Real-Time Systems – Scheduling Exercises

1. Given the following precedence graph of four jobs:

   A 4 (0, 7) → B 2 (3, 10)
   C 2 (1, 5) → D 1 (0, 6)

   Explain and discuss the scheduling policies EDF, SPT, LPT, LST (MLF), LRT using the example! What follows with respect of EDF if job C has deadline 7 instead of 5?
   What follows if a job E 1 (2, d] with d = 4 resp. d = 9, E independent from A,...,D is added to the job set?

   2. Discuss the EDF policy (properties/advantages and limitations/disadvantages)!

   3. a) Explain notations, assumptions and principles of the scheduling for systems of periodic tasks!
      b) Explain the frame-based approach for the time-driven scheduling of periodic tasks!

   4. Determine the appropriate frame sizes for a cyclic schedule for the following systems of periodic preemptible tasks described by (p; e) with p: period, e: execution time.
      a) (6; 1), (10; 2), (18; 2)
      b) (4; 0,5), (5; 1), (10; 2), (24; 9)

   5. A system uses the cyclic EDF algorithm to schedule sporadic jobs. The cyclic schedule of periodic tasks in the system uses a frame size of 5, and a major cycle contains 6 frames. Suppose that the initial amounts of slack time in the frames are 1; 0.5; 0.5; 0.5; 1; and 1. Suppose that a sporadic job S₁(23; 1.5) arrives in frame 1, sporadic jobs S₂(16; 0.8), S₃(20; 0.5), and S₄(17; 0.8) arrive in frame 2 (the deadlines of the jobs are relative to the end of their respective frames). In which frame are the accepted jobs scheduled?

   6. Discuss the schedulability of the following systems of periodic tasks according to RMS and EDF! Use appropriate admission criteria!
      a) T = {(8, 3), (9, 2), (18, 3)}
      b) T = {(8, 4), (12, 4), (20, 4)}
      c) T = {(8, 4), (10, 2), (12, 3)}
      d) T = {(3, 1), (6, 2), (18, x)}

   7. Given three sets of periodic tasks with utilization of 0.67, 0.86, and 1.0, respectively. What do you know about the schedulability of these task sets?

   8. Explain the “schedulable utilization”!

   9. Explain why the policy SPT (shortest processing time) is not suited for scheduling fixed-priority real-time tasks, particularly for periodic task sets!
A. Construct the initial segment in the time interval \([0, 750]\) of a RM schedule and an EDF schedule of the following periodic tasks sets, and discuss the results! Jobs missing their deadlines should be aborted.

   a) \(T = \{(100, 20), (150, 50), (250, 100)\}\)
   b) \(T = \{(100, 20), (150, 50), (250, 120)\}\)

B. Consider a fixed-priority system of 13 periodic, independent tasks with periods

   5, 24, 8, 30, 9, 12, 10, 18, 7, 21, 17, 11, 4.

The operating system (OS) only supports 4 priority levels. Explain two methods to map the task priorities to OS priorities and describe the mapping of task priorities to OS priorities for the given task set!