

Introduction to Computer Science: Mid-Term Exam

November 9, 2018. 9:30 - 11:00

Name: _____

Student ID: _____

Instructions: This paper consists of fifty multiple-choice (MC) questions. Each question has one and only one correct choice. Each carries 2 marks. You have to answer all of them. Please circle your choice by using either blue or black ball pen. In the end of the paper, there is an appendix introducing the set of instructions of an artificial CPU. Dictionary, calculator, cell phone and computer are not allowed to be used in the examination.

Question 1

What was the original use of computers?

- (a) Telecommunication.
- (b) Internet access.
- (c) Computation.
- (d) Data storage.

Question 2

Which of the following electronic technologies is the key for making the personal computer in the 1970s?

- (a) Transistor
- (b) Integrated circuit
- (c) Microprocessor
- (d) Nanotechnology

Question 3

What is the contribution of Douglas Engelbart in the evolution of computer?

- (a) Develop the first mouse.
- (b) Develop the first operating system.
- (c) Develop the first power generator.
- (d) Develop the first vacuum tube.

Question 4

What is the major problem in the first generation personal computer, like Apple I?

- (a) The operating system interface is command based. It is not user friendly.
- (b) The size of a personal computer is very big. The CPU is not made of microprocessor.
- (c) The price of a personal computer is very expensive.
- (d) It is unable to connect to the Internet.

Question 5

From the professor's viewpoint, which one of the following information systems is inevitable?

- (a) Transaction processing system.
- (b) Management information system.
- (c) Decision support system.
- (d) Executive information system.

Question 6

Which of the following items are part of information technologies ?

- (i) Projector
- (ii) Browser
- (iii) Bar code scanner

Answer :

- (a) (i) & (ii)
- (b) (ii) & (iii)
- (c) (i) & (iii)
- (d) (i), (ii) and (iii)

Question 7

Which of the following statement(s) is(are) true?

- (i) Without logic gate, it is not possible to have an information system.
- (ii) Without computer, it is not possible to have an information system.
- (iii) Without information system, a firm is not able to do administration.

Answer:

- (a) (i) only
- (b) (i) & (ii) only
- (c) (iii) only
- (d) (ii) & (iii) only

Question 8

Which of the following statement(s) is(are) true?

- (i) All arithmetic operations can be implemented by logic gates.
- (ii) Representing a negative number in 2's-complement format can let addition/subtraction easily be realized by using full adder.
- (iii) All logic operations can be implemented by NAND gates.

Answer :

- (a) (i) & (ii)
- (b) (ii) & (iii)
- (c) (i) & (iii)
- (d) (i), (ii) and (iii)

Question 9

The truth table of an half adder is shown below.

A	B	C	D
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

The implementation of this half adder can be done by two logic gates, say X and Y . Logic gate X is with A and B as input and C as output, while logic gate Y is with A and B as input and D as output. What should logic gates X and Y are?

- (a) X is a OR gate, while Y is an AND gate.
- (b) X is a XOR gate, while Y is an AND gate.
- (c) X is a AND gate, while Y is an OR gate.
- (d) X is a AND gate, while Y is an XOR gate.

Question 10

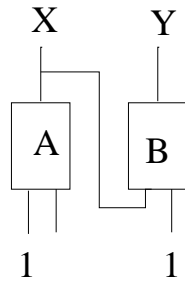
The following is the truth table of a full adder. What are the values X and Y ?

A	B	D	C	Z
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	X
1	0	1	1	0
1	1	0	1	0
1	1	1	1	Y

- (a) $X = 0, Y = 0$.
- (b) $X = 0, Y = 1$.
- (c) $X = 1, Y = 0$.
- (d) $X = 1, Y = 1$.

Diagram for Questions 11-15

The following schematic diagram is for Question 11 to Question 15. It is a circuit consisting of two logic gates.



Question 11

What are the output values X and Y if A is an XOR gate, B is an AND gate and the input (from left to right) is 101.

- (a) $X = 0, Y = 0$.
- (b) $X = 0, Y = 1$.
- (c) $X = 1, Y = 0$.
- (d) $X = 1, Y = 1$.

Question 12

What are the output values X and Y if A is an OR gate, B is an OR gate and the input (from left to right) is 111.

- (a) $X = 0, Y = 0$.
- (b) $X = 0, Y = 1$.
- (c) $X = 1, Y = 0$.
- (d) $X = 1, Y = 1$.

Question 13

What are the output values X and Y if A is an AND gate, B is an XOR gate and the input (from left to right) is 101.

- (a) $X = 0, Y = 0$.
- (b) $X = 0, Y = 1$.
- (c) $X = 1, Y = 0$.
- (d) $X = 1, Y = 1$.

Question 14

What are the output values X and Y if A is an OR gate, B is an NAND gate and the input (from left to right) is 111.

- (a) $X = 0, Y = 0$.
- (b) $X = 0, Y = 1$.
- (c) $X = 1, Y = 0$.
- (d) $X = 1, Y = 1$.

Question 15

What are the output values X and Y if A is an NAND gate and B is an NAND gate and the input (from left to right) is 111.

- (a) $X = 0, Y = 0$.
- (b) $X = 0, Y = 1$.
- (c) $X = 1, Y = 0$.
- (d) $X = 1, Y = 1$.

Question 16

C Programming language is _____ for building a software.

- (a) a communication scheme
- (b) a coding scheme
- (c) a Visual Basic interface
- (d) a .NET interface

Question 17

Which of the following language is the lowest (machine) level language?

- (a) Machine code.
- (b) C language.
- (c) Assembly language.
- (d) SQL.

Question 18

To convert a C program to machine code, we need to use a _____.

- (a) DevC compiler
- (b) Java Development Kit
- (c) Visual Basic Compiler
- (d) Dictionary

Question 19

Which of the following software has an interpreter inside?

- (i) Window OS
- (ii) Chrome
- (iii) Matlab

Answer:

- (a) (i) and (ii) only.
- (b) (ii) and (iii) only.
- (c) (i) and (iii) only.
- (d) (i), (ii) and (iii).

Question 20

Information is a set of data that have been shaped into a form that is _____.

- (a) meaningless and useless to human being
- (b) meaningful and useful to human being
- (c) meaningless and useless to information systems
- (d) meaningful and useful to information systems

Question 21

What is the value of the unsigned integer '11111011' in decimal form?

- (a) 247.
- (b) 251.
- (c) 253.
- (d) None of the above.

Question 22

What is the value of the unsigned integer '1111111111111111' in decimal form?

- (a) $2^{17} - 1$.
- (b) $2^{16} - 1$.
- (c) $2^{15} - 1$.
- (d) None of the above.

Question 23

Convert -20_{10} in **8-bit 2'S complement formate**.

- (a) 10010100₂
- (b) 00010100₂
- (c) 11101011₂
- (d) 11101100₂

Question 24

Convert -148_{10} in **16-bit 2'S complement formate** and then convert this binary bit patterns in hexadecimal form.

- (a) *FEEB*.
- (b) *FF6B*.
- (c) *FF6C*.
- (d) *FEEC*.

Question 25

x and y are two binary numbers which are in **4-bit 2's complement formate**, where

$$x = 0010_2 \text{ and } y = 1101_2.$$

Clearly, y is a negative number. What is the result of $x + y$ in decimal formate?

- (a) 1_{10}
- (b) -1_{10}
- (c) 0_{10}
- (d) -7_{10}

Question 26

With reference to ASCII code, what are the bit patterns of the characters '0', '1' and '2' respectively?

- (a) 00110010, 00110001, 00110000
- (b) 00110000, 00110001, 00110010
- (c) 00011110, 00011111, 00100000
- (d) 00100000, 00011111, 00011110

Question 27

With reference to ASCII code, what are the bit pattern of the string '0 1'? (Note that there is a space between '0' and '1'?)

- (a) 001100000011000000110001
- (b) 001100000010000000110001
- (c) 001100000011000000110000
- (d) 001100000010000000110000

Question 28

In the ASCII code table, there are many strange characters like codes from number 128 to 159. What are the reasons why we need to consider these characters?

- (a) To encode European language.
- (b) To encode Asian language.
- (c) To encode African language.
- (d) To encode South American language.

Question 29

In the ASCII code table, what is the purpose to have the strange characters from code number 176 to code number 178?

- (a) To support graphical visual effect on command-based monitor.
- (b) To encode European language.
- (c) They are redundant, no special purpose.
- (d) None of the above.

Question 30

In accordance with ASCII code, each English character is represented by 8 bits. For Chinese characters, how many bits are required for coding?

- (a) 8 bits
- (b) 16 bits
- (c) 24 bits
- (d) 32 bits

Question 31

Refer to the artificial CPU and its commands, what will be the content of *M4* if the following commands are executed?

```
DEF M1 0
DEF M2 2
DEF M3 5

MOV IA M1
IF IA == 0
    MOV IA M2
    MOV IB M3
    ADD IA IB
    MOV M4 OUT
ELSE
    MOV IA M1
    ADD IB M2
    MOV M4 OUT
ENDIF
```

- (a) 2.
- (b) 7.
- (c) 5.
- (d) 0.

Question 32

What will be the content of *M4* if the following program segment is executed?

```
DEF M1 16
DEF M2 22
DEF M3 10

MOV IA M1
```

```

MOV IB M2
CMP IA IB
MOV M4 OUT
MOV IA M2
MOV IB M3
CMP IA IB
MOV IA OUT
MOV IB M4
ADD IA IB
MOV M4 OUT

```

- (a) 28.
- (b) 30.
- (c) 32.
- (d) 34.

Question 33

Refer to the artificial CPU and its commands, what will be the content of $M4$ if the following commands are executed?

```

DEF M1 1
DEF M2 2
DEF M3 3

MOV IA M1
IF IA == 0
    MOV IA M3
    SHL IA 00000100
    MOV IA OUT
    MOV IB M2
    ADD IA IB
    MOV M4 OUT
ELSE
    MOV IA M2
    SHL IA 00000100
    MOV IA OUT
    MOV IB M3
    ADD IA IB
    MOV M4 OUT
ENDIF

```

- (a) 10.
- (b) 11.
- (c) 14.
- (d) 15.

Question 34

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?

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

- (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
-----

```

Question 35

Given that there are five memories $M1$, $M2$, $M3$, $M4$ and $M5$. Here is the program segment to instruct the circuit.

```

-----
MOV IA M1
MOV IB M2
MUL IA IB
MOV M5 OUT
MOV IA M3
MOV IB M4
MUL IA IB
MOV IA OUT
MOV IB M5
ADD IA IB
MOV M5 OUT
-----

```

Which of the following mathematical equation is identical to the operation of the following program segment?

- (a) $M5 = M1 + M2 \times M3 + M4$.
- (b) $M5 = (M1 + M2) \times M3 + M4$
- (c) $M5 = M1 \times (M2 + M3) \times M4$.
- (d) $M5 = M1 \times M2 + M3 \times M4$.

Question 36

Given that there are five memories M1, M2, M3, M4 and M5. Here is the program segment to instruct the circuit.

```

-----
MOV IA M1
MOV IB M2
MUL IA IB
MOV IA OUT
MOV IB M4
SUB IA IB
MOV IA OUT
MOV IB M3
ADD IA IB
MOV M5 OUT
-----

```

which of the following mathematical equation is identical to the operation of the following program segment?

- (a) $M5 = M1 \times M2 + (M3 - M4)$.
- (b) $M5 = M1 \times M2 + (M4 - M3)$
- (c) $M5 = (M3 - M4) - M1 \times M2$.
- (d) $M5 = (M4 - M3) - M1 \times M2$.

Question 37

If the content in M1 is either '1' or '0', which of the following mathematical equation is identical to the operation of the following program segment?

```

MOV IA M1
IF IA == 1
    MOV IA M2
    MOV IB M3
    SUB IA IB
    MOV IA OUT
    SHL IA 00000010
    MOV M4 OUT
ELSE
    MOV IA M3
    MOV IB M2
    ADD IA IB
    MOV IA OUT
    SHL IA 00000100
    MOV M4 OUT
ENDIF

```

- (a) $(1 - M1) \times (2 \times (M2 - M3)) + M1 \times (2 \times (M2 + M3))$.
- (b) $M1 \times (2 \times (M2 - M3)) + (1 - M1) \times (2 \times (M2 + M3))$.
- (c) $4 \times (M2 - M3) \times (1 - M1) + 2 \times (M2 + M3) \times M1$.
- (d) $2 \times (M2 - M3) \times M1 + 4 \times (M2 + M3) \times (1 - M1)$.

Question 38

Given that there are five memories M1, M2, M3, M4 and M5. Here is the program segment to instruct the circuit.

```

-----
MOV IA M1
MOV IB M2
MUL IA IB
MOV IA OUT
DIV IA IB
MOV IA OUT
MOV IB M3
ADD IA IB
MOV M5 OUT
-----

```

which of the following mathematical equation is identical to the operation of the following program segment?

- (a) $M5 = M1 \times M2 + M3$.
- (b) $M5 = M1/M2 + M3$
- (c) $M5 = M1 + M3$.
- (d) None of the above.

Question 39

Given that there are five memories M1, M2, M3, M4 and M5. Here is the program segment to instruct the circuit.

```

-----
MOV IA M1
MOV IB M2
MUL IA IB
ADD IA IB
MOV M5 OUT
-----

```

which of the following mathematical equation is identical to the operation of the following program segment?

- (a) $M5 = M1 \times M2 + M2$.
- (b) $M5 = M1 \times M2 + M1$
- (c) $M5 = M1 + M2$.
- (d) None of the above.

Question 40

Given that there are five memories M1, M2, M3, M4 and M5. Here is the program segment to instruct the circuit.

```

-----
MOV IA M1
MOV IB M2
MUL IA IB
MUL IA IB
MOV IA OUT
MOV IB M3
MUL IA IB
MUL IA IB
MOV IA OUT
MOV IB M4
SUB IA IB
-----

```

```

SUB IA IB
MOV M5 OUT
-----

```

which of the following mathematical equation is identical to the operation of the following program segment?

- (a) $M5 = M4 - M1 \times M2 \times M3$.
- (b) $M5 = M4 - (M1 + M2) \times M3$
- (c) $M5 = M1 \times M2 \times M3 - M4$.
- (d) $M5 = (M1 + M2) \times M3 - M4$.

Question 41 - Question 50 are logical questions. You need to select one of the following options for your answer. Both *X* and *Y* are arguments.

- (a) *X* is true. *Y* is not true.
- (b) *X* is not true. *Y* is true.
- (c) Both *X* and *Y* are true but *X* and *Y* have no logical implication.
- (d) Both *X* and *Y* are true. *X* is the cause of *Y* (*X* implies *Y*, or *Y* is an implication of *X*).
- (e) Both *X* and *Y* are not true.

Question 41

X: There was no computer in 400 years ago.
Y: There was no information system in 400 years ago.

Question 42

X: UK made the first commercial computer in the 20 century.
Y: UK used computer successfully to break the encryption code that the German army was using in radio communication.

Question 43

X: In every telecom firm, her 4G telecom network has already connected to the Internet via the exchange servers.
Y: Cell phone can connect to the Internet even if WiFi is not available.

Question 44

X: Safari is a browser developed for MacOS.
 Y: It is not possible to install Safari in a computer running Window OS but no other migration assistant.

Question 45

X: Apple APP Store is a platform for uploading and selling Android Apps.
 Y: Customers of Google Play are the developers who upload the Apps.

Question 46

X: Vacuum tube was invented in the 1900s.
 Y: Electronic logic gates were developed in the early 20 century.

Question 47

X: All logic gates can be made by NAND gates.
 Y: Any logic circuit can be made by NAND gates.

Question 48

X: BIOS stores the first instruction to be executed by the CPU when a computer is turned on.
 Y: A computer will not be function if BIOS has been broken down.

Question 49

X: Operating systems like MacOS and Windows are designed to handle multitasking.
 Y: We can open MS WORD and at the same time open Chrome (a browser) to search information over the Internet.

Question 50

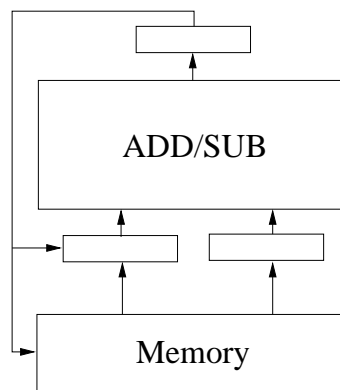
X: Algorithm A as depicted in Appendix can solve the abnormal ball problem (the 9-ball problem).
 Y: In term of the number of using pan balance, Algorithm A is the best algorithm to solve the abnormal ball problem.

APPENDIX

In this appendix, it includes the information about the artificial CPU and the source codes of five programs. Please read them carefully!

Artificial CPU

Below is a simple circuit. It consists of a **memory** with 16 memory spaces (from M1 to M16), an **ALU block**, 2 **input registers** (IA and IB) and one **output register** (OUT). M1 to M16, IA, IB and OUT are all 8 bits long. Numbers are represented in *2's compliment* format.



Eleven commands (MOV, ADD, SUB, MUL, DIV, CMP, SHL, SHR, DEF, MSK and IF) are provided for instructing the above circuit. The syntax and the descriptions of these commands are depicted in Table 1.

Notes on CPU Commands

1. For the "CMP" command, if $X = 0110$ and $Y = 1101$, $OUT = 1011$.
2. For "SHL" and "SHR" commands, the content of Y can only be one of the following.

Y	Meaning
10000000	(Shift 7 bits)
01000000	(Shift 6 bits)
00100000	(Shift 5 bits)
00010000	(Shift 4 bits)
00001000	(Shift 3 bits)
00000100	(Shift 2 bits)
00000010	(Shift 1 bits)
00000001	(No shift)

Table 1: Commands for using the CPU.

Syntax	Description
MOV X Y	Copy the content of Y to X
ADD X Y	$OUT = X + Y$.
SUB X Y	$OUT = X - Y$.
MUL X Y	$OUT = X \times Y$.
DIV X Y	$OUT = X/Y$.
CMP X Y	$OUT = b_1b_2b_3b_4b_5b_6b_7b_8$. $b_i = 0$ if $X_i = Y_i$. $b_i = 1$ if $X_i \neq Y_i$.
SHL X Y	OUT is the content of X shifting left Y bits.
SHR X Y	OUT is the content of X shifting right Y bits.
DEF X N	Define X as the number N.
MSK X M	Mask the value of X by M.
IF ELSE	Condition statement.

For example, if

$$X = 00011000, Y = 00000100,$$

the OUT of "SHL X Y" is 01100000 and the OUT of "SHR X Y" is 00000110.

- For the "DEF" command, N must be a number in *decimal* form. X can only be a memory location. "DEF" command is not applicable for assigning values to a register. It is used to assign a value to a memory location. For example, "DEF M1 12" means that memory location $M1$ will be assigned with a value 12. Therefore, $M1 = 00001100$.
- For the "MSK" command, it is used for masking a register (either IA or IB) by the mask M (in binary). The mask must be 8 bits long.

Suppose that the content of IA and M are defined as follows :

$$IA = 01001001, M = 11110000.$$

Then, the output OUT will be "01000000". The last four bits are masked. Here is an example.

```
-----
DEF M1 45
```

```
MOV IA M1
MSK IA 00001111
MOV M2 OUT
-----
```

Initially, $M1$ is assigned with value 45. In binary form, the content reads "00101101". Thus, the output OUT is "00001101".

- The "IF-ELSE" command is an advanced level command. It is for conditional statement. Once it is executed, the CPU will perform multiple steps in order to make it works. You do not need to know the detail how it works. In term of its usage, it is simple. Here is an example.

```
-----
DEF M1 1
DEF M2 2
DEF M3 1

MOV IA M1
IF IA == 0
    MOV IA M2
    MOV IB M3
    ADD IA IB
    MOV M4 OUT
ELSE
    MOV IA M1
    ADD IB M2
    MOV M4 OUT
ENDIF
-----
```

Command "IF" checks if the content of IA is identical to "0". If it is, it will perform $M2+M3$ and output the result to $M4$. Otherwise, it will perform $M1+M2$ and output the result to $M4$.

```
-----
DEF M1 1
DEF M2 2
DEF M3 1

MOV IA M1
IF IA == 0
    MOV IA M2
    MOV IB M3
    ADD IA IB
```

```
MOV M4 OUT
ENDIF
-----
```

In this example, the CPU performs $M2 + M3$ only if IA is zero. Otherwise, it performs nothing.

6. For the "IF-ELSE" command, the following conditions are allowed for you to define. Here NUM must be stated in decimal form but not in binary.

```
-----
IA == NUM
IA > NUM
IA >= NUM
IA < NUM
IA <= NUM
-----
```

Algorithm A

The filename of the following program is "registration.cpp".

Step 1: LABEL the balls from 1 to 9.

MEMORIZE the number 1 in your brain.

LABEL this number BN.

Step 2: REPEAT

 USE the pan balance to weight the BN and BN+1 balls.

 IF their weights are the same,

 IF BN == 7,

 The 9th ball is abnormal.

 ELSE

 SET BN = BN+1.

 END

 ELSE

 USE the pan balance to weight the BN and BN+2 balls.

 IF their weights are the same,

 The BN+1 ball is abnormal.

 ELSE

 The BN ball is abnormal.

 END

 END

UNTIL the abnormal ball has been found.