ECE3140

Eric Berg — Problem Set #3 — May 1, 2017

Q1. a) Average Response Time: $\frac{(6+10+14+17+26)}{5} = \boxed{14.6}$

Maximum lateness: $\boxed{3 \text{ (on } J_1)}$

Number of jobs that miss deadline = $\boxed{5 \text{ (all of them)}}$

b) Average Response Time: $\frac{(4+8+11+20+26)}{5} = \boxed{13.8}$

Maximum Lateness: $\boxed{23 \text{ (on } J_1)}$

Number of jobs that miss deadline: $\boxed{1}$

Q2. $\sigma = \langle J_1, J_2, J_3 \ldots J_n \rangle \quad C_i \le C_k \quad 1 \le i < k \le n$

σ Avg Response $= \frac{1}{n} \sum_{i=1}^{n} (n+1-i) C_i$

$= \frac{1}{n} \left[\cancel{n}C_1 + \cancel{(n-1)}C_2 + \ldots + (n+1-i) C_i + \ldots + (n+1-k) C_k + \ldots + \cancel{C_n} \right]$

swap i and K

σ_{swap} Avg Response $= \frac{1}{n} \left[\cancel{n}C_1 + \cancel{(n-1)}C_2 + \ldots + (n+1-i) C_k + \ldots + (n+1-k) C_i + \ldots + \cancel{C_n} \right]$

Comaper two response tymes

$$\left[\cancel{(n+1-i)} C_i + \ldots + \cancel{(n+1-K)} C_K \right] \overset{?}{\le} \left[(\cancel{n+1}-i) C_k + \ldots + (\cancel{n+1}-k) C_i \right]$$

$$-iC_i + \ldots + -KC_K \overset{?}{\le} -iC_K + \ldots + -KC_i$$

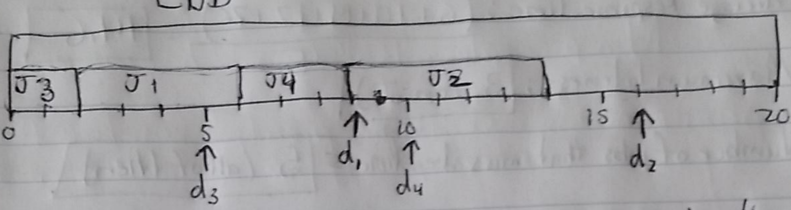
$$C_K \cancel{(K-i)} \ge C_i \cancel{(K-i)}$$

$$\boxed{C_K \ge C_i} \longrightarrow \text{means } K > i$$

Given $C_i < C_K$ for all $1 \le i < K \le n$, therefore, swapping any two jobs results in a new average response time that is not better than the original

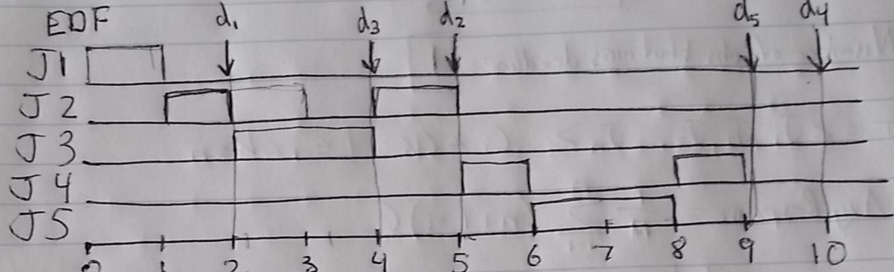
Q3.

EDD

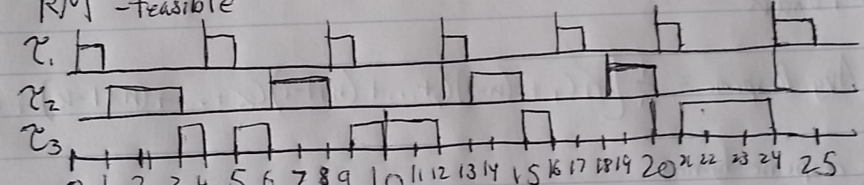


Each finish time is less than its corresponding deadline, so EDD produces a feasible schedule

Q4. EDF



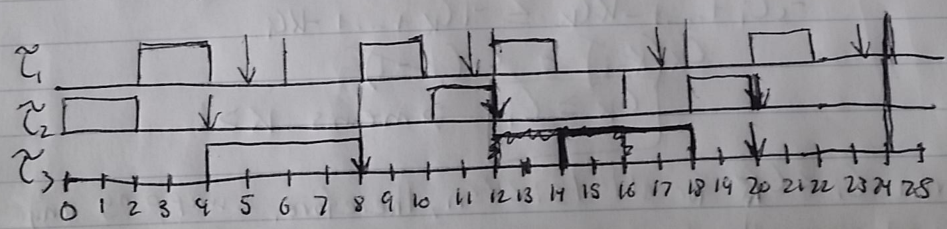
Q5. RM - feasible



Q6. EDF schedulability CPU utilization = $\left(\frac{1}{4} + \frac{2}{6} + \frac{3}{10}\right) = \boxed{0.88<1}$

therefore tasks are schedulable

Q7.



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Q8. Priority Inheritance protocol: $P_{\tau_1} > P_{\tau_2} > P_{\tau_3}$

- task can be blocked at most for one critical section be each lower priority task

can be blocked by τ_2 for 3 seconds (resource A) and τ_3 for 6 seconds (resource C)

$\boxed{\tau_1 \text{ Maximum block time} = (3-1) + (6-1) = 7}$
(resources A and C)