CIS 721 - Real-Time Systems
Fall 2015
Course Syllabus

Time and Place: M,W,F 12:30-1:20, 122 Nichols Hall
Required Textbook: Real-Time Systems by Jane W.S. Liu (2000)
Recommended Textbook: Real-Time Systems Design and Analysis by Laplante and Ovaska (2014)

Instructor: Mitch Neilsen
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Office Hours: M,W 1:30-3:00 (or by e-mail)

Prerequisites: CIS 520 (Operating Systems)

Course Objective: Learn fundamental techniques and procedures used in the design and analysis of hard real-time embedded systems, including language and operating system support, scheduling, feasibility analysis, design tools, and verification tools.

Grading	
homework (several)	20%
programming projects (3)	40%
quizzes (2)	25%
final exam (Wed., Dec. 16, 4:10-6:00 pm)	15%

Notes: Homework is intended to help you gain an understanding of the material, whereas the exams are used to test your mastery of the material. Homework is due on the assigned due date. Late homework will have five points deducted for each working day that it is late. Working days are Monday through Friday. Each homework is worth a maximum of 25 points. After one week it is worth 0 points. The programming assignments are generally worth a maximum of 50 points; after two weeks they are worth 0 points. Each individual student must complete a project. You are responsible for defining the scope of your project. The individual project can be either an experimental investigation or research paper. The project must be a fairly significant piece of work, not just a simple survey. While it doesn't have to be publishable, the scope and size should be similar to a conference paper.

Collaboration Policy: Discussion of techniques and ideas covered in class is encouraged. However, every line of work on all assignments must be your own. No discussion is allowed on exam questions.

Academic Accommodations for Disabled Students: Any student with a disability who needs a classroom accommodation, access to technology or other assistance in this course should contact Disability Support Services and/or the instructor.

Course Outline:

1. Introduction
    - Ch. 1: Example real-time applications
    - Ch. 2: Hard vs. soft real time
    - Ch. 3: Real-time reference model (definitions used throughout)
2. Uniprocessor Scheduling of Independent Tasks
    - Static scheduling
        - Ch. 5: Clock-driven scheduling and cyclic executives
    - Dynamic scheduling
        - Dynamic-priority scheduling:
            * Ch. 4.6: Optimality of EDF and LLF
            * Ch. 6.3: Utilization-based schedulability test for EDF
            * Non-preemptive EDF
        - Static-priority scheduling:
            * Ch. 6.4: Optimality of RM and DM
            * Ch. 6.7: Utilization-based schedulability test for RM
            * Ch. 6.5-6.6: Demand-based scheduling for static-priority systems
    - Dealing with real systems
        - Ch. 6.8: Practical considerations
        - Timing analysis of real systems
3. Real-time operating systems
    - Ch. 12.1-12.2: Real-time operating system functions
    - Ch. 12.6-12.7: Commercial real-time operating systems
    - Open-source real-time operating systems
4. Intractibility results - what makes this hard
    - Preemptive systems
        - Dynamic-priority systems
        - Static-priority systems
    - Non-preemptive systems
        - Dynamic-priority systems
        - Static-priority systems
    - Survey of results on uniprocessor scheduling based on the following metrics:
        - Preemptive vs. non-preemptive
        - Dynamic vs. static priorities
        - Synchronous vs. asynchronous job release times
        - Deadlines equal to or less than period, or arbitrary
        - Periodic vs. sporadic tasks
5. Beyond uniprocessor task models with independent tasks
    - Resources and access control
        - What happened to the Mars Rover Pathfinder?
        - Ch. 8: Priority inheritance and priority ceiling protocols
        - Resource sharing under EDF
        - Lock-free approach

- Modelling and validation of real-time systems
  - RT-Spin
  - UPPAAL

Harassment Policy: "I believe that engineers must not only be the people who know how to do things right, but also those who know the right things to do." (Quote by Dr. Joseph Bordogna, National Science Foundation) One purpose of your education is to help you develop skills, approaches, and abilities that are necessary for effective teamwork, and for your success in your profession and as a citizen. It is important that you understand your rights and responsibilities regarding the University's Sexual and Racial Harassment policies. Full text of the policies can be found on KSU's web site at:

`<http://www.ksu.edu/uauc/fhbook/fhxj.html>`

If you experience any situations, in or out of class, that seem inappropriate or that make you uncomfortable, a list of resources and courses of action to assist you can be found on the College of Engineering web site at:

`<http://www.engg.ksu.edu/students/statement-harrassment.htm>`

Honor System: Kansas State University has an Honor System based on personal integrity, which is presumed to be sufficient assurance that, in academic matters, one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor System. The policies and procedures of the Honor System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. The honor system website can be reached via the following URL:

`<http://www.ksu.edu/honor>`

A component vital to the Honor System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.