

College of Computer Science, Zhejiang University

# Introduction to Computer Architecture

Spring Semester, 2008–2009

Lecture time: Monday, 9:50 – 11:50AM, in West-CaoGuangBiao 104

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## Instructor:

### •Jiang Xiaohong

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CourseFTP: <ftp://10.71.75.200> username: archj; password: archj.

Q&A: CC98 forum

Teacher Assitant: Liu Yang

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## Textbook:

### •Computer Architecture – A Quantitative Approach (4th edition)

John L. Hennessy and David A. Patterson

China Machine Press

### •Computer Architecture – A Quantitative Approach (3rd edition) (Chinese Version)

Translated by Zheng, Weimin(郑纬民等) etc.

Publishing House of Electronics Industry

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## Prerequisites:

Computer Organization, Assemble Language, Operating System

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## Grading:

- 5%: Class participation & performance
  - 20%: Homework
  - 15%: Pop quiz
  - 15%: Literature Reading
  - 45%: Final examination (close-book paper test)
  - Bonus: doing optional assignments or extra excellent job in literature reading
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## Homework & Literature Reading

### Homework:

- Total 4 times, once per chapter
- Submission deadline will be normally one week after assigned, and will be announced on CC98.
- For doing homework, discussion is greatly encouraged, but every student is required to **Do and Submit** the homework individually.

### Literature reading:

- Three abstracts of three papers, each more than 1500 words.
- Better to find three papers in the same topic in the last recent 3 years.
- Write a review of these three papers. More than 3000 words.
- Reading grading:  $3\%(\text{abs1}) + 3\%(\text{abs2}) + 3\%(\text{abs3}) + 6\%(\text{review})$ .

### Submission rule and late policy:

- All assignments are required to be written in English.
  - All assignments are required to be submitted in time to the appointed directory on the course ftp site.
  - Please name your submitted document as “StID\_Name\_hw1” in DOC or PDF.
  - Two day late submission will get 10% off from grading; Four day late homework will get 20% off from grading.
  - Late assignments **more than four days** are **NOT** acceptable.
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## Topics:

Introduction to the course ( 1 credit-hour )

Chapter 1: Fundamentals of Computer Design (5 credit-hours)

1.1 Introduction

- 1.2 Classes of Computers
- 1.3 Defining Computer Architecture
- 1.4 Trends in Technology
- 1.5 Trends in Power in integrated circuits
- 1.6 Trends in cost
- 1.7 Dependability
- 1.8 Measuring, reporting and summarizing performance
- 1.9 Quantitative principles of computer design
- 1.10 Performance and price-performance
- 1.11 Answer to assignments

Chapter 2: Instruction Set Principles and Examples ( 5 credit-hours)

- 2.1 Introduction
- 2.2 Classifying instruction set architecture
- 2.3 Memory addressing
- 2.4 Type and size of operands
- 2.5 Operation in the instruction set
- 2.6 Instructions for control flow
- 2.7 Encoding an instruction set
- 2.8 The role of compilers
- 2.9 The MIPS architecture
- 2.10 Answer to assignments

Chapter 3: Pipelining: Basic and Intermediate Concepts ( 12 credit-hours)

- 3.1 Introduction
- 3.2 The Major hurdles of pipelining-pipeline hazards
- 3.3 How is pipelining implemented ?
- 3.4 What makes pipelining hard to implement?
- 3.5 Extending the MIPS pipeline to handle multicycle operations
- 3.6 The MIPS R4000 pipeline
- 3.7 Survey of Instruction Level Parallelism
- 3.8 Answer to assignments

Chapter 4 : Memory Hierarchy Design 10 hours

- 4.1 Introduction
- 4.2 Cache performance
- 4.3 Six Basic cache optimizations
- 4.4 Eleven advanced optimizations of cache performance

- 4.5 Memory technology and optimizations
- 4.6 Virtual memory
- 4.7 Protection and examples of virtual memory
- 4.8 Virtual memory and virtual machines
- 4.9 The design of memory hierarchies
- 4.10 AMD opteron memory hierarchy
- 4.11 Answer to assignments

Chapter 5: Multiprocessors ( 2 credit-hours)

- 5.1 Introducton
- 5.2 Symmetric Shared-Memory Architecture
- 5.3 Performance of Symmetric Shared-Memory Architecture
- 5.4 Distributed shared memory and directory-based coherence

Chapter 6: Perspective of computer architecture ( 2 credit-hours)

Overview of the course: ( 3 credit-hours)

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**Lab assignments ( In course : computer architecture experiment)**

1. Understand how to design a simple and to know the MIPS instructions to be implemented. Learn to install and use MaxPlus II. Use MaxPlusII to design CPUs and perform function simulation step by step according to the project tutorial.

- a) Function Unit design, including Multiplexers, Adder, Shifter, ALU, Register file
  - b) Single-cycle CPU
  - c) Multiple-cycle CPU
  - d) Pipelined CPU (selective. If it is finished, bonus score can be added to the grade.)
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