory
  - I/O & Filesystem
- Support to multithread/multiprocess

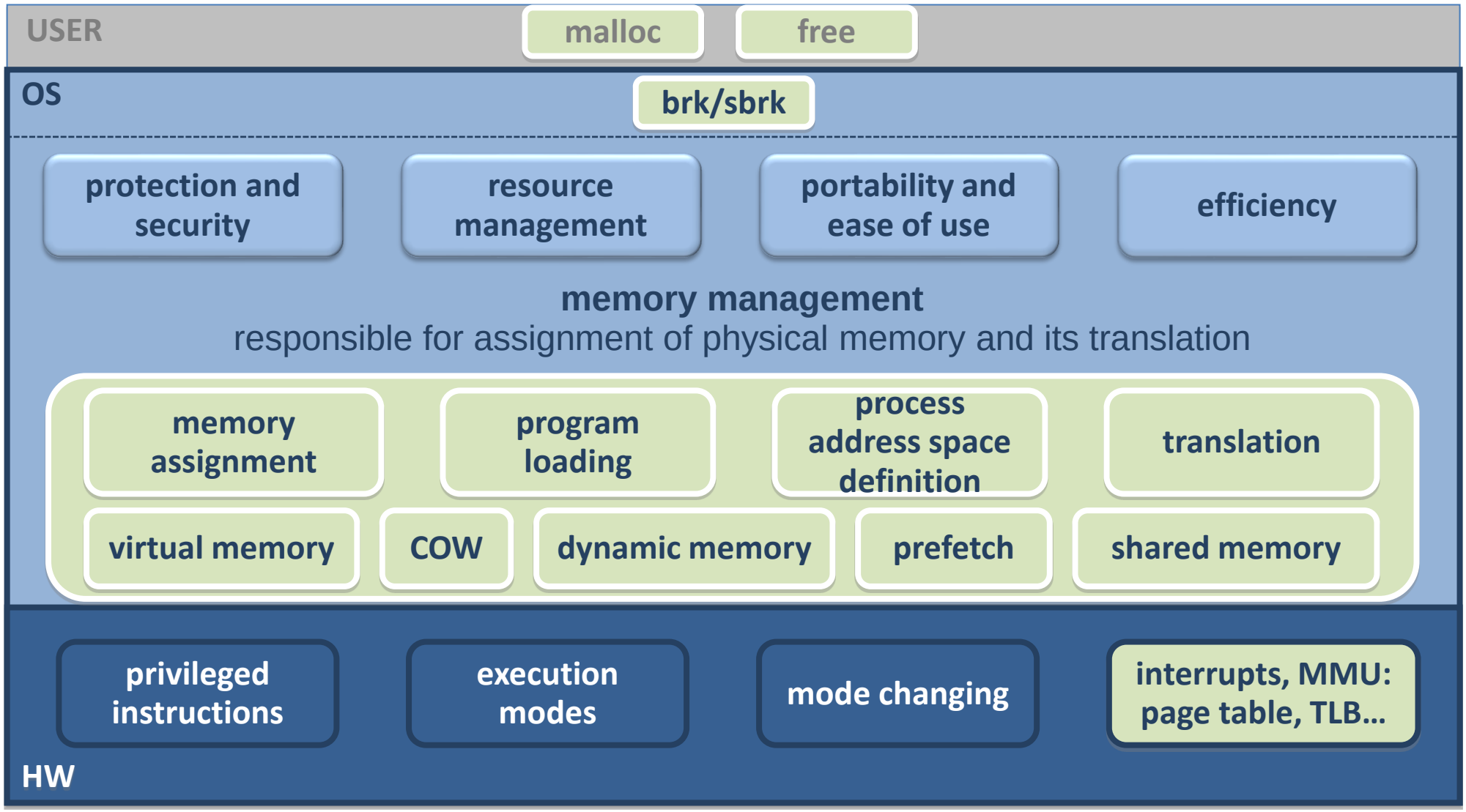
OS: SW between user and HW



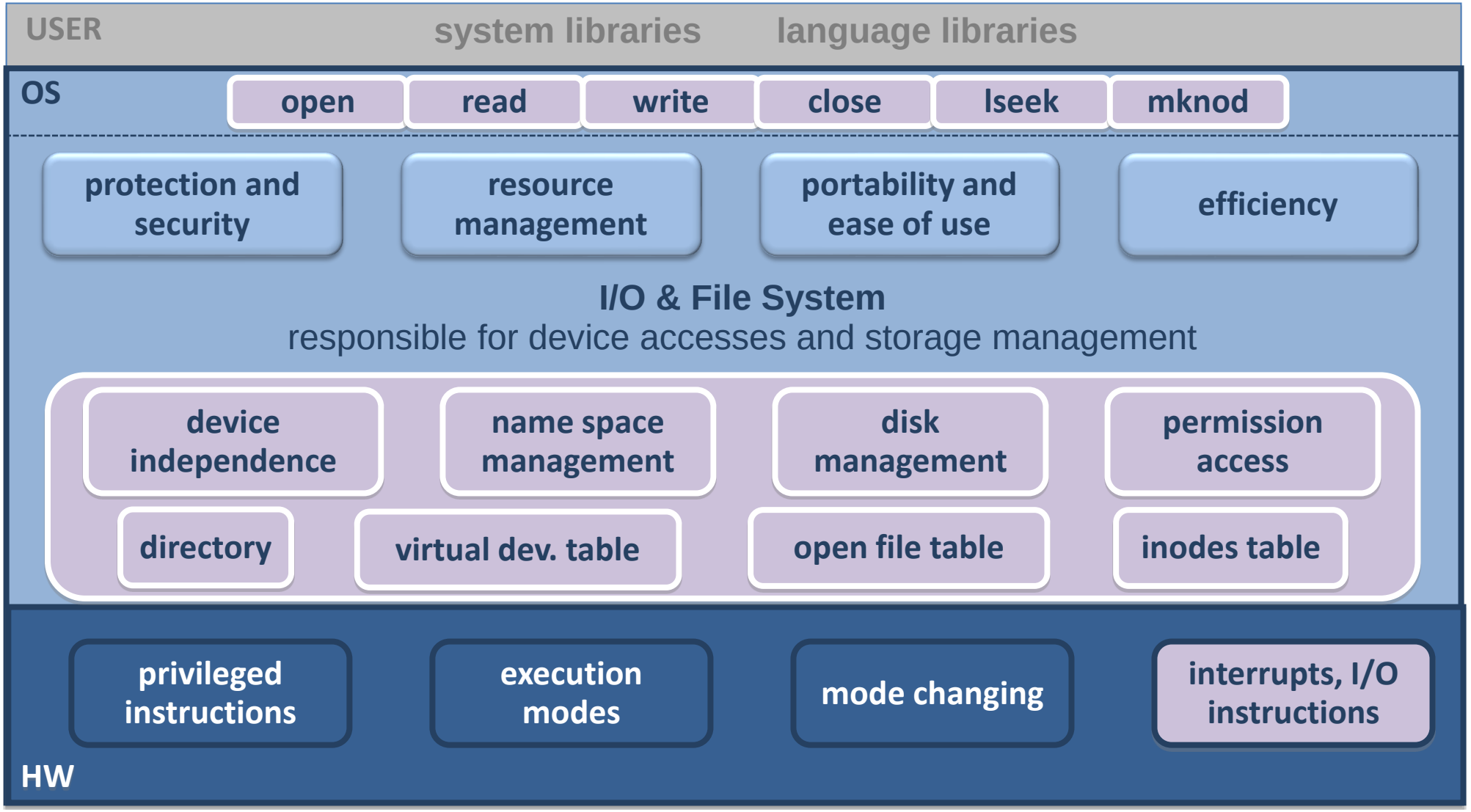
OS: process management



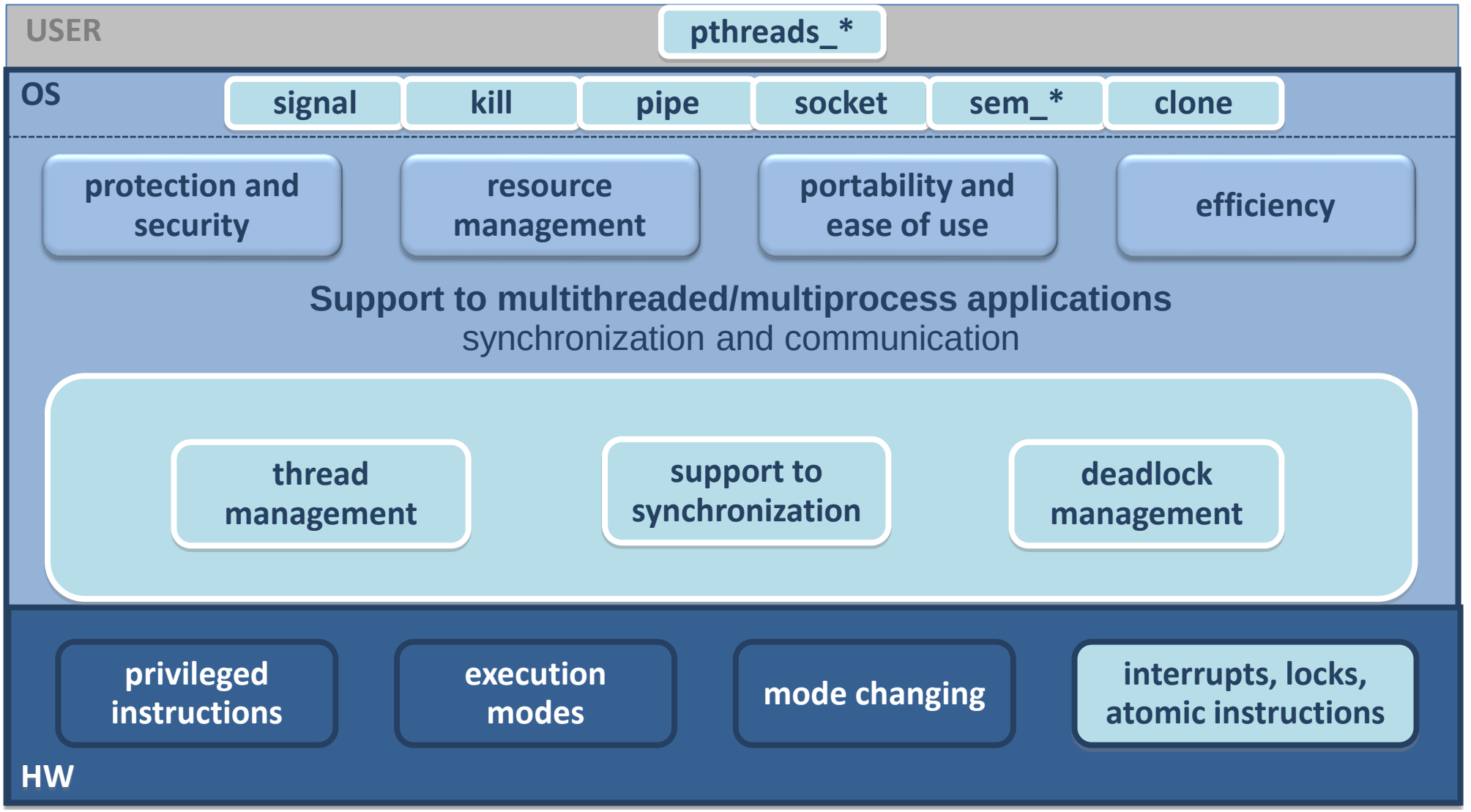
OS: memory management



OS: I/O & File System



OS: Support to multithreaded/multiprocess



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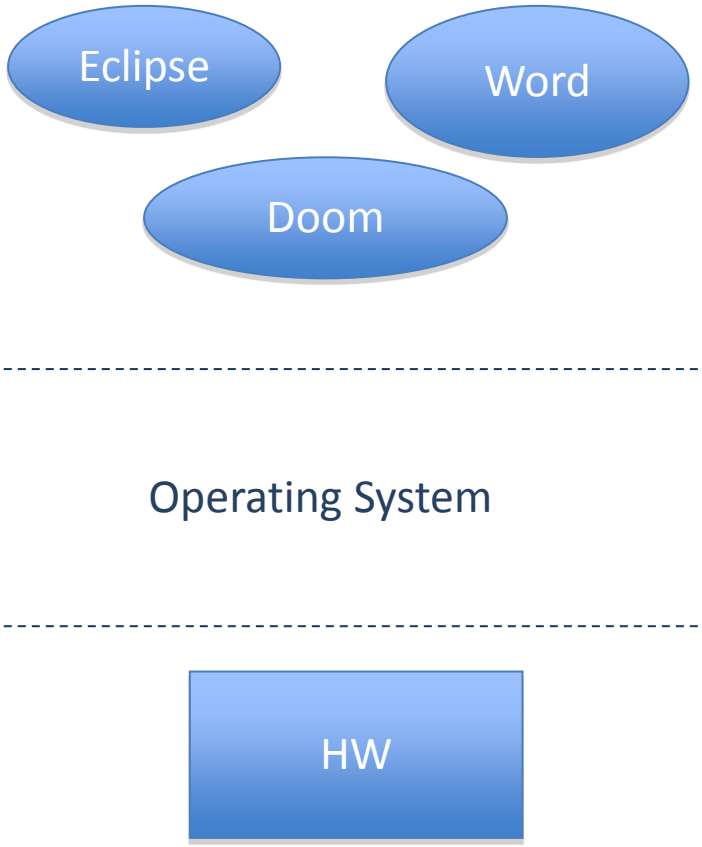
- **System Initialization**
  - Boot Process
    - Power ON
    - BIOS
    - Bootloader
    - System Initialization
  - Example: Linux & Windows

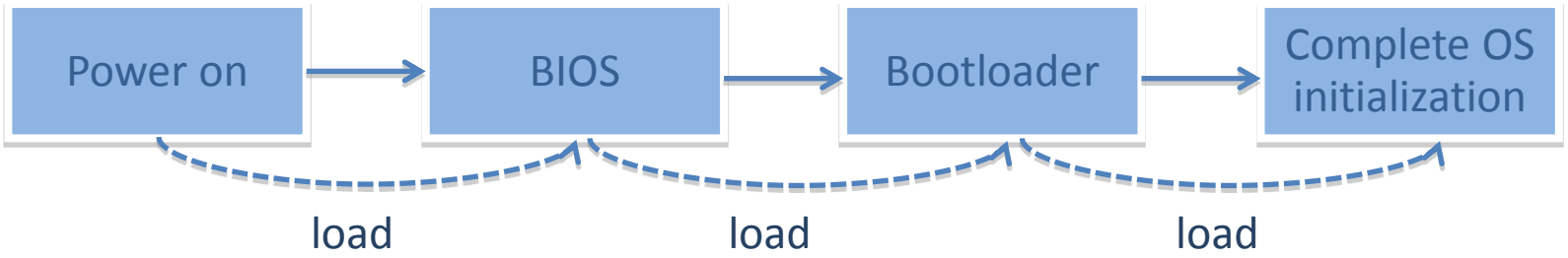
System initialization

- Starting from a computer
- A user wants to execute applications on top of it
- The operating system manages the HW resources to execute the apps.
- But, how the operating system is self-loaded and executed?
  - The boot process



Boot Process

- System Load and initialization
  - Stages



Power ON

- HW reset signal
  - Reset all devices
- Load BIOS code into memory
  - Hardcoded in the motherboard
  - Remember that, in order to execute any code, it must be loaded into memory
- Start BIOS code execution

BIOS (Basic Input Output System)

- Power-On Self Test (POST)
  - Detect & Initialize HW devices
- Load an OS into memory
  - From a bootable device
  - Disk organization:
    - MBR + Partition table
    - Partitions (with one or more bootable)
  - Copy MBR to a fixed location in memory
    - Single disk sector
  - A single disk sector limits OS features: 512 bytes too small
    - So, OS kernels are stored somewhere else in the disk
    - Bootloader instead
- Start bootloader code execution

Bootloader

- Load the image of an OS kernel into memory
  - Search for an OS in disk
  - Load OS sectors from disk to memory
    - Using BIOS
    - Using Real Mode
- Start OS kernel code execution

OS kernel

- Initialize OS itself
  - Internal structures
    - Process management
    - Memory management
    - I/O management
  - HW
    - Keyboard, video adapter card, …
    - IDT, GDT, …
  - Switch to Protected Mode
- Start Initial Process

Example: Linux & Windows

- Both OS do basically the same things
- The main differences resides in:
  - Boot loader:
    - Linux offers the possibility to load different OS from different partitions
    - Windows just uses the first bootable partition found
      - By default, allows to choose other windows versions installed in the machine
      - Workaround is possible to load different os's: create a file with the boot sector of the partition
- Understanding the linux kernel: Appendix A (Boot process)
- Windows internals: Chapter 13 (Boot process)