

## CSE222: Computer Architecture &amp; Organization

**Final Exam 2020S(B)**

(May 2020, SCCC)

**Part I (60)**

## 1. (10 pts) Answer Questions

(a) What is Architecture, and what is Microarchitecture?

(b) What is big-endian, what is little-endian byte order? Given the following hexadecimal number **0xA1B2C3D4**, indicate how this number is saved as big-endian and little-endian in the following memory block:

Big-endian byte order

0x1003	0x1002	0x1001	0x1000

Little-endian byte order

0x1003	0x1002	0x1001	0x1000

(c) What is multiplexer, what is decoder?

(d) What is the difference between combinational circuits and sequential circuits?

2. (14 pts) Simplify the following Boolean equations **using Boolean algebra theorems**, Write out the procedure showing how to get the final result. Draw logical diagrams after simplification (using logical gates):

$$(1) F = \overline{A} C (\overline{A} B D) + \overline{A} B \overline{C} \overline{D} + A \overline{B} C$$

$$(2) \quad F = (A + \overline{B}) (\overline{A} + \overline{B} + \overline{C}) C$$

3. **(16 pts)** Below is a Boolean equation in Sigma format:

$$F(A,B,C,D) = \sum (0, 1, 2, 3, 4, 5, 6, 8, 10, 12, 14)$$

- (1) Simplify the equation using K-map; Draw a logical diagram, using logic gates to implement the function
  - (2) Draw logical diagram, using 4:1 multiplexer(s) + 2:1 multiplexer to implement the function
4. **(20 pts)** You are asked to design a voting system for a company. 4 persons in the company have different voting weights, which are: A: 40%, B: 25%, C: 20%, D: 15%. A decision passes (output = 1) if it gets more than 50% of votes. Design a logic circuits to implement this voting system:
- (a) Specify the function in a truth table
  - (b) Describe the function in Boolean expression in SOP form.

- (c) Build the circuit using logical gates. If need, simplify the Boolean equation in (b) first, then draw logical diagram
- (d) Build the circuit using 4:1 multiplexer(s), draw the logical diagram

## Part II (40 pts): MIPS programming

1. (15 pts) Write MIPS program:
  - (1) Define a word variable **m**
  - (2) Prompt to enter an integer number from console, save the number into **m**
  - (3) Calculate  $7 * m$ , display result
  - (4) Use another method to calculate  $7 * m$ , display result
2. (25 pts) For the following pseudo code, write MIPS program to implement the function:

```
// define an array of size 12
int [] array = new int [12];
// initialize array with random numbers
for (int i=0; i<12; i++) {
    array[i] = generate-random-number-in-range [-100, 100];
}

// call function searchForMinElementInArray (array, 12);
int [] result = searchForMinElementInArray()
// display return result:
Display "the minimum element <number> is found at location <location>"

// this method will check array and search for the maximum elements in array
// return this number and its location where this number is found in array
int [] searchForMinElementInArray (int [] array, int arraySize) {
    int idx = 0;
    for (int i=1; i<arraySize; i++)
        if (array[i] < array[idx]) {
            idx = i;
        }
    return new int[2] { array[idx], idx };
}
```