**CPSC 457 - Assignment 4**
**Erick Yip**
**30028293**

1.

| Process | Arrival Time | Burst Time | Start | Finish | Turnaround | Waiting |
|---|---|---|---|---|---|---|
| P1 | 0 | 12 | 0 | 22 | 22 | 10 |
| P2 | 2 | 1 | 2 | 3 | 1 | 0 |
| P3 | 3 | 3 | 3 | 7 | 4 | 1 |
| P4 | 5 | 1 | 5 | 6 | 1 | 0 |
| P5 | 9 | 5 | 9 | 14 | 5 | 0 |

Gantt Chart: (each block represent 1s quantum)
Average wait time: (10+1)/5 = 2.2 units

2.

| Process | Arrival | Burst | Start | Finish | Turnaround | Waiting |
|---|---|---|---|---|---|---|
| P1 | 0 | 12 | 0 | 21 | 21 | 9 |
| P2 | 2 | 1 | 2 | 3 | 1 | 0 |
| P3 | 3 | 3 | 3 | 9 | 6 | 6 |
| P4 | 5 | 1 | 6 | 7 | 2 | 6 |
| P5 | 9 | 5 | 10 | 18 | 9 | 13 |

Gantt Chart: (each block represent 1s quantum)
Context Switches: 18 [none -> 1, 1 -> 2, 2 -> 1, 1 -> 3, 3 -> 4, 4 -> 3, 3 -> 1, 1 -> 3, 3 -> 5, 5 -> 1, 1 -> 5, 5 -> 1, 1 -> 5, 5 -> 1, 1 -> 5, 5 -> 1, 1 -> 5, 5 -> 1]

3. Gantt Chart: (each block represent 1s quantum, white text represent Q1, yellow represent Q2, red represent Q3)


5.

| Process | Allocation | Request | Available |
|---|---|---|---|
| p1 | 0 0 1 | 1 2 1 | 0 1 0 |
| p2 | 0 1 0 | 0 1 1 | |
| p3 | 1 1 2 | 1 2 2 | |
| p4 | 1 0 0 | 0 2 1 | |
| p5 | 0 0 1 | 0 1 0 | |

## Detection Algorithm

1. Initialize:
   Work = Available
   Finish[i] = (Allocation[i] == 0) for all i = 1,2,3, … n
2. Find an index i such that:
   Finish[i] == false and **Request[i] ≤ Work**
   If no such i exists, go to step 4
3. Work = Work + Allocation[i]
   Finish[i] = true
   go to step 2
4. If Finish[i] == true for 1 ≤ i ≤ n, then system is not in deadlock
   Otherwise, all processes Pi for which Finish[i] == false are deadlocked

**This system is not in a deadlock.**

Full execution:

| Step | i | work | Finish |
|---|---|---|---|
| 1 | - | {0,1,0} | {F,F,F,F,F} |
| 2 | 5 | {0,1,0} | {F,F,F,F,F} |
| 3 | 5 | {0,1,1} | {F,F,F,F,T} |
| 2 | 2 | {0,1,1} | {F,F,F,F,T} |
| 3 | 2 | {0,2,1} | {F,T,F,F,T} |
| 2 | 4 | {0,2,1} | {F,T,F,F,T} |
| 3 | 4 | {1,2,1} | {F,T,F,T,T} |
| 2 | 1 | {1,2,1} | {F,T,F,T,T} |
| 3 | 1 | {1,2,2} | {T,T,F,T,T} |
| 2 | 3 | {1,2,2} | {T,T,F,T,T} |
| 3 | 3 | {3,3,4} | {T,T,T,T,T} |
| 2 | Doesn’t exist | {3,3,4} | {T,T,T,T,T} |
| 4 | Doesn’t exist | {3,3,4} | {T,T,T,T,T} |

Since Finish is true for 1 <= i <= 5, the system is not in deadlock