CSIS 612 Real-Time Systems and Applications

Syllabus
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Graduate Program in Software
CSIS 612: Real-Time Systems and Applications

Instructor
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2115 Summit Avenue
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Office: OSS 308
Office Hours: 3:30 – 5:00 PM Monday
Also by prior appointment.

Class Rooms / Hours
5:45 – 9:00 PM Monday, Room OSS 328

Class Tutors:
There is no tutor for this class.
Text Books

Textbooks and Other Materials
An Embedded Software Primer, by David E. Simon, Addison Wesley 1999 (or later).


Class notes, papers.

Optional Textbooks


Course Description

Course Objectives
- To introduce and explain the characteristics of real-time systems.
- To learn about software components and techniques that are specific to real-time systems.
- To conduct some researches related to real-time systems.

Course Topics
- Introduction of real-time systems and their characteristics
- Real-time system design methodology and pitfalls
- Real-time programming languages and tools
- Real-time operating systems and examples
- Real-time scheduling and concurrency control
- Reliability and fault tolerance in real-time systems

Prerequisite
CSIS610 Operating Systems Design or equivalent knowledge.
# Tentative Class Schedule

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Topics</th>
<th>Reading assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/30</td>
<td>*Introduction to real-time systems– Hard/Soft RTSs, RTS Misconceptions</td>
<td>*Simon Ch 1 *Liu Ch 1.4</td>
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<tr>
<td>2</td>
<td>2/6</td>
<td>*Interrupts, software architectures</td>
<td>*Simon Ch 4, 5</td>
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<tr>
<td>3</td>
<td>2/13</td>
<td>*Real-time OS (round-robin, co-routine, reentrancy, preemption, semaphores, deadlock)</td>
<td>*Simon Ch 6, 7</td>
</tr>
<tr>
<td>4</td>
<td>2/20</td>
<td>*Real-time OS (tasks, message queues, memory, time, events)</td>
<td>*Simon Ch 7, 8 *Liu Ch 12</td>
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<td></td>
<td></td>
<td>*Real-time OS (Non-preemptive critical section NPCS, data freshness)</td>
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<tr>
<td>5</td>
<td>2/27</td>
<td>*Concurrent Programming (shared vars, message passing, Petri-net, FSM)</td>
<td>*Notes</td>
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<tr>
<td>6</td>
<td>3/6</td>
<td>*Petri-net and fault-tolerance</td>
<td>*Notes</td>
</tr>
<tr>
<td>7</td>
<td>3/13</td>
<td>*Languages, development tools (linker, loader, host, target), debugging tools</td>
<td>*Simon Ch 9, 10 *Liu Ch 4, 5</td>
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<td></td>
<td>*Off-line scheduling (clock-driven scheduling)</td>
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<td></td>
<td>3/20</td>
<td><em>3/20-3/23 Spring break (<strong>NO class</strong>)</em>*</td>
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<tr>
<td>8</td>
<td>3/27</td>
<td><strong>Mid-term exam</strong></td>
<td>*Project plan due</td>
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<tr>
<td>9</td>
<td>4/3</td>
<td>*Scheduling (exe. Time estimation, cyclic, schedulability, on-line scheduling, RM, EDF)</td>
<td>*Liu Ch 5, 6</td>
</tr>
<tr>
<td>10</td>
<td>4/10</td>
<td>*Scheduling (RM, EDF, deadline-monotonic anomaly, stability, aperiodic scheduling)</td>
<td>*Liu Ch 6, 7</td>
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<td>*Scheduling (completion time theory), Priority inversion, inheritance, ceiling</td>
<td>*Liu Ch 8</td>
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<td>4/17</td>
<td><strong>Easter, (<strong>NO class</strong>)</strong></td>
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<tr>
<td>11</td>
<td>4/24</td>
<td>*Concurrency control, serializability, convex ceiling</td>
<td>*Notes</td>
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<tr>
<td>12</td>
<td>5/1</td>
<td>*Relaxing serializability, imprecise computation</td>
<td>*Liu Ch 8, 10 *Liu Ch 11</td>
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<td></td>
<td></td>
<td>*Real-time communication, real-time data mining</td>
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<tr>
<td>13</td>
<td>5/8</td>
<td>*Project presentation</td>
<td>*Notes prepared by teams</td>
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<tr>
<td>14</td>
<td>5/15</td>
<td><strong>Final exam</strong></td>
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Course Project

You will conduct one study report and presentation in a team of maximum three people in this semester. You are all required to participate to the maximum of your ability in the project.

Project topics can be selected from

1) Lego Mindstorms robots
2) MatLab Simulink / Virtual Reality
3) Text book chapters that are NOT covered in the class,
4) IEEE real-time system conferences (IEEE RTSS, RTAS, Data Engineering) proceedings, journals (IEEE Real-Time System Journal), transactions (IEEE Transactions on Software Engineering),
5) Commercial real-time embedded magazines (CMP Embedded System Programming), or
6) Appropriate sources and topics consent by the instructor.

At the end of the class (one week after the final exam) all teams must submit a Final Report that includes the following additional information: Lessons Learned, Annotated Bibliography, Copies of Referenced Materials, Visual Materials (final report printout, presentation slides).
Exams and Grading

Exams
There will be two exams for this class. The exams are in class and closed book. The exams will be based primarily on the materials covered in class but will include some research type questions as well.

Grading
Homework assignments 10%
Project 25%
Midterm exam 30%
Final exam 35%

Letter grade will be assigned approximately as follows:

80% — 100% A, A-
70% — 80% B+, B, B-
60% — 70% C+, C, C-
Below 60% F

*** Final distribution may be adjusted based on the class performance.

*** Students who do **NOT** take exam(s) or miss project presentation will receive an “F” grade.
Course Resources

Computing Resources
OSS 327 Computer Lab, Window NT machines.

Please check your UST e-mail account regularly.

Support Staff
Instructor Chih Lai for questions regarding the materials covered in class.
GPS Lab assistant Marius Tegomeh (962-5517, mutegomoh@stthomas.edu) for questions on using the equipment in Room 327.

Attendance Policy
Course attendance is expected, but no grade is given for it. Students who miss sessions are responsible for all information in that session. Students who need to miss presentations or exams due to unavoidable conflicts must arrange in advance to make up the session with the instructor.

Course Assignments
Homework will be assigned from time to time during the semester in order to reinforce the concepts/techniques discussed in the class. Assignments will be collected on the specified due dates. NO late submission will be accepted without proper reasons.
Web Sites

- Lego Mindstorms– mindstorms.lego.com/
  mindstorms.lego.com/eng/products/vc/vcsoft.asp,


- Data gloves– 5dt.com/products/pdataglove5.html