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E-LEAD

PERFECT SCORE OF **150/150** AS A TESTAMENT
TO EXCEPTIONAL E-LEARNING METHODS

Unit 2 : Process and Thread Management

Lecture 1

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1. Process Concept
2. Process states
3. Process Control Block(PCB)

Learning & Course Outcomes

- LO1: Understand the fundamental concepts of processes and their states.
- LO2: Identify the components and role of the Process Control Block (PCB)
- LO3: Describe the different types of schedulers and their functions in process management.

Course Outcomes

- CO2: Evaluate and analyze process and thread scheduling techniques, discerning their benefits and challenges.

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Process Concept

- **Process: A process can be thought of as a program in execution (or) A process is the unit of work in a modern time-sharing system. A process will need certain resources such as CPU time, memory, files and I/O devices to accomplish its task. These resources are allocated to the process either when it is created or while it is executing.**

The process concept includes the following:

1. Process

2. Process state

3. Process Control Block

4. Threads

Process Concept(Continuing…)
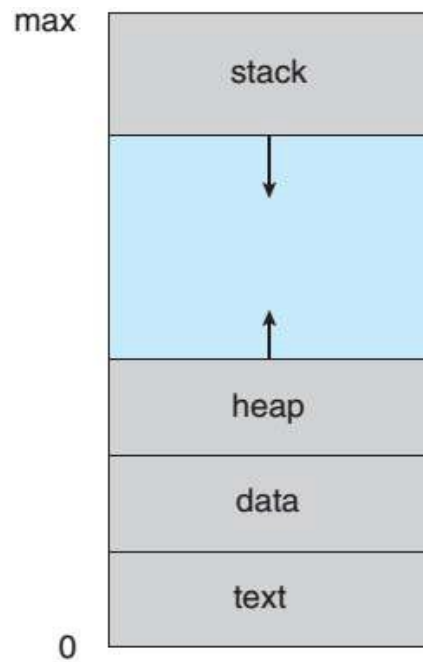
The below figure shows the structure of process in memory:

max

stack

heap

data

text

0

Fig: Process in mem
ory

The process contains several sections: **Text, Data, Heap and Stack.**

🕐 **Text Section** contains the program code. It also includes the current activity, as represented by the value of the **program counter** and the contents of the processor's registers.

🕐 **Process stack** contains temporary data such as function parameters, return addresses and local variables.

🕐 **Data section** contains global variables.

🕐 **Heap** is memory that is dynamically allocated during process run time.

Difference between Program and Process

- A program is a *passive* entity, such as a file containing a list of instructions stored on disk often called an **executable file**.
- A process is an *active* entity with a program counter specifying the next instruction to execute and a set of associated resources.
- A program becomes a process when an executable file is loaded into memory.

Two common techniques for loading executable files are double-clicking an icon representing the executable file and entering the name of the executable file on the command line as in **prog.exe** or **a.out.**

Although two processes may be associated with the same program, they are considered as two separate execution sequences. For instance, several users may be running different copies of the mail program or the same user may invoke many copies of the web browser program. Each of these is considered as a separate process.

Process State

As a process executes, it changes **state**. The process state defines the current activity of that process.
A process may be in one of the following states:
- **New**: The process is being created.
- **Ready**: The process is waiting to be assigned to a processor.
- **Running**: Instructions are being executed.
- **Waiting**: The process is waiting for some event to occur such as an I/O completion or reception of a signal.
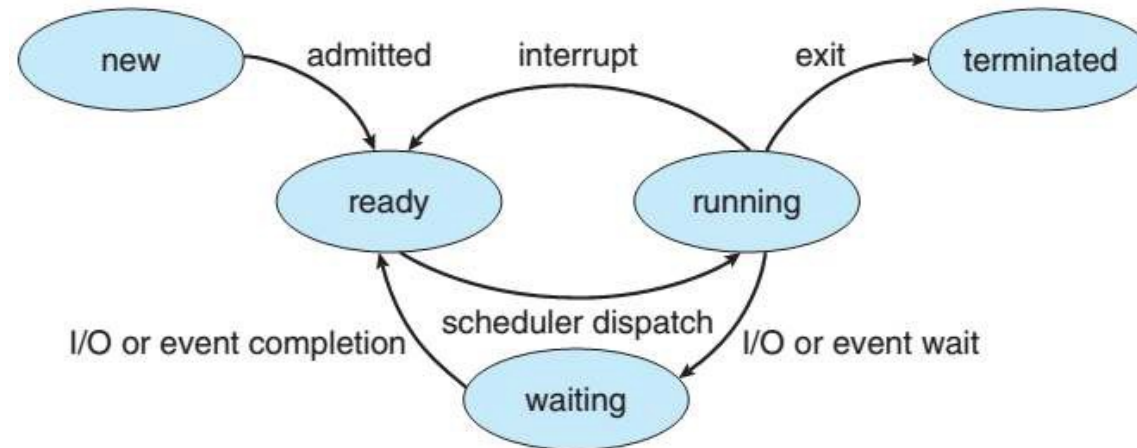- **Terminated**: The process has finished execution.

Fig: Process State

Note: Only one process can be *running* on any processor at any instant of time.

Process Control Block

- Each process is represented in the operating system by a **Process Control Block (PCB)**. It is also called a **Task Control Block**.

- PCB serves as the repository for any information that may vary from process to process.

The PCB contains information related to process such as:

Process state: The state may be new, ready, running, waiting and terminated.

Program counter: The counter indicates the address of the next instruction to be executed for this process.

CPU registers: The registers vary in number and type, depending on the computer architecture. They include accumulators, index registers, stack pointers and general Purpose registers etc. Along with the program counter, this state information must be saved when an interrupt occurs, to allow the process to be continued correctly afterward.
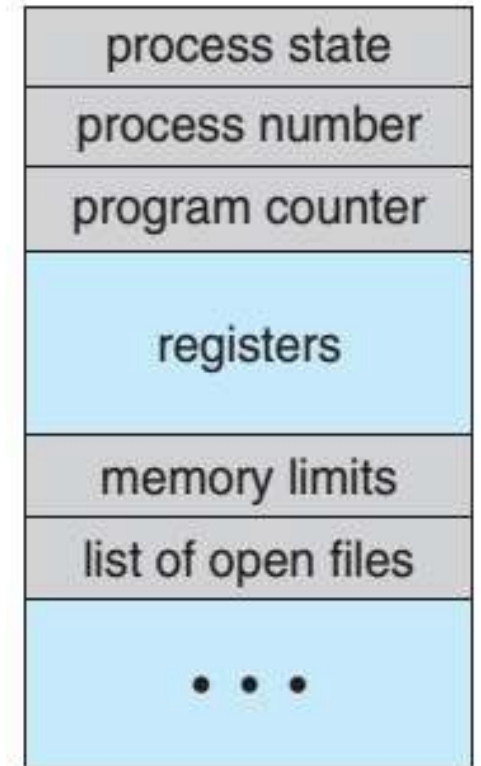
process state
process number
program counter
registers
memory limits
list of open files
• • •

Fig: Process Control Block

Process Control Block Information

- **CPU-scheduling information**: This information includes a process priority, pointers to scheduling queues and any other scheduling parameters.

- **Memory-management information**: This information includes the base and limit registers values, the page tables or the segment tables depending on the memory system used by the operating system.

- **Accounting information**: This information includes the amount of CPU and real time used, time limits, account numbers, job or process numbers and so on.

- **I/O status information**: This information includes the list of I/O devices allocated to the process, a list of open files and so on.

Process Scheduling

- The objective of multiprogramming is to have some process running at all times, to maximize CPU utilization.
- The objective of time sharing is to switch the CPU among processes so frequently that users can interact with each program while it is running.
- To meet these objectives, the **Process Scheduler** selects an available process for program execution on the CPU.

Process scheduling involves three things:
1. Scheduling Queues
2. Schedulers
3. Context Switch

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MCQ's

1. What is a process in the context of operating systems?
A) A program in execution
B) A passive entity stored on disk
C) A function within a program
D) A user interface application

2. Which section of a process in memory contains the program code?
A) Data section
B) Stack
C) Heap
D) Text section

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MCQ's

3. What is the role of the Process Control Block (PCB) in an operating system?
A) To execute process instructions
B) To store process-related information
C) To manage hardware resources
D) To schedule process execution

4. Which process state indicates that the process is being created?
A) New
B) Ready
C) Running
D) Terminated

MCQ's

5. What does the process state 'Running' signify?
A) The process is waiting for an event
B) The process is being created
C) Instructions are being executed
D) The process has finished execution

6. What information does the CPU-scheduling section of the PCB contain?
A) Process priority and scheduling queue pointers
B) Program counter and CPU registers
C) Memory management information
D) I/O status information

MCQ's

7. In process scheduling, what is the main objective of multiprogramming?
A) To minimize CPU utilization
B) To switch the CPU among processes
C) To have some process running at all times
D) To maximize the number of processes in memory

8. What is the main difference between a program and a process?
A) A program is active; a process is passive
B) A program is passive; a process is active
C) A program is stored in memory; a process is stored on disk
D) There is no difference between a program and a process

MCQ's

9. What does the term 'context switch' refer to in process management?
A) Switching between user and kernel modes
B) Switching the CPU from one process to another
C) Loading a program into memory
D) Allocating memory to a process

10. Which of the following is NOT a typical state of a process?
A) Running
B) Ready
C) Waiting
D) Suspended

Answers

1. A) A program in execution
2. D) Text section
3. B) To store process-related information
4. A) New
5. C) Instructions are being executed
6. A) Process priority and scheduling queue pointers
7. C) To have some process running at all times
8. B) A program is passive; a process is active
9. B) Switching the CPU from one process to another
10. D) Suspended

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Summary/Key Points

This section provides an explanation of the process and thread concepts in operating systems, including their definitions, characteristics, and differences. It also covers the different states of a process, the components of a process control block.

- A process is a program in execution and requires resources such as CPU time, memory, and I/O devices.
- The process state defines the current activity of a process, which can be new, ready, running, waiting, or terminated.
- The process control block (PCB) contains information about a process, including its state, program counter, CPU registers, and scheduling information.
- Threads are units of execution within a process and can run concurrently on multi-core systems.

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Coming up-next lecture

1. Process Scheduling
2. Operation on Processes

Thank You