

Computational Science and Engineering
Final Exam in
Computer Architecture and Networks

Winter Term 2009/2010
February 17, 2010

Points: 110

Time: 90 minutes

Instructions:

Write all answers onto these sheets – no other answers will be counted! You will get additional scratch paper to work out your solutions, however, this will not be collected and not be counted!

This exam is a **closed book** exam- i.e. no books, notes, or similar aids and also no electronic calculators of any kind are permitted!

Do not use red or green pens.

In case you need to leave the room, you need to deposit your test sheet. Only one person is allowed to leave the room at one time.

There will be an announcement 10 minutes before the end of the test time.

After the test, please remain seated until all tests have been collected and counted.

Name: _____

Matr. Number: _____

Signature: _____

Question 1, Numbering Systems (10 points):

In the following table, each row represents the same (positive) number represented in a different numbering system. The numbering system is denoted in the upper row. Complete the table by filling in the missing number representations!

Binary	Octal	Decimal	Hexadecimal
11100111			
	765		
		100	
			EEE

Question 2, PC Hardware (30 points):

Outline the basic structure of a microprocessor and its units (e.g. Pentium-II) with L1 caches and instruction phase units:

Illustration

Question 3, Two's Complement (8 points):

Transform the following **octal** numbers into the corresponding binary representation using the two's complement (16 digits):

Octal representation	Binary / Two's complement
-99	
140	
-100	

Question 4, Pipelining (12 points):

Explain the difference between a standard pipeline, a superscalar pipeline and a VLIW pipeline by drawing an illustration for each case:

a) Standard Pipeline:

b) Superscalar Pipeline

c) VLIW Pipeline

Question 5, Itanium Processor:

How does an Itanium processor handle **if - then - else** constructs, i.e.

```
IF (A>B) THEN
```

```
  C=D
```

```
ELSE
```

```
  E=F
```

```
ENDIF
```

?

What are rotating registers used for? Explain how an Itanium processor uses them!

Explain the difference between data and control speculation! Where is an Advanced Lookup Table being used?

Question 5, Processor/Architecture Development (15 points):

Moore's law states that the number of transistors on a chip doubles every 1 ½ years. While this led to an increase of clock frequencies without much need to rewrite you programs in order to obtain better performance, by looking at the development of microprocessors! Starting from the first microprocessor in 1971, what phenomena can be observed ?

What does Bell's Law stand for?

Question 6, Cache (25 points):

What is a replacement strategy for a cache architecture?

What replacement strategy can be used for:

- A direct mapped cache?

- A fully associative cache?

- An n-way set associative cache?

Explain the concept of the MESI cache coherency protocol as implemented in SMP systems (state diagram **not** required)!

How can a direct mapped and a fully associative cache with n cache lines be defined in terms of set associativity?

Question 8, Endian (10 points):

What does the term “Endianness” refer to? Give some examples of architectures which use Big/Little Endian!

Which approach is considered better – Big or Little Endian? Explain why!
