ECSE-426: MICROPROCESSOR SYSTEMS
FALL 2009
(3 CREDITS, TUES. 1:05-2:25, ROOM ENGTR 2110)

Course Outline

General Information

Prerequisites: ECSE-323 and EDEC 206

Instructor: Jean-Samuel Chenard
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Office Hours: By appointment.

Academic Policies

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/) for more information).

Additional policies governing academic issues which affect students can be found in the McGill Charter of Students' Rights (Chapter One of the Student Rights and Responsibilities Handbook available as a PDF on www.mcgill.ca/secretariat/documents/)

If you have a disability please contact the instructor to arrange a time to discuss your situation. It would be helpful if you contact the Office for Students with Disabilities at 514-398-6009 before you do this.

In accord with McGill University’s Charter of Students’ Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

Course Objectives and Learning Outcome

The objective of this course is to provide the necessary understanding and skills for students to design and build microprocessor systems. By the end of the course, you should:

1. understand computer organization and design principles;
2. be proficient in assembly programming for embedded systems, and be aware of its benefits and disadvantages;
3. have experience in developing embedded-C solutions;
4. know how to connect peripheral devices and how to program a microprocessor to interface with them;
5. understand the principles of instruction set architectures and microarchitectures and their impact on microprocessor design and implementation;

Course Content

The course adopts a top-down approach to teaching microprocessor programming and design. The lectures focus on structured computer organization, and progress through "layers", commencing at the problem-oriented language level (embedded C), traversing through the assembly language level, to the instruction set architecture, microarchitecture, and ending at the hardware layer.

The lectures will explain how these concepts have impacted real-world architectures, including the Intel Pentium microprocessors and low-power microcontrollers, such as Texas Instruments MSP430 series used for experimental work. The lectures also incorporate a tutorial element that is focused on explaining the operation of the experimental software and hardware.

The course focuses primarily on experimental work. There are three experiments and a project in the course. The first three experiments are designed to familiarize students with the primary components of microprocessor programming (including use of the compiler, assembler, simulators, interrupt service routines, timers, and UART). The project involves the wiring of peripheral hardware devices to the primary board, programming to interact with these devices, and software integration.

Lecture Material	**# of Lectures**
Introduction Historical perspective, computer systems organization, Basic Design Principles	1
Problem-Oriented Language Level and Assembly Layer Embedded C and assembly language	1
Instruction Set Architecture Properties, registers, instructions, data types, instruction formats, addressing, instruction types, control flow.	2
IO, Processor Interfacing Interrupts, clocks/timers, interacting with peripheral devices (UART/USART).	2
Microarchitecture Microinstructions, pipelining, branch prediction, prefetching	2
Design Principles Embedded systems, RISC vs CISC, dual-core, hyperthreading; examples: Pentium, MIPS, ARM machines.	2

Course Materials

There is no official textbook for this course. The book by Tanenbaum is the most closely related to the course material.

Recommended Reading:

A. Tanenbaum, *Structured Computer Organization*, fifth edition, Prentice-Hall, 2005.
*J. H. (John H.) Davies, *MSP430 microcontroller basics*, Oxford : Newnes, 2008.
C. Hamacher, Z. Vranesic and S. Zaky, *Computer Organization*, fifth edition, McGraw-Hill, 2002.

*Available as an e-book from http://muse.mcgill.ca

Articles and Manuals:

Supplementary documents will be posted on the WebCT course page (manuals for hardware, articles on example microarchitectures).

On-line Help:

The instructor and the teaching assistants will be monitoring the WebCT discussion groups on a regular basis. If you have a technical question, please use this medium to request help. Be sure to provide enough background on your issue so that others can relate if they encounter similar problems.

Assignments and Evaluation

Evaluations	**Contribution to Final Grade**		
Experiment 1	14	Demonstration	8
		Report	6
Experiment 2	15	Demonstration	10
		Lab Notes	5
Experiment 3	15	Demonstration	10
		Lab Notes	5
Project	40	First Demonstration	13
		Final Demonstration	15
		Report	12
Quizzes (4)	16		

Each team of 2 students need only submit one report for each experiment (students who wish to submit individual reports should check with the instructor). Instructions concerning the expectations for the lab reports will be available on WebCT.

Each student will be given an individual grade for the demonstration component of each experiment. Assessment will be primarily based on the quality of the work (which will be a shared mark), but individual response to questions will also affect the evaluation.

Four 15 minutes quizzes will be conducted at the start of four lectures during the term. Each of these will assess knowledge and understanding of lecture material presented since the previous quiz as well as aspects of the most recently completed experiment.

Penalties for Absences from Demos or Late Assignments (w/o valid excuse)

There is a 5 percent deduction in the maximum available grade per day for late reports or lab notes. (Friday to Monday counts as 1 day). If you are absent from a demo without excuse, you will have an opportunity to reschedule the demo for 65 percent of the grade.

Lab Groups and Room Access

The first three experiments will be conducted in pairs. The lab groups will be assigned lab hours and will reserve time slots for lab demonstrations. Further instructions concerning access to the lab and access to the hardware will be provided during the semester.

The final project will be conducted in groups of 4.

Tentative Schedule

After a preliminary introductory lecture, there will be nine lectures with approximately the same format: 45 minutes on theory, a 5-minute break, and 30 minutes tutorial on how the theory is implemented in practice using your laboratory materials.

Week (Monday)	Lecture	Tutorial	Experiment
1: Aug. 31	Intro		
2: Sept. 7	C & Assembly	MSP430, Crossworks Assembly	1: Assembly
3: Sept. 14	Instruction Set Architecture (ISA)	Timers	1: Timers, Embedded C **DEMO 1**
4: Sept. 21	ISA continued, Quiz 1	UART	2: UART, I/O, CPLD
5: Sept. 28	I/O, Interfacing	Wireless	2: **DEMO 2**
6: Oct. 5	I/O, Interfacing, Quiz 2		3: Wireless
7: Oct. 12	Microarchitecture		3: Wireless **DEMO 3**
8: Oct. 19	Microarchitecture, Quiz 3	Peripherals	Project Part A
9: Oct. 26	Design Principles	USART	Project Part A
10: Nov. 2	Design Principles, Quiz 4		**Partial Demo**
11: Nov. 9			Project Part B
12: Nov. 16			Project Part B
13: Nov. 23			**Final Demo**