



Försättsblad till skriftlig tentamen vid Linköpings Universitet

(fylls i av ansvarig)

Datum för tentamen	2011-12-15
Sal	KÅRA
Tid	08-12
Kurskod	TDTS10
Provkod	TEN2
Kursnamn/benämning	Datorarkitektur
Institution	IDA
Antal uppgifter som ingår i tentamen	4
Antal sidor på tentamen (inkl. försättsbladet)	5
Jour/Kursansvarig	Erik Larsson
Telefon under skrivtid	013-286619, 0709-656619
Besöker salen ca kl.	15 och 17
Kursadministratör (namn + tfnr + mailadress)	Madeleine Häger
Tillåtna hjälpmedel	Inga
Övrigt (exempel när resultat kan ses på webben, betygsgränser, visning, övriga salar tentan går i m.m.)	10 arbetsdagar efter tentamen

Exam
Computer Architecture
TDTS10

December 15, 2011 - 14:00-18:00

Jour: Erik Larsson(0709-656619, 013-286619)

Hjälpmedel/Admitted material:

- Engelsk ordbok
- Dictionary from English to your native language

General instructions:

- This exam has 4 assignments and 4 pages, including this one.
- Read all assignments carefully and completely before you begin.
- Use a new sheet for each assignment.
- You may answer in either English or Swedish.
- Write clearly. Unreadable text will be ignored.
- Be precise in your statements. Unprecise formulations may lead to a reduction of points.
- Motivate clearly all statements and reasoning.
- Explain calculations and solution procedures.
- The assignments are not ordered according to difficulty.
- The exam is designed for 40 points.
- Grading: U, 3, 4, 5. The preliminary threshold for passing is 22 points.
- For ECTS, LiU make use of: 5=A, 4=B, 3=C, and UK=Fx.

1. Execution (15 points)

- Assume an instruction format as: OPCODE:SOURCE:DESTINATION and register and memory content as below (all data is in decimal form). If SOURCE is given as 3 (decimal form), which data is used at:
 - direct addressing
 - indirect addressing
 - register addressing, and
 - register indirect addressing.

Register:

R0=0

R1=1

R2=2

R3=3

PC=4

Memory:

Address:Data

0:1

1:2

2:3

3:4

4:5

5:6

6:7

7:8

8:9

- Compare a CISC and a RISC processor in terms of instruction set.
- Explain output dependency through an example (assembly code).
- What is Amdahl's law and what can one conclude from it?
- How did Flynn classify computer architectures?
- Discuss through example which conflicts (hazards) that might occur in a super-scalar architecture depending on instruction issue policy.

2. Memory System (15 points)

- Given is:

Assume an Intel 80486 with:

a single on-chip cache of 8 Kbytes

line size: 16 bytes

4-way set associative organization

How many sets is there in the cache ($8\text{Kbytes}=2^{13}\text{bytes}$)?

- What techniques exist to keep a cache consistent? How does these techniques work?
- Assume a memory system with paging where every page/frame is 64 bytes (2^6bytes). What is the physical address for the following two logical addresses:

Logical addresses:

1. 00101000

2. 10101010

Page table:

00 -> 11

01 -> 10

10 -> 00

11 -> 01

- Why is a Translation Look-Aside Buffer (TLB) used?
- Which cache system (Pentium or PowerPC as below) would you recommend for a pipelined processor (motivate)?

Pentium

two on-chip caches, one for data and one for instructions.

each cache: 8 Kbytes

line size: 32 bytes (64 bytes in Pentium 4)

2-way set associative organization

PowerPC 601

a single on-chip cache of 32 Kbytes

line size: 32 bytes

8-way set associative organization

3. Processor Design (5 points)

- Explain how to use a stack to enable procedure calls
- Explain how to use a large register file to enable procedure calls
- Programmed I/O is one alternative to handle I/O operations. How does programmed I/O work? What alternatives exist (discuss and explain)?
- Memory-mapped I/O is one alternative to communicate with I/O. What alternatives exist? Discuss processor design/implementation alternatives between the two alternatives.

4. Operating system (5 points)

- A process may be in different states (such as running); list and explain the states in which a process can be, and explain how, when and why a process moves between states.
- What is time sharing used for?
- What is a process control block and what is it used for in general and in particular at a context switch?