Scheduling Algorithms (2)

Real-Time and Embedded Systems (M)

Tutorial 3

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Tutorial Outline

- Review of problem set 2
- Review of lectures
- Worked examples
- Question & answer

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Review of Problem Set 2

- Question 1: Consider a system of four periodic tasks $T_1 = (8, 1)$, $T_2 = (15, 3)$, $T_3 = (20, 4)$, and $T_4 = (22, 6)$ that are to be scheduled and executed according to a structured cyclic schedule with fixed frame size. What is an appropriate frame size? [4 marks]

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Review of Problem Set 2

- Question 2: Consider the following two systems of independent preemptable periodic tasks. Are these systems schedulable using the Rate Monotonic algorithm? Explain your answers.
  - $T_1 = (5, 1)$, $T_2 = (3, 1)$, and $T_3 = (15, 3)$

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Review of Problem Set 2

- Question 2: Consider the following two systems of independent preemptable periodic tasks. Are these systems schedulable using the Rate Monotonic algorithm? Explain your answers.
  - $T_1 = (5, 2)$, $T_2 = (4, 1)$, $T_3 = (10, 1)$, and $T_4 = (20, 3)$

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Review of Problem Set 2

- Question 3: The periodic tasks $T_1 = (3, 1)$, $T_2 = (4, 2)$, and $T_3 = (6, 1)$ are scheduled according to the rate monotonic algorithm. Draw the time-demand functions of the tasks. Are the tasks schedulable? Justify your answer.

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Review of Lectures

- Aperiodic and sporadic jobs
  - Assumptions, definitions and system model
- Simple approaches
  - Background, interrupt-driven and polled execution
  - Periodic servers
- Bandwidth-preserving servers
  - Deferrable server
  - Sporadic server
  - Constant utilization servers
  - Total bandwidth servers
  - Weighted fair queuing servers
- Scheduling sporadic jobs

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Key Learning Outcomes

- Understanding of how aperiodic jobs can be scheduled using a bandwidth preserving server task
- Understanding of various types of bandwidth preserving server, trade-offs in their design, schedulability of the various types of server
- Understanding of how to accept and schedule sporadic jobs

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Example (1a)

- Consider a system with three periodic tasks:
  - $T_1 = (\ 6, 1)$
  - $T_2 = (10, 1)$
  - $T_3 = (14, 3)$
- What does an EDF schedule for this system look like?

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Example (1b)

- Consider a system with three periodic tasks:
  - $T_1 = (\ 6, 1)$
  - $T_2 = (10, 1)$
  - $T_3 = (14, 3)$
- A deferrable server with period 4 and budget (execution time) 1 is added. Is the system schedulable?

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Example (1c)

- Consider a system with three periodic tasks:
  - $T_1 = (\ 6, 1)$
  - $T_2 = (10, 1)$
  - $T_3 = (14, 3)$
- A deferrable server with period 4 and budget (execution time) 1 is added. Is the system schedulable?
- An aperiodic task arrives with $r_A = 6$ and $e_A = 2$. What does the schedule look like? How does the budget of the server vary?

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Example (2)

- Consider a system of three periodic tasks $T_1 = (3, 1)$, $T_2 = (4, 0.5)$ and $T_3 = (10, 2)$. The system must support three aperiodic jobs:
  - A_1 which is released at time 0.5
  - A_2 which is released at time 12.25,
  - A_3 which is released at time 17

  The aperiodic jobs execute for 0.75 units of time. The system is scheduled using RM, with a simple sporadic server $T_s = (5, 0.5)$ supporting the aperiodic jobs.
- Simulate the system for sufficient time to show how the aperiodic tasks are scheduled. Calculate the response times for each of the aperiodic tasks.

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Summary

- Should understand how to evaluate the schedules for various types of server
- Should understand how to demonstrate correctness of a system with aperiodic or sporadic tasks scheduled using a bandwidth preserving server

- Any Further Questions?

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