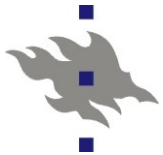
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

581365 Computer Organization II (Tietokoneen rakenne)

Autumn 2010

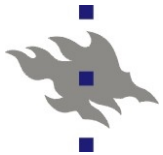
Teemu Kerola

Faculty of Science
Matemaattis-luonnontieteellinen tiedekunta



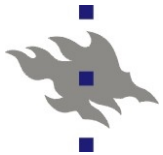
Computer Organization II

- Position
  - Advanced (MSc) level course (2005 degree requir.)
  - Intermediate (BSc) level course (2010 degree requir.)
- 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

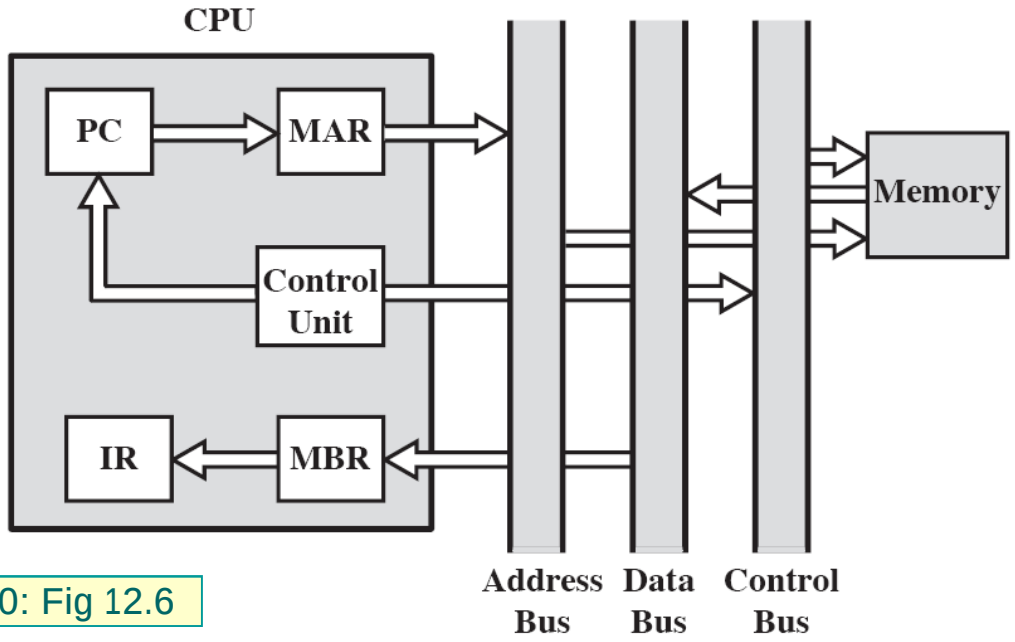
- Course book (Make sure you have one!)
  - **Stallings W., Computer Organization & Architecture**, Designing for Performance (**8th ed**), Prentice-Hall, 2010.
  - (7&6th ed.) possible, but MISSING a lot of material
- Lecture course home page (Autumn 2010)
  https://www.cs.helsinki.fi/en/courses/581365/2010/s/k/1
  - Schedule, slides, exercises, announcements, links, etc.
- Course home page
  http://www.cs.helsinki.fi/group/nodes/kurssit/tikra/
  - Old courses, slides in Finnish and English, etc.
  - Later: https://www.cs.helsinki.fi/en/courses/581365/ ?



Schedule Autumn 2010

- Lectures: 2.11. – 9.12.2010
  - Tue and Thu 14-16 (D122), Teemu Kerola
  - In English when needed
- Practice sessions:
  - Thu 14-16 (D122), Teemu Kerola
  - General discussion in English
  - Table discussion in Finnish (if everyone understands)
- Course Exam
  - Tue 14.12.2010, 9-12 (A111)
  - Tue 25.1.2011, 16-20 (A111), make-up exam/final exam
  - All exams also in English, if requested in advance

Comp Org I (TITO)
Lowest Presentation Level



Sta10: Fig 12.6

A := B + C;

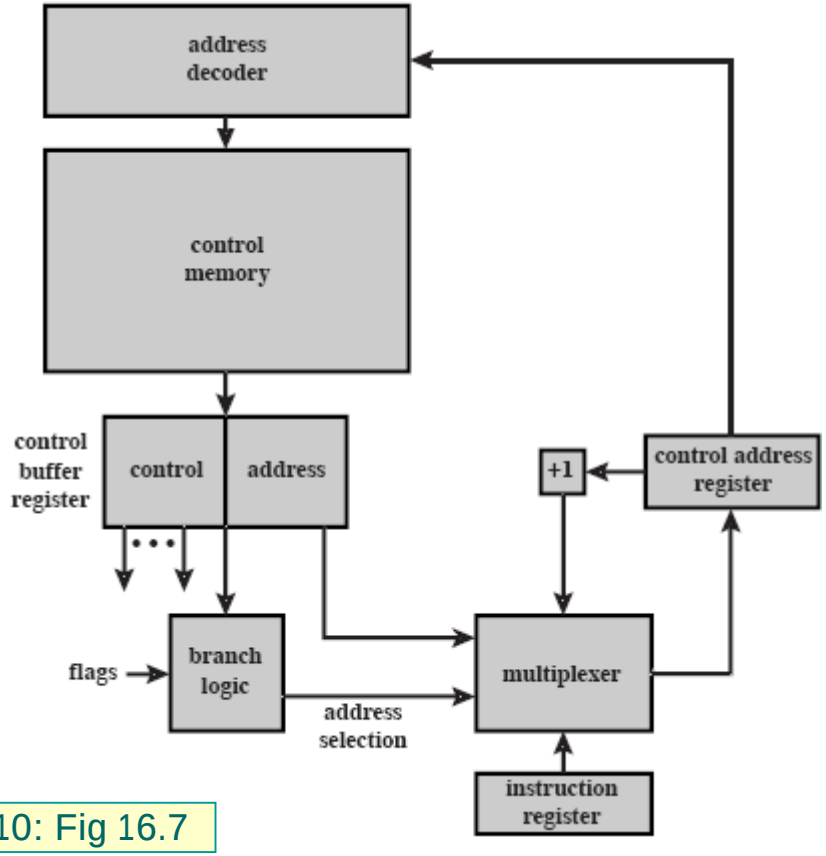
High-level lang.

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

Assembler

Functionality! What happens in the system?

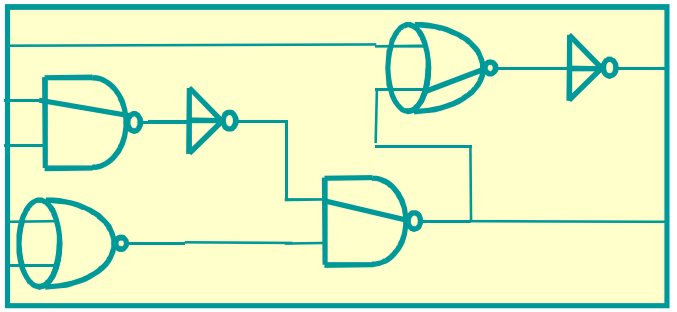
Comp Org II (TIKRA)
Lowest Presentation Level



Sta10: Fig 16.7

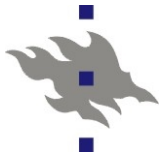
MOV AX, B
ADD AX, C
MOV A, AX

Assembler



Logical circuits

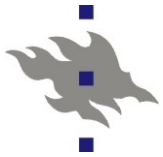
Implementation! How is the hardware composed of?
What makes it tick? How do ticks translate to work?



Learning goals

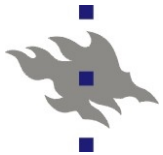
- **Digital logic:** Combinatorial & Sequential Circuits
- **Bus:** multiplexing, signaling
- **Memory hierarchy:** cache, TLB
- **Arithmetics**: Booth algorithm, representations
- **Instruction set**: operands, operations, memory reference
- **Processor structure and functions**: pipelining, RISC,CISC
- **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



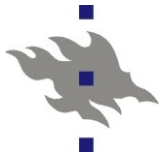
Work during the course

- 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

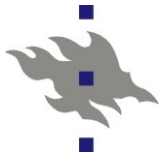
- All lectures are summary lectures
  - Slides are just the “table of content” for summary lectures
  - Students are expected to have studied lecture topic in advance
    - Read given chapters from the text book!

- 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



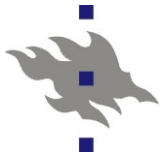
Practice Sessions

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



Projects

- All volunteer with extra projects
- Project 1: Make 2 new practice problems
  - Team project, 1-4 students
  - Understand some topics better
- Project 2: Study diary
  - Can work with a team
  - Each student will turn in their own diary
  - 1st part turned in already after 3 weeks
  - Understand all topics better



Grading

Course Component	Available points toward grade	Minimum points needed to pass
Practice Sessions (homeworks, attendance)	6	1
Course Exam	30	15
Extra Projects	6	0
Total	42	18

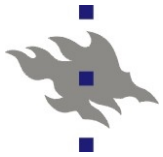
How much time do I need to invest for this course?

- Simple time estimations (for planning)
  - VERY OLD: 6,5 weeks*(2*(4+2) h/wk) = **78 h**
  - OLD: 4 cu = 2 study weeks: 2 * 40 h = **80 h**
  - CURRENT: 1 year / 60 cu = 1600 h / 60 cu
    = 26.67 h / 1 cu = **107 hours** / 4 cu
- 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
  - 2009: Translation to English from the Finnish slide set
  - 2010: Updated most slides to 8th edition