CG2271 Real Time Operating Systems
Tutorial 7
Scheduling Algorithms

1. Given a set of tasks with the following specifications:

Task	C_i	P_i
P1	2	6
P2	3	8
P3	4	15

a. What is the CPU utilization of this set of tasks?

U = 2/6 + 3/8 + 4/15
= 0.975

b. Is this set of tasks RMS schedulable under the L&L criteria?

Threshold in L&L = $3(2^{1/3} - 1)$
= 0.78

Since U > 0.78, tasks may not be RMS schedulable.

c. Is this set of tasks RMS schedulable under Critical Instant Analysis?

$S_{1,0} = C_1 = 2$

$S_{2,0} = C_1 + C_2 = 2+3 = 5$
$S_{2,1} = C_2 + \text{ceil}(S_{2,0}/6)$
$= 3 + 2 * \text{ceil}(5/6)$
$= 5$
$S_{2,2} = 3 + 2 * \text{ceil}(5/6)$
$= 5$

$S_{3,0} = 2+3+4 = 9$
$S_{3,1} = C_3 + 2 * \text{ceil}(9/6) + 3*\text{ceil}(9/8)$
$= 4 + 4 + 6$
$= 14$
$S_{3,2} = C_3 + 2 * \text{ceil}(14/6) + 3*\text{ceil}(14/8)$
$= 4 + 6 + 6$
$= 16$

Task 3 is not schedulable.

d. Schedule the tasks using RMS

Time	Task	Deadline	Outstanding
0	P1	P1,P2,P3	P2P3
1	P1		P2P3
2	P2		P3
3	P2		P3
4	P2		P3
5	P3		
6	P1	P1	P3
7	P1		
8	P2	P2	P3
9	P2		P3
10	P2		P3
11	P3		
12	P1	P1	P3
13	P1		P3
14	P3		
15	P3*	P3	P3 (NEW)
16	P2	P2	P3
17	P2		P3
18	P1	P1	P2P3
19	P1		P2P3
20	P2		P3
21	P3		
22	P3		
23	P3		
24	P1	P1,P2	P2P3
25	P1		P2P3
26	P2		P3
27	P2		P3
28	P2		P3
29	P3		
30	P1	P1,P3	P3
31	P1		P3
32	P2	P2	P3
33	P2		P3
34	P2		P3
35	P3		
36	P1	P1	P3
37	P1		
38	P3		
39	P3		
40	P2	P2	P3
41	P2		P3
42	P1	P1	P2P3
42	P1		
43	P2		
44	P3*	P3	P3 (NEW)

e. Schedule the tasks using EDF

Time	Task	Deadline	Outstanding
0	P1	P1,P2,P3	P2P3
1	P1		P2 P3
2	P2		P3
3	P2		P3
4	P2		P3
5	P3		
6	P1	P1	P3
7	P1		P3
8	P3	P2	P2
9	P3		P2
10	P3		P2
11	P2		
12	P2	P1	P1
13	P2		P1
14	P1		
15	P1	P3	P3
16	P2	P2	P3
17	P2		P3
18	P2	P1	P1P3
19	P1		P3
20	P1		P3
21	P3		
22	P3		
23	P3		
24	P3	P1,P2	P1P2
25	P1		P2
26	P1		P2
27	P2		
28	P2		
29	P2		
30	P1	P1,P3	P3
31	P1		P3
Time	**Task**	**Deadline**	**Outstanding**
32	P2	P2	P3
33	P2		P3
34	P2		P3
35	P3		
36	P1	P1	P3
37	P1		P3
38	P3		
39	P3		
40	P3	P2	P2
41	P2		
42	P2	P1	P1
43	P2		P1
44	P1		
45	P1	P3	P3

46	P3		
47	P3		
48	P1	P1,P2	P2P3
49	P1		P2P3
50	P2		P3
51	P2		P3
52	P2		P3
53	P3		
54	P3	P1	P1
55	P1		
56	P1	P2	P2
57	P2		
58	P2		
59	P2		
60	P3	P3	

2. Briefly show that, in Critical Instant Analysis, if $S_{i,\,final} > P_i$, task P_i may not meet its deadlines.

The $S_{i,\,final}$ value represents the worst case timing of the task *i* inclusive of time spent being pre-empted. Thus if $S_{i,\,final} > P_i$, this means that at the worst case, the task will run beyond its period and thus miss its deadline.