PROCESS

PROCESS

Process – a running program

- a process is an activity of some kind. It has a program, input, output, and a state.
- A single processor may be shared among several processes, with some scheduling algorithm being used to determine when to stop work on one process and service a different one.

- Multiprogramming – computer can do several things at the same time
  - Ex : While running a user program, a computer can also be reading from a disk and outputting text to a screen or printer
  - the CPU is running only one program, in the course of 1 second, it may work on several programs, thus giving the users the illusion of parallelism
- Multiprocessor – true hardware parallelism, which have two or more CPUs sharing the same physical memory

PROCESS VS PROGRAM

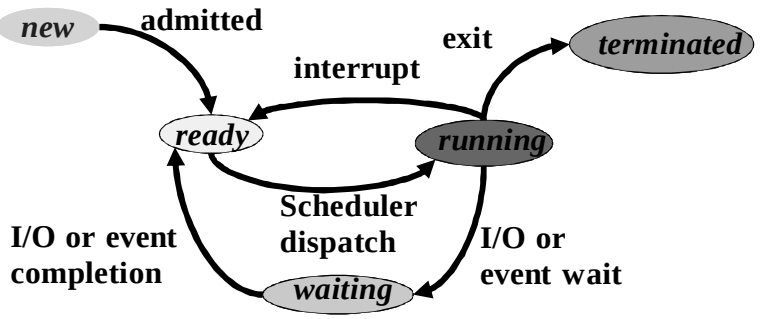
- The analogy :
  - Program – course schedule, test schedule, books
  - Process – learning and teaching activities in class

PROCESS AND OS

- OS schedules and sends processes to be executed by CPU.
- OS allocates resources for processes.

Process State

A process changes state as it executes.



Process Concept

An operating system executes a variety of programs

- batch systems - jobs
- time-shared systems - user programs or tasks
- job and program used interchangeably

Process - a program in execution

- process execution proceeds in a sequential fashion

A process contains

- program counter, stack and data section

Process States

New - The process is being created.

Running - Instructions are being executed.

Waiting - Waiting for some event to occur.

Ready - Waiting to be assigned to a processor.

Terminated - Process has finished execution.

Process Control Block

Contains information associated with each process

- Process State - e.g. new, ready, running etc.
- Program Counter - address of next instruction to be executed
- CPU registers - general purpose registers, stack pointer etc.
- CPU scheduling information - process priority, pointer
- Memory Management information - base/limit information
- Accounting information - time limits, process number
- I/O Status information - list of I/O devices allocated

Process Scheduling Queues

Job Queue - set of all processes in the system

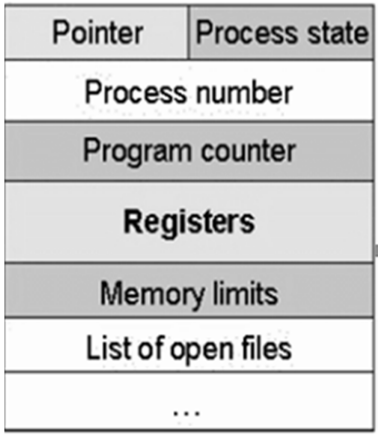
Ready Queue - set of all processes residing in main memory, ready and waiting to execute.

Device Queues - set of processes waiting for an I/O device.

Process migration between the various queues.

Queue Structures - typically linked list, circular list etc.

Process Control Block (PCB)



Schedulers

Long-term scheduler (or job scheduler) -

selects which processes should be brought into the ready queue.
invoked very infrequently (seconds, minutes); may be slow.
controls the degree of multiprogramming

Short term scheduler (or CPU scheduler) -

selects which process should execute next and allocates CPU.
invoked very frequently (milliseconds) - must be very fast

Medium Term Scheduler

swaps out process temporarily
balances load for better throughput

Process Profiles

I/O bound process -

spends more time in I/O, short CPU bursts, CPU underutilized.

CPU bound process -

spends more time doing computations; few very long CPU bursts, I/O underutilized.

The right job mix:

Long term scheduler - admits jobs to keep load balanced between I/O and CPU bound processes

Process Creation

Processes are created and deleted dynamically

Process which creates another process is called a *parent* process; the created process is called a *child* process.

Result is a tree of processes

e.g. UNIX - processes have dependencies and form a hierarchy.

Resources required when creating process

CPU time, files, memory, I/O devices etc.

Context Switch

Task that switches CPU from one process to another process

the CPU must save the PCB state of the old process and load the saved PCB state of the new process.

Time for context switch is dependent on hardware support (1- 1000 microseconds).

Process Creation

Resource sharing

Parent and children share all resources.

Children share subset of parent's resources - prevents many processes from overloading the system.

Parent and children share no resources.

Execution

Parent and child execute concurrently.

Parent waits until child has terminated.

Address Space

Child process is duplicate of parent process.

Child process has a program loaded into it.

UNIX Process Creation

Fork system call creates new processes

execve system call is used after a fork to replace the processes memory space with a new program.

Process Termination

Process executes last statement and asks the operating system to delete it (*exit*).

- Output data from child to parent (via wait).
- Process' resources are deallocated by operating system.

Parent may terminate execution of child processes.

- Child has exceeded allocated resources.
- Task assigned to child is no longer required.
- Parent is exiting
  - OS does not allow child to continue if parent terminates
  - Cascading termination