CS & IT ENGINEERING

Operating System

CPU Scheduling

DPP 01 Discussion Notes

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[NAT]

#Q. 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 processes for FCFS scheduling algorithm is 6 milliseconds?

Process	A.T	B.T	C.T	T.A.T	W.T
P_1	4	5	12	8	3
P_2	5	3	15	10	7
P_3	8	4	23	15	11
P_4	7	2	17	10	8
P_5	3	1	7	4	3
P_6	0	6	6	6	0
P_7	7	2	19	12	10

Gantt chart for FCFS:-

P_6	P_5	P_1	P_2	P_4	P_7	P_3

0 6 7 12 15 17 19 23

Average waiting $\Rightarrow \dfrac{3+7+11+8+3+10}{7}$

$\Rightarrow \dfrac{42}{7} = \underline{\underline{6\,ms}}$.

[NAT]

#Q. 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)?

4.57

Process	A.T	B.T	C.T	T.A.T	W.T
P_1	5	6	21	16	10
P_2	3	3	11	8	5
P_3	1	4	15	14	10
P_4	2	2	8	6	4
P_5	4	1	6	2	1
P_6	0	3	3	3	0
P_7	1	2	5	4	2

Gantt chart for SJF:-

P_6	P_7	P_5	P_4	P_2	P_3	P_1

0 3 5 6 8 11 15 21

Average waiting time =

$$\frac{10+5+10+4+1+0+2}{7} = \frac{32}{7}$$

$\Rightarrow 4.57\,ms.$

[NAT]

#Q. Consider a CPU performance metric throughput which is calculated as:

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

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

Gantt chart for SJF:-

P1		P2	P5	P4	P6	P3

0 3 4 10 11 13 16 20

Throughput $\Rightarrow \dfrac{6}{20} \Rightarrow \underline{\underline{0.3}}$

[NAT]

#Q. Consider a CPU performance metric throughput which is calculated as:

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

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

Gantt chart for FCFS policy:-

P_1	P_2	P_3	P_4

0 4 7 8 13

Throughput $\Rightarrow \frac{4}{13} \Rightarrow X$

Gantt chart for SJF policy:-

P_3	P_2	P_1	P_4

0 1 4 8 13

Throughput $\Rightarrow \frac{4}{13} \Rightarrow Y$

$$x - y = \frac{4}{13} - \frac{4}{13} = \underline{\underline{0}}.$$

[NAT]

#Q. 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 14.25 ns (rounded up to 2 decimal place)?

Process	A.T	B.T	C.T	T.A.T
A	0	5	5	5
B	0	3	8	8
C	0	9	17	17
D	0	10	27	27

$$\boxed{T.A.T = C.T - A.T}$$

Gantt chart for FCFS policy: -

A	B	C	D

0 5 8 17 27

$$\text{Average T.A.T} = \frac{(5+8+17+27)}{4} \Rightarrow \frac{57}{4} \Rightarrow \underline{\underline{14.25}}\ \text{ns}$$

[NAT]

#Q. 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 process A under Round-Robin scheduling with time slice of one time unit is ______?

Processes	A.T	B.T	
A	0+	~~4~~ ~~3~~	~~2~~ ~~1~~ 0
B	0+	~~1~~ 0	
C	0+	~~6~~ ~~5~~ ~~4~~	3
D	0+	~~2~~ ~~1~~ 0	

$\boxed{T.S / T.Q = 1}$

10.

Gantt chart for R.R using $\boxed{T.Q = 1}$

Ready Queue :- ~~A~~ ~~B~~ ~~C~~ ~~D~~ ~~A~~ ~~C~~ ~~D~~ ~~A~~ ~~C~~ A C

A	B	C	D	A	C	D	A	C	A

0 1 2 3 4 5 6 7 8 9 10

[MCQ]

#Q. 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?

$q = s$ → wastage of time

CPU.

A 50%

B Zero

C 100%

D Not predictable

[NAT]

#Q. 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 7.4 milliseconds (rounded up to 1 decimal place)?

Processes	A.T	B.T	C.T	T.A.T	W.T
P_1	0	~~12~~ 11	32	32	20
P_2	1	~~6~~ 4 ~~8~~ ~~7~~	14	13	5
P_3	2	7	21	19	12
P_4	3	~~2~~ 0	5	2	0
P_5	7	3	10	3	0

T.A.T =

$$\boxed{C.T - A.T}$$

$$\boxed{W.T = T.A.T - B.T}$$

Gantt chart:

P_1	P_2	P_4	P_2	P_5	P_2	P_3	P_1

0 1 3 5 7 10 14 21 32

$$\text{Avg. W.T} \Rightarrow \frac{20+5+12+0+0}{5} = 7.4 \text{ ms.}$$

[NAT]

#Q. 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 7.5 milliseconds with time slice of 3 milliseconds (rounded up to 1 decimal place)?

Processes	A.T	B.T	C.T	T.A.T	W.T
P_1	0	$\cancel{2}^{0}\ \cancel{8}\ \cancel{5}$	16	16	8
P_2	1	$0\ \cancel{4}\ \cancel{7}$	14	13	9
P_3	2	$\cancel{1}\ 0$	7	5	4
P_4	4	$0\ \cancel{5}\ \cancel{2}$	18	14	9

Gantt chart:

Ready Queue :- $\cancel{P_1}\ \cancel{P_2}\ \cancel{P_3}\ \cancel{P_1}\ \cancel{P_4}\ \cancel{P_2}\ \cancel{P_1}\ P_4$

P_1	P_2	P_3	P_1	P_4	P_2	P_1	P_4

0 3 6 7 10 13 14 16 18

$$\text{Avg. W.T} \Rightarrow \frac{8+9+4+9}{4}$$

$$\Rightarrow \frac{30}{4} = 7.5\ \text{ms}$$

[NAT]

#Q. 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 72 % (rounded to nearest integer)?

Total available RAM = 2GB (2^{31} Bytes)

OS occupies RAM = 256 MB (2^{28} Bytes)

user process = 128 MB (2^{27} Bytes)

No. of simultaneous process $\Rightarrow$ (2GB − 256MB) / 128 MB

$$\frac{2048\,MB - 256\,MB}{128\,MB} \Rightarrow \frac{1792\,\cancel{MB}}{128\,\cancel{MB}}$$

$$\Rightarrow \underline{\underline{14}}.$$

Max. I/O wait that can be tolerated = $1 - p^n \Rightarrow \boxed{1 - p^{14} = 0.99}$

$1 - 0.99 = p^{14} \Rightarrow p \Rightarrow 71.96\% \cong \underline{\underline{72\%}}.$

THANK - YOU