CS 330 - Winter 2025
Assignment W3

Due: Wednesday, January 29, 2025 (start of class)

You should submit a physical copy of your written homework at the start of class.

[2 points] Collaboration Statement

Be sure to include a collaboration statement with your assignment, even if you worked alone.

[36 points] Problem 1 - EDF with Constrained Deadlines

In this problem, you will work with the following task set, in which each task is represented as (T_i, C_i, D_i).

$$\tau = \{ \ (10, 3, 8) \, , (6, 2, 5) \, , (8, 1, 8) \, , (6, 1, 5) \ \}$$

This is a constrained-deadline task set. You will check schedulability under EDF with both the Density Test and the Demand-Bound Function.

a) First, apply the Density Test to this task set. Given the result, can we make any guarantee (positive or negative) about whether EDF can schedule this task set on one processor? Make sure to show your work.

b) When computing the DBF, if we have $U < 1$, then we can limit the number of possible time instants to check that $dbf(t) \leq t$. We will use the following definitions:

- The hyperperiod $H = lcm(T_1, T_2, \ldots, T_n)$ is defined as the least common multiple of all periods.
- Let $D_{max} = \max_{1 \leq i \leq n} D_i$ be the largest relative deadline.
- We can define $L^* = \frac{\sum_{i=1}^{n} (T_i - D_i) u_i}{1 - U}$ (an explanation is given in Sec. 4.6.2 of the textbook).

Now, calculate the following numbers:

$U =$

$H =$

$D_{max} =$

$L* =$

c) Given your solutions to part (b), you can generate the set D of time instants (all of which are absolute deadlines) that must be checked, defined as $D = \{d_k \mid d_k \leq \min(H, \max(D_{max}, L^*))\}$. List these times.

d) Given the set of times to check from part (c), fill in the following table. Note that you will not need all of the rows.

t	$dbf(t)$	$dbf(t) \leq t$?

e) Sketch the $dbf(t)$ function corresponding to the table you completed in part (d). Make sure to include the line $dbf(t) = t$.

f) Given your solutions to parts (a) and (d), was it necessary to perform both tests? Which would you perform first, if you had to choose an order, and why?

[22 points] Problem 2 - RM

a) Draw a schedule from $t = 0$ to $t = 20$ for the following task set, assuming Rate Monotonic scheduling. Be sure to draw one line per task, and include all release and deadline arrows and all completion hats.

$$\tau = \{ \ (T_i, C_i) \ \} = \{ \ (7, 2), (5, 1), (12, 5) \ \}$$

b) Given the following task set, apply the RM utilization test for $n = 4$ tasks.

$$\tau = \{ \ (T_i, C_i) \ \} = \{ \ (7, 1), (13, 3), (14, 2), (23, 4) \ \}$$

Can we make any claim about whether RM is guaranteed to generate a feasible schedule for this task set?

c) Come up with a synchronous implicit-deadline periodic task set of three tasks that fails the RM utilization test (for $n = 3$), but the first job of each task completes by its deadline.