MID-TERM EXAMINATION

Course: **COMPUTER SYSTEM PROGRAMMING**	
Time: **60 minutes**	Term: 1 – Academic year: **2021-2022**
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Student name:	Student ID:

Problem 1. (20 points)

Assume we are running code on a 5-bit binary and 2-digit hexadecimal machine and we can represent a decimal number in 1's complement, 2's complement and bias 10. Fill in the empty boxes. Write number in 2-digit hexadecimal format. If the number can not be represented, please fill "__".

Description	1's complement	2's complement	Bias 10
0			
-10			
12			
-17			
25			

Short explanation:____

Problem 2. (20 points)

Assume a 12-bit floating-point representation (1 sign bit, 5 exponent bits, and 6 fraction bits). Use "round to nearest, half to even" (as in IEEE 754).

a. Convert 0 10100 110011 (a 12-bit FP) to its decimal equivalent.

The exponent is: ______________

The value of the fraction (without implicit 1.) is:______________

Final decimal value:______________

b. Convert −32.8 to its 12-bit floating-point equivalent.

The base-2 normal notation is:________________

The 5-bit encoding of the exponent is:__________

The 6-bit encoding of the fraction is:__________

c. Using the same 12-bit floating-point format (3 hex digits):

Hex encoding of positive infinity:____________

Hex encoding of smallest positive, normalized number:____________

Short explanation:____

Problem 3. (20 points)

In the following questions assume the variables a and b are signed integers and that the machine uses two’s complement representation. Also assume that MAX_INT is the maximum integer, MIN_INT is the minimum integer, and W is one less than the word length (e.g., W=31 for 32-bit integers).

Match each of the descriptions on the left with a line of code on the right.

<table>
<tr><td>1. a&b
2. a
3. a*7
4. (a<0)?1:-1
5. !a</td><td>a. ~ (~a | (b ^ (MIN_INT + MAX_INT)))
b. ((a^b) & ~b) | (~(a^b) & b)
c. 1 + (a<<3) + ~a
d. (a<<4) + (a<<2) + (a<<1)
e. a^(MIN_INT + MAX_INT)
f. ~((a | (~a + 1)) >> W) & 1
g. ~((a >> W) << 1)
h. a >> 2</td></tr>
</table>

Short explanation:____

Problem 4. (20 points)

Address	Value
0x100	0xFF
0x104	0xAB
0x108	0x09
0x10C	0x11

Register	Value
%eax	0x100
%ecx	0x1
%edx	0x3

Fill in the following table the effect of the following instructions, both in term of the register or memory location that will be updated and the resulting value:

Instruction	**Destination**	**Value**
addl %edx,%eax		
subl %edx,-1(%eax,edx,2)		

incl %eax		
imull $2,4(%eax)		
subl (%eax),-4(%eax)		

Short explanation:____

Problem 5. (20 points)

Complete the C code

```c
/* a=%rdi, i=%esi, x=%rdx, y=%rcx */
long f2(long *a, int i,long x, long y)
{
	long res = 0;
	for (int j = ___;___ ; j++)
	{
		res = ___ + ___ ;
		if ( ___ > ___ )
		{
			return _____ ;
		}
	}
	return ___;
}
```

```
f2:
	movl $1, %r8d
	movl $0, %r10d
.L2:
	cmpl %esi, %r8d
	jg .L6
	movl %esi, %r9d
	subl %r8d, %r9d
	movslq %r9d, %r9
	addq (%rdi,%r9,8), %r10
	leaq (%r10,%rcx), %r9
	cmpq %rdx, %r9
	jg .L5
	addl $1, %r8d
	jmp .L2
.L6:
	leaq (%r10,%rdx), %rax
	ret
.L5:
	movq %rcx, %rax
	ret
```

Short explanation:____