

## LAB SESSION - WEEK 1

### EXERCISES ON PERFORMANCE AND BINARY REPRESENTATION

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#### Performance

##### Exercise 1.1 - Textbook problems

For this exercise, solve the following three problems from the lecture textbook.

- Problems 1.5 and 1.6 (page 55)
- Problem 1.9 (page 56)

#### Binary Representation

##### Exercise 1.2 - ASCII encoding

Using Table 2, decode the ASCII encoded text contained in the following hexadecimal number.

48656C6C6F2073747564656E7421

Write your answer in the following box.

Using Table 2, write the ASCII representation of the following string of text.

Fast CPU

Write your answer in the following box.

##### Exercise 1.3 - Division in fields

A 32-bit number can be divided in several bit fields. Consider the following 32-bit value (the prefix 0x means that the value is represented as hexadecimal number).

0x006382b3

Consider also that we have 6 fields with the following bit sizes: 7, 5, 5, 3, 5, 7 and that the most significant bit is part of the first field. Using the information presented in Table 1, write the hexadecimal and binary representation of the fields. (*Hint: Write the number in binary before trying to identify the fields*). The number that we have considered in this exercise corresponds to a real RISC-V instruction. If you are curious to find which one it is, you can use Tables 19.2 and 20.1 (pages

104-107 and 109) of the RISC-V specification<sup>1</sup>.

Complete the following table with your answer.

Field number	Field size	Hexadecimal value	Binary value
1			
2			
3			
4			
5			
6			

Now consider we have 7 fields with the following bit sizes: 7, 2, 3, 9, 1, 4, 6 and that the most significant bit is part of the first field. Using the information presented in Table 1, write the hexadecimal and binary representation of the fields.

Complete the following table with your answer.

Field number	Field size	Hexadecimal value	Binary value
1			
2			
3			
4			
5			
6			
7			

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<sup>1</sup>The RISC-V Instruction Set Manual, Volume 1: User-Level ISA. Version 2.2. <https://riscv.org/specifications/>

**Exercise 1.4 - Integer representation**

This exercise considers the representation of signed and unsigned integers stored in an 8 bit register. The register itself contains 8 binary values but these values can be interpreted differently depending whether the value is signed or unsigned and whether it is converted to hexadecimal or decimal representation. For more help you can see Table 3 and section 2.4 (page 73) of the lecture textbook<sup>1</sup>.

Fill in the empty spaces in the following table.

Integer representation	Decimal value	Binary value	Hexadecimal value
Unsigned	37		
Signed	47		
Signed	-47		
Signed	-52		
Unsigned			FD
Signed			FD
Signed		10011010	
Unsigned		10011010	

**Reference Tables**

BIN	HEX	DEC	BIN	HEX	DEC
0000	0	0	1000	8	8
0001	1	1	1001	9	9
0010	2	2	1010	A	10
0011	3	3	1011	B	11
0100	4	4	1100	C	12
0101	5	5	1101	D	13
0110	6	6	1110	E	14
0111	7	7	1111	F	15

Table 1: Binary (BIN), hexadecimal (HEX) and decimal (DEC) conversion.

	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>0</b>	NUL	DLE	SP	0	@	P	'	p
<b>1</b>	SOH	DC1	!	1	A	Q	a	q
<b>2</b>	STX	DC2	"	2	B	R	b	r
<b>3</b>	ETX	DC3	#	3	C	S	c	s
<b>4</b>	EOT	DC4	\$	4	D	T	d	t
<b>5</b>	ENQ	NAK	%	5	E	U	e	u
<b>6</b>	ACK	SYN	&	6	F	V	f	v
<b>7</b>	BEL	ETB	'	7	G	W	g	w
<b>8</b>	BS	CAN	(	8	H	X	h	x
<b>9</b>	HT	EM	)	9	I	Y	i	y
<b>A</b>	LF	SUB	*	:	J	Z	j	z
<b>B</b>	VT	ESC	+	;	K	[	k	{
<b>C</b>	FF	FS	,	<	L	\	l	
<b>D</b>	CR	GS	-	=	M	]	m	}
<b>E</b>	SO	RS	.	>	N	^	n	~
<b>F</b>	SI	US	/	?	O	_	o	DEL

Table 2: ASCII table. The top row and the leftmost column indicate respectively the most and the least significant hexadecimal digit.

<b>Binary value</b>	<b>Decimal value</b>
01111111	127
01111110	126
...	...
00000010	2
00000001	1
00000000	0
11111111	-1
11111110	-2
...	...
10000001	-127
10000000	-128

Table 3: 8-bit two's complement integers. The leftmost digit in the binary value column contains the most significant bit.