SERVICES PROVIDED BY OS

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AP

CSE DEPARTMENT

Operating System

- ▶ Is a program that controls the execution of application programs
    - ▶ OS must relinquish control to user programs and regain it safely and efficiently
    - ▶ Tells the CPU when to execute other pgms
- ▶ Is an interface between the user and hardware
- ▶ Masks the details of the hardware to application programs
    - ▶ Hence OS must deal with hardware details

Services Provided by the OS

- Facilities for Program creation
  - editors, compilers, linkers, and debuggers
- Program execution
  - loading in memory, I/O and file initialization
- Access to I/O and files
  - deals with the specifics of I/O and file formats
- System access
  - Protection in access to resources and data
  - Resolves conflicts for resource contention

Services Provided by the OS

- ▶ Error Detection
  - ▶ internal and external hardware errors
    - ▶ memory error
    - ▶ device failure
  - ▶ software errors
    - ▶ arithmetic overflow
    - ▶ access forbidden memory locations
  - ▶ Inability of OS to grant request of application

- ▶ Error Response
  - ▶ simply report error to the application
  - ▶ Retry the operation
  - ▶ Abort the application

Services Provided by the OS

- Accounting
  - collect statistics on resource usage
  - monitor performance (eg: response time)
  - used for system parameter tuning to improve performance
  - useful for anticipating future enhancements
  - used for billing users (on multiuser systems)

Major Achievements of OS

▶ To meet the difficult requirements of multiprogramming and time sharing, there have been 5 major achievements by OS:

- ▶ Processes

- ▶ Memory management

- ▶ Information protection and security

- ▶ Scheduling and resource management

- ▶ System structure

Process

- Introduced to obtain a systematic way of monitoring and controlling pgm execution

- A process is an executable program with:

  - associated data (variables, buffers…)

  - execution context: ie. all the information that

    - the CPU needs to execute the process

      - content of the processor registers

    - the OS needs to manage the process:

      - priority of the process

      - the event (if any) after which the process is waiting

      - other data (that we will introduce later)

A simple implementation of processes

- The process index register contains the index into the process list of the currently executing process (B)

- A process switch from B to A consist of storing (in memory) B's context and loading (in CPU registers) A's context

- A data structure that provides flexibility (to add new features)
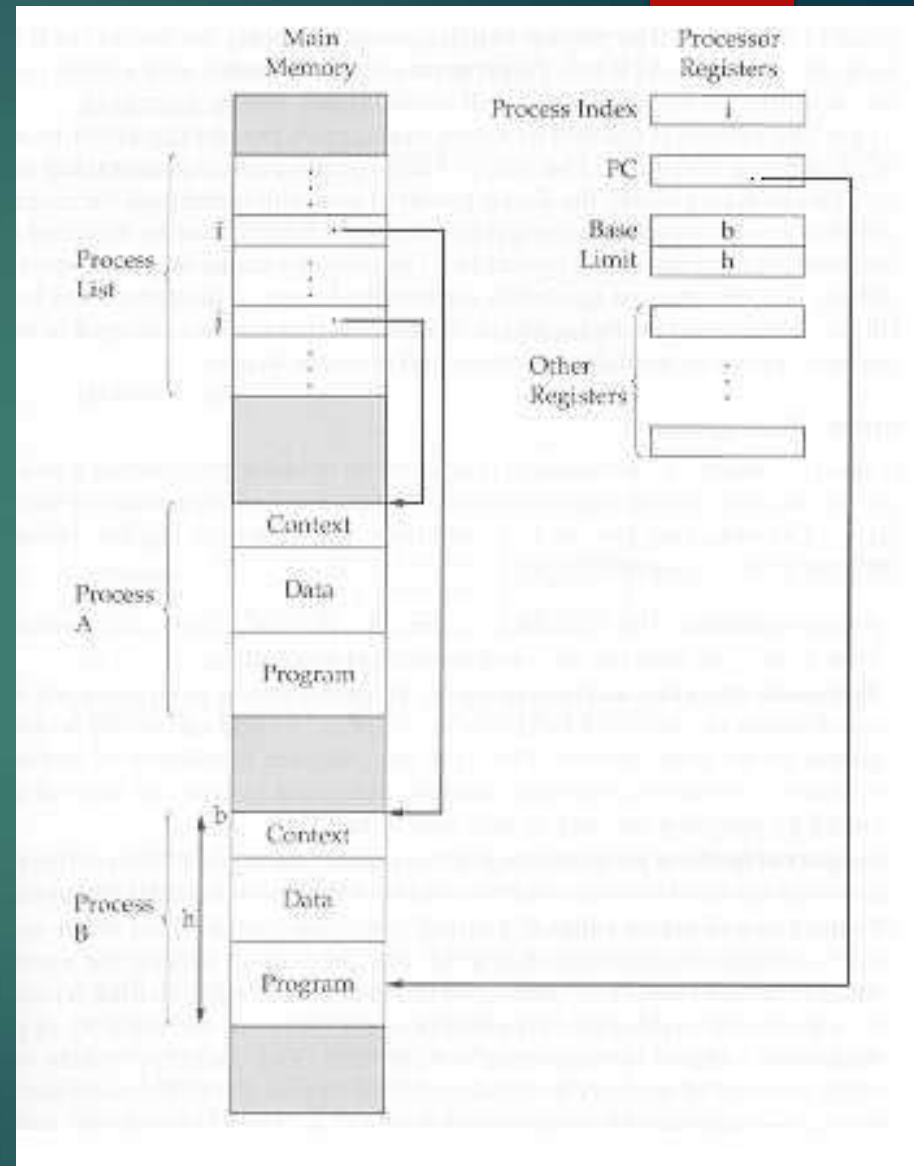
Memory Management

▶ The key contribution is virtual memory

▶ It allows programs to address memory from a logical point of view without regard to the amount that is physically available

▶ While a program is running only a portion of the program and data is kept in (real) memory

▶ Other portions are kept in blocks on disk

  ▶ the user has access to a memory space that is larger than real memory

Virtual Memory

- ▶ All memory references made by a program are to virtual memory which can be either
    - ▶ a linear address space
    - ▶ a collection of segments (variable-length blocks)
- ▶ The hardware (mapper) must map virtual memory address to real memory address
- ▶ If a reference is made to a virtual address not in memory, then
    - ▶ (1) a portion of the content of real memory is swapped out to disk
    - ▶ (2) the desired block of data is swapped in

File System

- ▶ Implements long-term store (often on disk)
- ▶ Information stored in named objects called files
  - ▶ a convenient unit of access and protection for OS
- ▶ Files (and portions) may be copied into virtual memory for manipulation by programs

Security and Protection

- ▶ Access control to resources
  - ▶ forbid intruders (unauthorized users) to enter the system
  - ▶ forbid user processes to access resources which they are not authorized to

Characteristics of Modern Operating Systems

- New design elements were introduced recently
  - In response to new hardware development
    - multiprocessor machines
    - high-speed networks
    - faster processors and larger memory
  - In response to new software needs
    - multimedia applications
    - Internet and Web access
    - Client/Server applications

Microkernel architecture

- ▶ Only a few essential functions in the kernel
    - ▶ primitive memory management (address space)
    - ▶ Interprocess communication (IPC)
    - ▶ basic scheduling
- ▶ Other OS services are provided by processes running in user mode (servers)
    - ▶ device drivers, file system, virtual memory…
- ▶ More flexibility, extensibility, portability…
- ▶ A performance penalty by replacing service calls with message exchanges between process...

Multithreading

▶ A process is a collection of one or more threads that can run simultaneously

▶ Useful when the application consists of several tasks that do not need to be serialized

▶ Gives the programmer a greater control over the timing of application-related events

▶ All threads within the same process share the same data and resources and a part of the process's execution context

▶ It is easier to create or destroy a thread or switch among threads (of the same process) than to do these with processes

Symmetric Multiprocessing (SMP)

- ▶ A computer with multiple processors

- ▶ Each processor can perform the same functions and share same main memory and I/O facilities (symmetric)

- ▶ The OS schedule processes/threads across all the processors (real parallelisme)

- ▶ Existence of multiple processors is transparent to the user.

- ▶ Incremental growth: just add another CPU!

- ▶ Robustness: a single CPU failure does not halt the system, only the performance is reduced.