Försättsblad till skriftlig tentamen vid Linköpings universitet

Datum för tentamen	2017-01-11
Sal (2)	G35(1) TER1(59)
Tid	14-18
Kurskod	TDTS10
Provkod	TEN2
Kursnamn/benämning **Provnamn/benämning**	Datorarkitektur Skriftlig tentam
Institution	IDA
Antal uppgifter som ingår i tentamen	14
Jour/Kursansvarig Ange vem som besöker salen	Zebo Peng
Telefon under skrivtiden	013-282067
Besöker salen ca klockan	15:30
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Helene Meisinger, 013-281868,
Tillåtna hjälpmedel	Engelsk ordbok
Övrigt	
Antal exemplar i påsen	

TEKNISKA HÖGSKOLAN I LINKÖPING
Institutionen för datavetenskap (IDA)
Zebo Peng

Tentamen i kursen
TDTS10 Datorarkitektur

Examination of the course
TDTS10 Computer Architecture

2017-01-11, 14:00-18:00

Hjälpmedel:

Engelsk ordbok.

Poänggränser:

Maximal poäng är 40.
För godkänt krävs 20 poäng.

Supporting material:

English dictionary.

Points:

Maximum points: 40.
You need 20 points to pass the exam.

Jourhavande lärare (Teacher on duty)

Zebo Peng, tel. 013-28 2067

Note: You can give the answers in English or Swedish.

1. What are the basic components of a CPU and their main functions? How do the CPU components work together to execute instructions?

(2 p)

2. What is a Harvard architecture? What is the main feature of such an architecture? What are the advantage and disadvantage of such an architecture?

(2 p)

3. a) We have discussed three common replacement algorithms that are used in a virtual memory organization. Describe briefly each of these algorithms.

b) Why is the random replacement algorithm used sometimes as a cache replacement algorithm, but it should not be used for virtual memory replacement?

(3 p)

4. In the IBM 360 Model 65 computers, memory addresses are assigned to two separate main memory units in such a way that all even-numbered words are in one unit and all odd-numbered words in the other. What may be the purpose of this particular arrangement? Explain why this memory organization is useful.

(2 p)

5. What is the function of each of the following registers? Why are they needed?

a) instruction address register (program counter).

b) accumulator register.

c) base register.

(3 p)

6. a) What is a ROM? What are its main features?

b) What can a ROM be used for? Give an example where a ROM is used, and explain why it is useful to use a ROM, instead of a RAM, in your example.

c) Sometimes, a ROM is used as a part of the main memory. Why? What is usually stored in this ROM as a part of the main memory?

(4 p)

Note: You can give the answers in English or Swedish.

7. a) What are the differences among sequential access, direct access, and random access?

b) Give an example to illustrate the main features of each of these three different memory types.

c) What is the general relationship among access time and capacity of a given memory technology?

(3 p)

8. a) Why is instruction pipeline widely used to enhance performance of modern computers?

b) What are the three main types of hazards that can reduce the performance of an instruction pipeline? What are the impacts of each of these hazards?

c) In your opinion, which hazard causes the biggest problem for instruction pipeline? Why?

(4 p)

9. a) Describe the concept of overlapping register windows. How is a register window used?

b) Which problem is addressed by using the overlapping register windows?

c) Why can the overlapping register windows improve dramatically the performance of a computer system?

(3 p)

10. a) Provide a taken/not-taken (T/NT) execution pattern consisting of exactly 4 branches where a bimodal predictor will perform better than a one-bit predictor. Assume that the one-bit predictor is initially set at 0 (not taken) while the bimodal predictor is initially set at 01 (weakly not taken). Your answer should be of the form {T, T, T, NT}, for example.

b) Explain why the bimodal predicator gives better prediction results than those of the one-bit predictor.

(3 p)

11. a) What are assembly programs?

b) What is an assembler? What are the basic functions of an assembler?

(2 p)

Note: You can give the answers in English or Swedish.

12. a) What is the most essential characteristics of a superscalar architecture?

b) Describe the following two policies for instruction execution, and explain which one gives better performance:

- in-order issue with out-of-order completion, and
- out-of-order issue with out-of-order completion.

c) Why is the window of execution an important mechanism for a superscalar architecture?

(3 p)

13. a) Identify all the different types of data dependencies in the following code. Indicate the type of dependency you have identified for each one, and give the reasons for your answers.

```
L1: move r3,r9        Note: r3 <- r9
    load r8,(r3)      Note: r8 <- memory location pointed by r3
    add r4,r3,4       Note: r4 <- r3 + 4
    load r9,(r4)      Note: r9 <- memory location pointed by r4
    ble r8,r9,L1      Note: branch to L1 if r8 <= r9
```

b) Which of the identified dependencies can be eliminated? How?

(3 p)

14. a) What is a NUMA computer system?

b) Draw a picture of a typical NUMA system. Use the picture to illustrate and discuss the important concepts and components of such a system.

(3 p)