(CS2.201a) Computer Systems Organization (Spring 2023) 02.02.2023

Quiz 1

Alloted time: 45 minutes

Instructions:

- There are two questions with sub-parts, printed over two sides of a sheet.
- Discussions amongst the students are not allowed. Any dishonesty shall be penalized heavily.
- Be clear in your arguments. Vague arguments shall not be given full credit.

1. Consider a 5-bit floating-point representation based on the IEEE floating-point format, with one sign bit, two exponent bits ($k = 2$), and two fraction bits ($n = 2$).

failing this exam lmao

   (a) Compute the bias.

   (b) Compute e, E, f, M and the fractional value for each of the following 5 bit floating point representations: 0 00 01, 0 00 11, 0 01 10, 1 01 11, 0 10 01 and 0 01 00.

e	:	The value represented by considering the exponent field to be an unsigned integer
E	:	The value of the exponent after biasing
f	:	The value of the fraction
M	:	The value of the significand
$2^E \times M$	:	The (unreduced) fractional value of the number

E = e - bias
M = n + 1 + f

   (c) Compute the value of the smallest normalized number and the largest denormalized numbers under the given 5-bit floating point representation.

M ∈ [1, 1 7/8]

[2 + (6 x 5 x 0.5) + 3 marks]

2. The following (uncommented) assembly code was modified from what was discussed in class.

```
.factorial:
        cmp r0, 1
        beq .return
        bgt .continue
        b .return
.continue:
        sub sp, sp, 8
        st r0, [sp]
        st ra, 2[sp]
        sub r0, r0, 1
        call .factorial
        ld r0, [sp]
        ld ra, 2[sp]
        mul r1, r0, r1
        add sp, sp, 8
        ret
.return:
        mov r1, 1
        ret
.main:
        mov r0, 3
        call .factorial.
```

Q. Write sequence of registers and memory updates done by the program.

If there are inaccuracies in the program, point them out (with formal explanation) and fix them.

Else, say 'no bugs'.

r0 = BRb
r0 = 2
r0 = 1
r0 = 2
r0 = 3

r1 = #6

sp = 4992
sp = 4984

4994 — ra (3)
4992 — 3
4986 — ra (2)
4984 — 2