

CSCI-UA.0201-001
Computer Systems Organization
Exam 1 Fall 2018 (time: 60 minutes)

Last name:

First name:

NetID:

Notes:

- **If you perceive any ambiguity in any of the questions, state your assumptions clearly.**
 - **Questions vary in difficulty; it is strongly recommended that you do not spend too much time on any one question.**
 - **The exam consists of 5 pages, 5 questions, and a total of 50 points. Last paper is left intentionally blank, for you to use if you want.**
 - **You answer on the question sheet.**
-

1. (5 points) Circle the correct answer among the choices given. If you circle more than one answer, you will lose the grade of the corresponding question.

(A) If we write a C program that consists of 5 C files. The output of the assembler will be:

1. five files 2. one file 3. depends on the type of the compiler 4. depends on OS

(B) By seeing the number: 0xFFFF700B we know for sure that it is a:

1. negative number 2. positive number
3. unsigned number 4. We do not know for sure

(C) Suppose we have a 32-bit machine. The size of “long int *” is:

1. 4 bytes 2. 8 bytes
3. 2 bytes 4. Depends on the OS.

(D) Suppose we have a 64-bit machine. The size of “long int *” is:

1. 4 bytes 2. 8 bytes
3. 2 bytes 4. Depends on the OS.

(E) If we write a C program that includes a parenthesis that we opened but forgot to close.

Then:

1. the compiler will complain 2. the assembler will complain
2. the linker will complain 3. the loader will complain

2. [4 points] We have seen that the floating point presentation has normalized encoding and denormalized encoding. State two reasons we need denormalized encoding. Every reason must not be more than one sentence.

- **To be able to present 0**
- **To present very small numbers.**

3. [8 points] Suppose you want to include this condition in your C code: **if(x & mask)**
x is a char. You want the condition to be true if the third bit from the left of x is set to 1.

- What value **mask** must have in binary?

00100000

- What value **mask** must have in hexadecimal?

0x20

- Suppose $x = 5$, will the condition be true? Show the value of $x \& \text{mask}$ in binary to justify.

00000101 & 00100000 = 00000000 → condition is false

- What if $x = -5$? Show the value if x in binary to justify.

11111011 & 00100000 = 00100000 → condition is true

4. Suppose we have the following piece of C code (%p in printf just prints the address in hex):

```
void foo(int i)
{
    char a[2];
    double d= 3.14;

    a[i] = 0xFFFFABCD;
    printf("%d", d);
}
```

a. [2 points] How many bytes does array a require?

2 bytes

b. [2 points] Suppose array a is stored at address A1. What is the address of a[0]? What is the address of a[1]?

a[0] will be stored in A1

a[1] will be stored in A1+1

c. [3 points] Suppose array a is stored at address A1. Will variable d always be stored in memory after array a? Justify.

Not necessarily. It depends on whether the OS will find an empty spot, big enough, for d after the array a.

d. [3 points] Something is wrong with the line: **a[i] = 0xFFFFABCD;** What is it?

a is an array of characters. The number assigned to a[i] is outside the range that a character can present.

e. If we call the function foo as follows: foo(2);

- [3 points] What will happen?

You will overwrite whatever is stored after array a in memory. The compiler may not complain especially if foo() is called at runtime with a number not known during compilation.

- [3 points] Will this affect the value of d? Justify

If d is stored just after array a, it will be affected. Otherwise, no.

5. Given the following C code:

```
int compute(int a, int b)
{
    int c;

    while (b != 0) {
        c = (a & b) << 1;
        a=a^b;
        b=c;
    }

    return a;
}
```

- a. [4 points] Suppose the two inputs to the above function are: $a = 10$ and $b = 20$
What will the function return (both in decimal and in binary)?

It will return 0000...011110 → 30 in decimal

- b. [3 points] Given the above two inputs ($a = 10$, $b = 20$), how many times will the above loop execute? For each iteration, write down the value of c .

**The loop will be executed once.
 c will have the value 0**

- c. [4 points] Assume $x = 5$ and we call `compute(~x, 1)`, what will be the value returned (in binary and decimal). [Hint, you can use dots “...” to represent repeated bits when you state the binary result]

**5 → 00000....0101 ~5 → 11111...1010
the output will be 11111..1011 → -5**

- d. [6 points] Suppose we have two pointer `int * k` and `int * m` declared inside `compute`. Write three statements: one to make k point to a , the second to make m points to b , and the third to execute statement **$a=a^b$** ; using only k and m .

`k = &a; m = &b; *k = (*k)^(*m);`