

INTRODUCTION TO COMPUTER ORGANIZATION

CS 2504

Fall 2007

Instructor: Dimitris Nikolopoulos, Associate Professor

I. COURSE OUTLINE

This course provides an in-depth introduction to the the fundamental computer system abstractions and hardware components. The course is based on a hardware/software approach, which starts by presenting the elements of machine languages used by software to communicate with and guide program execution on the hardware. Following a detailed treatment of machine languages using a specific microprocessor family (MIPS), including instructions, data types, arithmetic and storage management, the course discusses the critical execution and storage components of modern microprocessors, including datapath and control logic, pipelines, and memory hierarchies. Selected topics such as performance analysis, multi-processors, clusters, I/O and networking are also discussed, depending on time availability.

II. LEARNING OBJECTIVES

Having successfully completed this course, the student will be able to:

- Write programs in assembly language and perform elementary performance optimizations.
- Use elements of logic design to implement specific microprocessor components.
- Understand implications of hardware on software design and optimization.
- Perform elementary performance analysis of a computer system.

III. TENTATIVE SCHEDULE

- Introduction to the course - 1 week
- Assembly language programming - 3 weeks
- Arithmetic - 1 week
- Logic design, hardware description - 1 week
- Control and Data Path - 2 weeks
- Pipelining - 2 weeks
- Memory Hierarchies - 2 weeks
- Selected topics: I/O, multiprocessors, clusters, performance analysis - 2 weeks

The lectures will include material on assembly simulators and hardware description languages, which will be offered to assist students in programming assignments.

IV. PREREQUISITES

C or better in CS 2204 & (CS 2704 or 2605)

V. TEXTS AND SPECIAL TEACHING AIDS:

The textbook for this course is: *Computer Organization and Design: The Hardware/Software Interface, Third Edition, Elsevier (Morgan Kaufmann), ISBN 1-55860-604-1.*

A web page will be maintained regularly for the course and you are strongly advised to visit the web page (<http://courses.cs.vt.edu/cs2504/fall2007/>). The web page will include instruction manuals and reading material in addition to the textbook. You may find this material helpful in your programming assignments. There will also be a class forum, where you may freely discuss questions and problems you are having with the assignments, questions on the instructional material, or other procedural issues of the course. The course will be using Blackboard discussion forums for this semester (unlike the CS forum used in earlier semesters).

VI. COURSE ASSIGNMENTS:

The coursework includes homework assignments, which are a blend of programming assignments and problems, a mid-term exam and a final exam. The relative weights of these components are: **60%** for the homework assignments, **20%** for the mid-term exam and **20%** for the final exam. This distribution follows the reasonable assumption that you will spend more effort during the semester while working on programming assignments and this effort should be rewarded accordingly. Typically, 10 sets of homework problems are assigned during the course of the semester. Homework includes a variety of programming assignments and some homework assignments are more labor-intensive than others. The course will be using Blackboard for the management of the assignments¹. Homework problems will be posted online, roughly on a bi-weekly basis. Homework assignments are individual and you may not exchange code or answers with your classmates. There will be a forum for CS2504, which you are encouraged to use for questions and concerns regarding the assignments. The forum has been an invaluable tool for providing clarifications and corrections on the assignments in the past. You will be given a simulator of MIPS processors for carrying out your assembly language programming assignments in the first part of the semester. For the first time this year, in the second part of the semester, the course will include material on hardware description languages and will use hardware description languages instead of graphical tools for designing basic processor components. You will be given the necessary tools to program using hardware description languages.

VII. GRADING AND POLICIES:

Grading formula: You will be graded on a curve for this class. 95% of the average score of the Top-10% of the class will be the base for an "A". 85% of the average score of the Top-10% of the class will be the base for a "B" and so on.

¹Note that unlike previous semesters, the course will not be using the CS Curator tool.

Attendance and honor issues: Although class attendance is not graded or enforced, you are expected to attend classes and participate actively in class discussions. You are also expected to abide by the University's honor code (see: <http://www.honorsystem.vt.edu/constitution.html>) and to exercise common sense during your conduct with your classmates and the instructor regarding the assignments of this course. A common principle is that you may share ideas with your classmates, but you may not share code.

Late homework assignments: There is a strict policy for late homework assignments: late homework is penalized by 10%, for each calendar 24-hour period beyond the deadline. Note that this implies that answers to homework problems may not be posted online due to one or more students being late in turning in their homework. Please be aware of this, as this may affect your study plans for the exams. At any rate, answers to a set of homework problems will be posted before the next set becomes available. Homework problems will be assigned once and there is no provision for make-up homework or other means of earning back lost points. Only in extraordinary circumstances, and with proper documentation provided by the University, the instructor will accommodate requests for make-up homework. In the event that a student is granted permission to do make-up homework, the homework problems will be different than the problems given to the rest of the class, the homework will be assigned towards the end of the semester, and the topics covered by the make-up homework will not necessarily be the same as the topics covered by the missed homework given to the rest of the class. Please note also, that in general, hardware failures are not considered as acceptable justification for late homework. You are largely responsible for backing up your code and data and guaranteeing that such failures will not have a significant impact on your classwork.

Instructor and TA contacts: Due to the high volume of e-mail received daily by the instructor, using e-mail for specific questions related to class material and assignments may incur an exceedingly high response time and is discouraged. In particular, do not expect to receive answers to e-mails including a snippet of code and the question "what is wrong with it?" The instructor strongly recommends to use the office hours (both his and those of the TAs) and the class forum for questions on assignments and class material. The office hours will be posted on the course web page, along with directions on how to locate the office of the instructor and the TA. This is another substantial change from the offerings of the course in previous semesters, when e-mail was used massively and quite inefficiently, for all class issues. You should also make a best effort to prepare any technical questions you have (in particular, coding questions) and provide enough evidence for the instructor or the TA to help you in a meaningful manner. For example, it helps if you include memory dumps and register dumps whenever you discuss bugs in your assembly code. Do not expect the instructor to debug code step by step for you. If you insist on using e-mail, use "CS2504: <assignment>", as your subject, where assignment is something like "Homework X". E-mail messages with no subjects or not self-descriptive subjects will be ignored and/or deleted at large.

Instructor absence and make-up lectures: In the event the instructor is absent due to documented professional travel commitments, a best effort to find a replacement will be made by the instructor, otherwise the class will be cancelled with sufficient prior notice.