# (Distans)Tentamen i kursen

# Datorarkitektur - TDDI03

# 2021-01-11, kl. 8-11

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| **Hjälpmedel:** | **Supporting material:** |
| Engelsk ordbok. | English dictionary. |
| Föreläsningsmaterial | Lecture slides |

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| **Poänggränser:** | **Points:** |
| Maximal poäng är 40. | Maximum points: 40. |
| För godkänt krävs sammanlagt | In order to pass the exam you need a |
| 21 poäng. | 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 7:45. 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 11:00!** (The students who have officially approved extended time will have to send back their exam latest 12:00). **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, January 11th 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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1. Why do we need a memory hierarchy instead of just a simple one level memory? Why and how does such a hierarchy work? What does it bring? Discuss!

(4p)

2. Compare the three mapping strategies we have studied for cache memories: consider their basic working principle, pros and cons. Discuss.

(4p)

3. 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% but the access time increases from 1 ns to 1.2 ns. Do the calculations and find out if this was a smart move.

(4p)

4. An eight-way set-associative cache has lines of 16 ($=2^4$) bytes and a total size of 64 Kbytes ($=2^{16}$). The main memory has a size of 64 Mbyte ($=2^{26}$). Show the format of main memory addresses (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 1500 instructions and a pipelined processor with 12 stages. What is the ideal acceleration achieved? What is the ideal acceleration with 20 stages? What is the ideal acceleration with 120 stages? So, should processors have 120 pipeline stages or even more? Justify your answer. Discuss.

(4p)

6. Why is good branch prediction particularly important with superscalars? Think at the instruction window and how you can fill it up. Discuss, elaborate.

(4p)

7.  Data dependencies. Give an example for each kind (example different from those in the lecture notes). Why are some of them 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 superscala? Discuss.

    (4p)

8.  If you compare the Pentium 4 with the Nehalem architecture, what is the basic difference? What is the reason for the evolution in this direction? Comment.

    (4p)

9.  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)

10. We have a parallel computer with 100 processors. If we run a program on it, do we get it 100 times faster? Justify your answer, explain, discuss.

    (4p)