

COSC6384 Real-Time Systems – Spring 2023

Assignment 1 - Due: Monday, February 17, 2023

Problem 1.

Does the EDF scheduler obey the Queue discipline?
Does the EDF scheduler obey the Stack discipline?
Justify your answer with an example for each of them.

Problem 2.

Suppose a task consists of n subtasks J_i 's, each of which has computation time C_i , $i=1,\dots,n$. This task requests service at time T and has absolute deadline D . Provide a formula to compute the latest start time for each subtask such that the deadline of the entire task can be satisfied.

Problem 3.

Is the following task set LLF-schedulable? If not, explain. If yes, give an LLF schedule.

TASK	PERIOD	COMPUTATION TIME
A	20	6
B	10	1
C	15	4
D	30	1
E	10	3

Problem 4.

Schedule the task set from problem 3 using the FIFO (FCFS), EDF, and RM schedulers.

Problem 5.

Determine whether there is a feasible schedule for the following set of periodic processes. If yes, show the schedule and the steps used to derive it.

$$\begin{aligned}T1: c_{1,1} &= 4, c_{1,2} = 6, c_{1,3} = 6, d_1 = p_1 = 42 \\T2: c_{2,1} &= 2, c_{2,2} = 4, d_2 = 12, p_2 = 14 \\T3: c_3 &= 8, d_3 = p_3 = 42\end{aligned}$$

T1 must rendezvous with T2 after the first, second, and third scheduling blocks.
T2 must rendezvous with T1 after the first scheduling block.

Problem 6.

We call the density of a task T , $C/\min(D, P)$, where C is the computation time, D is the relative deadline, and P is the period.

Prove: A system of independent, preemptable tasks can be feasibly scheduled on one processor if its density is equal to or less than 1.

Problem 7.

Which of the following systems of periodic tasks are schedulable by the rate-monotonic algorithm? By the earliest-deadline-first algorithm? Explain your answer. (Numbers are of form (Period, Computation Time))

- (a) $T = \{(10, 4), (16, 4), (20, 4)\}$
- (b) $T = \{(5, 2), (10, 3), (12, 3)\}$
- (c) $T = \{(7, 3), (9, 5), (15, 3)\}$

Problem 8.

Construct a task set that can be scheduled by the RM, EDF and LLF algorithms.

Problem 9.

Show three periodic tasks that do not satisfy the simple schedulable utilization (Schedulability Test 2) but can still be RM-scheduled.

Problem 10.

Is it possible to find a set of n^4 tasks which can be scheduled on a multiprocessor systems with n processors. Justify your answer.

Problem 11.

Under what condition(s) are the RM algorithm and the EDF algorithm equivalent?

Problem 12.

Is there a scenario where EDF is not optimal? If so, show an example.

Problem 13.

Given a set of periodic tasks determine if the tasks are Rate Monotonic Schedulable.

T1: $c_1 = 5$ $p_1 = 50$

T2: $c_2 = 11$ $p_5 = 70$

T3: $c_3 = 14$ $p_3 = 100$

T4: $c_4 = 15$ $p_4 = 120$

T5: $c_5 = 26$ $p_5 = 140$

T6: $c_6 = 60$ $p_6 = 300$