CS 330 - Winter 2020
Assignment W2

Due: Wednesday, January 29, 2020 (start of class)

You should submit a physical copy of your written homework at the start of class. Be sure to include a collaboration statement with your assignment, even if you worked alone. This is worth 2 points.

[18 points] Problem 1 - EDF with Implicit Deadlines

For this problem, we will work with the following task set:

$$\tau = \{(T_i, C_i)\} = \{(4, 1), (6, 1), (8, 3), (10, 2)\}.$$

a) Perform the utilization-based schedulability test. What does it say about the schedulability of the task set generally?

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

c) Make a change to some task parameter that causes the task system to fail the utilization-based schedulability test. Explain the change you made, the result of the test, and what that means about whether some other algorithm could schedule it.

[30 points] Problem 2 - 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. Recall that the density test checks if $\Delta \leq 1$. Make sure to show your work.

b) Note that we can limit the number of possible times to check, as $U < 1$. First, calculate the following (recall the definitions from class, and from Theorem 4.6 in the book; note that the book calls $L*$ what we called $t*$ in class):

$U =$

$H =$

$D_{max} =$

$t* =$

c) Given your solutions to part (b), you can generate the set D of times that must be checked. 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)	result

e) 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?

[20 points] Problem 3 - 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.

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

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.

[30 points] Problem 4

a) Consider the following task set:

$$\tau = \{(T_i, C_i, D_i)\} = \{(8, 2, 6), (16, 7, 15), (24, 4, 20), (48, 2, 40)\}.$$

Use Time-Demand Analysis (see page 106 of Buttazzo for a helpful walk-through of the algorithm) to show that task τ_3 meets its deadlines under Deadline-Monotonic scheduling. Make sure to show your work, including the values of $R_3^{(k)}$ and $I_3^{(k)}$ for each iteration k.

b) Draw the TDA graph for task τ_3 lined up with the schedule for times $t = 0$ to $t = 20$. This should look like Figure 4.16 on Buttazzo page 107. Make sure to include release and deadline arrows, and completion hats. (Note that Buttazzo doesn't include completion hats and draws releases as vertical bars, but you should have them as state).

c) Perform TDA again for task τ_3 assuming that the worst-case execution time of task τ_2 is increased to 9, i.e., that $C_2 = 9$. (You do not have to re-draw the schedule or TDA graph.)