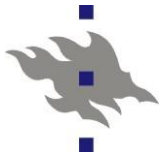
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

581365 Tietokoneen rakenne
Computer Organization II

Spring 2009

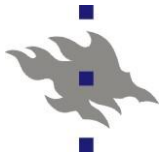
Tiina Niklander

Matemaattis-luonnontieteellinen tiedekunta



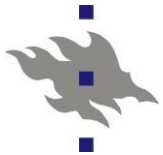
Computer Organization II

- Advanced (master) level course!
- Prerequisite: Computer Organization I (TiTo)
  - Main hardware
  - Symbolic assembly language, machine instructions
  - Instruction cycle (on CPU)
- Related to Operating Systems
  - Interrupts
  - Virtual memory
  - I/O Techniques



Material

- Course book (Make sure you have one!)
  - Stallings W.: Computer Organization & Architecture, Designing for Performance (7th ed), Prentice-Hall, 2005.
  - (6th ed.) still OK, but missing some material
- Course page (for this Spring course) http://www.cs.helsinki.fi/u/niklande/opetus/tikra/2009/index.en.html
  - Slides, exercises, announcements, links, etc.
- Course main page http://www.cs.helsinki.fi/kurssit/syventavat/581365/
  - Old courses, slides in Finnish and English, etc.
- Newsgroup: hy.tktl.opiskelu.tikra

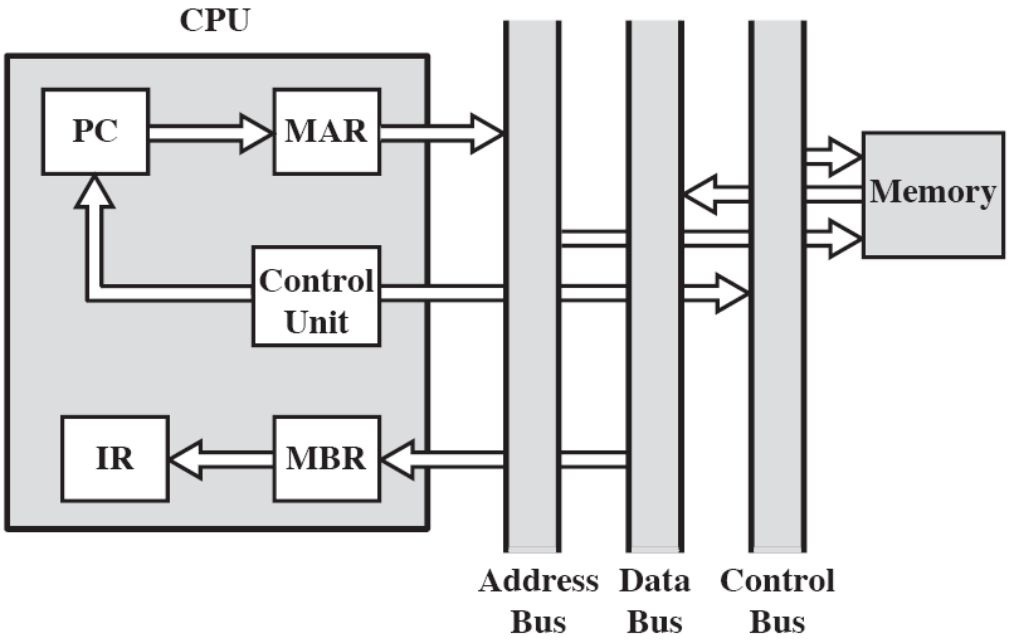


Schedule Spring 2009

- Lectures: 9.3. – 24.4.2009
  - In Finnish: Tue and Thu 14-16, B222
  - English summary: Fri 14-16 C220
- Exercises:
  - In Finnish, 1. to 12.03. 16-18 B119, 2. pe 20.03. 14-16 C221, 3.-6. to 23.03.-24.04. 16-18 B119 (Liisa Marttinen)
  - In English Fri 13.3. – 24.4. 12-14 C220
- Course Exam
  - Wed 29.4. 9.00-12 A111

- Separate exams are also available

Comp Org I (TITO): lowest presentation level



A := B + C;

High-level lang.

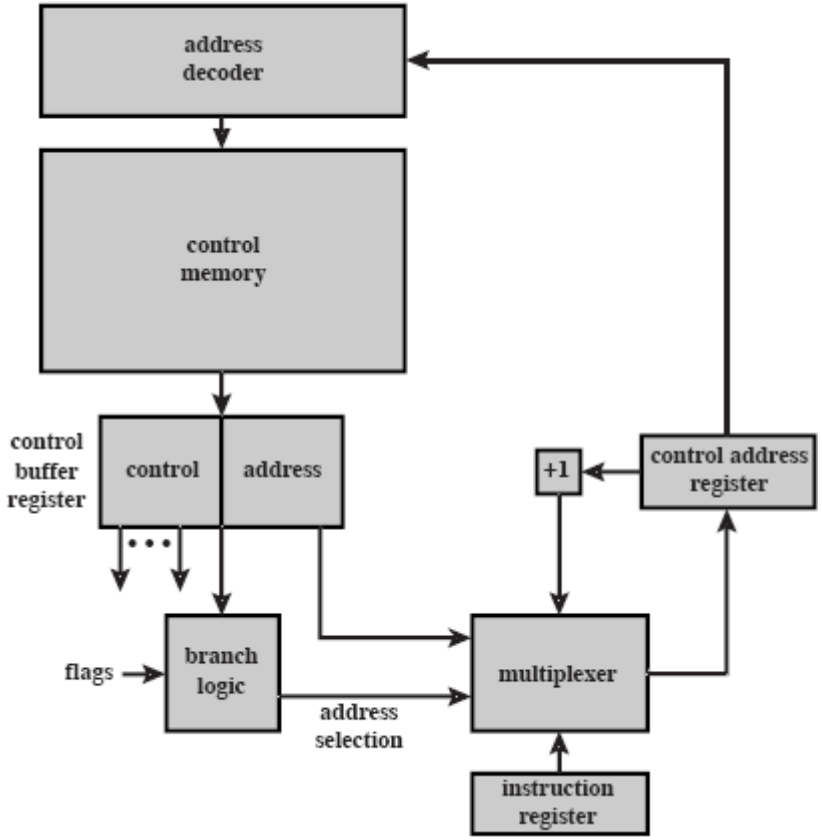
MOV AX, B
ADD AX, C
MOV A, AX

Assembler

Functionality! What happens in the system?

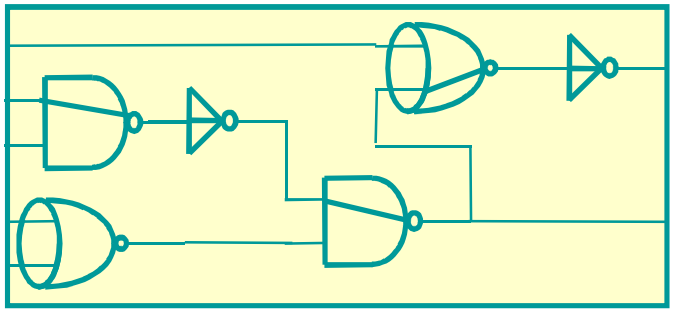
Sta06: Fig 12.6

Comp Org II (TIKRA): lowest presentation level



MOV AX, B
ADD AX, C
MOV A, AX

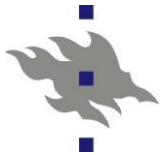
Assembler



Logical circuits

Implementation! How is the hardware composed?

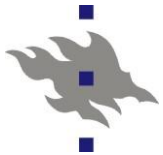
Sta06: Fig 17.7



Learning goals

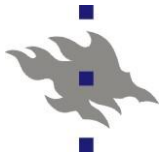
- **Digital logic:** truth table, Karnaugh-maps, flip-flop, ...
- **Bus:** multiplexing, signaling
- **Memory hierarchy:** cache, TLB
- **Arithmetics**: Booth algorithm, representations
- **Instruction set**: operands, operations, memory reference
- **Processor structure and functions**: pipelining, RISC,CISC
- **Control**: micro-operations, micro-programmed control, clock pulse

More detailed learning goals (at the moment only in Finnish) are available from course main page



Course content and schedule

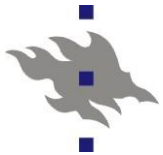
- Week 1
  - Overview (Ch 1 – 8)
  - Bus (Ch 3)
- Week 2
  - Digital logic (App B)
  - Memory, cache (Ch 4, 5)
- Week 3
  - Virtual memory(Ch 8.3-8.6)
  - Computer arithmetics (Ch 9)
- Week 4
  - Instruction set (Ch 10, 11)
  - CPU struc.& func. (Ch 12)
- Week 5
  - RISC-architecture (Ch 13)
  - Instruction-level parallelism, superscalar processor (Ch 14)
- Week 6
  - IA-64 and other architectures (Ch 15)
  - Control Unit (Ch 16-17)



Motto

”It is not good exercise,
If you do not sweat”

“Kunto ei nouse
ellei tule hiki.”

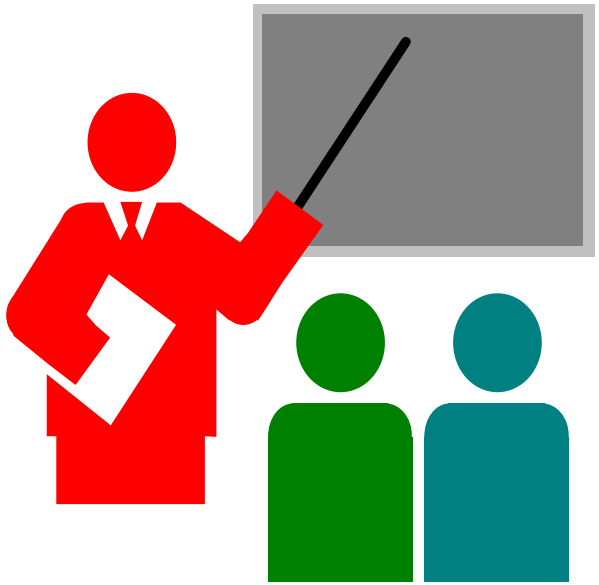


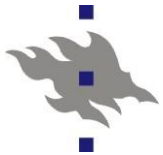
Work during the course

- Combine the details together to form a larger picture (in your mind)!
  - 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 teacher, assistant, 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

Be active!

- Do all exercises in advance!
  - On your own / in small teams.
  - Think about the problem during several days
    - at least before giving up
  - **Learning by doing!**
- Ask about the problematic parts
  - While solving the questions
  - When solutions are presented
  - Afterwards from instructors
  - Beginning of next meeting

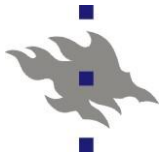




Note!

- These slides are just the “table of content”
  - ~ notes of the lecturer
- **Read the book!**
  - ~ just following the lectures or summary is not enough
- Spend enough time in learning the content
  - Simple time estimation (for planning)
  - VERY OLD: ~ 6,5 weeks*(2*(4+2)) = 78 hours
  - OLD: 4 op = 2 ov: 2 * 40 = 80 hours
  - CURRENT: 1 year / 60 op = 1600 t / 60 op
    = 26.67 t / 1 op = 107 hours / 4 op

Enjoy the course!



Credits

- Teemu Kerola 1999-2003
  - Original slides (in English), blue layout
    - Based on 5th edition
  - Updated to 6th edition 2002
- Auvo Häkkinen 2004-2005
  - Most slides translated to Finnish, orange layout
    - Figures integrated to slides
  - Updated to 7th edition 2005
- Teemu Kerola 2006
- Liisa Marttinen 2007
- Tiina Niklander 2009
  - Translation to English from the Finnish slide set