# CS2022 ASSIGNMENT 7 (Due Date: Oct 28, 2022)

**Instructions**: You have to answer all of them.

## Question 1

(a) In a computer, which hardware device is the key device to execute an instruction (in forms of machine code) of an operating system?

(b) In a computer, which hardware device is the key device to execute an instruction (in forms of machine code) of an application software, like Chrome?

(c) Once a computer has just been power on, a CPU will execute a dedicated instruction. This instruction is hardwired in a special read-only-memory (ROM) device. What is the name of this memory device?

(d) If two CPUs have different architectures, would it be possible that their sets of instructions be the same? [Hint: Consider Table 1 in the lecture note "Processor and Computer". If we would like to add the instruction "MOV RB RM" in the set of instructions for the processor shown in Figure 5, how could we make it possible?]

(e) In the lecture, I have introduced four levels of programming, namely high level, middle level, low level assembly language programming and the lowest level microprogramming. For the high level and middle level programming, state for each level one programming language which is developed for that level.

(f) In a computer, which device contains the instructions of the executable file of Chrome?

(g) In a computer, which device contains the instructions of the executable file of an operating system?

(h) Nowadays, almost all computers and cell phones must have a memory device called RAM. Why does the CPU not simply access directly to the hard disk or solid state drive which is the main memory?

(i) Direct memory access (DMA) is a hardware device specialized designed for the transferring between the RAM and the main memory. Describe how does it work.

(j) If a factory is an analogy to a processor, which role is the best analogy of a switch?

(k) If a factory is an analogy to a processor, which role is the best analogy of a microprogram designer?

(l) If a factory is an analogy to a processor, what is the best analogy of a memory device?

(m) If a factory is an analogy to a processor, what is the best analogy of an instruction?

(n) In between a processor and the main memory, there are four types of signals to be transferred. They are the "instruction", "data", "memory address" and "control signals". Let say, the number of bits for an instruction, a data or memory address is 16. In such case, the number of physical pins of a CPU will be larger than 48. To reduce the number of pins to be minimum, there are 16 pins for handling the signals "instruction", "data" and "memory address". Describe how does it work.

(o) With reference to the Section 3.4 "Process and Computer (Supplement)", which factors are used for program complexity? Note that a program could be a microprogram or a C program.

(p) State the names of two families (equivalently series) of operating systems.

(q) In a computer or a cell phone, there are so many hardware devices. To synchronize all these devices, there must a special circuit or device to be connected to all these devices. What is the name of this circuit or device?

## Question 2

Three numbers have been stored in M1, M2 and M3. Which of the following program segments can correctly give the output of the following formulae?

$$M4 = M1 + M2 \times M3.$$

(a)
```
----------------
MOV IA M1
MOV IB M2
MUL IA IB
MOV IA OUT
MOV IB M3
ADD IA IB
MOV M4 OUT
----------------
```

(b)
```
----------------
MOV IA M1
MOV IB M2
ADD IA IB
MOV IA OUT
MOV IB M3
MUL IA IB
MOV M4 OUT
----------------
```

(c)
```
----------------
MOV IA M2
MOV IB M3
MUL IA IB
MOV IA OUT
MOV IB M1
ADD IA IB
MOV M4 OUT
----------------
```

(d)
```
----------------
MOV IA M2
MOV IB M3
ADD IA IB
MOV IA OUT
MOV IB M1
MUL IA IB
MOV M4 OUT
----------------
```

(e) None of the above.

# Question 3

With reference to the four-logic-gate as shown in Figure 1 in the lecture note "Processor and Computer", what is the truth table of the following logical operation?

$$Z = \neg A \oplus \neg B,$$

where $\neg A$ refers to the logical operation "NOT A" and $A \oplus B$ refers to the logical operation "XOR A B".

| A | B | Z |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

# Question 4

With reference to the four-logic-gate as shown in Figure 1 in the lecture note "Processor and Computer", which of the following micro-program(s) can perform the logical operation.

$$Z = \neg A \oplus \neg B,$$

where $\neg A$ refers to the logical operation "NOT A" and $A \oplus B$ refers to the logical operation "XOR A B".

(i) 7-Step micro-program.

S1: $S_1 = S_8 = 1$. Other connectors and switches are set to 'Disconnection' mode.

S2: $S_{14} = 01$ and $S_{15} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S3: $S_{13} = 01$ and $S_{12} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S4: $S_1 = S_8 = 1$. Other connectors and switches are set to 'Disconnection' mode.

S5: $S_{14} = 01$ and $S_{13} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S6: $S_{15} = 01$ and $S_{12} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S7: $S_4 = S_7 = S_{11} = 1$. Other connectors and switches are set to 'Disconnection' mode.

(ii) 8-Step micro-program.

S1: $S_1 = S_8 = 1$. Other connectors and switches are set to 'Disconnection' mode.

S2: $S_{14} = 01$ and $S_{16} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S3: $S_{13} = 01$ and $S_{12} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S4: $S_1 = S_8 = 1$. Other connectors and switches are set to 'Disconnection' mode.

S5: $S_{14} = 01$ and $S_{13} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S6: $S_{16} = 01$ and $S_{12} = 10$. Other connectors and switches are set to 'Disconnection' mode.

S7: $S_4 = S_7 = S_{11} = 1$. Other connectors and switches are set to 'Disconnection' mode.

S8: $S_{14} = 01$ and $S_{15} = 10$. Other connectors and switches are set to 'Disconnection' mode.

(iii) One-step micro-program.

S1: $S_4 = S_7 = S_{11} = 1$. Other connectors and switches are set to 'Disconnection' mode.

**Answer:**

(a) (i) and (ii).

(b) (ii) and (iii).

(c) (i) and (iii).

(d) (i), (ii) and (iii).

(e) None of the above.