Today's Topics

- What's an OS?
- What's an OS for?
- Classifications of OS
- Components of OS
- Scheduling
- Memory management

What's an OS ?

- **Definition** : Software that controls the execution of programs and that may provide services such as resource allocation, scheduling, input/output control, and data management. Although operating systems are predominantly software, partial hardware implementations are possible.

Main Function of OS

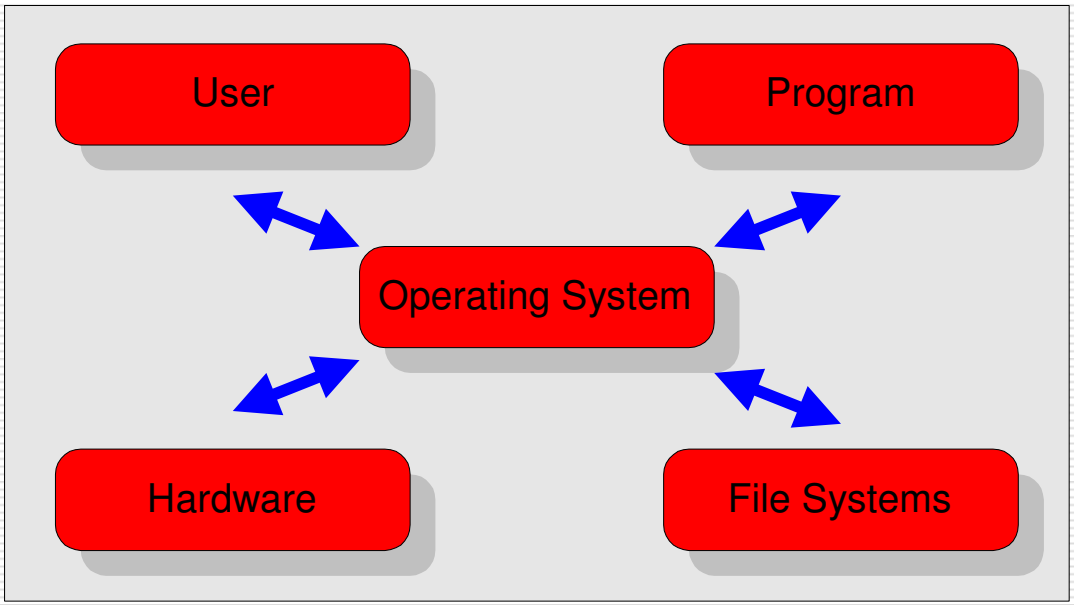
- Convenience
- Efficiency

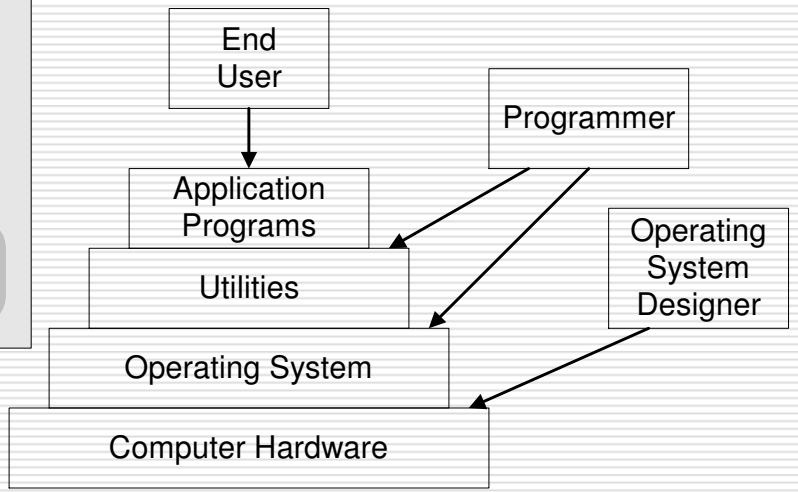
Functions

- User Interface, e.g. GUI , command-line interface
- Managing computer hardware
- File system management
- Supporting program creation and execution
- System access

Conclusion

- OS is the manager between computer and human.





Classifications of OS

- *Interactive* or *batch*
  - *Typical OS these days can do both.*
- *Mutiprogramming* or *uniprogramming* (*Multitask* or *Unitask*)
  - *Only multiprogramming OS's exist.*
- *Multiuser* or *Single User*
  - *PC's OS tends to be single user, but Linux is multiuser.*

Batch multiprogramming vs. Time sharing

- Principal objective
  - Batch : maximize processor use
  - Time sharing : minimize response time
- Source of directives
  - Batch : Job control language commands
  - Time sharing : commands entered at the terminal

Basic Components of an OS

- Interface
- Scheduler (long-term scheduler)
- Dispatcher (short-term scheduler)
- Resource allocator

Scheduling

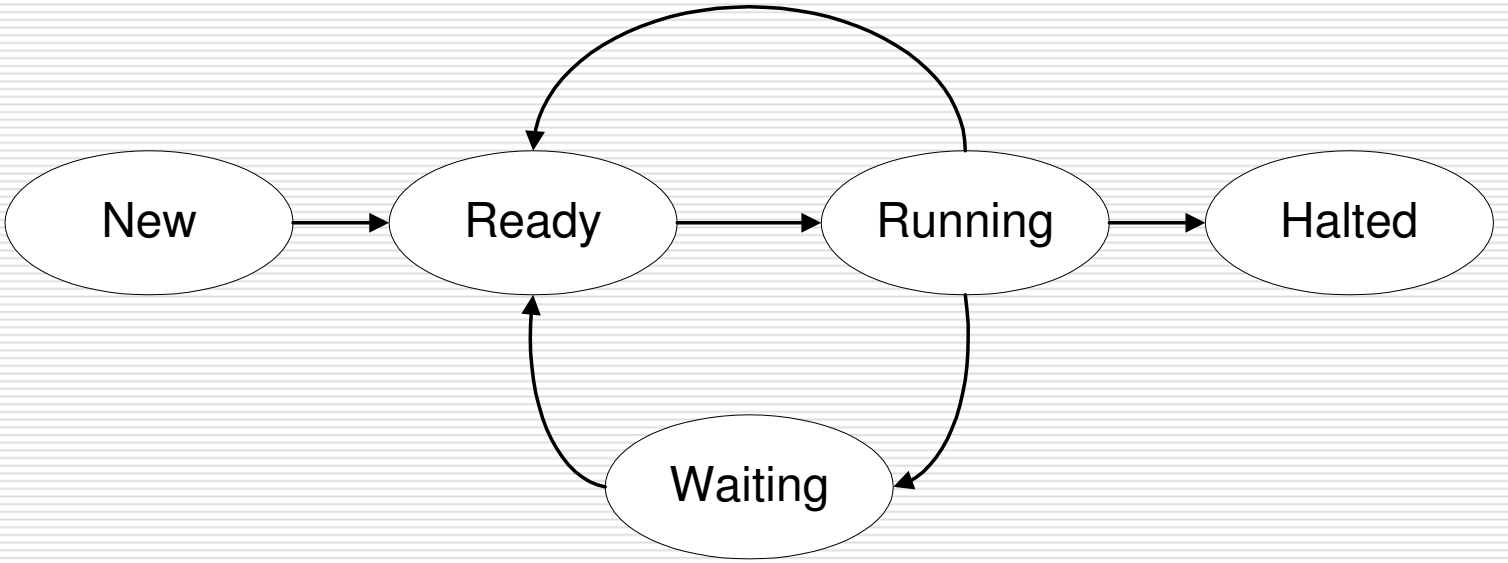
- Types of scheduling
  - Long-term scheduling: the decision to add to the pool of processes to be executed
  - Short-term scheduling: the decision as to which available process will be executed by the processor
  - I/O scheduling: the decision as to which process's pending I/O request shall be handled by an available I/O device

Long-term Scheduling

- Controls degree of multiprogramming
- A job or user program -> process, added to the queue for the short-term scheduler
- Criteria:
  - Priority
  - Approximated execution time
  - I/O requirement

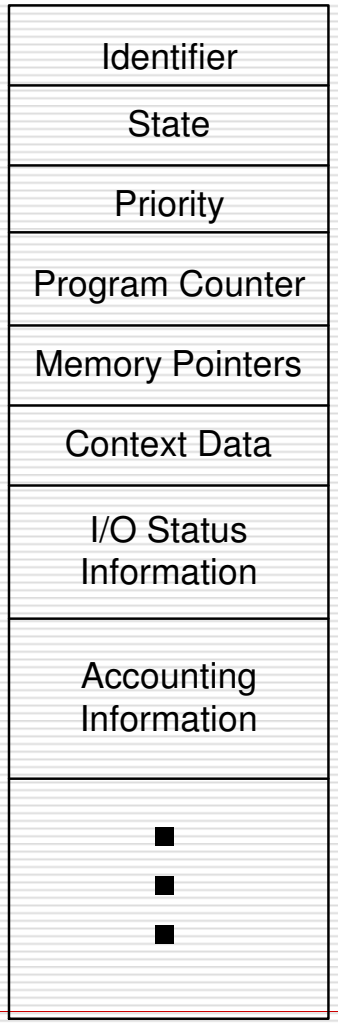
Short-term scheduling

- Makes decision of which job to execute next
- Five-state process model

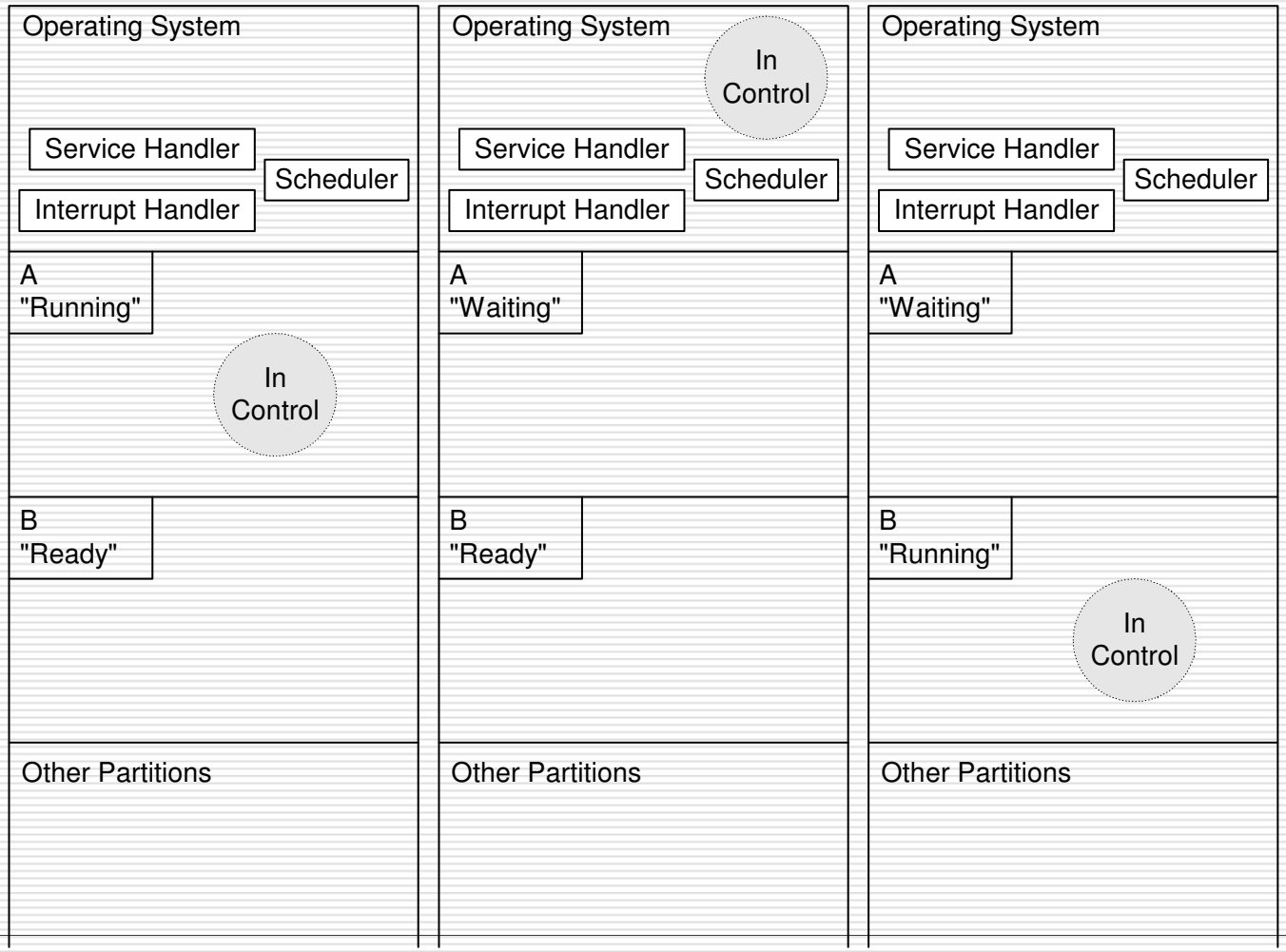


Short-term scheduling (2)

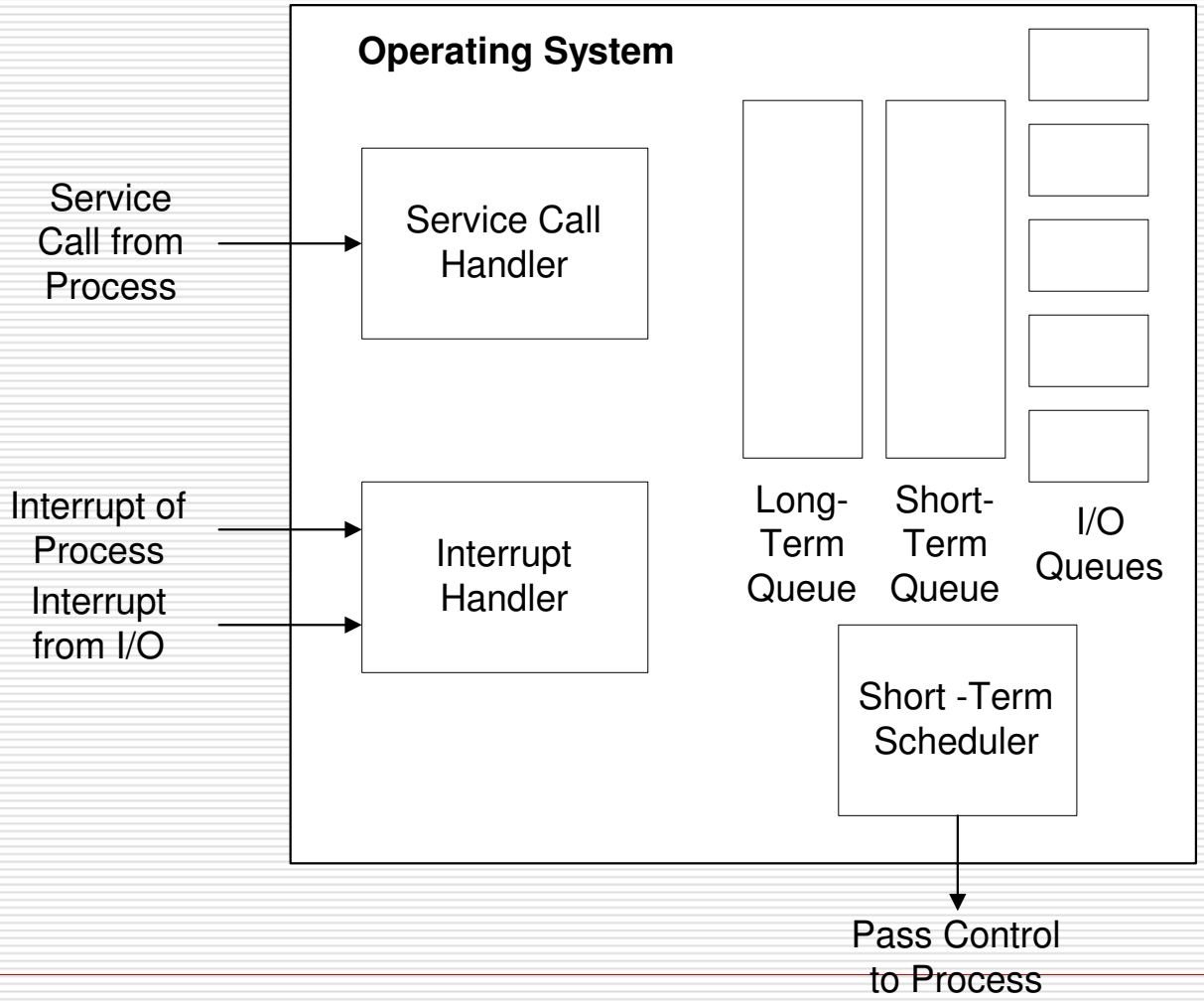
- Process control block : information indicating the state of the process and other information necessary for process execution



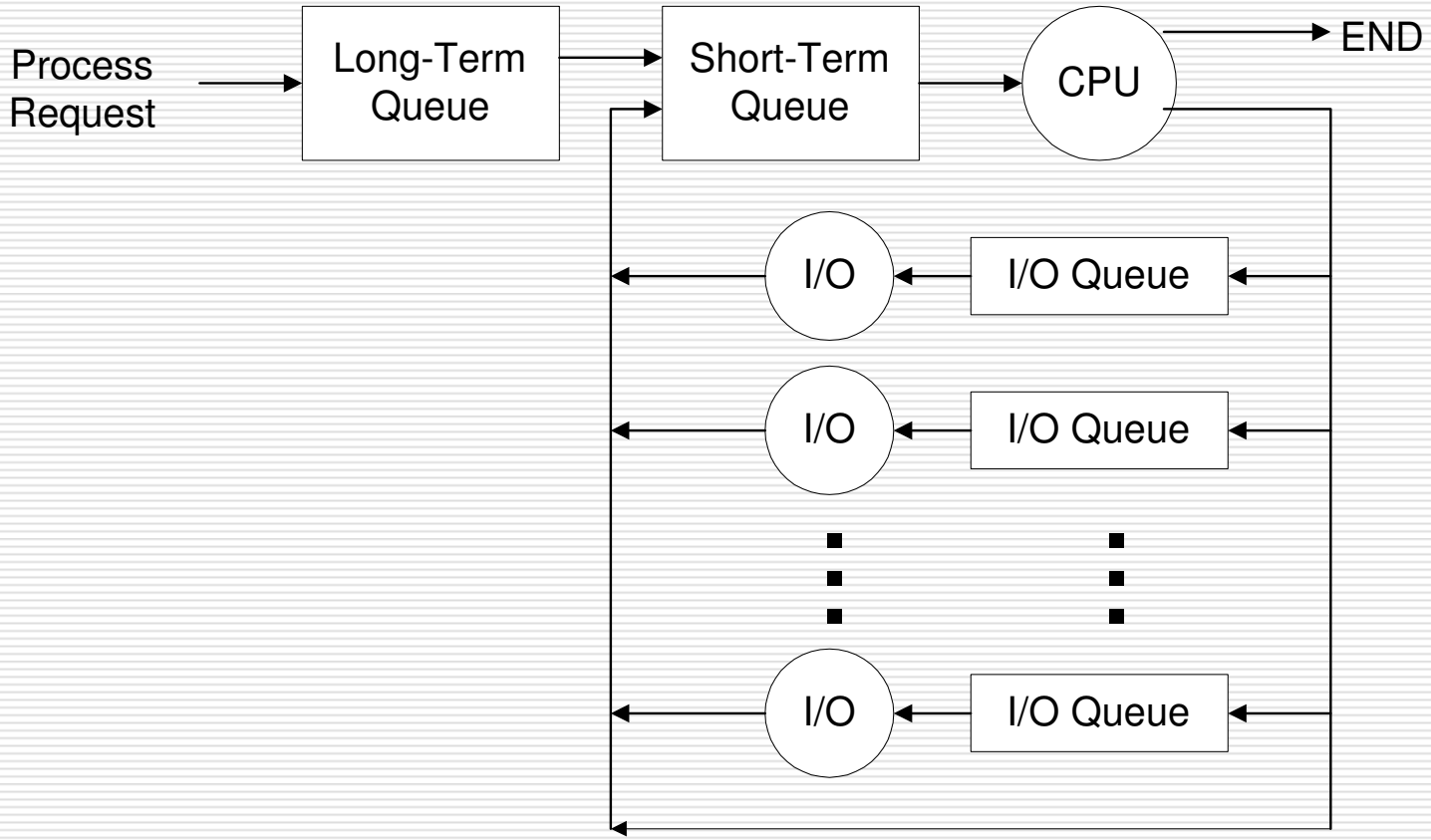
Scheduling Example



Key Elements of OS for Multiprogramming



Queuing diagram representation



Multiprogramming schemes

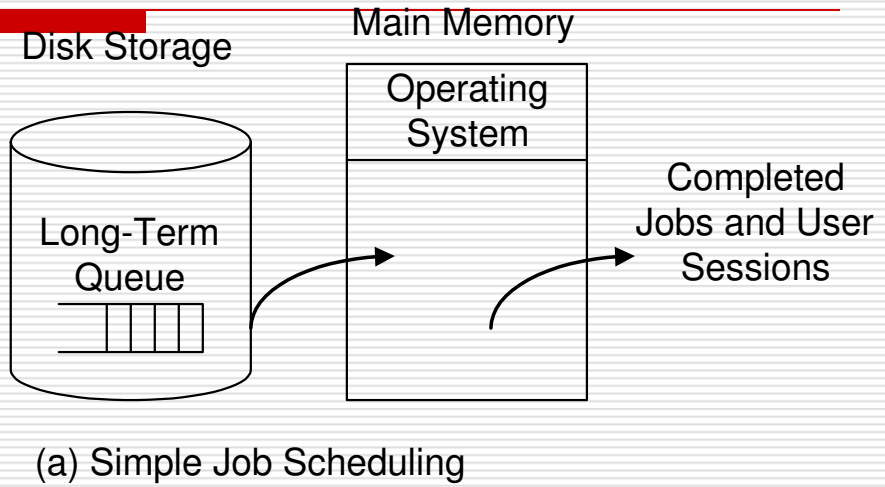
- Cooperative multiprogramming (Non-preemptive multiprogramming): Windows, MacOS
- Preemptive multiprogramming: UNIX, Linux

Memory Management

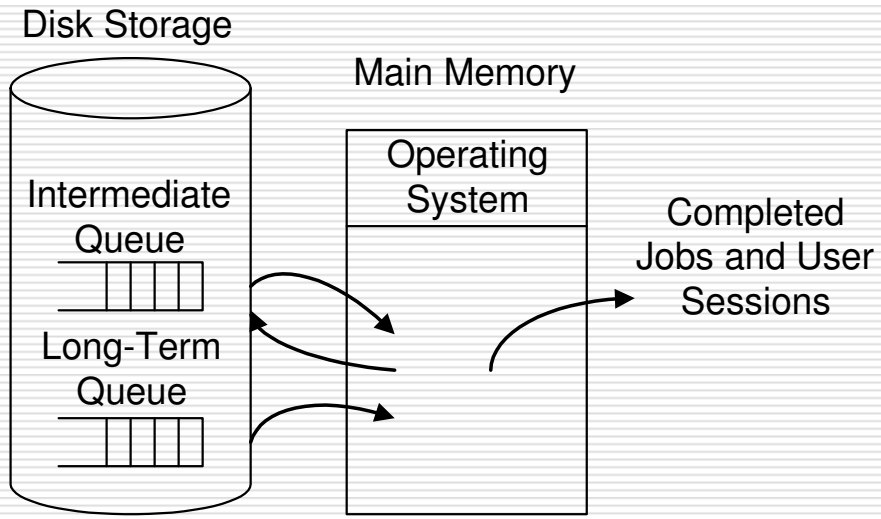
- Maximizes the use of the processor by packing as many processes into memory as possible.
- Two parts of Main memory: System (OS) + User
- Memory management -> controls subdivision of “user” part of memory

Swapping

- Put processes in I/O queue into *Intermediate queue* and add a process from long-term queue



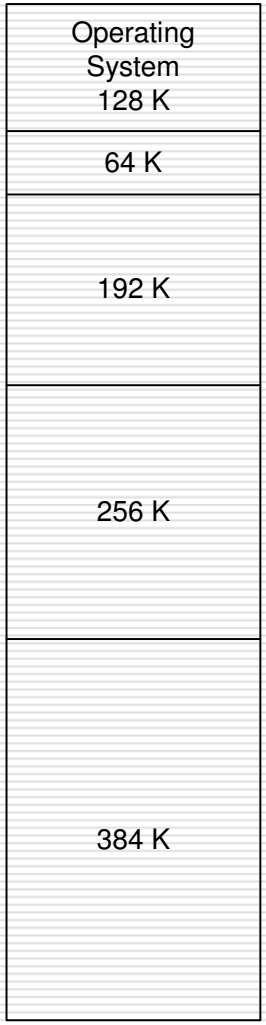
(a) Simple Job Scheduling



(b) Swapping

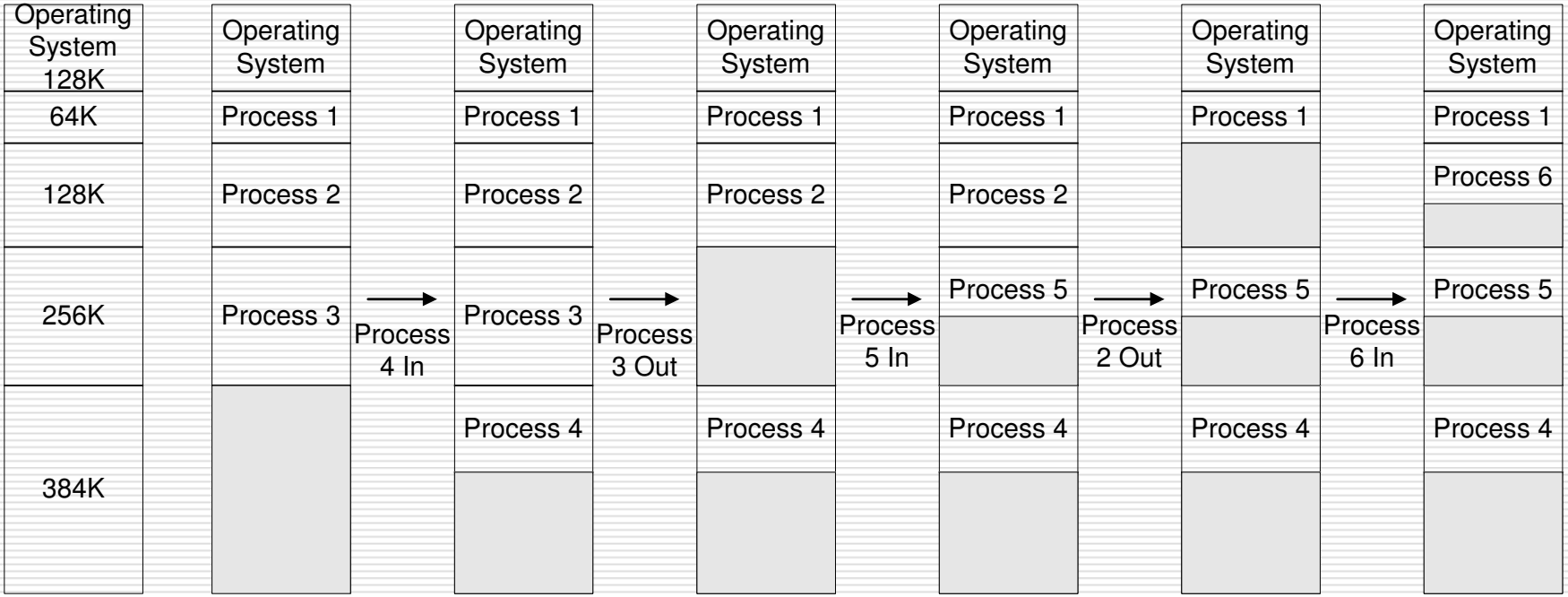
Partitioning

- Subdivide memory into small parts
- Methods:
  - Fixed-size partition
  - Variable-size partition



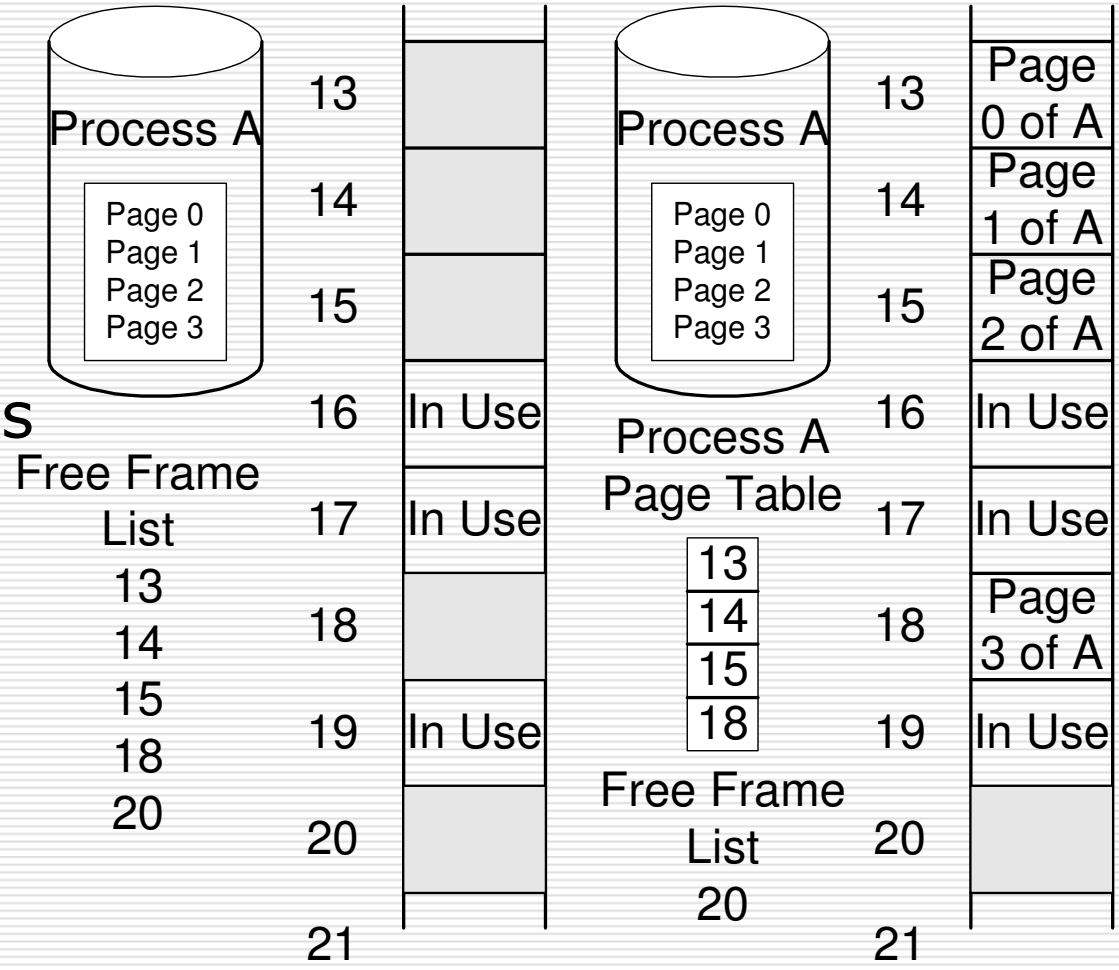
Partitioning (2)

- Compaction: OS shifts the processes in memory to place all the free memory together in one block.



Paging

- Divide process into small fixed-size chunks -> *pages*
- Assign these chunks to chunks of memory -> *frames* (or *page frame*)
- OS must maintain the *page table*



Virtual memory

- Demand paging: each page of a process is read in only when needed, *on demand*.
- Page Fault: the program uses an instruction or data on a page not in main memory.
- *A process can be larger than all of main memory*.
- Main memory=real memory, memory on the disk = ***virtual memory***

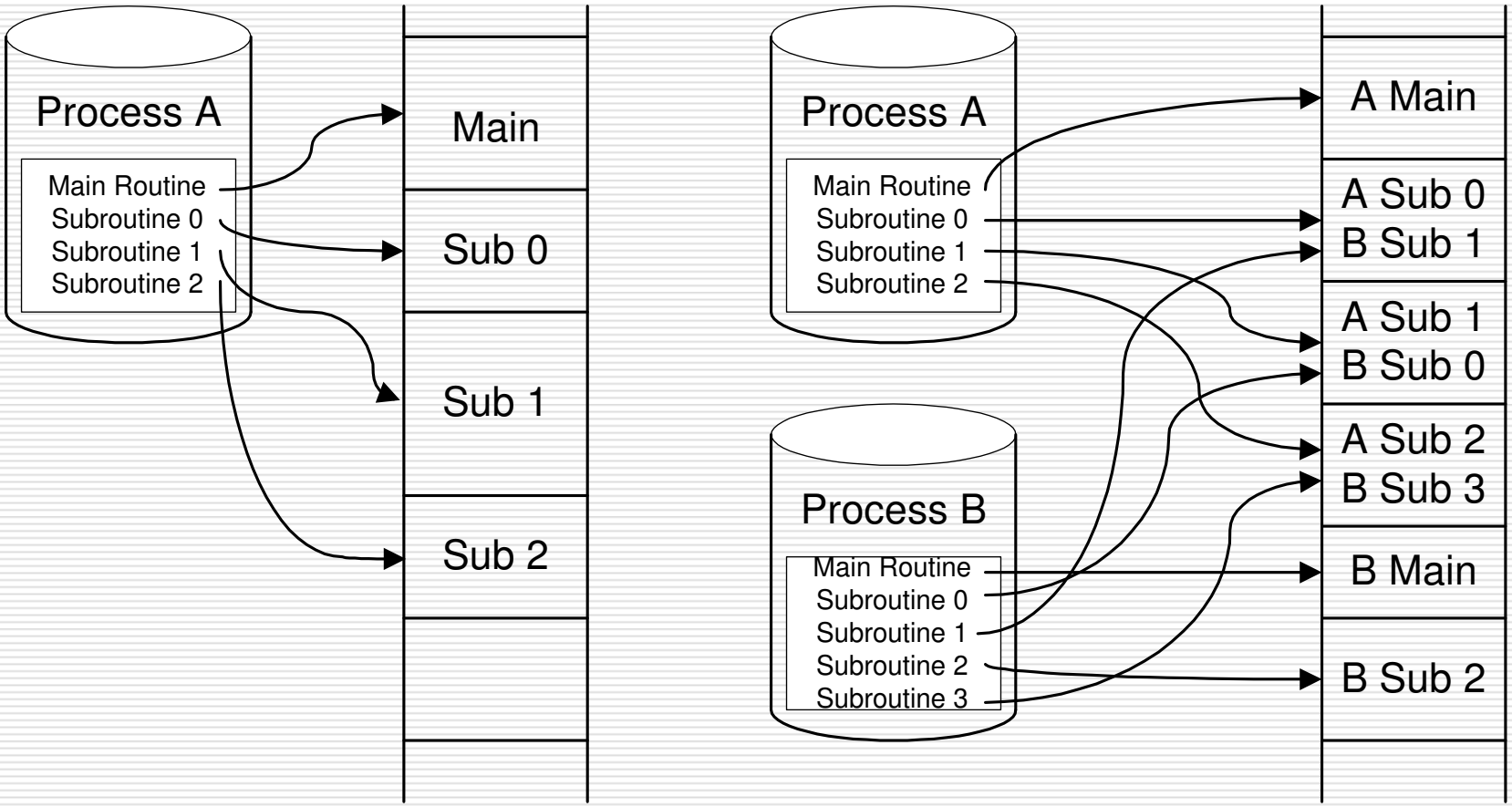
Segmentation

- Segmentation is visible to programmers.
- Memory = multiple address spaces or segments
- Segments are variable and dynamic.
- Can create program segments and data segments
- Each segment may be assigned access and usage rights.

Segmentation (2)

- Advantages:
  - Simplifies the handling of growing data structure
  - Allows programs to be altered and recompiled independently
  - Lends itself to sharing among processes
  - Lends itself to protection
- Can be combined with Paging.
- Modern processors support both mechanisms.

Segmentation (3)



Current OS's

- WINDOWS
- Linux
- MacOS
- Others : UNIX(Solaris, HP-UX), iOS, Android, Symbian, etc.
- Shares Estimates (%):
  - Desktop,laptop : Win 92.2 Mac 6.4 Lin 1.4
  - Tablets : iOS 57.6 Android 39.1
  - Servers : Lin 63.9 Win 36.1
  - Supercomputer : Lin 91.4 IBM 5.6