CS21B061
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# Homework-1

Ques 1) Let us assume that there is a task which involves $n$ processes

TASK :- Analytically prove the optimality of the SJF scheduling.

Sol$^n$ :- SJF scheduling associates with each process the length of the process's next CPU burst. If the next CPU burst of 2 processes are same, first come first serve is used to break the tie.

→ Avg. waiting time for $n$ processes :-

$$w_T = \frac{(w_1 + w_2 + \dots + w_n)}{n} \quad \text{— (i)}$$

where $w_T$ :- total waiting time

⇒ $w_i = w_{i-1} + t_{i-1} \quad \forall\ i \in [1, n]$ — (ii)

where $t_{i-1}$ :- burst time of $(i-1)^{th}$ process.

Consider $w_0 = 0$ & $t_0 = 0$

using (i) & (ii) :-

$w_1 = w_0 + t_0$

$w_2 = w_1 + t_1 = w_0 + t_0 + t_1$

$w_3 = w_2 + t_2 = w_0 + t_0 + t_1 + t_2$

$\vdots$

$w_n = w_{n-1} + t_{n-1} = w_0 + \sum_{i=0}^{n-1} t_i$

$$\Rightarrow \quad w_T = \frac{n \times w_0 + n t_0 + (n-1)t_1 + (n-2)t_2 + \dots + t_{n-1}}{n}$$

$$w_T = \frac{(n-1)t_1 + (n-2)t_2 + \dots + t_{n-1}}{n} \quad \text{— (iii)}$$

taking 2 random processes $i$ & $j$ where

$t_i > t_j$ & $j > i$

swapping them, we get new avg. waiting time as:

$$w'_T = \frac{(n-1)t_1 + \dots + (n-i)t_j + \dots + (n-j)t_i + \dots + t_{n-1}}{n}$$

$\hookrightarrow$ (iv)

subtracting (iii) & (iv)

$$w_T - w'_T = \frac{(j-i)(t_i - t_j)}{n}$$

now, $\because$ $j > i$ & $t_i > t_j$

$\therefore$ $w_T - w'_T > 0$

$\therefore$ $\boxed{w_T > w'_T}$

similarly, we can keep swapping until they are in increasing order.

Hence proved

Drawbacks :- It can't be implemented at CPU scheduling level, as there is no way to know the length of next CPU burst. We can approximate it at best & that too only to a certain degree.

Ques 2)

| Process id | Burst time (msec) | Arrival time |
|---|---|---|
| $P_1$ | 2 | 0 |
| $P_2$ | 1 | 0 |
| $P_3$ | 8 | 0 |
| $P_4$ | 4 | 0 |
| $P_5$ | 5 | 0 |

Gantt chart :-

| $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ | $P_3$ | $P_4$ | $P_5$ | $P_3$ | $P_5$ | $P_3$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–2 | 2–3 | 3–5 | 5–7 | 7–9 | 9–11 | 11–13 | 13–15 | 15–17 | 17–18 | 18–20 |

average response time $= \frac{0+2+3+5+7}{5} = \frac{17}{5} = 3.4$ msec

waiting time = turnaround time − burst time average turnaround time $= \dfrac{2+3+20+13+18}{5} = \dfrac{56}{5} = \underline{11.2\text{msec}}$

average burst time $= \dfrac{2+1+8+4+5}{5} = \dfrac{20}{5} = \underline{4\text{msec}}$

average waiting time $= (11.2-4)\text{msec}$

$= \underline{7.2\text{msec}}$