CIS 721 - Real-Time Systems
Homework #2
Fall 2015

Due: Friday, September 25, 2015, by 1:20 pm (turn in on paper)

Twenty-five points.

1. A system consists of four preemptive, periodic tasks, A, B, C, and D, assigned static priorities using the Rate Monotonic (RM) algorithm, with the following properties:

Task	Run Time (C_i)	Period (T_i)
A	1	8
B	2	16
C	8	24
D	8	48

   (a) What is the total utilization (U) of these four tasks?
   (b) Does Liu and Layland's Utilization-Based Test ensure that the task set is schedulable? What is the schedulable utilization for these n=4 tasks?
   (c) What if the run time of task A is increased to 3, is the task set still schedulable? Which test did you use? Show work.
   (d) As in (c), if the run time of task A is 3, draw a Gannt Chart to show how these tasks would be scheduled using the rate monotonic scheduling algorithm in the interval [0, 48]. Does checking the tasks over this interval ensure that the task set is feasible? If not, what is the minimum interval length that must be checked to ensure that the task set is schedulable? Explain briefly.

2. Which of the following task sets are schedulable if priorities are assigned using the rate-monotonic algorithm? Which of the following task sets are **simply periodic**? Justify your answer – specify which test(s) you used and show work.

   (a)

	Run Time (C_i)	Period (T_i)
A	3	6
B	2	12
C	5	18

   (b)

	Run Time (C_i)	Period (T_i)
A	2	5
B	3	10
C	6	20

   (c)

	Run Time (C_i)	Period (T_i)
A	4	8
B	2	10
C	3	14

3. A set of n independent, preemptable periodic tasks with relative deadlines equal to their respective periods are schedulable rate-monotonically if their utilizations $u_1, u_2, \ldots, u_n$ satisfy the inequality $(1 + u_1)(1 + u_2) \ldots (1 + u_n) <= 2$.

   (a) Show that this test is strictly stronger than Liu and Layland's Utilization-Based Test.

   (b) Apply both tests to a task set consisting of five periodic tasks with processor utilizations given by $u_1 = 0.8$, $u_2 = u_3 = u_4 = u_5 = 0.01$. What conclusions can be drawn?