LINKÖPINGS TEKNISKA HÖGSKOLA
Institutionen för datavetenskap
Petru Eles

(Distans)Tentamen i kursen

Datorarkitektur - TDDI03

2021-03-15, kl. 14-17

Hjälpmedel:

Engelsk ordbok.
Föreläsningsmaterial

Supporting material:

English dictionary.
Lecture slides

Poänggränser:

Maximal poäng är 40.
För godkänt krävs sammanlagt 21 poäng.

Points:

Maximum points: 40.
In order to pass the exam you need a total of minimum 21 points.

During the exam Petru will be available at: petru.eles@liu.se

Good luck !!!

Read carefully!

You have now got the exam subjects. I have sent them out at 13:45. You can now start and work. **You will have to send back the exam to me, by email (to petru.eles@liu.se), latest at 17:00!** (The students who have officially approved extended time will have to send back their exam latest 18:00). **Indicate on the exam your name and person number!**

During the exam you are allowed to use the lecture slides from the course and an English dictionary. You are not allowed to use any other material, physical or via phone, internet, etc.

You are not allowed to interact on any topic related to the exam with any person directly, or by phone, internet, etc. An exception is interaction by email with me (Petru Eles), in case you have any question related to the exam subjects.

You can send me back the exam as a Word or PDF document. You might have to draw figures or do some handwriting. In this case you can use scan/camera and send me back the file(s) together with the rest of the exam.

Since this is a remote exam with access to the lecture notes, the subjects are somewhat different from those with previous exams. You are asked to elaborate more on the subjects instead of just reproducing what is written in the lecture notes. You have to demonstrate your understanding of the issues and to make personal considerations. It does not help to just reproduce the lecture notes! If you follow the rules, it is also not possible that two of you give answers that are very similar.

The exams will be graded, as usual: U, 3, 4, 5.

You are required to sign and send back (scan/photo), together with the exam, a text with the following solemn declaration (signature should be by hand!):

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I hereby solemnly declare that during the TDDI03 exam, March 15th 2021, I did not use any other material than an English dictionary and the lecture notes given with the course. I did not consult any other material, physical or via phone, internet, etc.

During the exam I did not interact on any topic related to the exam with any person directly, or by phone, internet, etc. An exception is email with the course examinator.

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Du kan skriva på svenska eller engelska!

1. There exists a particular property of programs that allows memory hierarchies to be used efficiently. Which is this property? Explain. How do memory hierarchies make use of this property? How do they work?

   (4p)

2. Consider a system with main memory and two levels of cache. The access time to main memory is 100ns. The access time to the L1 cache is 1ns and to the L2 cache is 10ns. The hit rates are H1=90% and H2=95% for the L1 and L2 cache, respectively. What is the average (expected) memory access time? We increase the size of the L1 cache such that the hit rate H1 increases to 92%. Unfortunately, this also results in an increase of the L1 cache access time. What is the upper bound for the increased access time of the L1 cache, such that this change of the L1 cache still reduces the average memory access time?

   (4p)

3. Virtual and physical address: What is the difference? How is the translation from one to the other performed? Who is doing this translation?

   (4p)

4. An four-way set-associative cache has lines of 32 ($=2^5$) bytes and a total size of 128 Kbytes ($=2^{17}$). The main memory has a size of 64 Mbyte ($=2^{26}$). Show the format of main memory address (give the total number of address bits, what different groups of address bits indicate, and how long each of these groups is).

   (4p)

5. We have a code of 2000 instructions and a pipelined processor with 10 stages. What is the ideal acceleration achieved? Does the ideal acceleration increase with the number of pipeline stages? Should processors have a very large number of pipeline stages? Justify your answer. Discuss.

   (4p)

6. Give an example and illustrate that two bits dynamic branch prediction works better than one bit dynamic prediction.

   (4p)

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7. Data dependencies. Give an example for each kind (examples different from those in the lecture notes). Why are some of the dependencies not "true"? Discuss. Which of the dependencies do we need to consider with an in-order superscalar processor? Which do we need to consider with an out-of-order superscalar? Discuss.

(4p)

8. Why is superscalar not the ultimate solution? How do VLIW processors address some of the problems with superscalar processors? What are the advantages of VLIW architectures compared to superscalar? What are the disadvantages?

(4p)

9. The Itanium architecture inherits some features of VLIW processors. Which are those features? There is one basic disadvantage of VLIW architectures which Itanium solves. What is that disadvantage and how is it solved with the Itanium architecture?

(4p)

10. We have a parallel computer with 100 processors. We run a program and experience an acceleration of 60 relative to running on a single processor. Assuming that there are no communication and other overheads, what is the ratio of computation that has to be run sequentially for this program.

(4p)