

Computer Architecture Agenda

http://d3s.mff.cuni.cz/teaching/computer_architecture/



CHARLES UNIVERSITY IN PRAGUE

faculty of mathematics and physics

Lubomír Bulej

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Course information

- **Lecturer:** Lubomír Bulej
 - Dept. of Distributed and Dependable Systems
 - Malá Strana, 2nd floor, room no. 205
 - bulej@d3s.mff.cuni.cz
- **Lectures**
 - Wednesday 10:40, lecture room S4 (EN)
 - Thursday 9:00, lecture room S5 (CZ)
 - <http://d3s.mff.cuni.cz/teaching/nswi143>



Course contents

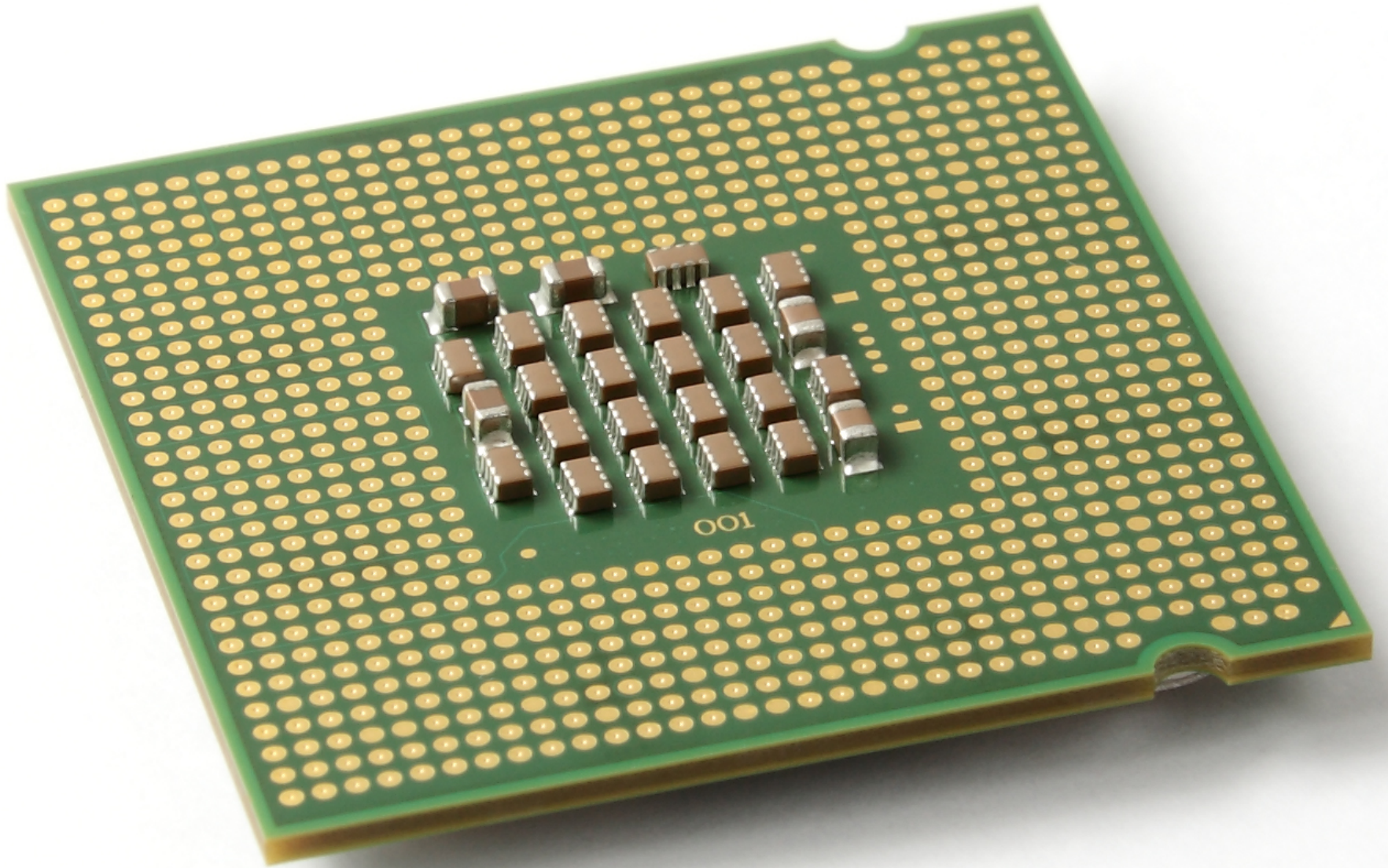
- **Processor architecture**

- Gates, combinatorial and sequential circuits, functional blocks, arithmetic operations
- Processor performance, basic metrics
- Instruction execution, data path and control

- **Computer architecture**

- Memory subsystem, cache
- Latency and throughput
- Parallel and vector processing





Why should you care?

... I'll be coding in Java, C#, Python, ...,
JavaScript or PHP all day!

Why do I need to know how
a computer (or a processor) works ?



Why should I care?

- **Course credits ...**
- **It's mandatory ...**



Why should I care?

- ~~Course credits ...~~
- ~~It's mandatory ...~~



Why should I care?

- ~~Course credits ...~~
- ~~It's mandatory ...~~
- I'll be coding web anyway...



TECH —

Steve Jobs: MobileMe “not up to Apple’s standards”

Apple CEO Steve Jobs sent an internal e-mail to Apple employees this evening...

JACQUI CHENG - 8/5/2008, 5:19 AM

NEWS Firefox 3.0 released, servers overwhelmed

By Peter Cohen

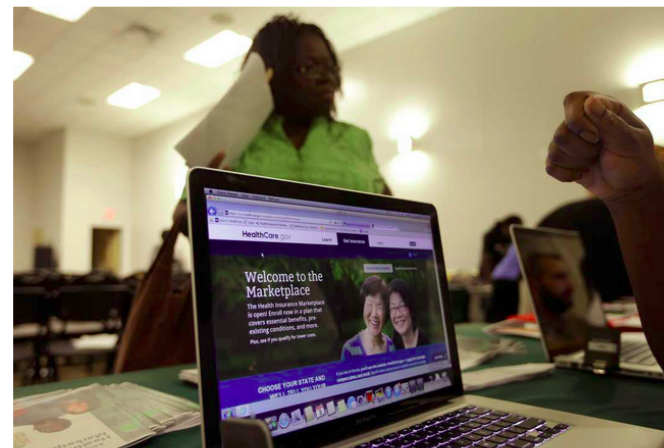
Macworld | JUN 17, 2008 12:24 PM PT

Mozilla has released [Firefox 3.0](#), the final release of the newest version of its popular Web browser. The company may have been a bit unprepared for the



Government did not test health care site as needed

Kelly Kennedy | USA TODAY
Published 12:33 AM EDT Oct 25, 2013



The HealthCare.gov website has had problems with delays and dropped information.
Lynne Sladky, AP

WASHINGTON — Not enough tests were performed on the HealthCare.gov website by the government and its contractors before the site was launched Oct. 1, a

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Australian Bureau of Statistics website CRASHES under the weight of traffic as millions attempt to complete their compulsory census form online - and avoid an \$1800 fine

- Australian Bureau of Statistics' census website has crashed online
- Millions have taken to social media to rant about the meltdown
- Residents have been met with error messages and unable to call hotline
- However, the online census is open until September 23

By CINDY TRAN FOR DAILY MAIL AUSTRALIA

PUBLISHED: 11:28 GMT, 9 August 2016 | UPDATED: 12:02 GMT, 10 August 2016

Millions of Australians attempting to complete the census online have been blocked from filling out their details after the website crashed - causing nationwide outrage.

The Australian Bureau of Statistics system descended into meltdown on Tuesday night, with millions of people taking to social media to rant their frustration.

Around 16 million people who are expected to log on to complete the compulsory survey on the night of August 9 have been met with error messages.

The online census has come to a crashing halt, leaving the website unavailable until further notice.

Why should I care?

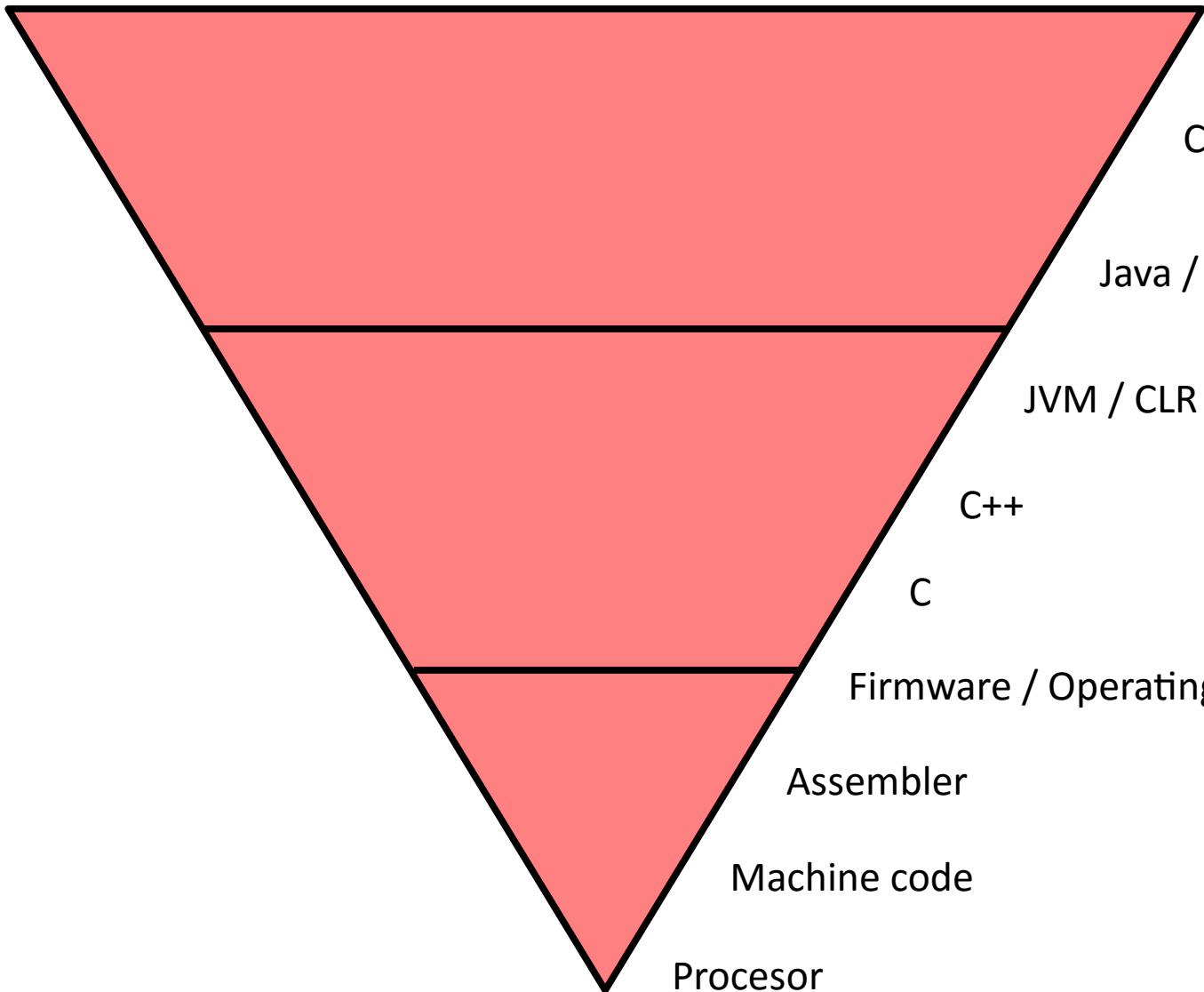
- ~~Course credits ...~~
- ~~It's mandatory ...~~
- I'll be coding web anyway...
 - But it may be handy to know...
 - ... how things work in a computer, because it influences how operating systems, virtual machines, etc. work



Why should I care?

- ~~Course credits ...~~
- ~~It's mandatory ...~~
- I'll be coding web anyway...
 - But it may be handy to know...
 - ... how things work in a computer, because it influences how operating systems, virtual machines, etc. Work
 - This will help me to ...
 - ... design and develop apps with more insight
 - ... diagnose and solve problems when (not if) they happen





Application framework

Component system

Java / .NET

JVM / CLR

C++

C

Firmware / Operating system

Assembler

Machine code

Processor



Why should I care?



Make sure students don't treat a computer as
a black box that, in some uncertain way, executes a program.

Understanding the basic principles of modern architectures
allows effective use of programming languages.



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● Books

- D. A. Patterson, J. L. Hennessy: *Computer Organization and Design*
 - Recommended for this lecture
- A. S. Tanenbaum: *Structured Computer Organization*
- W. Stallings: *Computer Organisation and Architecture*
- V. P. Heuring, H. F. Jordan: *Computer Systems Design and Architecture*



Literature (2)

- **Internet**

- Wikipedia
- Similar courses at other universities
 - MIT, Princeton, Berkeley, Carnegie Mellon, (Coursera, edX, ...)



How to check your understanding?

- **Try solving exercises**
 - „Check yourself“ sections in the *Computer Organization and Design* book



- **Written form only**

- Oral exam only in very special cases
- A set of questions covering the material from lectures

- **Requirements**

- Emphasis on understanding the basic principles and the ability to apply them in certain situations
 - As opposed to memorizing facts
- **Attention:** Passive knowledge from slides/book not enough



Some of what you should know about...

- ... after finishing the course
 - **Basic architecture of a computer**
 - **How does a processor execute instructions**
 - **How to measure/compare computer performance**
 - **What determines program performance and how can a programmer influence it**
 - **How does the processor/computer architecture impact program performance**
 - **Why can't we just increase CPU frequency all the time**
 - **Why do we need to move from single-core to multi-core CPUs**
 - **What a processor cache is and how does it work**
 - **Why cache coherence makes scaling difficult**



Why should you know?

- **Cultivating *mechanical sympathy*...**

- ... using a tool with an understanding how it operates best.

„You don't have to be an engineer to be a racing driver, but you do have to have mechanical sympathy.“

– Jackie Stewart, F1 racing driver

- **Applied to computer science**

- ... improving program performance on modern CPUs
- ... better utilization of computing resources
- ... comparing performance of different computers and assess their suitability to a given task
- **In a systematic fashion, not by trial and error**

