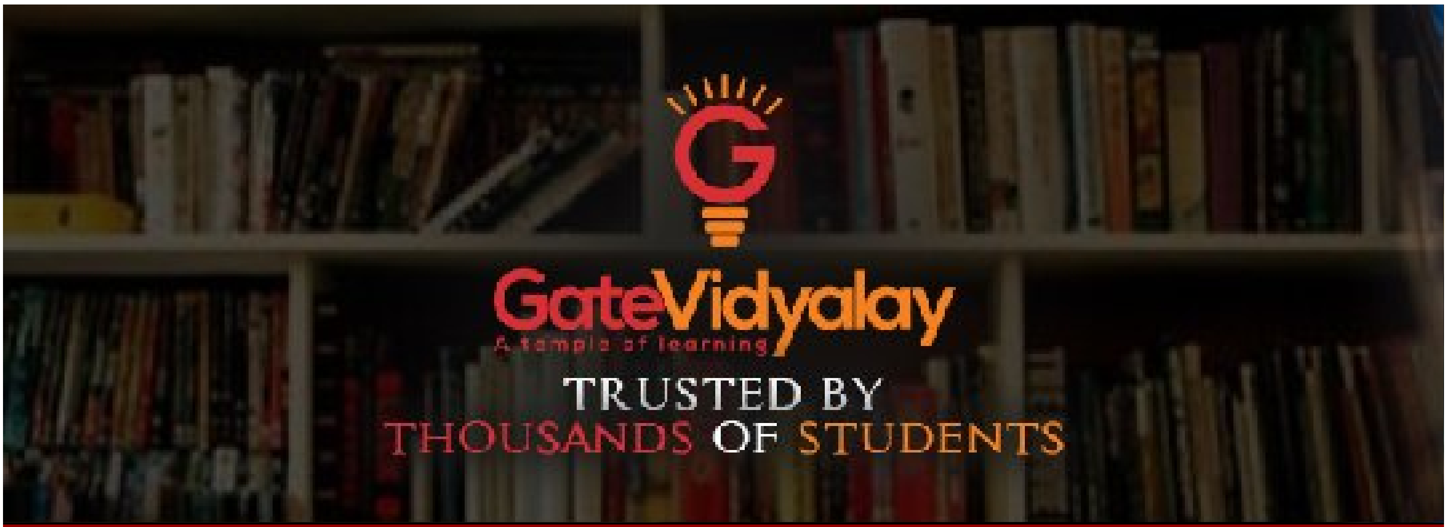


Process Synchronization | Race Condition in OS

Operating System

Process Synchronization-

When multiple processes execute concurrently sharing system resources, then inconsistent results might be produced.

- Process Synchronization is a mechanism that deals with the synchronization of processes.
- It controls the execution of processes running concurrently to ensure that consistent results are produced.

Need of Synchronization-

Process synchronization is needed-

- When multiple processes execute concurrently sharing some system resources.
- To avoid the inconsistent results.

Critical Section-

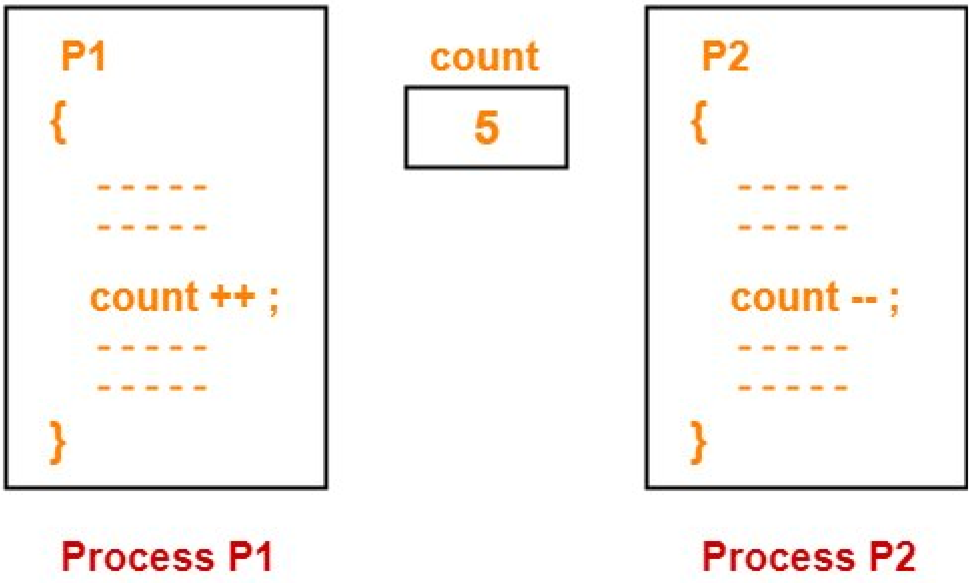
Critical section is a section of the program where a process access the shared resources during its execution.

Example-

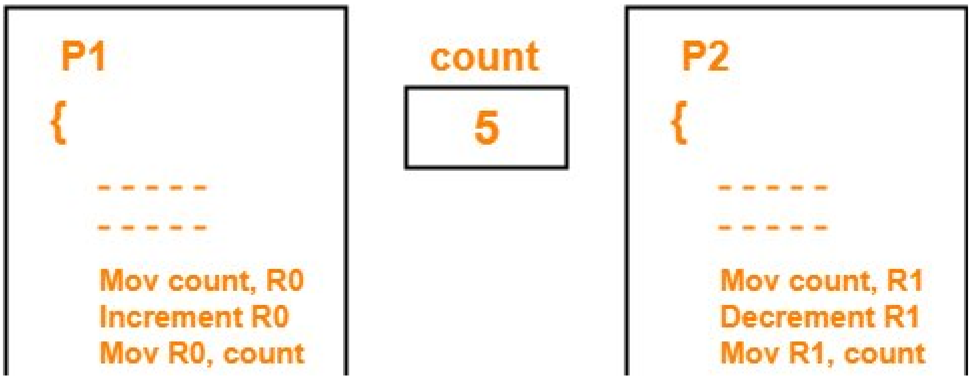
The following illustration shows how inconsistent results may be produced if multiple processes execute concurrently without any synchronization.

Consider-

- Two processes P_1 and P_2 are executing concurrently.
- Both the processes share a common variable named “count” having initial value = 5.
- Process P1 tries to increment the value of count.
- Process P2 tries to decrement the value of count.



In assembly language, the instructions of the processes may be written as-



Now, when these processes execute concurrently without synchronization, different results may be produced.

Case-01:

The execution order of the instructions may be-

$P_1(1), P_1(2), P_1(3), P_2(1), P_2(2), P_2(3)$

In this case,

Final value of count = 5

Case-02:

The execution order of the instructions may be-

$P_2(1), P_2(2), P_2(3), P_1(1), P_1(2), P_1(3)$

In this case,

Final value of count = 5

Case-03:

The execution order of the instructions may be-

$P_1(1), P_2(1), P_2(2), P_2(3), P_1(2), P_1(3)$

In this case,

Final value of count = 6

Case-04:

The execution order of the instructions may be-

$P_2(1), P_1(1), P_1(2), P_1(3), P_2(2), P_2(3)$

In this case,

Final value of count = 4

Case-05:

The execution order of the instructions may be-

$P_1(1), P_1(2), P_2(1), P_2(2), P_1(3), P_2(3)$

In this case,

Final value of count = 4

It is clear from here that inconsistent results may be produced if multiple processes execute concurrently without any synchronization.

Race Condition-

Race condition is a situation where-

- The final output produced depends on the execution order of instructions of different processes.

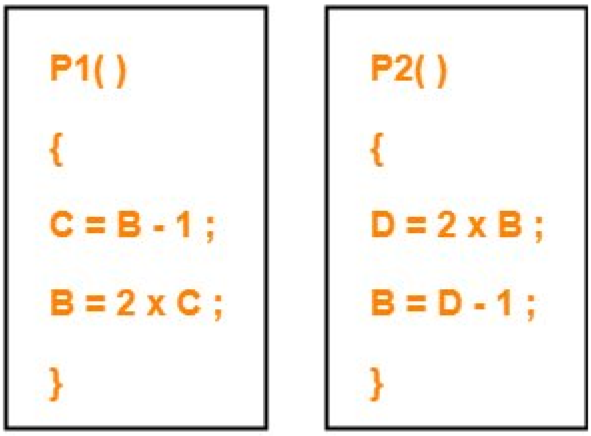
- Several processes compete with each other.

The above example is a good illustration of race condition.

PRACTICE PROBLEM BASED ON PROCESS SYNCHRONIZATION-

Problem-

The following two functions P1 and P2 that share a variable B with an initial value of 2 execute concurrently-



```
P1( )
{
C = B - 1 ;
B = 2 x C ;
}
```

```
P2( )
{
D = 2 x B ;
B = D - 1 ;
}
```

The number of distinct values that B can possibly take after the execution is-

1. 3
2. 2
3. 5
4. 4

Solution-

Different execution order of the instructions of P1 and P2 produce different results.

Case-01:

The execution order of the instructions may be-

$P_1(1), P_1(2), P_2(1), P_2(2)$

In this case,

Final value of B = 3

Case-02:

The execution order of the instructions may be-

$P_2(1), P_2(2), P_1(1), P_1(2)$

In this case,

Final value of B = 4

Case-03:

The execution order of the instructions may be-

$P_1(1), P_2(1), P_2(2), P_1(2)$

In this case,

Final value of B = 2

Case-04:

The execution order of the instructions may be-

$P_2(1), P_1(1), P_1(2), P_2(2)$

In this case,

Final value of B = 3

Case-05:

The execution order of the instructions may be-

$$P_1(1), P_2(1), P_1(2), P_2(2)$$

In this case,

Final value of B = 3

Case-06:

The execution order of the instructions may be-

$$P_2(1), P_1(1), P_2(2), P_1(2)$$

In this case,

Final value of B = 2

From here,

- Distinct values that may be produced are 2, 3 and 4.
- Number of distinct values that may be produced = 3

Thus, Option (A) is correct.

To gain better understanding of Process Synchronization,

Watch this Video Lecture

Next Article- Synchronization Mechanisms

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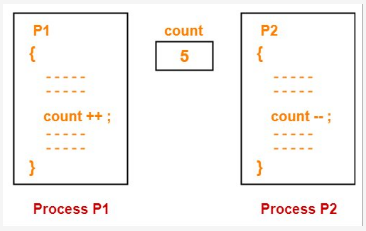
Summary



Article Name	Process Synchronization | Race Condition in OS
Description	Process Synchronization deals with the synchronization of processes. Race Condition in OS is a situation where multiple processes compete. Critical Section in OS is a part of the program where a process access the shared resource.
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Process Control Block

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Predicting Burst Time

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HRRN Scheduling

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Priority Scheduling

Problems On Scheduling Algorithms

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Problems On Segmented Paging

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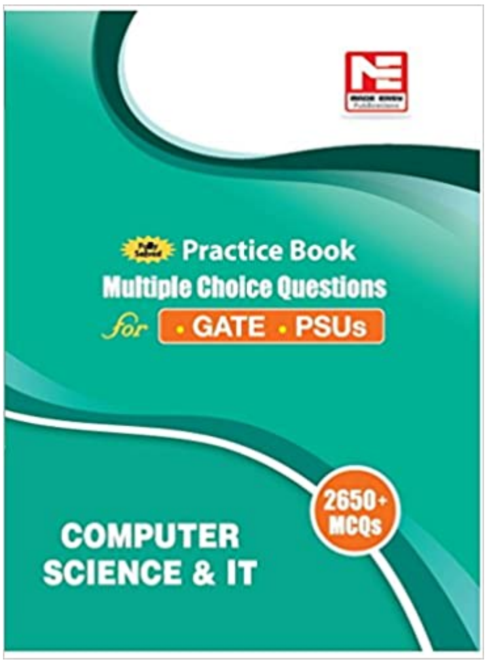
SSTF Disk Scheduling Algorithm

SCAN Disk Scheduling Algorithm

C-SCAN Disk Scheduling Algorithm

LOOK Disk Scheduling Algorithm

C-LOOK Disk Scheduling Algorithm



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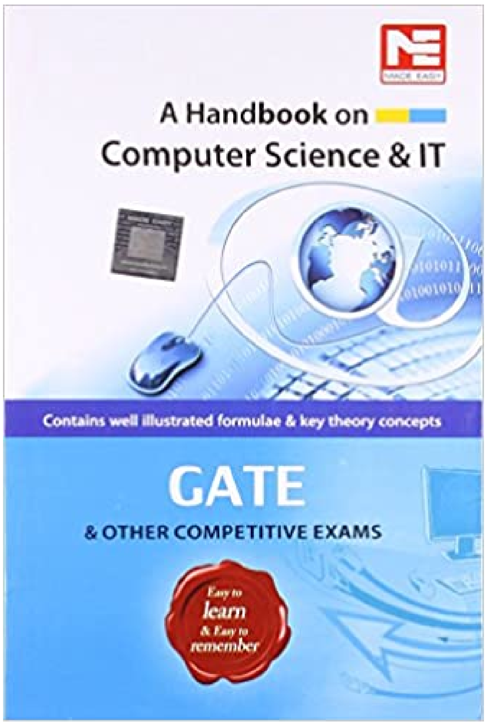
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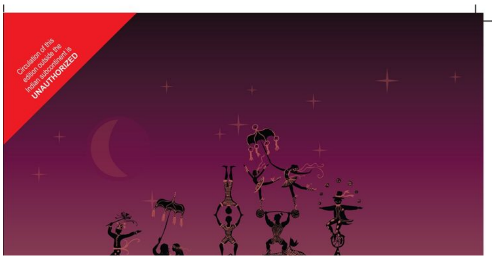
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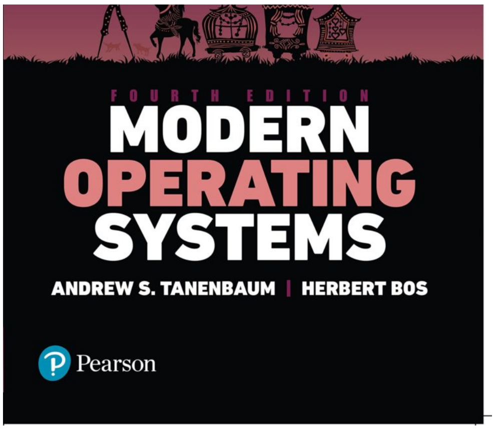

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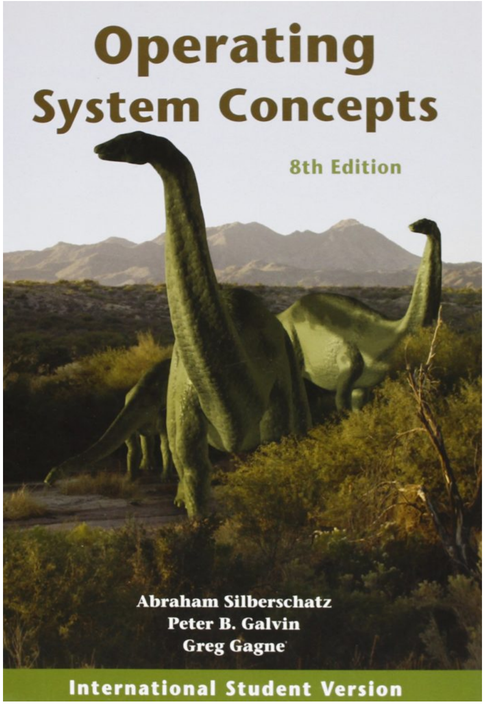

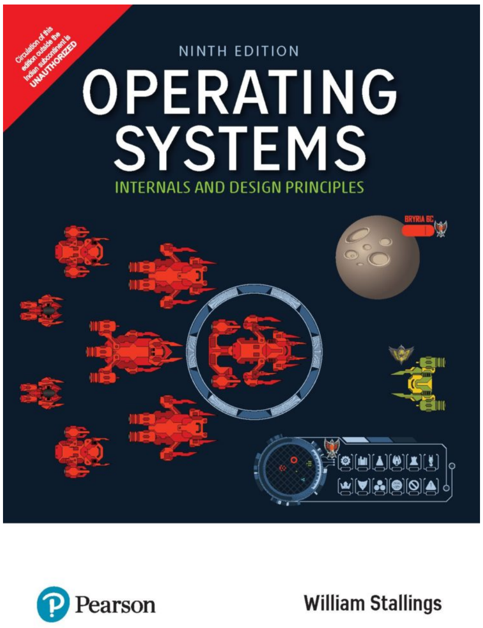
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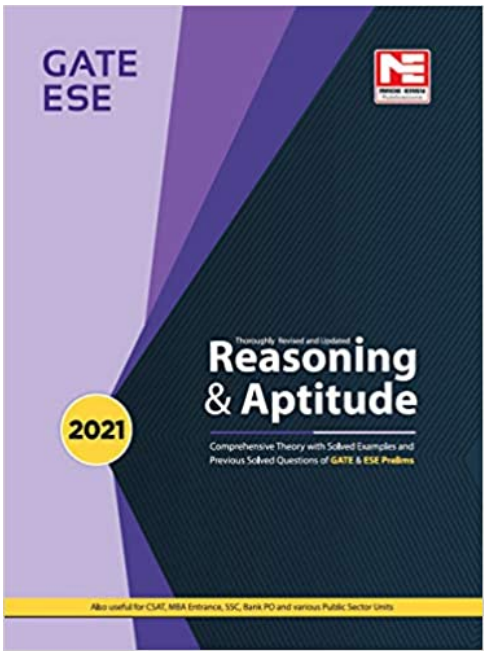
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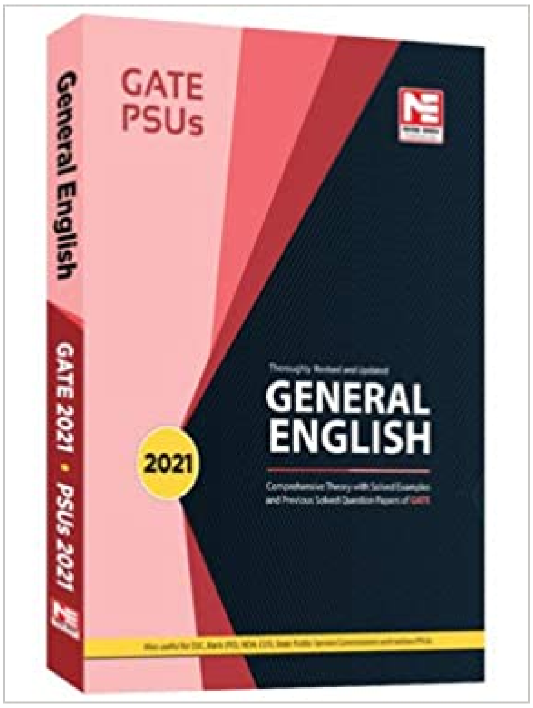

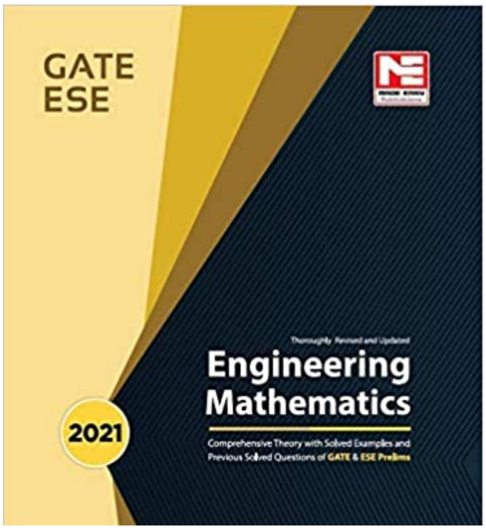
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