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Written Exam
Parallel Computer Architecture (DO8001)

January 25th, 2008, 13.00 - 17.00

Closed book exam.

Aids allowed: A dictionary, translating between English and your native language, or an English Thesaurus. It must be in printed form, not electronic!

Welcome to the exam!

READ THIS FIRST:

In most of the assignments in this exam you are asked to "describe" or "explain". Please write short and concise. It is not necessary that you cover everything that can possibly be connected to the topic – it is more important that what you write is clear, coherent, correct and relevant.

The facts that you find in the course literature are not "the law". If you have different opinion, don't be afraid to mention it. Of course, you are also free to take up things that are not to be found in the course literature, as long as they are of importance to the topic.

Please, read the assignments carefully, so that you give answer to the correct questions – and to all questions!

Good luck!

-- Bertil

Number of assignments: 4
Maximum points: 60
Bonus points from the seminars (maximum 32) will be added to the points of this written exam.

Required points:	40	60	75
Grade:	3	4	5

Grades may be raised based on excellent seminar achievements.

Assignment 1: Give Short Definitions (10 p)

Give short, clear and meaningful definitions and/or characterizations of the following ten terms.

("Short" means not more than 20 words - I will stop reading after that!!)
("Meaningful" means that (if the course was about sports) I would be satisfied with an explanation of "NHL" as "National Hockey League - the professional icehockey league in North America, regarded as the best in the world", but not with "three letters from the alphabet", even if the latter also is true ...).
In case of acronyms, try to not only define what the acronym stands for, but also give a very short characterization!

Terms
1. PRAM
2. Amdahl's law
3. Multicomputer
4. Instruction level parallelism
5. Out-of-order execution

Please check that you did not use more than 20 words in each case! That's all that I will read!

Assignment 2: Dynamic Interconnection Networks (15 p)

Many switched interconnection networks use 2x2 switches as building blocks. In this assignment you shall describe useful regular, multilayer network structures built from such switches. You shall also describe the capabilities and limitations of these networks as well as how the switch settings in the network are found based on the destination address.

Your description should be accompanied by proofs/arguments as well as by illustrative examples.

Assignment 3: Cache Coherence (15 p)

First, motivate the use of caches in multiprocessors. Then describe the cache coherence problem and explain how the problem is solved using the "snooping on the bus" principle. Describe different variations of snooping protocols. Finally, describe how the cache coherence problem can be solved when other interconnection networks than a bus are used? (Recommended length: about **2 pages**, including figures).

Assignment 4: Short Paper (20 p)

Choose **one** of the topics below. Recommended length: **2 - 3 pages**, including figures.

A. SIMD Architectures and Data-parallel Programming

- Describe the working principle of a SIMD architecture and what types of applications it is especially suited for.
- Mention some possible architectural variations.
- What are the main advantages with SIMD compared to MIMD?
- Describe the principles for programming of SIMD computers. Give examples of typical SIMD instructions and indicate how they can be used in applications. Describe how traditional high-level languages are extended to suit the programming of SIMD machines.

B. Parallelism in Modern Microprocessors

A modern micicroprocessor has several instructions in execution simultaneously through the use of pipelining. Describe short how this works and how “bypasses” (also known as “forwarding”) can be introduced in order to improve instruction density. Then describe various techniques used in order to allow the processor to also begin executing more than one instruction at the time. Compare these later techniques with each other, from different aspects.