

# Real-Time Systems Concepts

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## Major References:

Real-Time Systems, 國立臺灣大學, 郭大維教授  
Real-Time Computing, 國立交通大學, 張立平教授

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## Course Information (1/2)

- Instructor: 謝仁偉
  - [jenwei@mail.ntust.edu.tw](mailto:jenwei@mail.ntust.edu.tw)
  - Office: T4-509
- Course Information
  - 課程代碼: CS2017701
  - 上課時間: 二 34、四 6
  - 上課教室: TR-310-1
- Office Hours:
  - 四 78

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## Course Information (2/2)

- TA: 林紘立
  - [410121022@gms.ndhu.edu.tw](mailto:410121022@gms.ndhu.edu.tw)
  - RB-306-1
- All slides would be uploaded to the Moodle (<http://moodle.ntust.edu.tw>)



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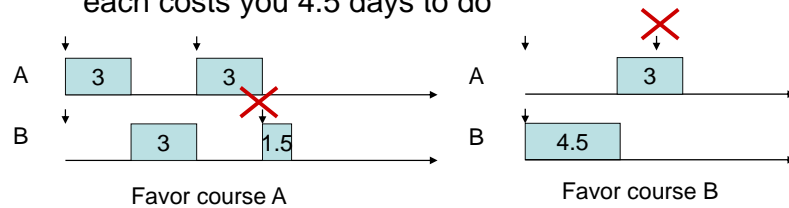
## Motivation (1/3)

- Take yourself as an example
  - Naturally you have a number of things to do with time pressure
    - Project deadlines
    - Meeting time
    - Class time
    - ...
  - Some of them regularly recur but some don't
    - Attend the class every Thursday (periodic)
    - Go to the movies on 8:00pm (aperiodic)
    - Date with a girl/boy friend (sporadic)
    - ...

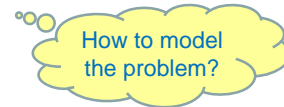
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## Motivation (2/3)

- You schedule yourself to meet deadlines
  - Course A: one homework is announced every 6 days, each costs you 3 days to do
  - Course B: one homework is announced every 9 days, each costs you 4.5 days to do



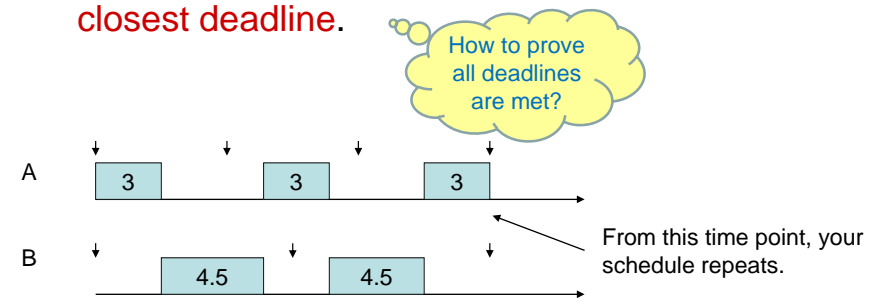
- You miss deadlines of one course if your policy favors either one course.



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## Motivation (3/3)

- Schedule to meet deadlines
  - Course A: (6, 3)
  - Course B: (9, 4.5)
- All deadlines are met if you do whatever has the **closest deadline**.



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## Introduction to Real-Time Systems

- What is a real-time system?  
Any system where a timely response by the computer to external stimuli is vital!
- Examples:
  - multimedia systems, virtual reality, games
  - avionics, air traffic control, nuclear power plant
  - stock market, trading system, information access, etc.
- Does the definition make every computer a real-time computer?  
Yes! It is if we need some response from a computer within a finite time!!

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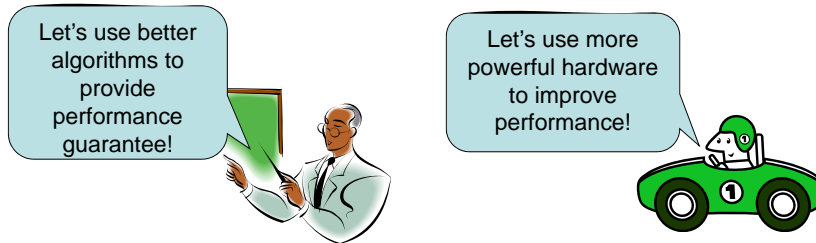
## Course Objectives

- Real-time scheduling theory, however, usually can't be directly applied to realistic systems
  - Then why should we learn theoretical matters?
  - That's to avoid choosing bad designs, and, of course, to come to a good design, e.g., a frequently overloaded system should provide stable prioritization rather than high resource utilization

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## Concepts for Real-Time Systems

- Guarantee, guarantee, and guarantee
  - Real-time systems are not high-performance systems



- How to provide performance guarantees with low hardware cost?
  - To answer this question, you have to know how to analyze your system.

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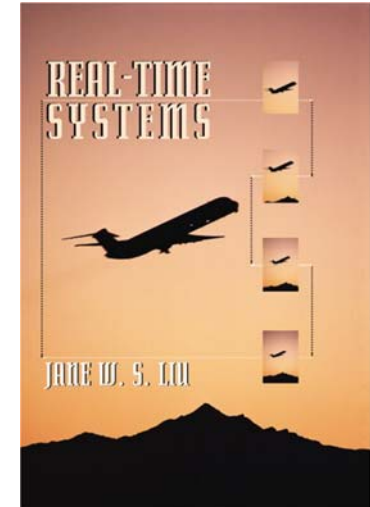
## Reference

### Real-Time Systems

- Jane W. S. Liu



- ISBN: 0-13-099651-3
- Publisher: Prentice Hall
- Copyright: 2000
- Format: 624 Pages
- Published: 04/13/2000



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## Outline of the Course (1/2)

- Priority-Driven Scheduling of Periodic Tasks
  - Fixed-Priority vs. Dynamic-Priority Algorithms
  - Exact Schedulability Test
  - Sufficient Schedulability Conditions
- Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems
  - Deferrable Servers
  - Sporadic Servers
  - Constant Utilization, Total Bandwidth, and Weighted Fair-Queueing Servers
  - Scheduling of Sporadic Jobs

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## Outline of the Course (2/2)

- Resources and Resource Access Control
  - Assumptions on Resources and Their Usage
  - Effects of Resource Contention and Resource Access Control
  - Nonpreemptive Critical Sections Protocol
  - Basic Priority-Inheritance Protocol
  - Basic Priority-Ceiling Protocol
  - Stack-Based, Priority-Ceiling (Ceiling-Priority) Protocol
  - Preemption-Ceiling Protocols
  - Controlling Accesses to Multiple-Unit Resources

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## Grading Policy

- 2 Midterm (50%)
- 1 Final (30%)
- Class Participation (20%)

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## Any Question?



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## Now I Would Like to Know Everyone of You...

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## See You on Thursday!

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