

OPERATING SYSTEMS



TOPICS



Overview

- What is an OS?
- Objectives and Functions
- Types of OS



Scheduling

- Long Term
- Medium Term
- Short Term



Memory Management

- The Heap
- Allocated Memory
- Paged Memory
- Segmented Memory
- Physical Memory

What is an OS?

Windows

Windows a series of software operating systems and GUIs produced by Microsoft. The most recent client version of is Vista. Windows 7 is scheduled on October 22, 2009.



Linux

Linux are OS based on the Linux kernel. It is free and open source; typically all the underlying source code can be used, freely modified, and redistributed by anyone.



Mac OS X

Mac OS X is a line of OS developed, marketed, and sold by Apple Inc. Mac OS X, whose “X” means “10”.



What is an OS?

- The OS is one of the most important components of any computer system.
- This is the system that runs the computer at its most basic level. Without an operating system, a computer is a **lifeless box**.
- The OS is the most fundamental program that runs on your computer. It serves as the basis for how everything else works.



What is an OS?

- ❖ OS are responsible for everything from starting up the computer when you push the "on" button to high level system security.
- ❖ The type of operating system a computer has also determines what types of software can be run on it.



The purpose of an OS

❖ to organize and control hardware and software so that the device it lives in behaves in a flexible but predictable way.



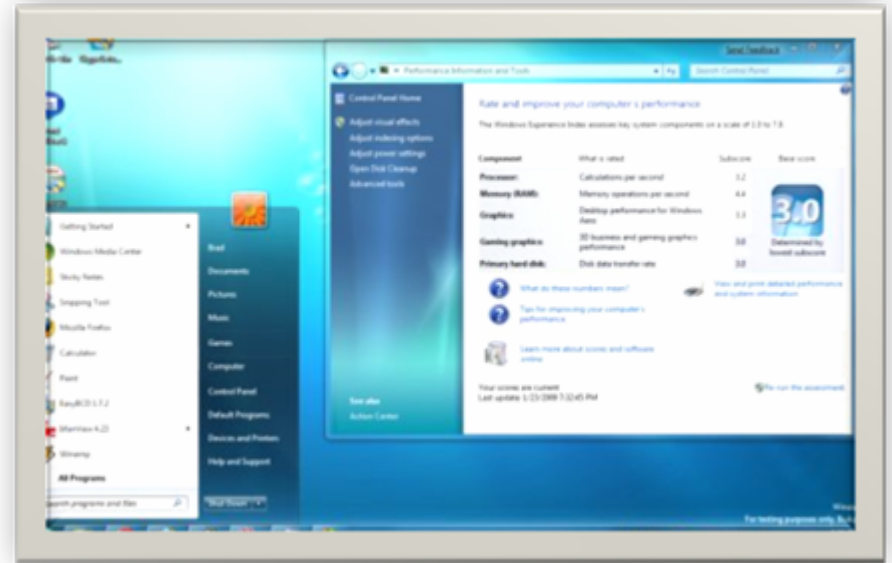
What is the function of an OS?

OS functions?

- ❖ It manages the hardware and software resources of the system.
- ❖ In a desktop computer, these resources include such things as
 - the processor (is an electronic circuit that can execute computer programs),
 - memory,
 - disk space and
 - more (On a cell phone, they include the keypad, the screen, the address book, the phone dialer, the battery and the network connection).

OS functions?

❖ It provides a stable, consistent way for applications to deal with the hardware without having to know all the details of the hardware.



OS functions?

- ❖ OS performs a variety of functions, including
 - determining what types of software you can install
 - coordinating the applications running on the computer at any given time
 - making sure that individual pieces of hardware, such as printers, keyboards, and disk drives, all communicate properly
 - allowing applications such as word processors, email clients, and web browsers, to perform tasks on the system
 - reporting errors

OS functions?

- ❖ The OS also determines how you see information and perform tasks. Some operating systems utilize a graphical user interface (GUI), which presents information through pictures (icons, buttons, dialog boxes, etc.) as well as words.

First task

- ❖ The first task, managing the hardware and software resources, is very important, as various programs compete for the attention of the **central processing unit (CPU)**.

First task

- ❖ In this capacity, the OS plays the role of the good parent, making sure that each application gets the necessary resources while playing nicely with all the other applications,
- ❖ as well as husbanding the limited capacity of the system to the greatest good of all the users and applications.

Second task

- ❖ The second task, providing a consistent application interface,
- ❖ is especially important if there a lot of types of computer using the operating system,
- ❖ or if the hardware making up the computer is always open to change.

Second task

- ❖ A consistent **application program interface** (API) allows a software developer to write an application on one computer and have a high level of confidence that it will run on another computer of the same type, even if the amount of memory or the quantity of storage is different on the two machines.

Note

- ❖ Even if a particular computer is unique, an operating system can ensure that applications continue to run when hardware upgrades and updates occur.
- ❖ One of the challenges facing developers is keeping their operating systems flexible enough to run hardware from the thousands of vendors manufacturing computer equipment.

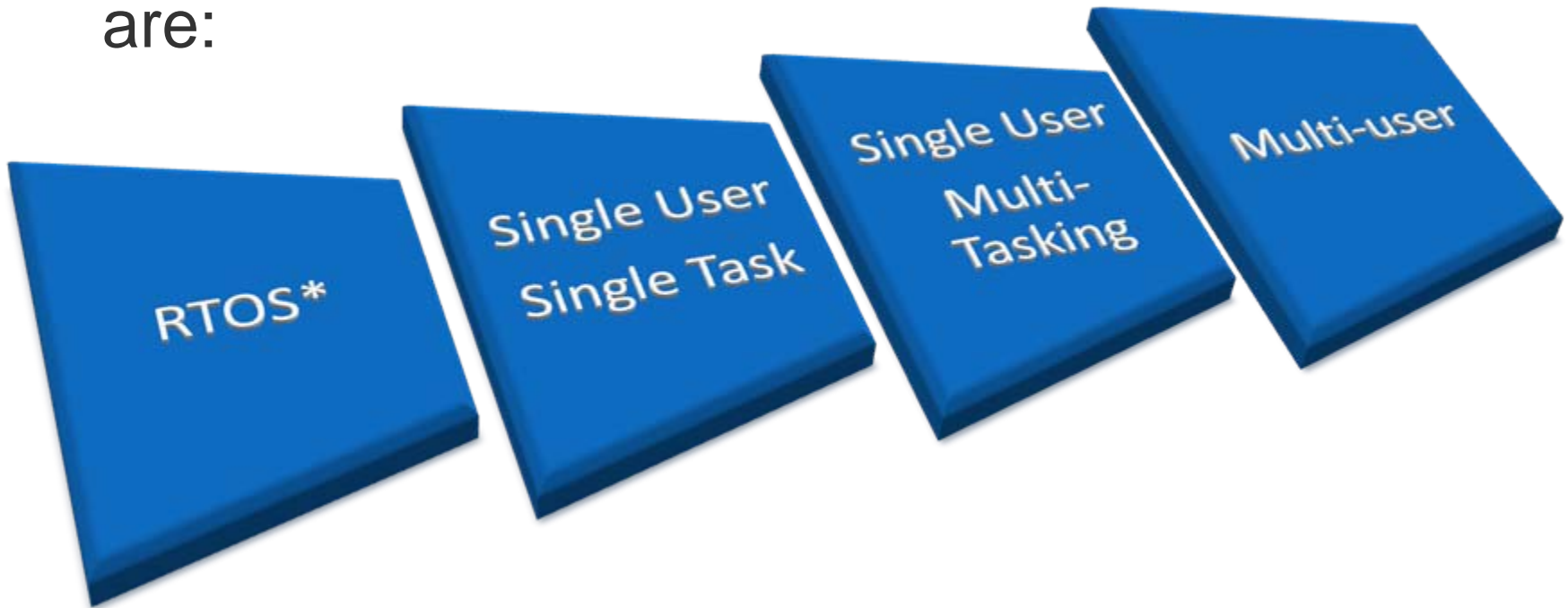
Note

- ❖ Today's systems can accommodate thousands of different printers, disk drives and special peripherals in any possible combination.

Types of OS

Types of Operating Systems

- ❖ Within the broad family of operating systems, there are generally four types, categorized based on the types of computers they control and the sort of applications they support. The categories are:



Real-time Operating System (RTOS)

❖ RTOS are used to control machinery, scientific instruments and industrial systems.



Real-time Operating System (RTOS)

- ❖ An RTOS typically has very little user-interface capability, and no end-user utilities, since the system will be a "sealed box" when delivered for use.
- ❖ A very important part of an RTOS is managing the resources of the computer so that a particular operation executes in precisely the same amount of time, every time it occurs.
- ❖ In a complex machine, having a part move more quickly just because system resources are available may be just as catastrophic as having it not move at all because the system is busy.

Single-user, single task

- ❖ As the name implies, this operating system is designed to manage the computer so that one user can effectively do one thing at a time.

Example of Single User, Single Task

❖ The Palm OS for Palm handheld computers is a good example of a modern single-user, single-task operating system.

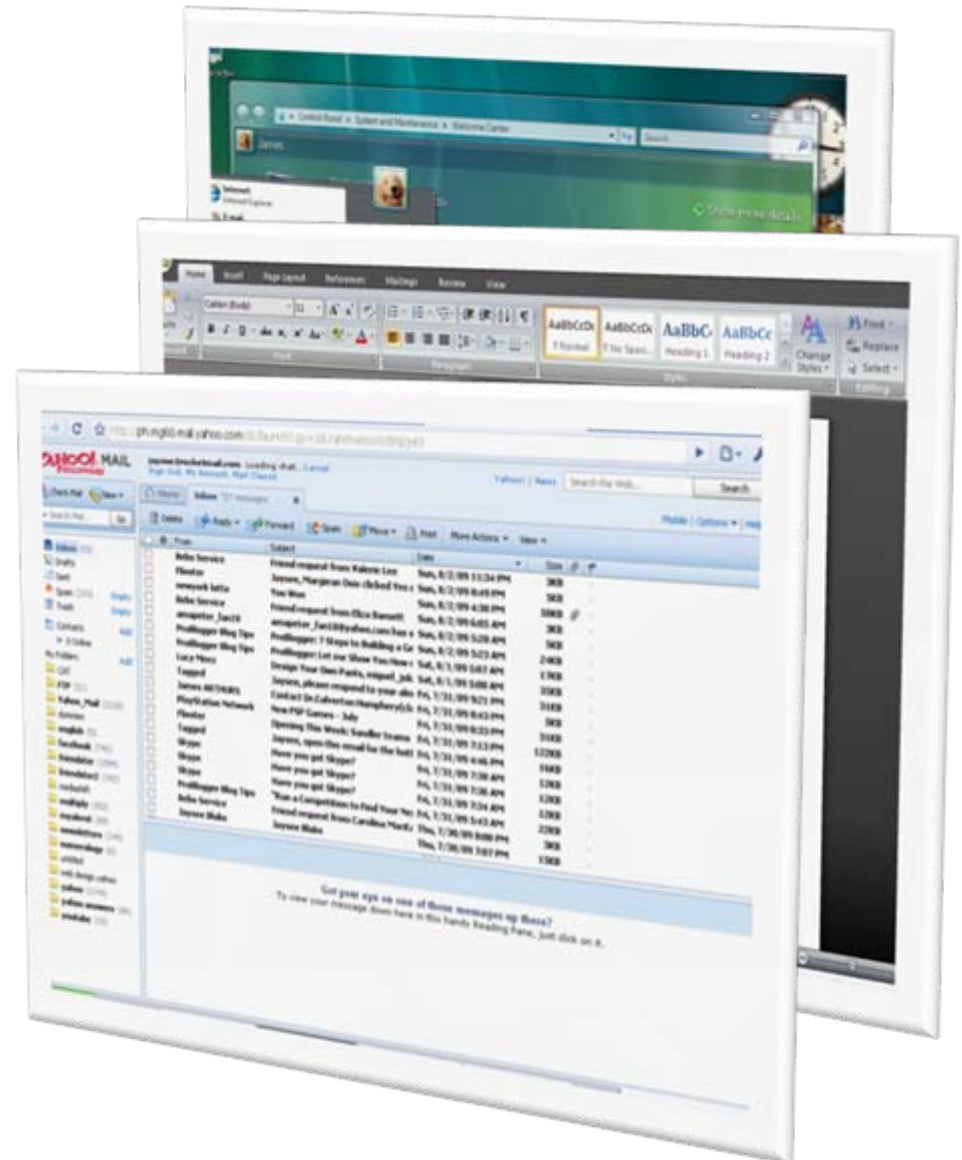


Single-user, multi-tasking

- ❖ This is the type of operating system most people use on their desktop and laptop computers today.

Example of Single User, multi Tasking

- ❖ Microsoft's Windows and Apple's MacOS platforms are both examples of OS that will let a single user have several programs in operation at the same time.
- ❖ For example, it's entirely possible for a Windows user to be writing a note in a word processor while downloading a file from the Internet while printing the text of an e-mail message.



Multi-user

- ❖ A multi-user operating system allows many different users to take advantage of the computer's resources simultaneously.
- ❖ The operating system must make sure that the requirements of the various users are balanced, and that each of the programs they are using has sufficient and separate resources so that a problem with one user doesn't affect the entire community of users.

Examples of Multi-user

- ❖ Unix, VMS and mainframe operating systems, are examples of multi-user operating systems.

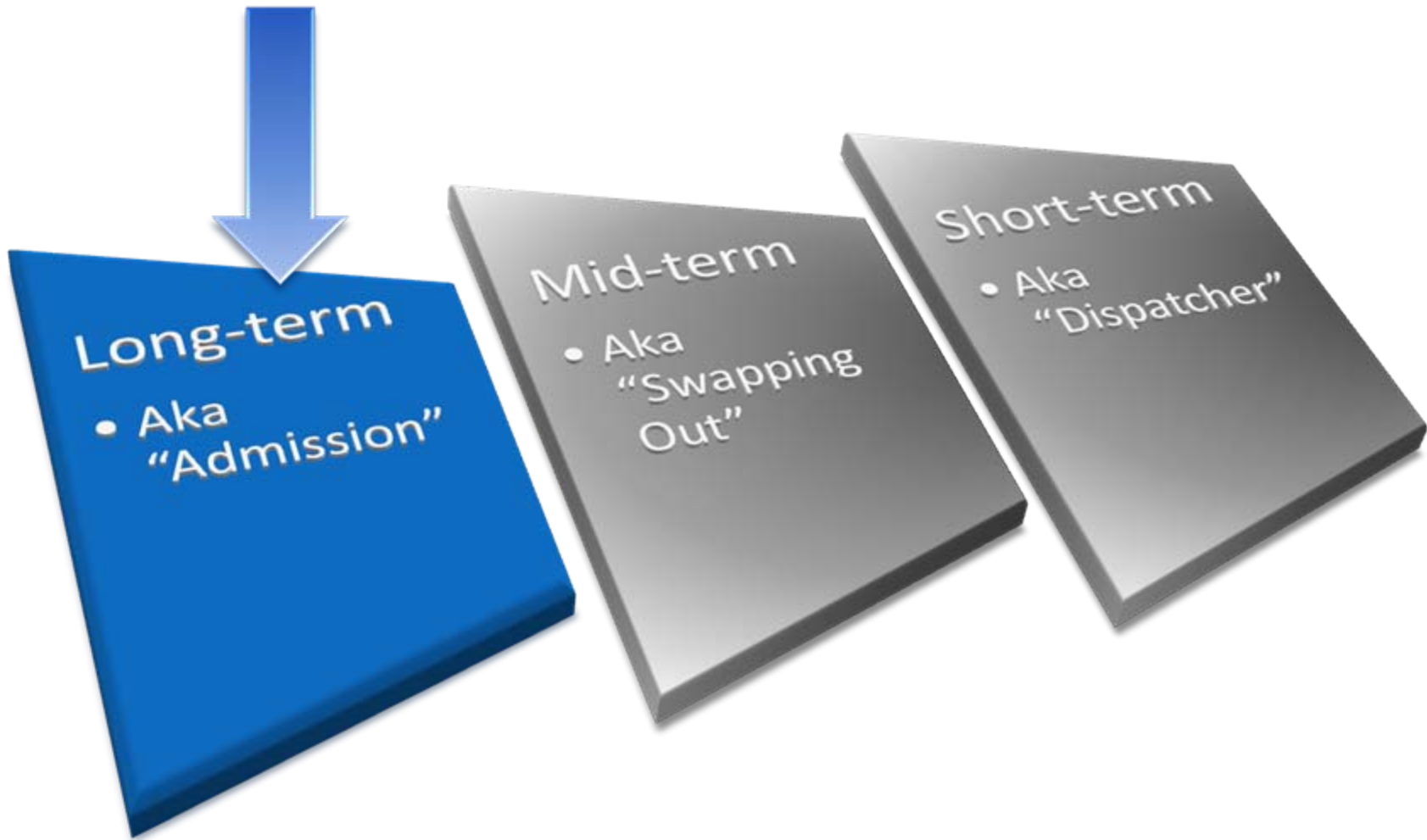


Scheduling

What is scheduling?

- ❖ Scheduling refers to the way processes are assigned to run on the available CPUs.
- ❖ This assignment is carried out by software known as a scheduler.

Types of OS schedulers



Long-term Scheduler

- ❖ Also called “admission”
- ❖ decides which jobs or processes are to be sent to the ready queue;
 - **Process** is an instance of a computer program. A computer program itself is just a collection of instructions, while a process is the actual execution of those instructions.
 - A "**ready**" process has been loaded into main memory and is awaiting execution on a CPU
 - **Queue** line of waiting processes

Long-term Scheduler

- ❖ that is, when an attempt is made to execute a program, its admission to the set of currently executing processes is either authorized by the long-term scheduler.
 - **Concurrent** all happening at one time

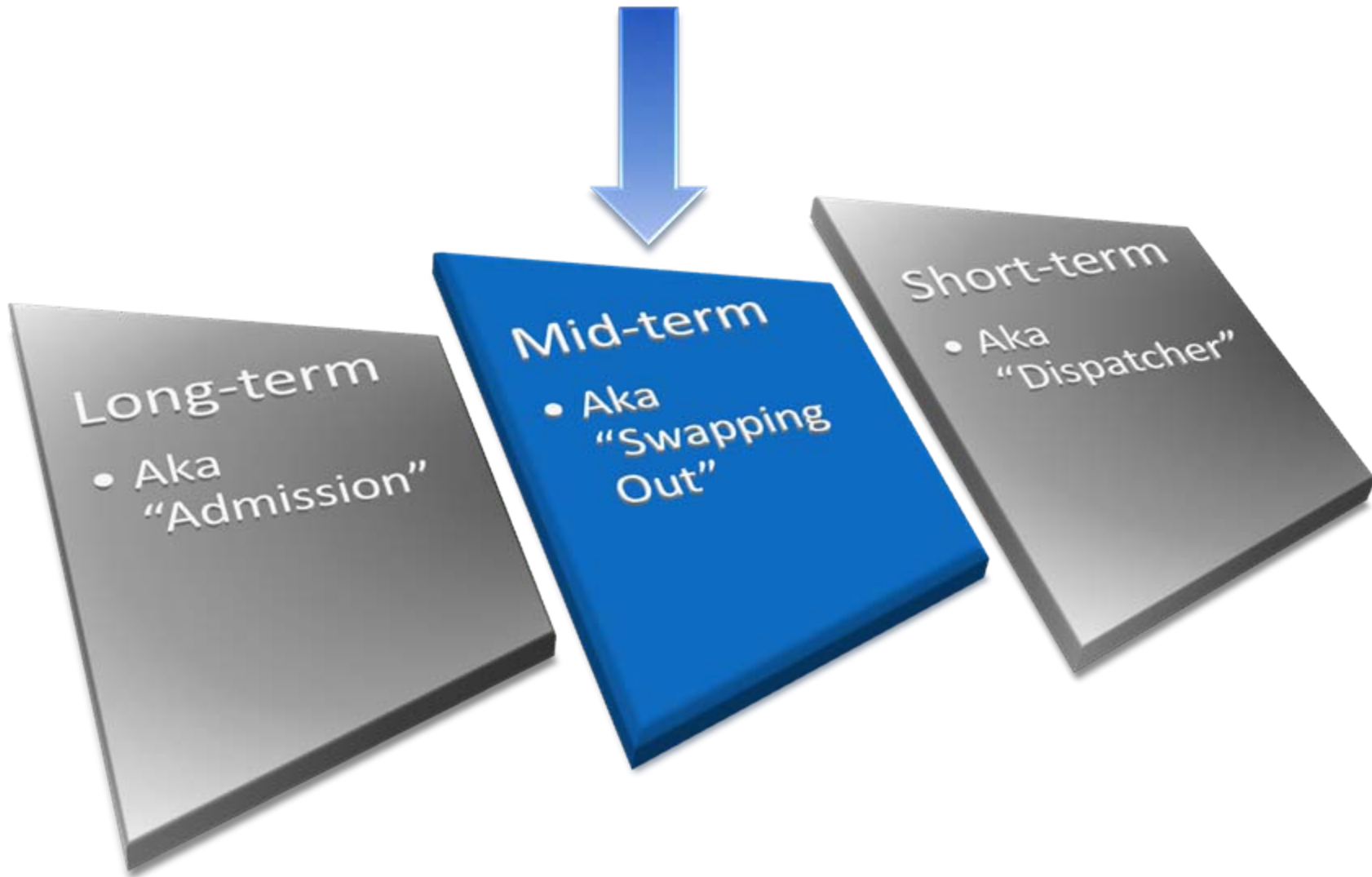
Long-term Scheduler

- ❖ In modern OS's, this is used to make sure that real time processes get enough CPU time to finish their tasks.
- ❖ Without proper real time scheduling, modern GUI interfaces would seem sluggish.
 - **GUI** Graphical User Interface. Everything you see on the screen.
 - **Real time** actual events happening at this moment
 - **Sluggish** moving slowly

Long-term Scheduler

- ❖ Long-term scheduling is also important in large-scale systems such as batch processing systems, computer clusters, supercomputers and render farms.
 - **Batch processing** is execution of a series of programs on a computer without human interaction.
 - A **computer cluster** is a group of linked computers, working together closely so that in many respects they form a single computer.
 - A **supercomputer** is a computer that is at the frontline of current processing capacity, particularly speed of calculation.
 - A **render farm** is a computer cluster built to render computer-generated imagery (CGI), typically for film and television visual effects, using off-line batch processing.

Types of OS schedulers



Mid-term Scheduler

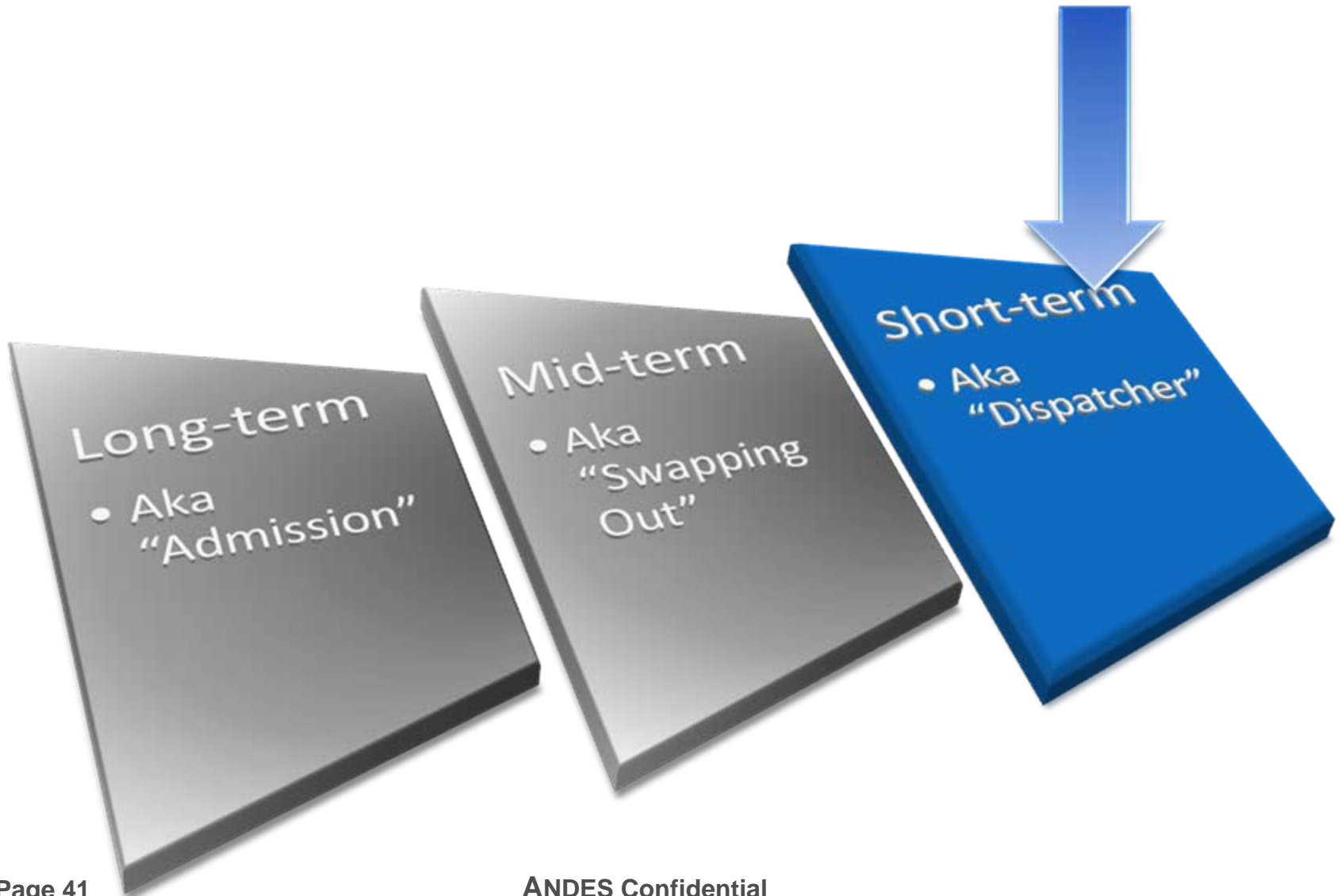
- ❖ referred to as "swapping out" or "swapping in"
- ❖ present in all systems with virtual memory,
- ❖ temporarily removes processes from main memory (RAM) and places them on secondary memory (such as a disk drive) or vice versa.
 - With **virtual memory**, the computer can look for areas of RAM that have not been used recently and copy them onto the hard disk. This frees up space in RAM to load the new application.

Mid-term Scheduler

- The mid-term scheduler may decide to 'swap out'
- ❖ a process which has not been active for some time,
 - ❖ or a process which has a low priority,
 - ❖ or a process which is taking up a large amount of memory



Types of OS schedulers



Short-term Scheduler

- ❖ also known as the “dispatcher”
- ❖ decides which of the ready, in-memory processes are to be executed

Short-term Scheduler

- ❖ makes scheduling decisions much more frequently than the long-term or mid-term schedulers because a decision will be made after every **time slice**, and these are very short.

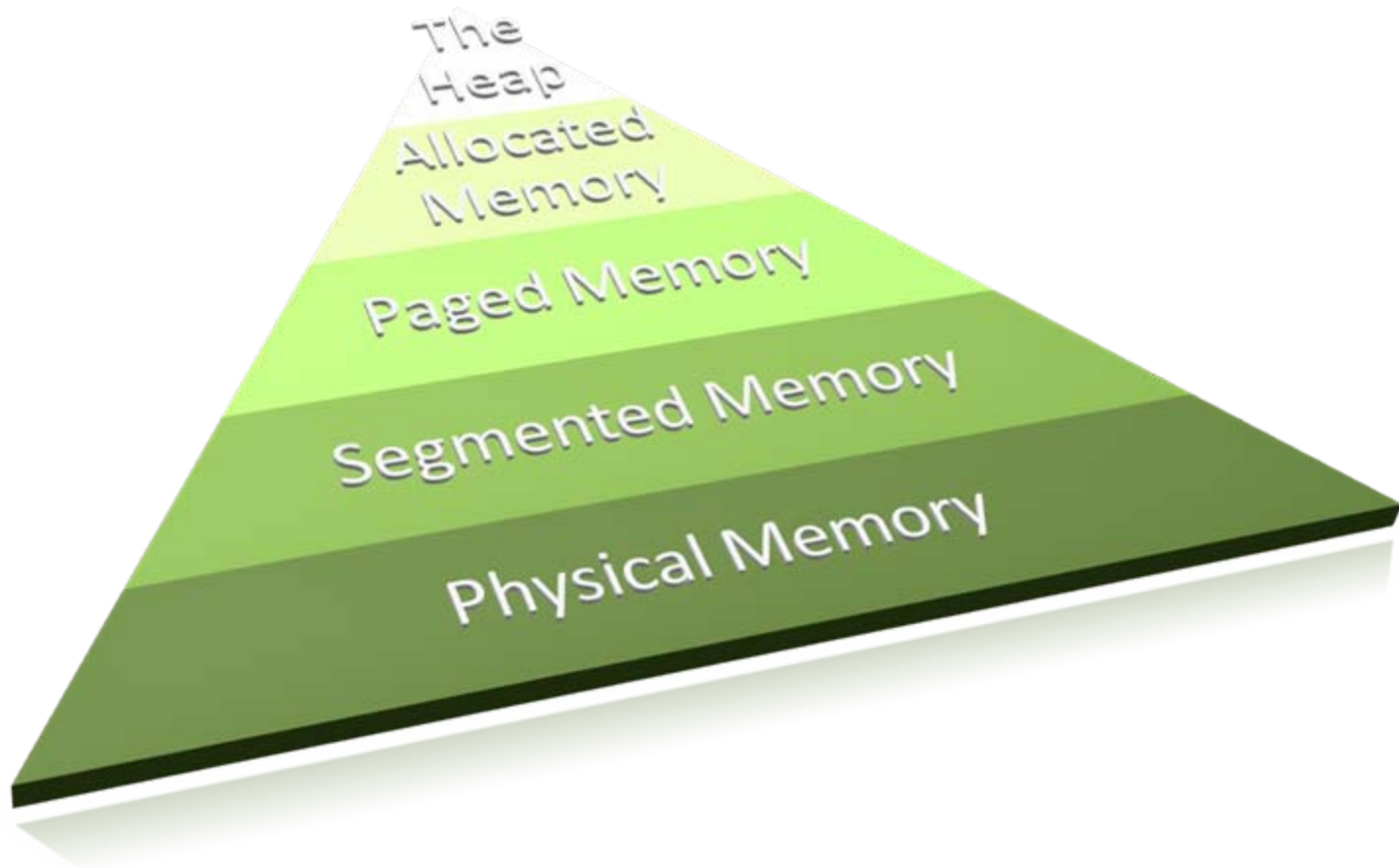
Short-term Scheduler

- ❖ This scheduler can be preemptive, implying that it is capable of forcibly removing processes from a CPU when it decides to allocate that CPU to another process.
 - **Preemptive** characteristic of securing something before someone else.

Memory Management

What is Memory Management?

- ❖ It is a term used to describe how the OS handles the available RAM. It is managed multiple levels.



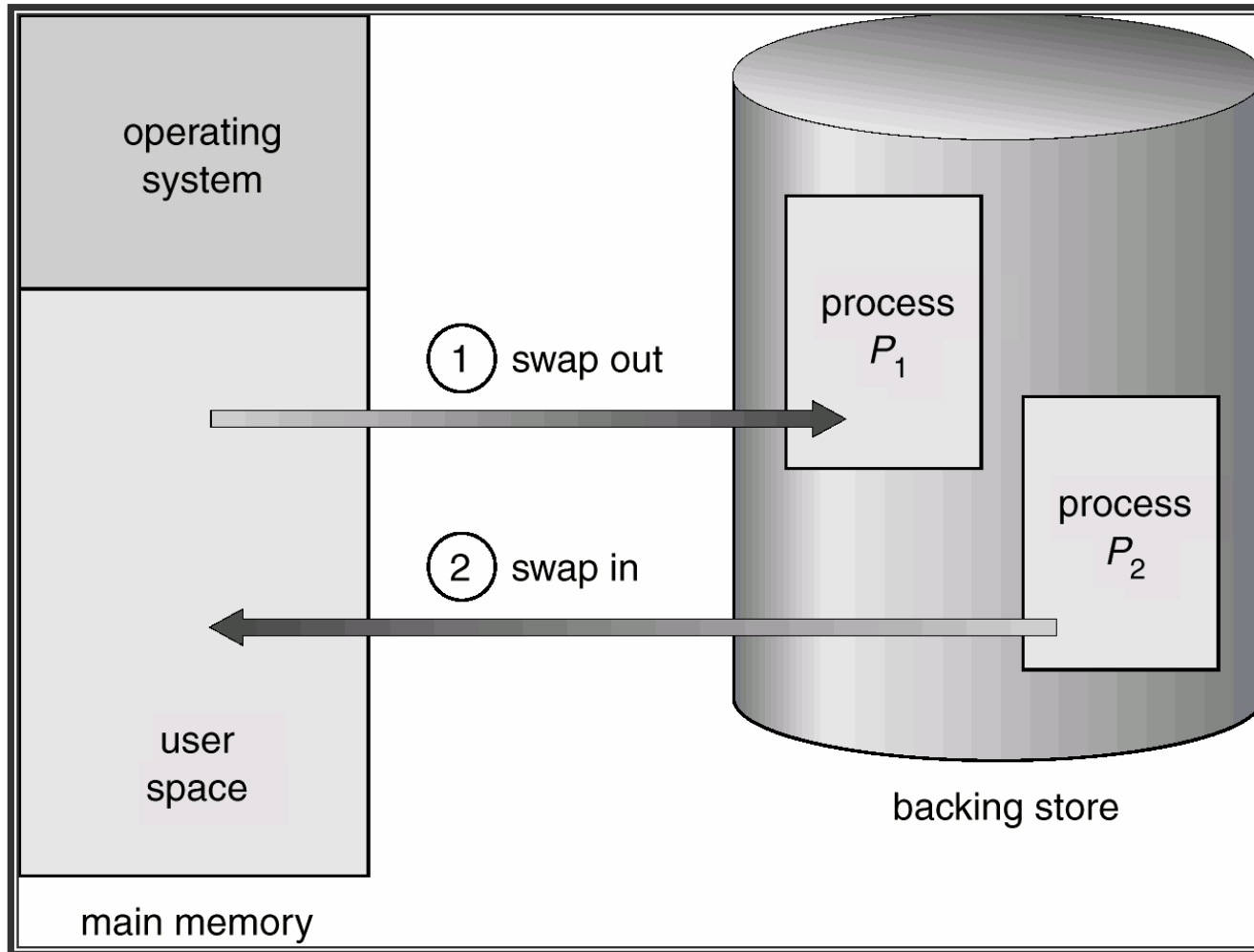
Relocation and Protection

- ❖ Cannot be sure where program will be loaded in memory
 - address locations of variables, code routines cannot be absolute
 - must keep a program out of other processes' partitions
- ❖ Use base and limit values
 - address locations added to base value to map to physical address
 - address locations larger than limit value is an error

Swapping

- ❖ A process can be *swapped* temporarily out of memory to a *backing store*, and then brought back into memory for continued execution.
- ❖ Backing store – fast disk large enough to accommodate copies of all memory images for all users; must provide direct access to these memory images.
- ❖ *Roll out, roll in* – swapping variant used for priority-based scheduling algorithms; lower-priority process is swapped out so higher-priority process can be loaded and executed.
- ❖ Major part of swap time is transfer time; total transfer time is directly proportional to the *amount* of memory swapped.
- ❖ Modified versions of swapping are found on many systems, i.e., UNIX, Linux, and Windows.

Schematic View of Swapping



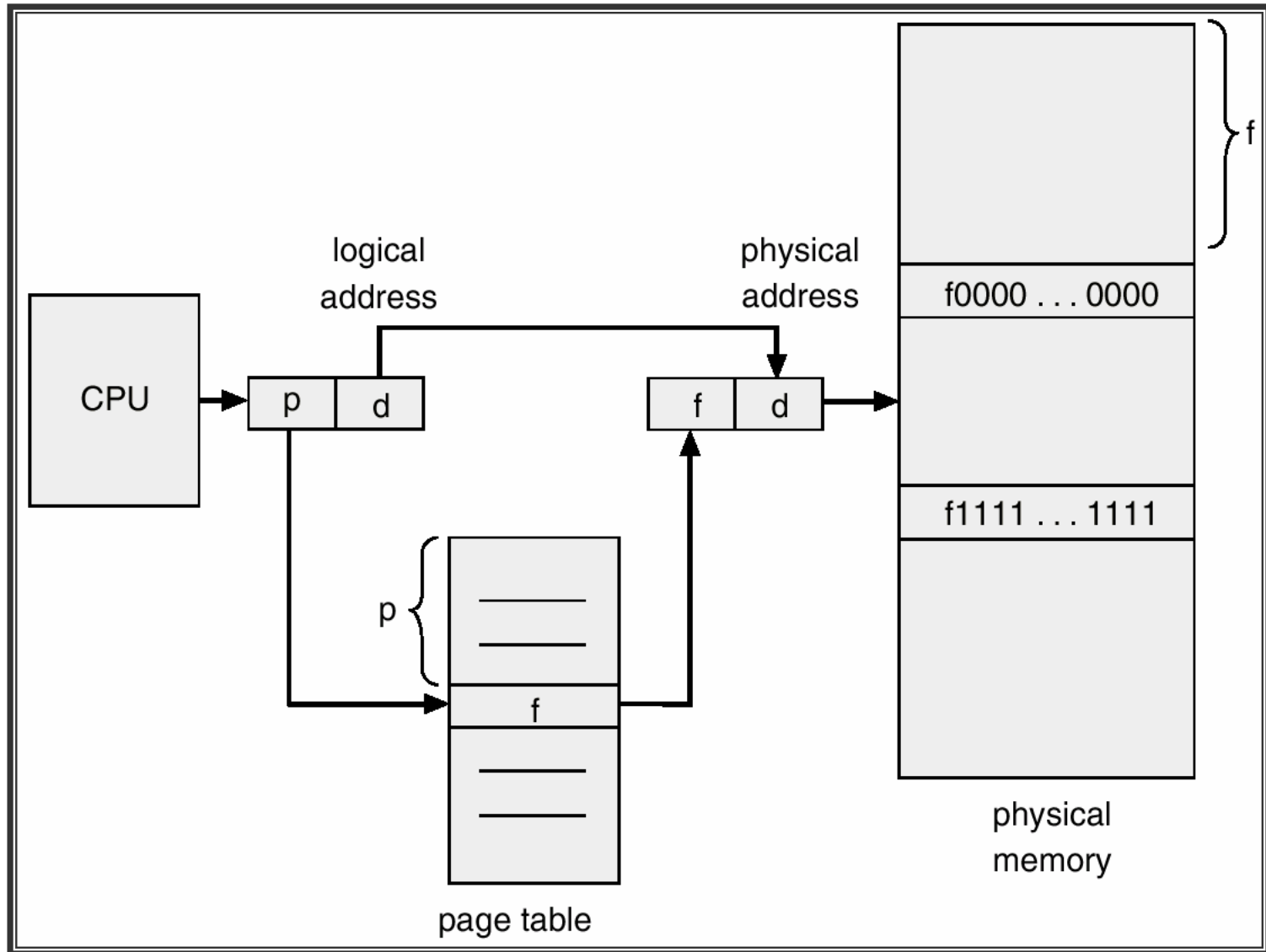
Paging

- ❖ Logical address space of a process can be noncontiguous; process is allocated physical memory whenever the latter is available.
- ❖ Divide physical memory into fixed-sized blocks called **frames** (size is power of 2, between 512 bytes and 8192 bytes).
- ❖ Divide logical memory into blocks of same size called **pages**.
- ❖ Keep track of all free frames.
- ❖ To run a program of size n pages, need to find n free frames and load program.
- ❖ Set up a page table to translate logical to physical addresses.
- ❖ Internal fragmentation.

Address Translation Scheme

- ❖ Address generated by CPU is divided into:
 - *Page number (p)* – used as an index into a *page table* which contains base address of each page in physical memory.
 - *Page offset (d)* – combined with base address to define the physical memory address that is sent to the memory unit.

Address Translation Architecture



Paging Example

