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

Tentamen i kursen
TDTS10 Datorarkitektur

Examination of the course
TDTS10 Computer Architecture

2018-04-04, 8:00-12:00

Hjälpmedel:

Engelsk ordbok.

Poänggränser:

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

Supporting material:

English dictionary.

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. What are the von Neumann architecture principles? What are the main advantages of the von Neumann architecture?

   (2 p)

2. a) What are the differences among sequential access, direct access, and random access of computer memories.

   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)

3. 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)

4. a) Give a short definition of seek time, rotational delay, read/write time, and data/transfer rate of a disk memory.

   b) Explain why a hard disk has much better performance in all the above four aspects, when compared with a floppy diskette.

   (3 p)

5. 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)

6. We have discussed two different cache write policies to be used when the CPU writes a word to the memory system. Describe them and discuss the advantages and disadvantages of each of them, respectively.

   (3 p)

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

7. a) Why is it useful to have many general-purpose registers in the CPU?

   b) Is there any disadvantage of having many general-purpose registers? Describe the most significant disadvantage, if there is any. Discuss one method that can be used to address this problem.

   (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. You have just purchased a high-speed hard disc to be connected to your computer. You have to select the most appropriate method to control the I/O operations with this hard disc. Which one will you select (you can make your own assumptions, if needed)? Why? Explain also how the selected method works.

   (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 predictor 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?

    c) What are the differences between a compiler and an interpreter for high-level programming languages?

    (3 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)