

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

**Tentamen i kursen  
TDTS10 Datorarkitektur**

**Examination of the course  
TDTS10 Computer Architecture**

**2018-08-27, 8:00-12:00**

**Hjälpmedel:**

Engelsk ordbok.

**Supporting material:**

English dictionary.

**Poänggränser:**

Maximal poäng är 40.  
För godkänt krävs 20 poäng;  
för betyg 4 krävs 27 poäng; och  
för betyg 5 krävs 33 poäng.

**Points:**

Maximum points for the exam are 40.  
You need 20 points to pass the exam;  
for grade 4, 27 points are needed; and  
for grade 5, 33 points are needed.

**Jourhavande lärare (Teacher on duty)**

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

1. Describe the basic components of a computer and the main functions of each of these components. Discuss also how these components work together to execute instructions.  
(2 p)

2. a) What does it mean by a memory hierarchy? Why it is useful to build a memory hierarchy?  
b) What is the fundamental assumption which makes a memory hierarchy work efficiently?  
(3 p)

3. a) What is the basic idea of associative mapping for cache organization? What are the advantages and disadvantages of the associative mapping organization?  
b) Why is the fully associative cache organization seldom used in practical computers? Which cache organization is commonly used? Why?  
(3 p)

4. a) What does it mean by virtual memory? Describe how a virtual memory works.  
b) Why is it not needed to have all of the pages of a program to be in the main memory while the program is being executed?  
c) How is a logical (virtual) address converted into a physical address of the main memory?  
(3 p)

5. a) What does it mean by interrupt-driven I/O? What are the advantages and disadvantages of this technique?  
b) Define the concept of multiple interrupts? What are the two main approaches used to handle multiple interrupts?  
(3 p)

6. a) What are the main issues to be considered when designing an instruction set?  
b) In what way the instruction set can influence the overall performance and implementation cost of a computer system?  
(3 p)

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

7. a) What is the basic principle of an instruction pipeline? Why is it useful to have such a pipeline?

b) In general, a larger number of pipeline stages gives a better performance. However, this has not led to the situation that we have a huge number of pipeline stages. Why?

(3 p)

8. a) Explain the difference between static and dynamic branch prediction.

b) Describe briefly an example of static branch prediction and dynamic branch prediction, respectively.

c) Which branch prediction method gives better prediction results? Why?

(4 p)

9. a) What are the main characteristics of a superscalar architecture? You should provide at least two of them.

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

c) Why do we have a “commit” mechanism in a superscalar architecture? How does this mechanism work?

(4 p)

10. 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)

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

11. Microprogramming can be used for several purposes, besides implementing the control functions of a computer. Discuss how microprogramming can be used to provide each of the following functions. For each function, describe briefly an example to illustrate the basic idea.

- a) operating-system support;
- b) control of special-purpose devices; and
- c) emulation of other computers.

(3 p)

12. Describe Flynn's classification of computers. Give briefly the definition of each alternative architecture class and an example of each class. Draw a block diagram to illustrate each architecture example you have given.

(3 p)

13. What are the basic features of CISC and RISC computers, respectively? Discuss the differences between the RISC and CISC machines, and the arguments for each of these two different computers.

(3 p)