9. **Consider the following set of process, with the length of the CPU burst time and arrival time given in millisecond.**

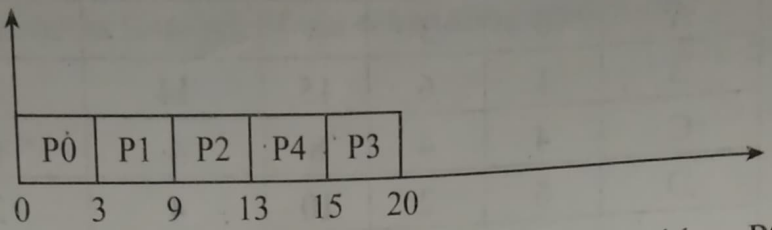
Process	Arrival time	Burst time
P0	0	3
P1	2	6
P2	4	4
P3	6	5
P4	8	2

Draw Gantt chart illustrating RR (Quantum = 2) and highest rank ratio next (HRRN) scheduling. Also find average waiting time and average turnaround time for each of the algorithm. [2077 Chaitra]

Solution:

For HRN algorithm:

Gantt chart:



Explanation: HRRN is non-preemptive algorithm. P0 arrive at t = 0, at time 3, P1 is only waiting, so P1 executes.

At time 9, processes P2, P3 and P4 are waiting.

Now,

Response ratio (RR) at time 9 for:

$$\text{Process P2} = \frac{(9-4)+4}{4} = 2.25 \text{ (maximum)}$$

$$\text{Process P3} = \frac{(9-6)+5}{5} = 1.6$$

$$\text{Process P4} = \frac{(9-8)+2}{2} = 1.5$$

Hence, P2 executes.

Similarly, at time 13, process P3 and P4 are waiting.

Now,

RR at 13 for:

$$\text{Process P3} = \frac{(13-6)+5}{5} = 2.4$$

$$\text{Process P4} = \frac{(13-8)+2}{2} = 3.5 \text{ (maximum)}$$

Hence, P4 executes.

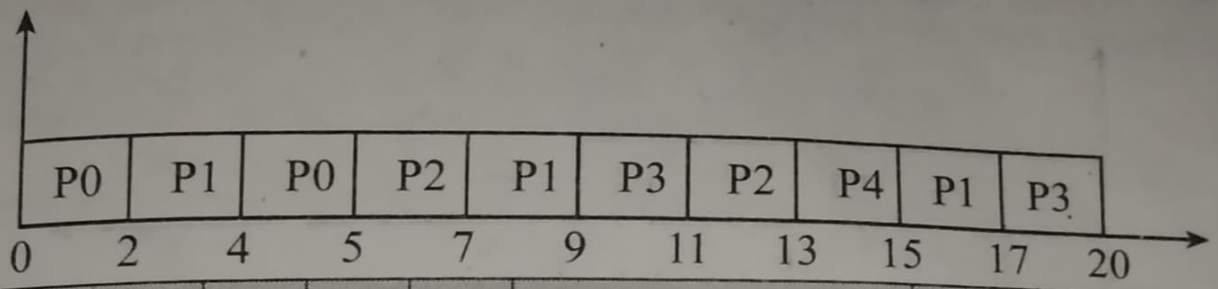
Process	AT	BT	FT	TAT (FT–AT)	WT (TAT–BT)
P0	0	3	3	3	0
P1	2	6	9	7	1
P2	4	4	13	9	5
P3	6	5	20	14	9
P4	8	2	15	7	5
				Total TAT = 40	Total WT = 20

$\therefore$ Average TAT $= \frac{40}{5} = 8$

$\therefore$ Average WT $= \frac{20}{5} = 4$

For round robin algorithm (Q = 2):

Gantt chart:



Process	AT	BT	FT	TAT (FT–AT)	WT (TAT–BT)
P0	0	3	5	5	2
P1	2	6	17	15	9
P2	4	4	13	9	5
P3	6	5	20	14	9
P4	8	2	15	7	5
				Total TAT = 50	Total WT = 30

$\therefore$ Average TAT $= \frac{50}{5} = 10$

$\therefore$ Average WT $= \frac{30}{5} = 6$

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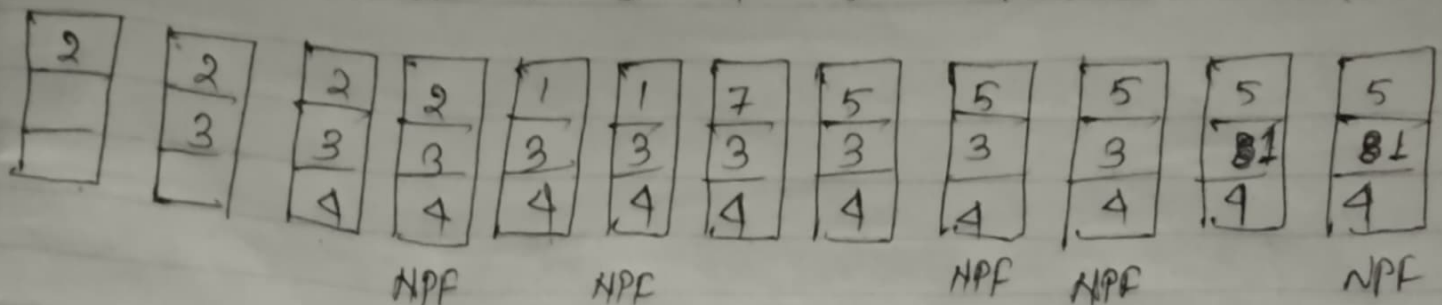
(8) Soln:-

Page replacement strings

2, 3, 4, 2, 1, 3, 7, 5, 4, 3, 1, 5

=> OPTIMAL page replacement Algorithm.

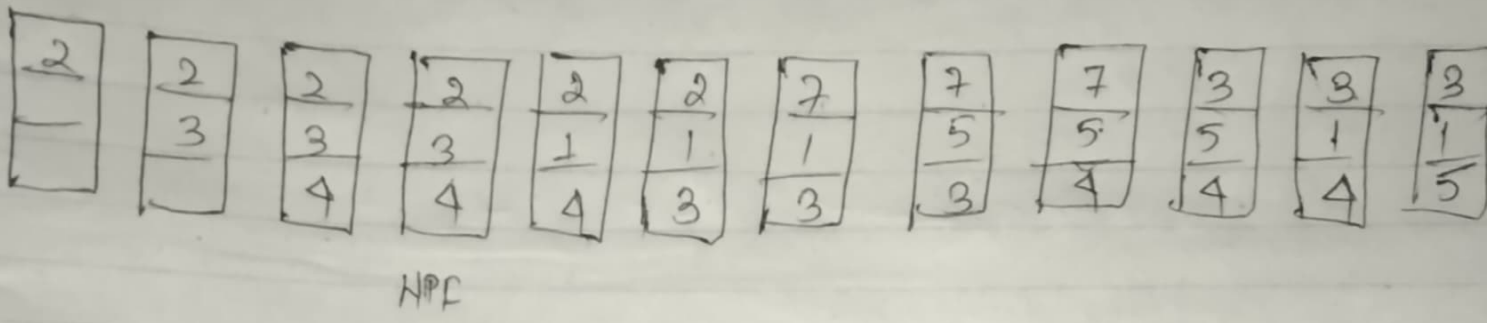
2 3 4 2 1 3 7 5 4 3 1 5



Total No. of page faults = 7

=> LRU (Least Recently used) page replacement algorithm

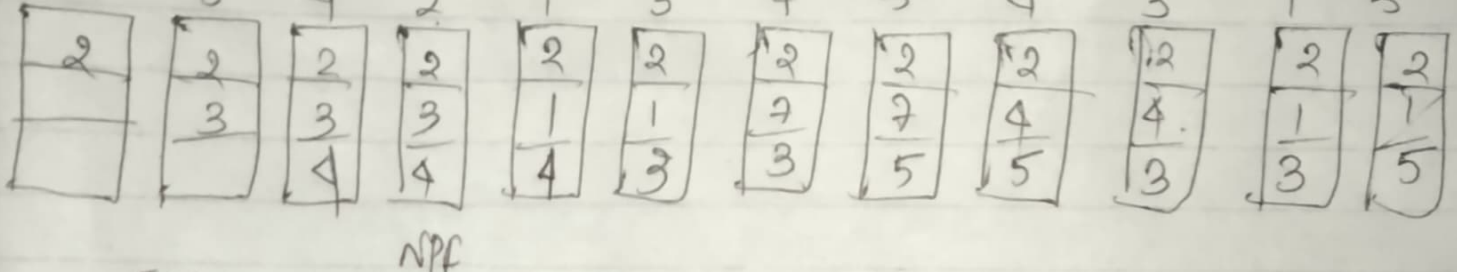
2 3 4 2 1 3 7 5 4 3 1 5



Total no. of page faults = 11

=> LFU (Least frequently used) page replacement algorithm

2 3 4 2 1 3 7 5 4 3 1 5



Total no. of page faults = 11

5). =)

Soln:-

Given FIFO order

86, 147, 91, 177, 94, 160, 102, 175, 130

(i) FCFS.

143 → 86 → 147 → 91 → 177 → 94 → 160 → 102 → 175 → 130

↑

Starting head position.

= |86 - 143| + |147 - 86| + |91 - 147| + |177 - 91| + |94 - 177| + |160 - 94| + |102 - 106| + |175 - 102| + |130 - 175|

= 57 + 61 + 56 + 86 + 83 + 34 + 4 + 73 + 45 = 499

Time taken for 1 cylinder movement = 10 ms

Taken taken for 499 cylinders movement 499 X 10 ms

= 4990 ms

(ii) SSTF

143 → 147 → 160 → 130 → 102 → 94 → 91 → 86 → 175 → 177

↑

Starting head position.

=) (147 - 143) + (160 - 147) + (130 - 160) + (102 - 130) + (94 - 102) + (91 - 94) + (86 - 91) + (175 - 86) + (177 - 175)

=)

(i) SSTF

143 → 147 → 160 → 130 → 102 → 94 → 91 → 86 → 175 → 177

(starting head position)

= |143-147| + |147-160| + |160-130| + |130-102| + |102-94| + |94-91| + |91-86| + |86-175| + |175-177|

= 4 + 13 + 30 + 28 + 8 + 3 + 5 + 89 + 2 = 182

Time taken for 1 cylinder movement = 10ms

Time " " 182 " " = 182 × 10 = 1820 ms

(ii) C-SCAN

143 → 147 → 160 → 175 → 177 → 199 → 0 → 86 → 91 → 94 → 102 → 130

= |147-143| + |160-147| + |175-160| + |177-175| + |199-0| + |0-86| + |91-86| + |94-91| + |102-94| + |130-102|

= 4 + 13 + 15 + 2 + 199 + 86 + 5 + 3 + 8 + 28 = 363

Time taken for 1 cylinder movement = 10ms

" " " 363 " " = 363 × 10ms = 3630

(iv) C-LOOK

143 → 147 → 160 → 175 → 177 → 86 → 91 → 94 → 102 → 130

= |147-143| + |160-147| + |175-160| + |177-175| + |86-177| + |91-86| + |94-91| + |102-94| + |130-102|

= 4 + 13 + 15 + 2 + 91 + 5 + 3 + 8 + 28 = 169

Time taken for 1 cylinder movement = 10ms

" " 169 " " = 169 × 10 = 1690 ms

(10) Soln:-

A = 7, B = 2, C = 6.

process	Allocation		
	A	B	C
P_0	0		
P_1	2		
P_2	3		
P_3	2		
P_4	0		

process	Allocation			Request		
	A	B	C	A	B	C
P_0	0	1	0	0	0	0
P_1	2	0	0	2	0	2
P_2	3	0	3	0	0	0
P_3	2	1	1	1	0	0
P_4	0	0	2	0	0	2

Now,

(a) Available

A = 0, B = 0, C = 0.

→ P_0 is executed

A	B	C
0	1	0

⇒ After that P_2 is executed.

A	B	C
3	1	3

→ P3 is executed.

A	B	C
5	2	4

→ P4 is executed

A	B	C
5	2	6

→ P1 is executed

A	B	C
7	2	6

Since, all the process is executed, so, the system is safe.

The execution sequence is

P0 → P2 → P3 → P4 → P1.

5). If P2 makes additional request (1,0,1) then the need of P2 is (1,0,1)

P0 is executed

A	B	C
0	1	0

After that no process can be executed and system goes in deadlock state.