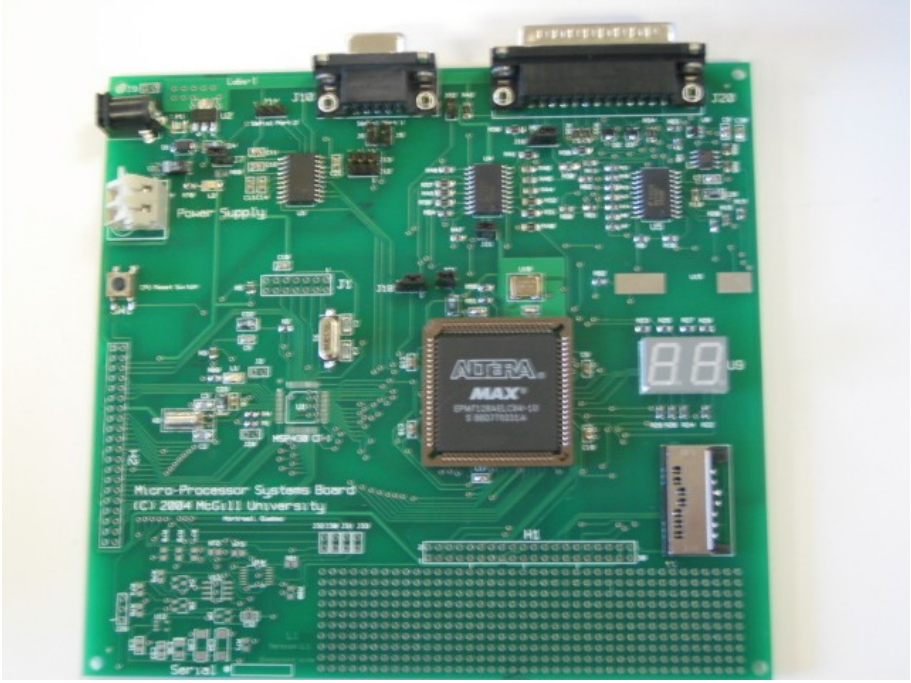
ECSE-426

Microprocessor Systems



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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).

Course Material

I extend my thanks to Prof. Mark Coates for providing the bulk of the material to teach this course

Course Outline

- **Prerequisites:** ECSE-323 and EDEC 206
- **Instructor:** Jean-Samuel Chenard
  Room 544 (VLSI Lab) McConnell
  (Ph) 514-800-1266
  e-mail: jsamch@macs.ece.mcgill.ca
- **Please put ECSE-426 as part of e-mail subject**
- **Office Hours**: after lectures; by appointment.
- **Teaching Assistants: George Ciobanu, Vlad Gabriel Feyer, Xuan Liu**

My Background

- B.Eng. '99 McGill, M.Eng '05
  - Low-power wireless sensor networks
  - Planar antenna design methods
- Worked in Industry
  - 1 year firmware design + board-level
  - 4 years in ASIC/FPGA in optical networking
- Working on my PhD
  - Debug methodologies for Network-on-Chip
  - Flexible (re-configurable) data processing
- Part time FPGA hardware and Embedded Systems consultant

Reference Books

- Reference
  - A. Tanenbaum, *Structured Computer Organization*, 5th edition, Prentice-Hall, 2005.
  - J. H. (John H.) Davies, *MSP430 microcontroller basics*, Oxford: Newnes, 2008.
    - *Note: Available as an e-book from http://muse.mcgill.ca*
  - C. Hamacher, Z. Vranesic and S. Zaky, *Computer Organization*, 5th edition, McGraw-Hill, 2002.

Course Objectives

- Primary objective: necessary understanding and skills to design and build microprocessor systems.
- By the end of the course, you should:
  - Understand computer organisation and basic design principles;
  - Have developed proficiency in assembly programming for embedded systems and awareness of its benefits and disadvantages;
  - Be experienced in developing embedded-C solutions;
  - Know how to connect peripheral devices and how to program a microprocessor to interface with them;
  - Understand the principles of instruction set architectures and microarchitectures and their impact on microprocessor design and implementation;

Assessment

- 16% Participation and Understanding
  - 4 quizzes (see course outline)
- 44% Lab Experiments
- 40% Project.

Assessment

Evaluations	Contribution to Final Grade		
Experiment 1	14	Demo	8
		Report	6
Experiment 2	15	Demo	10
		Lab Notes	5
Experiment 3	15	Demo	10
		Lab Notes	5
Project	40	Demo 1	13
		Final Demo	15
		Report	12
Quizzes	16		16

Assessment

- Demos – marks for performance, robustness, code quality, performance testing.
- Reports or Lab notes (concise but comprehensive, 1 per group) – detailed report guidelines will be posted on WebCT. Follow these closely.
- Students receive an individual grade for the demonstration component
- Generally the grades of the members in a group will be very similar
- Differentiation: response to questions or quality of components for which each member is responsible.
- Final project includes a peer evaluation sheet

Course Content

- Top-down approach to microprocessor programming and design.
- Lectures focus on structured computer organization, and progress through “layers” :
  - problem-oriented language level (embedded C) + assembly language level
  - Instruction set architecture
  - Microarchitecture
  - Hardware

Course Content

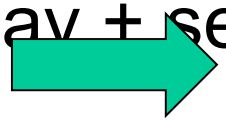
- Discuss design principles and impact on real-world architectures
  - Texas Instruments MSP430
  - ARM and commercial derivatives
  - Pentium
- The course focuses primarily on **experimental** work.
  - Each lecture: 45 minutes on theory and 30 minutes on how it applies to your hardware device and experiments.

Course Component	Lectures
Introduction Computer systems organization, Basic Design Principles	1
Problem-Oriented Language Level and Assembler Embedded C and assembly language	1
Instruction Set Architecture Properties, registers, instructions, data types, instruction formats, addressing, instruction types, control flow	2
I/O, 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, Pentium + picoJava machines	2

Course Experiment Structure

- 3 experiments + final project.

- Experiment 1: Assembly and C.
- Experiment 2: Intro. to hardware, timing, UART.
- Experiment 3: I/O, Interrupts.
- Project: Real-time clock, LCD display + serial interface between boards, sensors sensor network mote.



Course Timeline

Week (Mon.)	Lecture	Tutorial (*)	Experiment
1.Aug. 31	Intro		
2: Sept. 7	C + Assembly	MSP430	1: Assembly
3: Sept. 14	Instruction Set Arch.	Timers	1: Timers + C
4: Sept. 21	ISA ctd, Quiz 1	UART	2: UART I/O
5: Sept. 28	I/O, Interfacing		2: CPLD
6: Oct. 5	I/O, Interfacing, Quiz 2	USART	3: Wireless
7: Oct. 12	Microarchitecture	Wireless	3: Wireless
8: Oct. 19	Microarchitecture, Q 3	Peripherals	Project Part A
9: Oct. 26	Design Principles		Project Part A
10: Nov. 2	Design Principles, Q 4		Partial Demo
11. Nov. 9			Project Part B
12:Nov.16			Project Part B
13:Nov 23		* May be re-ordered	Final Demo

Course Info

- Labs conducted in pairs – write these on the circulated paper (otherwise random assignment).
- Both members must belong to same section!
- Final project in group of 4.
- Each team of 2 students need only submit one report for each experiment
- Four 15 minute quizzes will be conducted at the start of four lectures during the term.
  - lecture material since the previous quiz + most recently completed experiment.
- Penalties for Late Assignments
  - 5 percent per day (Fri.-Mon. = 1 day)
- Missed demo
  - reschedule for 65 percent of grade

Demonstration Time Slots

- Thursdays and Fridays
  - OK with everyone ?
  - Report conflicts with other courses ASAP
- Demos are scheduled during the time slot by the TAs
  - Don't miss your demo slot !
  - Both partners need to be present
  - Demo will last about 10 minutes per team
- Usually not the best time to add a feature...

Your Jobs This Week

- Preparation: review assembly/C programming for MSP430
- Read the assignment and think about it (construct a plan for a solution)
  - Check WebCT Postings
- Attend tutorial on Monday or Tuesday next week (according to your course section)

Next Week's Tutorial

- Overview of the CrossStudio for MSP430
  - Simple examples and use of the MSP430 core simulator.
- Tutorials are held at the start of the lab session in the MicroP lab.
  - 13:35 for Monday's tutorial
  - 14:35 for Tuesday's tutorial