Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2013-08-30
Sal (1) Om tentan går i flera salar ska du bifoga ett försättsblad till varje sal och ringa in vilken sal som avses	TER3
Tid	8-12
Kurskod	TDTS08
Provkod	TEN1
Kursnamn/benämning **Provnamn/benämning**	Datorarkitektur Skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	13
Jour/Kursansvarig Ange vem som besöker salen	Zebo Peng
Telefon under skrivtiden	0702582067
Besöker salen ca kl.	10:00
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Liselotte Lundberg, tel 281278, liselotte.lundberg@liu.se
Tillåtna hjälpmedel	Engelsk ordbok
Övrigt	
Vilken typ av papper ska användas, rutigt eller linjerat	rutigt
Antal exemplar i påsen	

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

Tentamen i kursen

TDTS08 Datorarkitektur

(Examination on TDTS 08 Advanced Computer Architecture)

2013-08-30, kl. 8-12

Hjälpmedel:

Engelsk ordbok.

Supporting material:

English dictionary.

Poänggränser:

Maximal poäng är 40.
För godkänt krävs 21 poäng.

Points:

Maximum points: 40.
You need 21 points to pass the exam.

Jourhavande lärare (Teacher on duty):

Zebo Peng, tel. 070 258 2067, 013-28 2067

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

1. a) Locality of reference is an important feature of programs, in the context of memory hierarchies. Explain what locality of reference means and why it is important.

   b) 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 might be the purpose of this particular arrangement? Explain also why this memory organization is useful.

   (3p)

2. a) For fully-associative mapping in a cache system, a main memory address is viewed as consisting of two fields. Define these two fields, and explain how they are used.

   b) What are the differences between fully-associative mapping and set-associative mapping? Why is set-associative mapping usually used?

   (3p)

3. A register file severs as a small and fast buffer for holding the variables that are currently manipulated by the CPU. From this point of view, a register file acts like a cache memory.

   a) Can we then draw the conclusion that we can replace the cache with a large register file? Why?

   b) Discuss the different characteristics of a large register file and a cache, including the way they are accessed and their usual contents, respectively.

   (3p)

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

   b) In general, a larger number of pipeline stages gives better performance. However, when the number of stages is becoming very large, the efficiency of the pipeline will not be further improved. Why? Discuss the different issues that prevent the number of pipeline stages to go beyond a certain limit.

   (3p)

5. a) What does it mean by static branch prediction? Give an example of a static branch prediction method.

   b) What are the advantages and disadvantages of static branch prediction, as compared to dynamic branch prediction?

   (3p)

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

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

b) Explain the following two policies for instruction execution:

- 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?

(3p)

7. a) Identify all the true data dependencies, output dependencies and anti-dependencies on the following code. Provide the reasons for your answers.

```
L2: move r3,r9        Note: r3 <- r9
    load r8,(r3)      Note: r8 <- memory location pointed by r3
    add r3,r3,4       Note: r3 <- r3 + 4
    load r9,(r3)      Note: r9 <- memory location pointed by r3
    ble r8,r9,L3      Note: branch to L3 if r8 less than/equal r9
```

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

(3p)

8. a) Draw a picture to show a typical VLIW architecture.

b) A VLIW architecture is said to support explicit parallel instruction execution. Define the concept of explicit parallelism. What are the advantages of exploiting explicit parallelism?

c) What is the main problem of a VLIW computer? How is this problem addressed by the IA-64 architecture?

(4p)

9. a) Why is the placement of the "load from memory" operations an important issue for performance?

b) Describe the speculative loading technique. What are the advantages of this technique?

c) Illustrate the speculative loading technique with a simple example.

(3p)

10. a) What does it mean by branch predication (as implemented in the Itanium machine)? How does it work? Illustrate the technique with an example.

b) What are the differences between branch predication and branch prediction? What are their advantages and disadvantages, respectively.

(3p)

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

11. a) What does it mean by parametric computing in the context of parallel processing? Give an example to illustrate the features of such an approach.

b) Why is the parametric computing approach appropriate to be used in a cluster computer?

(3p)

12. a) What is a thread? What does it mean by thread-level parallelism?

b) Describe the different multithreading approaches and discuss how they are applied in the context of superscalar architectures. What are the advantages and disadvantages of these different approaches, respectively?

(3p)

13. a) One argument for using a graphics processing unit (GPU) is that it is power efficient. Describe all features of a GPU architecture that contribute to the reduction of power consumption.

b) Can we use GPUs for non-graphics computation? Support your answer with some good arguments.

(3p)