COMP1411 (Spring 2020)   Introduction to Computer Systems

Take-home assignment   Due Date: 10:00am, 25th May, 2020

Question Paper

Instructions:

- You must type your answers into the provided answer book.
  DON'T type your answers into this question paper!
- Please check the detailed instructions in the provided answer book.
- You must answer questions by yourself only.
  You are not allowed to discuss with other people about questions and answers.

Question 1.   [25 marks]

1(a) Convert the following IEEE single-precision floating point number (32-bit)

$$0\ 01010101\ 10111010000000000000000$$

to a decimal number. Show your steps.

[9 marks]

1(b) Convert the decimal number -125.421875 into IEEE single-precision floating point number (32-bit). Show your steps.

[9 marks]

1(c) Consider the following C-language statement where x and y are "unsigned int" variables.

```
y = x * 62;
```

Rewrite the above statement into the following statement where each blank is an integer.

```
y = (x << __ ) - (x << __ );
```

Show your steps.

[7 marks]

Question 2.   [25 marks]

In this question, we consider the x86-64 instruction set architecture, as discussed in lectures 4, 5.

2(a) Write assembly code to copy a 8-byte integer from memory at address 0x1000
          to memory at address 0x1020.

Assume the following values (in hexadecimal format) are stored in registers.

Register	Value
%rax	0x1000
%rbx	0x1020
%rcx	
%rdx	

                                                                              [5 marks]

2(b) Convert the following C code to assembly language. **Mention** clearly which registers /
memory locations are used to represent your input arguments and temporary variables.

```
long F(long a, long b) {
    long sum=0;
    while (a>b) {
        sum = sum + b;
        b = b + 1;
    }
    return sum;
}
```

                                                                              [10 marks]

2(c) Name a condition code in the x86-64 instruction set architecture.
    Give an example of assembly code that is related to the above condition code;
    explain why.

                                                                              [10 marks]

OF it is overflow

Condition Codes is a single bit flag that is set by different instructions (arithmetic or logical)

addq

If computer add two number together and the result is extremely large, then the OF bit will be 1 and indicates that it is overflowed.

Question 3.   [25 marks]

Consider the execution of the following function (written in the C language).

```
void test() {
    int a=1;
    fork();
    a=a+2;
    if (fork()==0)
        a=a*3;
    printf("La: %d\n",a);
}
```


3(a) Draw the process graph for the execution of "test".   [10 marks]

3(b) Give an example of infeasible output of "test". **Explain** why it is infeasible output.

[8 marks]

3(c) The output of "test" depends on the scheduling of processes on CPU.
There can be many feasible output of "test".
Calculate the number of feasible output of "test". Show your steps.

[7 marks]

Question 4.   [25 marks]

4(a) Explain the meaning of the following command used in Linux shell:

```
./program    < a.txt    > b.txt
```

[8 marks]

4(b) What is virtual memory?
  Explain how virtual memory can be used for caching.

[9 marks]

4(c) Estimate the average time (in ms) to access a sector on the following disk:

Parameter	Value
Rotational rate	30000 RPM
Tavgseek	10 ms
Average number of sectors per track	1000

[8 marks]

Required answer

=Seek + rotation + transfer

=10+0.5*(60/30000)*1000+60/30000*1/1000*1000

=10+1+0.002

=11.002ms