CS 330 - Winter 2025
Assignment W6

Due: Wednesday, March 12, 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.

[28 points] Problem 1 - Partitioning Heuristics

Consider the following set of implicit-deadline tasks, where task $\tau_i = (T_i, C_i)$.

$$\tau = \{(\tau_1, \tau_2, \tau_3, \tau_4, \tau_5, \tau_6, \tau_7)\} = \{(4, 1),\ (5, 1),\ (8, 3),\ (10, 2),\ (4, 2),\ (8, 1),\ (12, 3)\}.$$

The total system utilization is 1.9, so we hope to schedule these tasks on a two-processor platform.

a) Use RM-Next-Fit to partition the tasks, assuming the "fit" check is performed using the RM utilization test, and tasks are considered in order of task ID. For full credit, show your work for each fit check. What is the final partitioning, how many processors are required, and what is the utilization of each processor?

b) Given your partitioning result in part (a), what is the ratio m/m_0 between the resulting number of processors m and the optimal number of processors m_0? How does this compare to the bound provided by Dhall and Liu for RM-Next-Fit?

c) Use RM-First-Fit to partition the tasks, assuming the "fit" check is performed using the RM utilization test, and tasks are considered in increasing order of periods (smallest first), with utilization as a tie-breaker (largest first). For full credit, show your work for each fit check. What is the final partitioning, how many processors are required, and what is the utilization of each processor?

d) Given your partitioning result in part (c), what is the ratio m/m_0 between the resulting number of processors m and the optimal number of processors m_0? How does this compare to the bound provided by Dhall and Liu for RM-First-Fit?

e) Use Worst-Fit to partition the tasks between 3 processors, assuming the "fit" check is performed using the RM utilization test, and tasks are considered in decreasing order of utilizations (largest first), with period as tiebreaker (smallest first). What is the final partitioning and what is the utilization of each processor?

Recall that Worst-Fit chooses the processor, of those where a task can fit, with the lowest utilization. Assume ties between processors are broken by processor ID (smallest first).

[20 points] Problem 2 - Baker's G-EDF Schedulability Test

a) Consider the following task set, in which each task is represented as $\tau_i = (T_i, C_i, D_i)$:

$$\tau = \{(\tau_1, \tau_2, \tau_3, \tau_4)\} = \{(8, 1, 5), (16, 8, 16), (24, 16, 20), (48, 16, 40)\}.$$

For this task set, we cannot perform the simple utilization-based test ($U \leq m(1 - u_{max}) + u_{max}$) as periods are not the same as deadlines. If we pretend they are (i.e., ignore D_i values), what does this test tell us for $m = 4$?

b) For the same task set from part (a), but now with its actual relative deadlines, perform Baker's simplified test assuming $m = 4$. For full credit, show your work in computing each task's contributions to the right-hand side.

c) The test from part (b) should have failed. How many processors do you need, according to Baker's simplified test?