DPP- 01

CS & IT

Operating System

CPU Scheduling

Q1 Consider the following process scenario.

Process	Arrival Time (in milliseconds)	Burst Time (In milliseconds)
P1	4	5
P2	5	3
P3	8	4
P4	7	2
P5	3	1
P6	0	6
P7	7	2

The average waiting time of processes for FCFS scheduling algorithm is _____ milliseconds?

Q2 Consider the following process scenario.

Process	Arrival Time (in milliseconds)	Burst Time (In milliseconds)
P1	5	6
P2	3	3
P3	1	4
P4	2	2
P5	4	1
P6	0	3
P7	1	2

The average waiting time processes for non-preemptive shortest job first scheduling algorithm is _____ milliseconds (rounded up to 2 decimal places)?

Q3 Consider a CPU performance metric throughput which is calculated as:

$$Throughput = \frac{Number\ of\ processes\ executed}{Total\ scheduling\ duration\ from\ first\ process\ arrival\ till\ last\ process\ completion}$$

For the following process scenario calculate the throughput calculated for non-preemptive SJF algorithm ___ per milliseconds (rounded up to 1 decimal place)?

Process	Arrival Time (in milliseconds)	Burst Time (in milliseconds)
P1	0	3
P2	4	6
P3	7	4
P4	9	2
P5	8	1
P6	6	3

Q4 Consider a CPU performance metric throughput which is calculated as:

$$Throughput = \frac{Number\ of\ processes\ executed}{Total\ scheduling\ duration\ from\ first\ process\ arrival\ till\ last\ process\ completion}$$

For the following process scenario calculate the throughput calculated for FCFS algorithm as x and for non-preemptive SJF scheduling as y. The value of x – y is _____?

Process	Arrival Time	Burst Time
P1	0	4
P2	0	3
P3	0	1
P4	0	5

Q5 Consider 4 processes A, B, C and D. All arrived at time 0 in the given order. The processes needed 5ns, 3ns, 9ns and 10ns respectively for their CPU burst to complete. The average turnaround time of processes if executed in FCFS order is _____ns (rounded up to 2 decimal place)?

Q6 Four processes to be executed on a single processor system arrives at time 0+ in the order A, B, C and D. Their CPU burst time requirements are 4, 1, 6, 2 time units respectively. The completion time of processe

A under Round-Robin scheduling with time slice of one time unit is _____?

Q7 On a system using round robin CPU scheduling, context-switch overhead is given by 's'. Time quantum is 'q'. The CPU efficiency, if q=s is?
(A) 50%
(B) Zero
(C) 100%
(D) Not predictable

Q8 Consider the following process scenario.

Process	Arrival Time (in milliseconds)	Burst Time (In milliseconds)
P1	0	12
P2	1	8
P3	2	7
P4	3	2
P5	7	3

The average waiting time processes for preemptive shortest remaining time first scheduling algorithm is _____ milliseconds (rounded up to 1 decimal place)?

Q9 Consider the following process scenario.

Process	Arrival Time (in milliseconds)	Burst Time (In milliseconds)
P1	0	8
P2	1	4
P3	2	1
P4	4	5

The average waiting time processes for round robin scheduling algorithm is _____ milliseconds with time slice of 3 milliseconds (rounded up to 1 decimal place)?

Q10 A computer system has 2GB of RAM and OS occupies 256MB of RAM. All the user processes are of 128MB and have same characteristics. If the goal is 99% CPU utilization, then the maximum I/O wait that can be tolerated is ____% (rounded to nearest integer)?

Answer Key

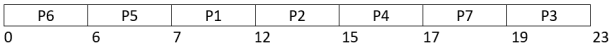
Q1	6~6
Q2	4~5
Q3	0.3~0.3
Q4	0~0
Q5	14.25~14.25
Q6	10~10
Q7	A
Q8	7.4~7.4
Q9	7.5~7.5
Q10	72~72

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

The gantt chart for the execution of the processes will be as follows:



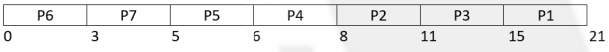
The completion time, turn around time and waiting time of processes are as follows:

Process	Arrival Time	Burst Time	Completion Time	Turn around time	Waiting Time
P1	4	5	12	8	3
P2	5	3	15	10	7
P3	8	4	23	15	11
P4	7	2	17	10	8
P5	3	1	7	4	3
P6	0	6	6	6	0
P7	7	2	19	12	10

Average waiting time = (3+7+11+8+3+0+10)/7 = 42/7 = 6

Q2 Text Solution:

The gantt chart for the execution of the processes will be as follows:



The completion time, turn around time and waiting time of processes are as follows:

Process	Arrival Time	Burst Time	Completion Time	Turn around time	Waiting Time
P1	5	6	21	16	10
P2	3	3	11	8	5
P3	1	4	15	14	10
P4	2	2	8	6	4
P5	4	1	6	2	1
P6	0	3	3	3	0
P7	1	2	5	4	2

Average waiting time = (10+5+10+4+1+0+2)/7 = 32/7 = 4.57

Q3 Text Solution:

Here when first process will be scheduled at 0 to execute then it will complete till 3 milliseconds. After that there will not be any process in ready state for 1 millisecond till 4 milliseconds. Hence for 1 millisecond the CPU will be idle. After that all processes will run one after another according to algorithm without any idle period.

Total execution time = 3 + 6 + 4 + 2 + 1 + 3 = 19

Total execution time including idle period = 19 + 1 = 20

Throughput = 6/20 = 0.3

Q4 Text Solution:

Total burst time = 4 + 3 + 1 + 5 = 13

All processes are arriving at 0 hence all algorithms will have scheduling length = 13 – 0 = 13

Hence for all algorithms throughput = 4 / 13

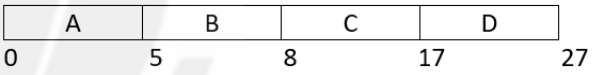
Hence x = 4/13,

Also y = 4/13

Hence, x – y = 0

Q5 Text Solution:

The gantt chart for the execution of the processes will be as follows:



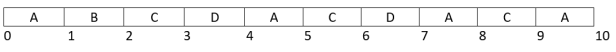
The completion time and turn-around time of processes are as follows:

Process	Arrival Time	Burst Time	Completion Time	Turn around time
A	0	5	5	5
B	0	3	8	8
C	0	9	17	17
D	0	10	27	27

Average turn-around time = (5 + 8 + 17 + 27) /4 = 57/4 = 14.25

Q6 Text Solution:

The Gantt chart for the execution of the processes will be as follows:



Process A completes at time 10.

Q7 Text Solution:

CPU efficiency is only when process executes, hence

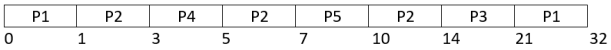
$$Efficiency = \frac{q}{q+s} * 100\%$$

For q = s

Efficiency = 50%

Q8 Text Solution:

The Gantt chart for the execution of the processes will be as follows:



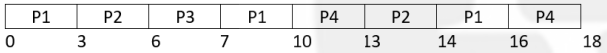
The completion time, turn-around time and waiting time of processes are as follows:

Process	Arrival Time	Burst Time	Completion Time	Turn around time	Waiting Time
P1	0	12	32	32	20
P2	1	8	14	13	5
P3	2	7	21	19	12
P4	3	2	5	2	0
P5	7	3	10	3	0

Average waiting time = (20+5+12+0+0)/5 = 7.4

Q9 Text Solution:

The Gantt chart for the execution of the processes will be as follows:



The completion time, turn-around time and waiting time of processes are as follows:

Process	Arrival Time	Burst Time	Completion Time	Turn around time	Waiting Time
P1	0	8	16	16	8
P2	1	4	14	13	9
P3	2	1	7	5	4
P4	4	5	18	14	9

Average waiting time = (8+9+4+9)/4 = 30/4 = 7.5

Q10 Text Solution:

From 2GB RAM if space for OS is removed then in remaining space only the user processes will be allocated.

Total available RAM = 2GB

OS occupied RAM = 256MB

User process = 128MB

Hence number of user processes (n) = (2GB – 256MB) / 128MB

= 16 – 2

= 14

For IO wait p and number of processes n,

CPU utilization = $1 - p^n$

$0.99 = 1 - p^{14}$

p = 0.719686 = 72%

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