Midterm Exam S1
Computer Architecture

Answer on the worksheet **Duration: 1 hr 30 min.**

Last name: ..... First name: ..... Group: .....

Exercise 1 (2 points)

Simplify the following expressions. Give each result in a power-of-two form. Write down the result only (do not show any calculation).

Expression	Result
$\frac{64^4 \cdot 16^5 \cdot 8^{-8}}{(256^{-3} \cdot 32^{16})^4}$	
$\frac{((65536 \cdot 32^{-3})^3 \cdot 2048^{10})^5}{(64^{-7} \cdot 1024)^{-7} \cdot 256}$	

Exercise 2 (3 points)

1. How many bytes do the following values contain? **Use a power-of-two notation**. Write down the result only (do not show any calculation).
   - 256 GiB = _____
   - 128 Kib = _____
   - 32 Mib = _____

2. How many bits do the following values contain? Use binary prefixes (Ki, Mi or Gi). **Choose the most appropriate prefix so that the integer numerical value will be as small as possible**. Write down the result only (do not show any calculation).
   - 2^{15} bits = _____
   - 4 MiB = _____
   - 2^{35} bytes = _____

Exercise 3 (5 points)

Convert the following numbers from the source form into the destination form. Do not write down the result in a fraction or a power form (e.g. write down 0.25 and not ¼ or 2^{-2}). Write down the result only (do not show any calculation).

Number to Convert	Source Form	Destination Form	Result
10111001.01101	Binary	Decimal	
CE.68	Hexadecimal	Decimal	
88.88	Decimal	Hexadecimal (2 digits after the point)	
105.40625	Decimal	Binary	
151.32	Base 8	Binary	
151.32	Base 8	Hexadecimal	
151.32	Hexadecimal	Base 8	
59.27	Decimal	Base 7 (3 digits after the point)	
32	Base 4	Base 5	
101110101.01011	Binary	Hexadecimal	

Exercise 4 (2 points)

Part 1: Encoding unsigned integers

1. Let us consider the following 8-bit addition: **250 + 10**
   The two operands and the result are 8 bits wide. Write down the base-10 representation of the 8-bit result.

2. Let us consider the following 8-bit subtraction: **4 – 10**
   The two operands and the result are 8 bits wide. Write down the base-10 representation of the 8-bit result.

Part 2: Encoding <u>signed</u> integers

3. Let us consider the following 8-bit addition: **120 + 10**
   The two operands and the result are 8 bits wide. Write down the base-10 representation of the 8-bit result.

4. Let us consider the following 8-bit subtraction: **–126 – 10**
   The two operands and the result are 8 bits wide. Write down the base-10 representation of the 8-bit result.

<u>Exercise 5</u> (4 points)

Perform the operations below. **Show all calculations.**

Base 2

		1	1	0	0	0	1	1	1	0
	–		1	1	1	0	0	1	1	1

Base 16

		9	C	A	8	
+		B	F	C	E	

Base 2

	1	0	1	0	1	0	0	0	1	1	0	0	

Base 8

		7	2	4	6	
+		2	6	5	3	

Exercise 6 (4 points)

1. A memory has 4000_{16} addresses.

   How many address lines does this memory have?

   Assuming that the lowest address is 0_{16}, what is the highest address (in hexadecimal)?

2. A memory has 10 address lines.

   How many addresses are available (in hexadecimal)?

   Assuming that the lowest address is 0_{16}, what is the highest address (in hexadecimal)?

3. The memory space of a microprocessor is made up of 4 memory devices (**M1**, **M2**, **M3** and **M4**). **M1** and **M2** both have 4000_{16} addresses. **M3** and **M4** both have 10 address lines. **M1** should be located in the lowest part of the memory space, followed by **M2**, **M3** and **M4**. The lowest address of the memory space is 0.

   Complete the table below (in hexadecimal):

M1	Lowest Address	
	Highest Address	
M2	Lowest Address	
	Highest Address	

M3	Lowest Address	
	Highest Address	
M4	Lowest Address	
	Highest Address	

   What is the minimum number of address lines required by the microprocessor?

Feel free to use the blank space below if you need to: