

Advanced Computer Architecture

Reading Instructions and Exam Questions

Examination

- Written examination
 - 1.5 points (2.3 ECTS-points)
- Exam questions both in Swedish and English
- Your answers in Swedish or English
- Grading
 - Max. number of points: 40
 - To pass the exam: minimum 21 points.
- Examination date and time: 2000-12-19, 14-18
 - <http://www.student.liu.se/search/>

For the Exam

- All lecture notes
 - Except "Power Dissipation in CMOS Circuits"
- Textbook
 - See the reading instructions on the course web page
- "The Technology Behind Crusoe Processors"
- Note:
 - No technical details or block diagrams corresponding to any microprocessor or particular computer architecture and circuit are requested at the exam

For the Exam

■ Prerequisites:

- | Chapter 2. Computer Evolution and Performance
 - | 2.1 A Brief History of Computers
 - | 2.2 Designing for Performance
- | Chapter 3. System Buses
 - | 3.1 Computer Components
 - | 3.2 Computer Function
 - | 3.3 Interconnection Structures
 - | 3.4 Bus Interconnection
- | Chapter 5. External Memory
 - | 5.1 Magnetic Disk
 - | 5.3 Optical Memory
 - | 5.4 Magnetic Tape

For the Exam

■ Prerequisites (continued):

- | Chapter 6. Input/output
 - | 6.1 External Devices
 - | 6.2 I/O Modules
 - | 6.3 Programmed I/O
 - | 6.4 Interrupt-Driven I/O
 - | 6.5 Direct Memory Access
 - | 6.6 I/O Channels and Processor
- | Chapter 9. Instruction Sets: Characteristics and Functions
 - | 9.1 Machine Instruction Characteristics
 - | 9.2 Types of Operands
 - | 9.4 Types of Operations
 - | 9.6 Assembly Language

For the Exam

■ Prerequisites (continued):

- | Chapter 10. Instruction Sets: Addressing Modes and Formats
 - | 10.1 Addressing
 - | 10.3 Instruction Formats
- | Chapter 14. Control Unit Operation
 - | 14.1 Micro-operations
 - | 14.2 Control of the Processor
 - | 14.3 Hardwired Implementation
- | Chapter 15. Microprogrammed Control
 - | 15.1 Basic Concepts
 - | 15.2 Microinstruction Sequencing

Topics

- Basic Issues in Computer Architectures
- The Memory System
- Instruction Pipelining
- RISC Architectures
- Superscalar Architectures
- VLIW Architectures
- Architectures for Parallel Computation
- Architectures for Low Power: Crusoe Processors

Exam Questions

- No examination history, but exam question examples available.
- Basic Issues in Computer Architectures
 - Which are the main components in the structure of a von-Neumann architecture?
Which are the primary functions of these components?

Exam Questions

- The Memory System
 - Why is the memory system of a computer organized as a hierarchy?
What are the basic elements of a memory hierarchy?
 - Which are the main characteristics of the two mapping algorithms for cache memories: direct and associative? Illustrate with a figure for each one.

Exam Questions

■ Instruction Pipelining

- What are pipeline hazards? Enumerate and briefly present the three types of pipeline hazards.
- Consider 7 instructions each with execution time T_{ex} . They are executed by a 6 stage pipeline. Pipeline overheads are ignored. How long does it take to execute the 7 instructions by the pipelined CPU (we suppose that there are no hazards)? Draw a figure.
- Static branch prediction: How does it work? Show three alternative approaches.

Exam Questions

■ RISC Architectures

- What are the main characteristics of RISC architectures?
- The design of RISC architectures is based on certain characteristics of currently used programs. Enumerate at least five such characteristics.

Exam Questions

■ Superscalar Architectures

- Data dependencies: Enumerate the three types of data dependencies and give an example for each.
- Give an example with output dependency and another one with anti-dependency. Show how they can be solved by register renaming. Which data dependencies have to be considered by a superscalar CPU using:
 - in-order issue with in-order completion?
 - out-of-order issue with out-of-order completion?

Exam Questions

■ VLIW Architectures

- What are the main characteristics of VLIW architectures? What are the advantages and disadvantages of VLIW architectures?
- What are the main characteristics of an EPIC processor? Compare with a VLIW architecture. Explain the notion of predicated execution.

Exam Questions

■ Architectures for Parallel Computation

- Flynn's classification of computer architectures: give the definition of the alternative architectures and draw for each one a block diagram.
- How does the ratio of sequential computations influence the speedup obtained with a parallel computer? Amdahl's law.
- What is the cache coherence problem in parallel architectures? What is a directory protocol and how does it solve the cache coherence problem?

Exam Questions

■ Architectures for Low Power: Crusoe Processors

- Why is low power consumption important? What are the main approaches to reducing power consumption?
- What is Code Morphing? Explain how the Code Morphing software works. Describe each of the three translation steps.
