TCSS 465A
Embedded Real-Time System Programming (Hardware & Software)
Spring 2007

Class: TTH 2:00 – 4:15 Dougan 270
Laboratory: Cherry Parkes 206 D

Web page: http://faculty.washington.edu/lcrum

Instructor: Professor Larry Crum
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Office Hours: TH 1:00-1:45, TH 6:45-?, F 11:30-12:00, 2:00-?
Appointment recommended for other times.

Text:
Shaw, Alan C.

Supplement:
Hard Real-Time Computing Systems - Predictable Scheduling Algor and App
Buttazzo, Giorgio C.
Springer ISBN: 0-387-23137-4

TCSS 465 Embedded Real-Time System Programming Catalog Description:
An examination of particular theory and practice in designing software embedded in electronic devices and controllers. Includes clocks, threads, multitasking, critical sections, monitors, scheduling, on chip and external device interfacing, communications, and fault tolerance. Prerequisite: TCSS 422; may not be repeated after achieving minimum grade of 2.0. Credit Hours: 5

One of the more interesting, challenging, and exciting areas of computing, and widely overlooked by students, is embedded computing, and especially real-time embedded computing. Remarkable adaptive, versatile, powerful, and economically viable, it provides critical foundations for evolving technology for how people live work and play. Transformations in societal infrastructures depend upon innovative applications of real-time embedded systems.

Design and programming of embedded systems is quite different from general purpose computing system design. The real-time constraints imposed by environmental inputs, and the critical demands of precise monitoring and controlling, require use of different paradigms, models, tools, and techniques. We will examine these differences and begin to develop expertise in the art and science of embedded system design.

References:
MicroC/OS-II The Real-Time Kernel, Labrosse, CMP Books
Real-Time Concepts for Embedded Systems, Qing Li, Wiley
Scheduling in Real-Time Systems, Francis Cottet etc., Wiley
Real-Time Systems, Scheduling, Analysis, and Verification, Albert Cheng, Wiley
Embedded Computing, A VLIW Approach to Architecture, Compilers, and Tools, Joseph Fisher etc., Kaufmann
Concurrent and Real-Time Programming in Java, Andy Wellings, Wiley
**Grading:** Projects (40%), Midterm (20%) Final Exam (25%), Class Contribution (15%)

*Characteristics of an A student* – Work done is outstanding quality and shows particular insight and creativity. It is consistently presented very professionally.

*Characteristics of a B student* – Work done is complete, predominance of it is correct, and it is presented professionally.

*Characteristics of a C student* – Work is basically complete and correct, and it is presented coherently and completely. The student is prepared to use the material in the next course but will likely need more study in the area.

**Laboratory:** We will do hands-on projects in our laboratory (CP 206D).

**Plagiarism:** Students are encouraged to collaborate with their colleagues on understanding assignments and gaining insight on solutions. However, *any significant contribution in a submission must be acknowledged and the responsible student or source given due credit*. See [http://depts.washington.edu/grading/issue1/honesty.htm](http://depts.washington.edu/grading/issue1/honesty.htm).

**Schedule:**

<table>
<thead>
<tr>
<th>Week</th>
<th>Real-Time Systems &amp; Software (Shaw/Buttazo)</th>
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<tbody>
<tr>
<td>1: Mar 27 - 29</td>
<td>Chap 1 – Introduction to Real-Time Systems, Introduction to the Cold Fire Processor &amp; the NetBurner</td>
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<tr>
<td>2: Apr 3 - 5</td>
<td>Chap 2 – Software Architectures, <em>Project 1 &amp; Scopes</em></td>
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<td>3: Apr 10 - 12</td>
<td>Chap 3 – Requirements &amp; Design Specifications</td>
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<td>4: Apr 17 - 19</td>
<td>Chap 4 – Systems of State Machines</td>
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<td>5: Apr 24 - 26</td>
<td>Chap 6 – Deterministic Scheduling, <em>Project 2</em></td>
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<tr>
<td>6: May 1 - 3</td>
<td>Chap 6 - Deterministic Scheduling</td>
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<td>7: May 8 - 10</td>
<td>Midterm <em>Project 3, Arch of Coldfire &amp; Assy Language, Interrupts</em></td>
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<td>8: May 15 - 17</td>
<td>Scheduling - Fixed Priority Server Scheduling <em>Project #1 Report Due</em></td>
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<td>9: May 22 - 24</td>
<td><em>Project 4, Scheduling – Dynamic Priority Server Scheduling</em> <em>Project #2 Report Due</em></td>
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<td>10: May 29 - 31</td>
<td>Demonstrations of <em>Project #4</em></td>
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<td>11: Jun 5</td>
<td>Final Exam 2:00 – 4:15</td>
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**Safety Escorts:** Safety escorts are available to accompany you to your vehicle 24 hours a day, 7 days a week. Call Campus Safety at 2-4416 from a campus phone, and 253-692-4416 from a non-campus phone.

**Reporting Emergencies:** From campus phones, report emergencies by dialing 9-911 and state the T-number that is on a sticker on the phone; from non-campus phones dial 911. Building location numbers are posted on all buildings. For assistance with non-emergencies call Campus Safety at 2-4416 from a campus phone, and 253-692-4416 from a non-campus phone.

**Emergency Procedures:** In case of emergency, follow your professor’s instructions. When an alarm sounds, evacuate the building immediately. MATT, CP, WG, GWP, and BB buildings assemble in the Cragle Parking Lot south of the library. BHS, WCG, and DOU buildings assemble near the transit station next to the Pinkerton Building on Broadway (across from Spaghetti Factory). Pinkerton occupants go to the convention center parking lot north of Pinkerton. For more information about emergency procedures and information, please go to: [http://www.tacoma.washington.edu/safety/](http://www.tacoma.washington.edu/safety/)

**Disability Support:** If you would like to request academic accommodations due to a temporary or permanent disability, contact Lisa Tice, Manager for Disability Support Services (DSS) in the Mattress Factory Bldg, Suite 206. An appointment can be made through the front desk of Student Affairs (692-4400), through Student Development and Success (692-4501), by phoning Lisa directly at 692-4493 (voice) or 692-4413 (TTY), or by e-mail lrice@u.washington.edu. Appropriate accommodations are arranged after you’ve conferred with the DSS Manager and presented the required documentation of your disability to DSS.