Computer Organization II

- Position
  - Intermediate (BSc) level course

- Prerequisite: Computer Organization I (TiTo)
  - Main hardware
  - Symbolic assembly language, machine instructions
  - CPU Instruction cycle
    - What happens in system during the cycle?

- Related to Operating Systems
  - Interrupts
  - Virtual memory
  - I/O Techniques
Course Material

- Course book (Make sure you have one!)
  - (7&6th ed.) possible, but MISSING a lot of material

- Lecture course home page (Spring 2012)
  https://www.cs.helsinki.fi/en/courses/581365/2012/k/k/1
  - Schedule, slides, exercises, announcements, links, etc.

- Course home page
  - Link to list of old exams
  - Old courses, slides in Finnish and English, etc.
  http://www.cs.helsinki.fi/group/nodes/kurssit/tikra/

Schedule Spring 2012

  - Mon 12-14 C222 and Wed 12-14 D122, Tiina Niklander
  - In English when needed

- Practice sessions:
  - Thu 12-14 (C222), Tiina Niklander
  - General discussion in English
  - Table discussions allowed in Finnish (if everyone understands)

- Course Exam (tentative time)
  - Wed 29.2.2012, 16.00 - 20
  - All exams also in English, if requested in advance
A := B + C;

High-level lang.

\[
\begin{align*}
\text{MOV AX, B} \\
\text{ADD AX, C} \\
\text{MOV A, AX}
\end{align*}
\]

Assembler

Functionality! What happens in the system?

Implementation! How is the hardware composed of? What makes it tick? How do ticks translate to work?

Logical circuits
Learning goals

- **Digital logic**: Combinatorial & Sequential Circuits
- **Bus**: multiplexing, signaling
- **Memory hierarchy**: cache, TLB
- **Arithmetics**: Booth algorithm, representations
- **Instruction set**: operands, operations, memory reference
- **Processor structure and functions**: pipelining, RISC, CISC
- **Control**: micro-operations, micro-programmed control, clock pulse
- **Parallel Processing**: types, cache coherence, multicore

More detailed learning goals are available from course page.

Course contents and schedule

- **Week 1**
  - Overview (Ch 1 – 8)
  - Digital logic (online Ch 20)
  - Bus (Ch 3)
- **Week 2**
  - Memory, Cache (Ch 4, 5)
  - Virtual memory (Ch 8.3-8.6)
- **Week 3**
  - Computer arithmetic (Ch 9)
  - Instruction sets (Ch 10, 11)
- **Week 4**
  - CPU struct. & func. (Ch 12)
  - RISC-architecture (Ch 13)
- **Week 5**
  - Instruction-level parallelism, Superscalar proc. (Ch 14)
  - Control Unit (Ch 15-16)
- **Week 6**
  - Parallel Processing (Ch 17)
  - Multicore (Ch 18)
  - Summary
Work during the course

- Combine the details together to form a larger picture
  - Try to continuously understand and analyse the connections
  - Stay awake!
- Make notes
  - Write down own ideas and questions immediately
- Ask questions
  - Question are never too simple.
    (If you missed the point, then somebody else missed it also)
  - Ask from teachers but also from co-students.
- Teamwork is allowed even with individual assignments
  - However, own paper must be written by you, even if you co-operated in learning the content

Summary lectures

- All lectures are summary lectures
  - Slides are just the “table of content” for summary lectures
  - Students are expected to have studied lecture topic in advance
    - Read given chapters from the text book!
- Lecture consists of
  - Summary of central topics for this lecture
  - Small group discussions on given topics
  - General discussions, based on small group discussions and student questions
Practice Sessions

- Mark down homeworks done
  - Grade points based on marked homeworks and attendance
- Split into tables
  - Tables in English or Finnish
- Discuss all problems in each table
- Ask questions if needed

Projects – write essays

- Three short essays during the course
  - Total 6 points from the essays
  - Each graded with scale 0-5 and then later converted to the course grading points
- Goals
  - Practise writing own text and scientific argumentation
    - Learn to present own ideas in written form
  - Based on new scientific articles
    - Current trends and latest research
Lecture 0: General Admin, Course Intro 16.1.2012

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Grading

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Available points toward grade</th>
<th>Minimum points needed to pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice Sessions</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(homeworks, attendance)</td>
<td></td>
</tr>
<tr>
<td>Course Exam</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Projects</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>20</td>
</tr>
</tbody>
</table>

How much time do I need to invest for this course?

- Simple time estimations (for planning)
  - 1 year / 60 cu = 1600 h / 60 cu = 26.67 h / 1 cu = 107 hours / 4 cu
  - 107 hours / 7 weeks = 15 hours each week

- Motto:
  "It is not good exercise, if you do not sweat"
  ("Kunto ei nouse, ellei tule hiki.")

Enjoy the course!
Credits

Teemu Kerola 1999-2003
- Original slides (in English), Based on 5th edition
- Updated to 6th edition 2002

Auvo Häkkinen 2004-2005
- Most slides translated to Finnish, orange layout
- Updated to 7th edition 2005

Teemu Kerola 2006

Liisa Marttinen 2007

Tiina Niklander 2008-2010
- Translation to English from the Finnish slide set 2009
- Updated most slides to 8th edition 2010

Teemu Kerola 2010
- Course update to 8th edition