Introduction to Computer Architecture
About the course and logistics

Introduction to Computer Architecture
Stefanos Kaxiras

Contents

• About the course

• What is computer architecture?
  (And why should you care?)

• Course logistics
About the course

About this course

• Introductory course to computer architecture
  – Teachers: Stefanos Kaxiras, Aletta Nylen
  – TAs: Ricardo Alves, Mehdi Alipour, Magnus Norgern, Germán Ceballos,
  – Oral presentations coach: Aletta Nylen

• Requirements: basic programming experience in an imperative language: C/Java

• Intensive course
  – 10hp
  – Includes Power and Parallelism
  – Workshops, Labs, Oral presentation, & Exam
# Contents

- **How a computer is built**
  - Logic → circuits → datapath
- **How a computer is controlled**
  - Instructions → microarchitecture → ISA → assembly
- **How a computer goes fast: Performance**
  - Pipelining → Hazards → Branch prediction, Caches, Virtual Memory
  - Parallelism
- **Contents**:
  - MIPS assembly
  - Logic design
  - Processor design
  - I/O and Memory
  - Caches
  - Virtual memory
  - Power
  - Parallelism

---

## Questions you should be asking...

- **Why should I care about this stuff?**
  - I’m not designing computers...
- **Architecture is essential for performance.**

- **Why are we using MIPS? I don’t own a MIPS computer...**
  - MIPS is simple. x86 is not.

- **MIPS = Microprocessor without Interlocking Pipeline Stages**
  - Made the textbook’s author (Hennessy) very wealthy. Used to be the main high-performance processor for graphics. Today it’s used in printers.

---

3/19/17
Learning Objectives

• Understand the **functionality and operation** of the basic elements of a computer system including processor, memory and input/output

• Reason about first-order **performance**

• Understand the **hardware/software interface**

• Understand and be able to write programs in **assembly language**

Course Logistics
Course structure

- **Class Lectures**
- **Book:** Computer Organization and Design, The Hardware/Software Interface (Hennessy/Patterson), 4th or 5th Ed.
  - Highly recommended
    (all exam material is in the lectures)
- **Workshops**
  - Required (pass/fail)
- **Labs**
  - Required (pass/fail)
- **Oral presentations**
  - In groups
  - Required (pass/fail)
- **Exam**
  - Gives you final grade e.g.: 3,4,5

Class Lectures

- We will go over the course material during the lectures.
- Slides for the lectures will be posted in studentportalen.
- As we are adjusting the material this year we will try to have them as soon as we can before the lecture so you can download them or print them and have them with you to keep notes.
- Some questions will be asked during the lectures and it would be good to have notepads to take notes.
Workshops

- Required attendance to pass. We will be taking absences in attendance sheets.
- During workshops we will be doing larger problems and going through the material together as an exercise.
- As the material in the workshops will be directly related to questions that may appear in the final exam it pays to be present.
- We will be posting the workshop problems in studentportalen before the workshop and the solutions after.
- You are required to work on the problems before coming to the workshop. Complete solutions are not necessary but familiarity with the material is expected. We will be conducting random tests during the workshop to see how much you have prepared. If you are consistently not prepared it may count as an absence.
- Furthermore for those consistently attending the workshops (no more than one absence or two if there is a good reason) will get a 10% bonus on the exam. We will be keeping name lists for this.

Labs

- There are going to be three labs.
- Typically labs are split between assembly language and processor design.
- The Teaching Assistants run the labs: Magnus Norgren magnus.norgren@it.uu.se, Mehdi Alipur mehdi.alipour@it.uu.se, Ricardo Alves ricardo.alves@it.uu.se, German Ceballos german.ceballos@it.uu.se
- You will be split in three groups in studentportalen for the labs. Please check your group before the lab.
- Preparation material will be given in the studentportalen and before the labs.
- You must start working on the Lab assignment before you come to the lab. If you complete the assignment, you demo it in the lab and you are done. Otherwise the Lab will help you to finish it. You must hand in (upload) the lab assignment no later than a week after the lab.
- If you have questions please let us know.
Oral presentations

– This part of the course will be administered by Aletta Nylén (aletta.nylen@it.uu.se).
– A preparation lecture and several workshops will be held for the oral presentations.
– You will be called to choose a topic out of a list we provide or propose one yourself.
– You will be split into smaller groups and you will present in your group.
– A number of special presentation classes are set apart for this purpose towards the second half of the course.

Points and grading

<table>
<thead>
<tr>
<th>Exam 5hp</th>
<th>Gives you final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labs 3hp</td>
<td>Pass/fail</td>
</tr>
<tr>
<td>Oral presentations 2hp</td>
<td>Pass/fail</td>
</tr>
<tr>
<td></td>
<td>Must do the oral presentation</td>
</tr>
</tbody>
</table>

• Labs correspond to 3 points and are pass/fail
• Oral presentations correspond to 2 points and are pass/fail
• The lectures and workshops correspond to 5 points and the grade (fail, 3, 4, 5) is given by the final exam.
• You get a 10% bonus by consistent participation in the workshops.
Course material

• The lecture slides define the material for the course that will be examined in the final exam.
• The material is based on the book: Computer Organization and Design, The Hardware/Software Interface (Hennessy/Patterson).
• You can use either the 4th or the 5th edition.
• However the book contains substantially more material than what we teach in a single period.
• Feel free to use any other material you can find. Information is freely available and you should always look for resources.
• We will also try to post as much as we can in studentportalen for your help.
• Online videos from other courses are useful but the material is going to be somewhat different. Please feel free to contact me for any questions you may have.

SCHEDULE

• Will be published in studentportalen
  – Minor changes may happen because of unexpected events (trips) and we will announce these in advance
  – Week of April 10 (v 15):
    • Monday April 10: Guest lecture from Intel: Jakob Engblom, jakob.engblom@intel.com
    • Tuesday April 11: Workshop: Logisim tutorial
    • Wednesday April 12: Lecture on Logic organized by TAs (Mehdi Alipour)
    • Thursday April 13: DAY OFF ! Enjoy !
How to **learn the most** in this class

- Do all of the following:
  - **Attend** the lectures
  - **Read** the book (BEFORE AND AFTER the lecture)
  - Do the **practice** problems (before and in the workshops)
  - Do the **labs** (& pass)
  - Do the **oral presentation** (& pass)

---

How to get help

- Ask questions **in-class** or **online**: we will be setting a piazza account for all interactions between Teachers/TAs and you
  - Answered by other students and the staff
  - For Labs ask the Tas
  - For Oral presentations ask Aletta

- **Review** on your own
  - Lectures are all online
  - Book isn’t going anywhere

- Work with **other students**
  - But don’t cheat (see the syllabus for details)
  - Lots of collaborative work in this course
  - We encourage you to work together
Other course website info

- Completed labs must be uploaded to studentportalen.uu.se

- Piazza Registering:
  - We will send out detailed instructions for registering
  - If you do not have a listed email then please contact the teacher

- Make sure you are registered for these sites to keep up with the course!