Introduction to Computer Science: Final Exam

January 8, 2021. 9:30 - 11:00

Name: _____

Student ID: _____

Instructions: This paper consists of 70 multiple choice questions. Section A consists of 40 questions. Each carries ONE mark. There is no penalty score if the answer is incorrect. That is to say,

$$\text{Score} = \begin{cases} +1 & \text{if the answer is correct,} \\ 0 & \text{if there is no answer,} \\ 0 & \text{if the answer is incorrect.} \end{cases}$$

Section B consists of 30 questions. Each carries TWO marks. Similar to the questions in Section A, there is no penalty score if the answer is incorrect. That is to say,

$$\text{Score} = \begin{cases} +2 & \text{if the answer is correct,} \\ 0 & \text{if there is no answer,} \\ 0 & \text{if the answer is incorrect.} \end{cases}$$

You need to answer all 70 questions. For each question, there is only ONE correct answer.

Please circle your answer, or write down your answer on the left of the question, either by using a blue or black ball pen. Dictionary and calculator are allowed.

Please do not take away this paper. This paper has to be returned for marking.

Section A

For the Question 1 to Question 5, you need to select one of the following options for your answer.

(a) Both X and Y are false.

(b) X is true. Y is false.

(c) X is false. Y is true.

(d) Both X and Y are true. X and Y are two independent events.

(e) Both X and Y are true. X is a cause of Y.

(f) Both X and Y are true. Y is a cause of X.

(g) Both X and Y are true. Y is the cause of X and X is also the cause of Y.

Question 1

X: IBM made the first electronic computer in the world.

Y: IBM invented vacuum tube and then vacuum tube-based electronic components in the early 20 century.

Question 2

X: The first generation Lyon Electronic Office (LEO) computer was made of vacuum tubes.

Y: The first generation Lyon Electronic Office (LEO) computer was made by an engineering team in Remington Rand.

Question 3

X: NASA was able to launch Apollo project and land the first human on the moon in the late 1960s.

Y: Microprocessor was invented in the 1950s.

Question 4

X: The number of binary bits to represent an English character is eight.

Y: The number of binary bits to represent a Japanese character is sixteen.

Question 5

X: The range of numbers in 16-bit floating point format is much larger than the range of numbers in 16-bit sign-magnitude fixed point format. Here, the range of numbers refers to the difference between the maximum and the minimum numbers which can be represented,

$$\text{RANGE} = \text{MAX NUM} - \text{MIN NUM}.$$

Y: The decimal number 0.1 can be represented in both the 16-bit floating point format and 16-bit sign-magnitude fixed point format.

Question 6

X: It is not possible to run Safari in a MacOS machine.

Y: Safari is a browser developed only for iOS.

Question 7

X: Mouse was co-invented by Xerox and Apple.

Y: Apple released the first personal computer with graphical user interface (GUI) for commanding the operating system.

Question 8

X: NOT, AND, OR, NOR and XOR gates can be implemented by AND gates only.

Y: Any digital logic circuit can be implemented by AND gates only.

Question 9

X DevC is a C compiler.

Y DevC is a C interpreter.

Question 10

X A C compiler can convert a C program source code (without any error) to an executable file consisting of the corresponding machine code.

Y A C compiler can convert an executable file to its corresponding C program source code.

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.
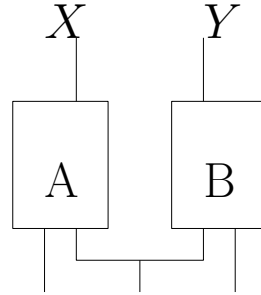
Question 11

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

With reference to the simple processor as shown in the Appendix, Figure 1, which of the following micro-instruction designs will execute the following instruction without error?

$$RZ = RA + RB,$$

where + is the OR operation.

(i) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{12} = \cdots = S_{18} = 00$.

(ii) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{12} = 01$. $S_{13} = \cdots = S_{18} = 00$.

(iii) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{12} = 01$. $S_{14} = 10$. The signals to other two-way switches are set to 00.

Answer :

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 17

With reference to the simple processor as shown in the Appendix, Figure 1, which of the following micro-instruction designs will execute the following instruction without error?

$$R1 = RA + RB,$$

where + is the OR operation.

(i) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{12} = \cdots = S_{18} = 00$.

(ii) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{14} = 01$. $S_{15} = 10$. The signals to other two-way switches are set to 00.

(iii) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{14} = 10$. $S_{15} = 01$. The signals to other two-way switches are set to 00.

Answer :

(a) (i) only.

(b) (ii) only.

(c) (iii) only.

(d) None of them.

Question 18

With reference to the simple processor as shown in the Appendix, Figure 1, which of the following micro-instruction designs will execute the following instruction without error?

$$R1 = RA + RB,$$

where + is the OR operation.

(i) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{14} = 10$. $S_{15} = 01$. The signals to other two-way switches are set to 00.

(ii) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{14} = 01$. $S_{15} = 10$. The signals to other two-way switches are set to 00.

(iii) $S_3 = S_6 = S_{10} = 1$. The control signals to other connectors are set to 0. $S_{14} = 01$. $S_{15} = S_{16} = 10$. The signals to other two-way switches are set to 00.

Answer :

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 19

With reference to the simple processor as shown in the Appendix, Figure 1, which of the following micro-instruction designs will execute the following instruction without error?

$$R1 = R2 = \neg RA,$$

where $\neg$ is the NOT operation.

(i) $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. $S_{14} = 01$. $S_{15} = S_{16} = 10$. The signals to other two-way switches are set to 00.

(ii) $S_1 = S_9 = 1$. The control signals to other connectors are set to 0. $S_{14} = S_{15} = S_{16} = 01$. The signals to other two-way switches are set to 00.

(iii) $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. $S_{14} = S_{15} = 01$. $S_{16} = 10$. The signals to other two-way switches are set to 00.

Answer :

(a) (i) only.

(b) (ii) only.

(c) (iii) only.

(d) None of them.

Question 20

With reference to the simple processor as shown in the Appendix, Figure 1, suppose that the registers are preset as $RA = 0$, $RB = 1$, $RZ = 0$, $R1 = R2 = R3 = R4 = 0$. What will be the contents of the registers RA and RZ after the following micro-instructions (S1, S2 and S3) have been executed?

S1: $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. The signals to all two-way switches are set to 00.

S2: $S_{14} = 01$. $S_{12} = S_{15} = 10$. The control signals to all connectors are set to 0. The signals to other two-way switches are set to 00.

S3: $S_2 = S_5 = S_9 = 1$. $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

Answer :

(a) $RA = 0, RZ = 0$.

(b) $RA = 0, RZ = 1$.

(c) $RA = 1, RZ = 0$.

(d) $RA = 1, RZ = 1$.

Question 21

With reference to the simple processor as shown in the Appendix, Figure 1, suppose that the registers are preset as $RA = 0$, $RB = 1$, $RZ = 0$, $R1 = R2 = R3 = R4 = 0$. What will be the contents of the registers RA and RB after the following micro-instructions (S1, S2 and S3) have been executed?

S1: $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. The signals to all two-way switches are set to 00.

S2: $S_{14} = 01$. $S_{12} = S_{15} = 10$. The control signals to all connectors are set to 0. The signals to other two-way switches are set to 00.

S3: $S_2 = S_5 = S_9 = 1$. $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

Answer :

(a) $RA = 0, RB = 0$.

(b) $RA = 0, RB = 1$.

(c) $RA = 1, RB = 0$.

(d) $RA = 1, RB = 1$.

Question 22

With reference to the simple processor as shown in the Appendix, Figure 1, suppose that the registers are preset as $RA = 1$, $RB = 0$, $RZ = 0$, $R1 = R2 = R3 = R4 = 0$. What will be the contents of the registers $R1$ and $R2$ after the following micro-instructions (S1, S2 and S3) have been executed?

S1: $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. The signals to all two-way switches are set to 00.

S2: $S_{14} = 01$. $S_{12} = S_{15} = 10$. The control signals to all connectors are set to 0. The signals to other two-way switches are set to 00.

S3: $S_2 = S_5 = S_9 = 1$. $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

Answer :

(a) $R1 = 0, R2 = 0$.

(b) $R1 = 0, R2 = 1$.

(c) $R1 = 1, R2 = 0$.

(d) $R1 = 1, R2 = 1$.

Question 23

With reference to the simple processor as shown in the Appendix, Figure 1, suppose that the registers are preset as $RA = 1$, $RB = 0$, $RZ = 0$, $R1 = R2 = R3 = R4 = 0$. What will be the contents of the registers $R3$ and $R4$ after the following micro-instructions (S1, S2 and S3) have been executed?

S1: $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. The signals to all two-way switches are set to 00.

S2: $S_{14} = 01$. $S_{12} = S_{15} = 10$. The control signals to all connectors are set to 0. The signals to other two-way switches are set to 00.

S3: $S_2 = S_5 = S_9 = 1$. $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

Answer :

(a) $R3 = 0, R4 = 0$.

(b) $R3 = 0, R4 = 1$.

(c) $R3 = 1, R4 = 0$.

(d) $R3 = 1, R4 = 1$.

Question 24

With reference to the simple processor as shown in the Appendix, Figure 1, the following micro-instructions (S1, S2 and S3) have been executed?

S1: $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. The signals to all two-way switches are set to 00.

S2: $S_{14} = 01$. $S_{12} = S_{15} = 10$. The control signals to all connectors are set to 0. The signals to other two-way switches are set to 00.

S3: $S_2 = S_5 = S_9 = 1$. $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

What of the following instruction have been executed?

Answer:

(a) $R1 = (\neg RA)RB$.

(b) $R2 = (\neg RA)RB$.

(c) $R1 = RA(\neg RB)$.

(d) $R2 = RA(\neg RB)$.

Question 25

With reference to the simple processor as shown in the Appendix, Figure 1, the following micro-instructions (S1, S2 and S3) have been executed?

S1: $S_1 = S_8 = 1$. The control signals to other connectors are set to 0. The signals to all two-way switches are set to 00.

S2: $S_{14} = 01$. $S_{12} = S_{15} = 10$. The control signals to all connectors are set to 0. The signals to other two-way switches are set to 00.

S3: $S_2 = S_5 = S_9 = 1$. $S_{12} = 10$. $S_{14} = 01$. $S_{15} = 10$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

What of the following instruction have been executed?

Answer :

(a) $R1 = (\neg RA)RB$.

(b) $R2 = (\neg RA)RB$.

(c) $R1 = RA(\neg RB)$.

(d) $R2 = RA(\neg RB)$.

Question 26

Refer to the artificial CPU and its commands in the Appendix.

```
----------------
MOV IA M1
MOV IB M2
ADD IA IB
MOV IA OUT
MOV IB M3
SUB IA IB
MOV M4 OUT
----------------
```

Suppose the initial contents of M1, M2, M3 and M4 are given by

$M1 = 0011, M2 = 0010, M3 = 0001, M4 = 0000.$

What is the content of M4 once the program is finished?

(a) 0010

(b) 0011

(c) 0100

(d) 0101

Question 27

```
----------------
MOV IB M1
MOV IA M2
ADD IA IB
MOV IA OUT
MOV IB M4
ADD IA IB
MOV M3 OUT
----------------
```

Suppose the initial contents of M1, M2, M3 and M4 are given by

$M1 = 0011, M2 = 0010, M3 = 0001, M4 = 0000.$

What is the content of M4 once the program is finished?

(a) 0010

(b) 0011

(c) 0100

(d) 0000

Question 28

Refer to the artificial CPU and its commands in the Appendix.

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

Suppose the initial contents of M1, M2, M3, M4 and M5 are given by

$$M1 = 0011, M2 = 0010, M3 = 0001,$$
$$M4 = 0100, M5 = 0110.$$

What are the contents of IA, IB, OUT and M5 once the program is finished?

(a) $IA = 0100$, $IB = 0110$, $OUT = 0010$, $M5 = 0010$

(b) $IA = 0000$, $IB = 0000$, $OUT = 0000$, $M5 = 0010$

(c) $IA = 0110$, $IB = 0100$, $OUT = 0010$, $M5 = 0010$

(d) $IA = 0100$, $IB = 0110$, $OUT = 0000$, $M5 = 0010$

Question 29

Refer to the artificial CPU and its commands in the Appendix. Suppose the initial contents of M1, M2 and M3 are given by

$$M1 = 0011, M2 = 0010, M3 = 0000.$$

Which one of the following programs performs the function equivalent to that

$$M3 = M1 - M2.$$

(a)
```
----------------
   MOV IB M1
   MOV IA M2
   SUB IA IB
   MOV IA OUT
----------------
```

(b)
```
----------------
   MOV IA M1
   MOV IB M2
   SUB IA IB
   MOV IA OUT
----------------
```

(c)
```
----------------
   MOV IB M1
   MOV IA M2
   SUB IA IB
   MOV M3 OUT
----------------
```

(d)
```
----------------
   MOV IA M1
   MOV IB M2
   SUB IA IB
   MOV M3 OUT
----------------
```

(e) None of the above.

Question 30

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) $M5 = M1 \times M2 + M3 \times M4.$

(e) None of the above.

Question 31

Which of the following language(s) its(their) characters are encoded in two-byte format?

(i) Chinese (Simplified).

(ii) Chinese (Traditional).

(iii) Japanese.

Answers:

7

(a) None of them.

(b) (i) only.

(c) (ii) only.

(d) (iii) only.

(e) (i) and (ii) only.

(f) (ii) and (iii) only.

(g) (i) and (iii) only.

(h) All of them.

Question 27

What are the common causes of a bad sector?

(i) Accidental collision between the reader head and the magnetic disk in a hard disk.

(ii) Natural deterioration of the physical property of a hard disk.

(iii) Strong magnetic field appears around the hard disk.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 28

To facilitate the storage and retrieval of a file from the memory, a file allocation table (FAT) has to be maintained for file management. Which of the following information are maintained in a FAT?

(i) File name.

(ii) Ending memory address of the file.

(iii) Starting memory address of the file.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 29

Which of the following information are managed by the operating system for file management?

(i) Open/close status of a file.

(ii) The location of a file.

(iii) The name of a file.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 30

Which of the following devices is responsible to execute the tasks for the operating system?

Answers:

(a) Graphical processing unit (GPU).

(b) Operating system processing unit (OSPU).

(c) Central processing unit (CPU).

(d) System processing unit (SPU).

Question 31

Which of the following programming language(s) is(are) interpreted language?

(i) Matlab programming language.

(ii) SPSS programming language.

(iii) SAS programming language.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 32

Which of the following software has an interpreter inside?

(i) iOS.

(ii) MacOS.

(iii) Chrome.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 33

In principle, which of the following items are considered as a program?

(i) The sequence of micro-instructions generated by the control unit for an instruction feeding to a CPU.

(ii) The machine codes of an executable file.

(iii) An operating system.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 34

Which of the following statement about the interaction between an application software and the operating system is *False*?

(a) Once an application software has a request for an operating system, it sends a request message on the service queue of the operating system.

(b) Once the operating system has completed a request, it sends the result message on the receiving queue of the application software.

(c) Normally, an application software has no right to instruct the operating system to change the priority of its request.

(d) Normally, an operating system does not change the priority of a request from any application software.

(e) Normally, an operating system will serve the requests in *first-come-first-serve* basis.

(f) None of them is false.

Question 35

How does an application software know that the service request to an operating system has completed?

(a) The application software from time to time will send a message to the operating system checking for the progress.

(b) The application software from time to time will check from its queue seeing if there is anything there.

(c) The operating system from time to time will send a message to the application software informing the progress.

(d) The operating system from time to time will check from its queue seeing if there is any *checking-for-progress* message coming.

Question 36

Regarding the design of an operating system, it is always said that it is *machine dependent*. Which of the following arguments are the explanations for the above conception?

(i) Consider that a processor as a machine. Different processors have different architectural designs. Thus, the instruction sets provided by different processors are different. The design of an operating system relies on the instruction set provided. Therefore, the operating systems developed for different processors would be different. That is to say, they are machine dependent.

(ii) Consider that a computer as a machine. Different computers might have different hardware designs. The operating system is design to manage those hardware in a computer. Therefore, the operating system developed for different computing machine would be different. That is to say, they are machine dependent.

(iii) An operating system is designed to provide functions to support various applications. Therefore, the design of an operating system must be machine dependent.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 37

Suppose your cell phone (with enough battery power) has been set to the following conditions but your cell phone is not able to access www.yahoo.com. Which of the following reason(s) is(are) likely the cause(s) of this connection failure?

```
WiFi              OFF
Bluetooth         OFF
Cellular          ON
Personal Hotspot  OFF
Carrier           ON
```

(i) There is no WiFi access point around.

(ii) The DNS in the telecom firm is down.

(iii) Web server www.yahoo.com is down.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 38

Which of the following statements are *true*?

(i) One purpose of the Project Loon is to build a wireless network up in the sky.

(ii) One purpose of the Project Loon is to release the Internet traffic load.

(iii) One purpose of the Project Loon is to extend the coverage of Internet to the deserts and rural areas.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 39

If we would like to show the following text on a webpage, which of the following codes should be added?

statistical analysis.

In the HTML file, what would be the correct coding for it?

(i)   `<b><i>statistical analysis</i></b>`

(ii) `<i><b>statistical analysis<b></i>`

(iii) `<i><b>statistical analysis</i></b>`

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 40

Here is a segment of HTML code.

```
<table>
<tr> <td>Instructor:</td>
     <td>John Sum</td> </tr>
<tr> <td>Office:</td>
     <td>Room 821</td></tr>
<tr> <td>Time:</td>
     <td>Friday 09:10-12:00 </td> </tr>
<tr> <td>Classroom:</td>
     <td>CS121</td> </tr>
</table>
```

Once the above program segment is interpreted, what will you see on the browser.

(a) `Instructor: John Sum`
    `Office: Room 821`
    `Time: Friday 09:10-12:00`
    `Classroom: CS121`

(b) `Instructor:John Sum`
    `Office:    Room 821`
    `Time:      Friday 09:10-12:00`
    `Classroom: CS121`

(c) `Instructor: John Sum`
    `Office:     Room 821`
    `Time:       Friday 09:10-12:00`
    `Classroom:  CS121`

(d) `Instructor:John Sum`
    `Office:Room 821`
    `Time:Friday 09:10-12:00`
    `Classroom:CS121`

Section B

Question 41

Which of the following statement about medium access control (MAC) is true?

(a) If a computer has detected that the medium is being in use, the computer will wait for a fixed period of time and then re-detect the medium seeing if it is in use. If the medium is not in use, it sends out the message to the medium.

(b) If a computer has detected that the medium is being in use, the computer will wait for a random period of time and then re-detect

the medium seeing if it is in use. If the medium is not in use, it sends out the message to the medium.

(c) If a computer has detected that the medium is not in use, the computer will wait for a fixed period of time and then re-detect the medium seeing if it is in use. If the medium is not in use, it sends out the message to the medium.

(d) If a computer has detected that the medium is not in use, the computer will wait for a random period of time and then re-detect the medium seeing if it is in use. If the medium is not in use, it sends out the message to the medium.

Question 42

CSMA/CA is a MAC protocol. Which of the following system(s) has(have) applied this protocol?

(i) WiFi network.

(ii) 3G/4G telecommunication network.

(iii) Ethernet.

Answers:

(a) None of them.

(b) (i) only.

(c) (ii) only.

(d) (iii) only.

(e) (i) and (ii) only.

(f) (ii) and (iii) only.

(g) (i) and (iii) only.

(h) All of them.

Question 43

Which of the following devices have a MAC address?

(i) Notebook computer.

(ii) Personal computer.

(iii) iPhone.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 44

Which of the following statements about *port number* are true?

(i) Each application server (web server for instance) is usually assigned to a unique port number.

(ii) Once a message has arrived a computer, the network operating system will check the port number specified in the message and then pass the message to the corresponding application server queue.

(iii) Two different application servers, say email server and web server, can use the same port number.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 45

Which of the following information must be included in an IP datagram?

(i) Source and destination MAC addresses.

(ii) Source and destination IP addresses.

(iii) Source and destination PORT numbers.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 46

Which of the following information are needed for the operating system to identify which browser the data in an IP datagram should be pass to?

(i) IP address.

(ii) Session ID.

(iii) Process ID.

Answers:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 47

Which of the following factors are the causes of packet loss in a wireless network?

(i) Channel noise being corrupted to the radio signal.

(ii) A packet has been forwarded for TTL times.

(iii) Nuclear explosion around the wireless network.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 48

Which of the following factors will affect the data transmission rate in wireless network?

(i) Error bit rate.

(ii) Data signal frequency.

(iii) Carrier wave frequency.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 49

Which of the following technologies/standards are not embraced in TCP/IP?

(i) HTTP.

(ii) Encryption technology.

(iii) IP address format.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 50

Which of the following statement(s) regarding the protocol CSMA/CA is(are) correct?

(i) A device needs to send out a RTS message to the medium once it has a frame of data to be sent to another device.

(ii) If there is a collision, i.e. multiple devices send out RTS messages at the same time, a device has to wait for a constant time and then re-send the RTS message to the medium.

(iii) A device can send out a frame of data to the medium only if it has received the CTS message.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 51

Which of the following program segments perform exactly the same thing as the program segment below?

```
for (i=0,i<3, i++)
  printf("*\n");
printf("Program end!");
```

(a)
```
i = 0;
while( i<3)
{ printf("*\n");
printf("Program end!");
i = i + 1; }
```

(b)
```
i = 0;
while( i<3)
{ printf("*\n"); i = i + 1; }
printf("Program end!");
```

(c)
```
i = 0;
while(i<3)
printf("*\n"); i = i + 1;
printf("Program end!");
```

(d)
```
i = 1;
while(i<3)
{ printf("*\n"); i = i + 1; }
printf("Program end!");
```

(e) None of the above.

Question 52

If the following C program segment is executed, what will you see on the screen?

```
i=0;
While (i<=5)
{
  printf("*");
  i = i+1;
}
printf("%d\n", i+1);
```

(a) *****5
    c:\>

(b) *****5

    c:\>

(c) *****6
    c:\>

(d) `*****6`

    `c:\>`

(e) None of the above.

Question 53

In C language, **rand()** is a command used for generating random number. Which of the following statements about this random number generator function is correct?

(a) Once the command "rand()%100" is executed, it will generate an random integer in between 1 to 100.

(b) Once the command "rand()%100" is executed, it will generate an random integer in between 0 to 99.

(c) Once the command "rand()%100" is executed, it will generate an random decimal number in between 1 to 100.

(d) Once the command "rand()%100" is executed, it will generate an random decimal number in between 0 to 99.

Question 54

Which of the following statements about comment delimiters "/*" and "*/" in C program are true?

(i) Whenever the compiler has encountered the comment delimiters, all the content inside the delimiters will be ignored.

(ii) Comment delimiters are used for adding the change history in a source code.

(iii) Adding comments in a source code is a way to help the programmer easily understand or recall the flow of the program.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 55

What will you see on the console if the following program segment is executed?

```
#include<stdio.h>
#include<stdlib.h>

main()
{
int i;

for(i=0; i<4; i++)
    printf("%d ", i%3);
printf("\n");
}
```

(a) 0 1 2 3
    `c:\>`

(b) 0 1 2 3

    `c:\>`

(c) 0 1 2 0
    `c:\>`

(d) 0 1 2 0

    `c:\>`

(e) None of the above.

Question 56

What will you see on the console if the following program segment is executed?

```
#include<stdio.h>
#include<stdlib.h>

main()
{
int i, tmp, A[5];

A[0]=6; A[1]=2; A[2]=8;
A[3]=1; A[4]=5;

for(i=0; i<4; i++)
    if(A[i] > A[i+1])
    {
    tmp = A[j];
    A[j] = A[j+1];
    A[j+1] = tmp;
```

```
    }

for(i=0; i<5; i++)
    printf("%d ", A[i]);
}
```

(a) 1 2 5 6 8
    c:\>

(b) 8 6 5 2 1
    c:\>

(c) 2 6 8 1 5
    c:\>

(d) 6 8 2 5 1
    c:\>

(e) None of the above.

Question 57

What will you see on the console if the following program segment is executed?

```
#include<stdio.h>
#include<stdlib.h>

main()
{
int i, A[5];
A[0]=6; A[1]=2; A[2]=8;
A[3]=1; A[4]=5;

for(i=0; i<4; i++)
    if(A[i] < A[i+1])
    {
    tmp = A[j];
    A[j] = A[j+1];
    A[j+1] = tmp;
    }
for(i=0; i<5; i++)
    printf("%d ", A[i]);
}
```

(a) 1 2 5 6 8
    c:\>

(b) 8 6 5 2 1
    c:\>

(c) 2 6 8 1 5
    c:\>

(d) 6 8 2 5 1
    c:\>

(e) None of the above.

Question 58

Which of the following programs can be compiled successfully by a C compiler?

(i)
```
main()
{
int i = 1, j = 2;
int z;

z = i+j;

return z;
}
```

(ii)
```
#include<stdio.h>

main()
{
int i = 1, j = 2;
int z;

z = i+j;

return z;
}
```

(iii)
```
#include<stdio.h>

main()
{
int i = 1,
    int j = 2;
int z;

z = i+j;

return z;
}
```

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 59

Refer to Program A. What is the content of "argv[0]" if the following command is typed?

`c:\>winnerloser w 2 3 8 4 7 9 11 2 1 33`

(a) winnerloser

(b) w

(c) 2

(d) 3

(e) 12.

Question 60

Refer to Program A. What is "atoi()" used for?

(a) To convert the string argv[2] to an integer number.

(b) To convert the string argv[2] to an array of integer numbers.

(c) To convert the string argv[2] to a floating point number.

(d) To convert the string argv[2] to an array of floating point numbers.

(e) None of the above.

Question 61

Refer to Program A. What will you see if the following command is typed?

`c:\>winnerloser w 2 3 8 4 7 9 11 2 1 33`

(a) `The value of the 2 winner is 11.`
    `c:\>`

(b) `The value of the 3 winner is 9.`
    `c:\>`

(c) `The value of the 2 looser is 2.`
    `c:\>`

(d) `The value of the 3 looser is 2.`
    `c:\>`

(e) None of the above.

Question 62

Refer to Program A. What will you see if the following command is typed?

`c:\>winnerloser l 2 3 8 4 7 9 11 2 1 33`

(a) `The value of the 2 winner is 11.`
    `c:\>`

(b) `The value of the 3 winner is 9.`
    `c:\>`

(c) `The value of the 2 looser is 2.`
    `c:\>`

(d) `The value of the 3 looser is 2.`
    `c:\>`

(e) None of the above.

Question 63

Refer to Program B. If your option of sorting style is "d" the numbers entered are "4 5 2 1 6", what will you see below the numbers you entered?

(a) `The sorted numbers are 1 2 4 5 6.`
    `c:\>`

(b) `The sorted numbers are 1 2 4 5 6.`

    `c:\>`

(c) `The sorted numbers are 6 5 4 2 1.`
    `c:\>`

(d) `The sorted numbers are 6 5 4 2 1.`

    `c:\>`

(e) None of the above.

Question 64

Refer to Program B. If your option of sorting style is "a" the numbers entered are "4 5 2 1 6", what will you see below the numbers you entered?

(a) `The sorted numbers are 1 2 4 5 6.`
    `c:\>`

(b) `The sorted numbers are 1 2 4 5 6.`

    `c:\>`

(c) ```
The sorted numbers are 6 5 4 2 1.
c:\>
```

(d) ```
The sorted numbers are 6 5 4 2 1.

c:\>
```

(e) None of the above.

Question 65

Refer to Program C. Which number is assigned to "Spade A" during the initialization step?

(a) 0.

(b) 12.

(c) 24.

(d) 36.

(e) None of the above.

Question 66

Refer to Program C. How many integer variables are included in the integer array 'PLAYER'?

(a) 2.

(b) 5.

(c) 10.

(d) 52.

(e) None of the above.

Question 67

Refer to Program C. After executing the program 'poker02.exe', the following results are displayed on the screen.

```
Here are the card.
Player 1: S10 S11 S12 S13
Player 2: D10 D11 D12 D13

c:\>
```

If the program 'poker02.exe' is re-executed, what will you see?

(a) The same results.

(b) ```
Here are the card.
Player 1: S 1 S 2 S 3 S 4
Player 2: D 1 D 2 D 3 D 4

c:\>
```

(c) ```
Here are the card.
Player 1: C 1 C 2 C 3 C 4
Player 2: H 1 H 2 H 3 H 4

c:\>
```

(b) No one knows, as the cards are re-shuffled with a new set of random numbers.

Question 68

Refer to Program D. Which of the following numbers are the possible outcomes of 'tmp'?

(i) 4.

(ii) 8.

(iii) 12.

Answer:

(a) (i) and (ii) only.

(b) (ii) and (iii) only.

(c) (i) and (iii) only.

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

Question 69

Refer to Program D. Which one of the following functions is the function of 'nlfunction()'?

(a) $f(x) = \tanh\left(\frac{x}{2} - 1\right) - \frac{1}{10}$.

(b) $f(x) = \tanh\left(\frac{x-1}{2}\right) - \frac{1}{10}$.

(c) $f(x) = \tanh\left(\frac{x}{2} - 1\right) - 1$.

(d) $f(x) = \tanh\left(\frac{x-1}{2}\right) - 1$.

(e) None of the above.

Question 70

Refer to Program E. Which one of the following algorithms is the program being implemented?

(a) Initialization:
```
Input x (<0) and y (>2).
Input Precision error 'ERR'.

DO
{
tmp = (x+y)/2;
IF (f(tmp)*f(x) < 0)
   {
   y = tmp;
   DIFF = |f(x) - f(y)|;
   }
ELSE
   {
   x = tmp;
   DIFF = |f(x) - f(y)|;
   }
} WHILE (DIFF > ERR)
```

(b) Initialization:
```
Input x (<0) and y (>2).
Input Precision error 'ERR'.

DO
{
tmp = (x+y)/2;
IF (f(tmp)*f(x) < 0)
   {
   x = tmp;
   DIFF = |f(x) - f(y)|;
   }
ELSE
   {
   y = tmp;
   DIFF = |f(x) - f(y)|;
   }
} WHILE (DIFF > ERR)
```

(c) Initialization:
```
Input x (<0) and y (>2).
Input Precision error 'ERR'.

DO
{
tmp = (x+y)/2;
IF (f(tmp)*f(x) < 0)
   {
   y = tmp;
```

```
   DIFF = |f(x) - f(y)|;
   }
ELSE
   {
   x = tmp;
   DIFF = |f(x) - f(y)|;
   }
} WHILE (DIFF < ERR)
```

(d) Initialization:
```
Input x (<0) and y (>2).
Input Precision error 'ERR'.

DO
{
tmp = (x+y)/2;
IF (f(tmp)*f(x) < 0)
   {
   x = tmp;
   DIFF = |f(x) - f(y)|;
   }
ELSE
   {
   y = tmp;
   DIFF = |f(x) - f(y)|;
   }
} WHILE (DIFF < ERR)
```

(e) None of the above.

APPENDIX

In this appendix, it includes the information about (i) the artificial processor, (ii) (ii) the artificial CPU and (iii) the source codes of five programs. Please read them carefully!

Artificial Processor

An artificial processor, with a sector of four logic gates and a sector of four registers, is shown in Figure 1. Each register is associated with a two-way switch. The signals to be fed to the switch and the corresponding actions are depicted in the following table.

S_i	Action
00	Disconnect.
01	Read from register.
10	Write to register.

For each connector, its control signal is either '0' (for disconnection) and '1' (for connection).

$$\text{Connection} = \begin{cases} \text{Connect} & \text{if } S_i = 1, \\ \text{Disconnect} & \text{if } S_i = 0. \end{cases}$$
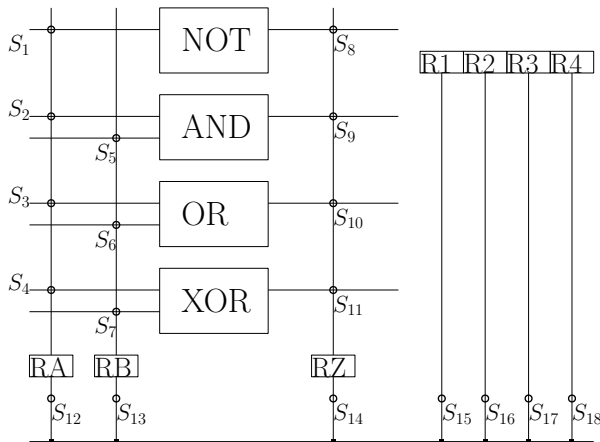
Two-Way Switches: Disconnected (00); Down (01), Up (10).

$(S_{12}, S_{13}, S_{14}, S_{15}, S_{16}, S_{17}, S_{18})$

Connectors: Disconnected (0), Connected (1).

$(S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_9, S_{10}, S_{11})$

Figure 1: A processor with four logic gates. Switches S_1 to S_{11} are simple switches (i.e. connectors). S_{12} to S_{18} are two-way switches.

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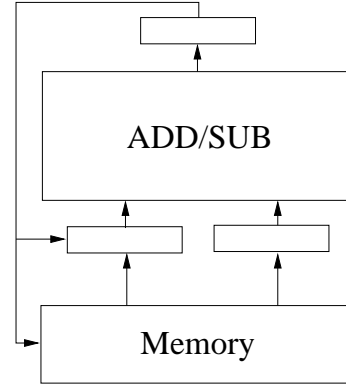
Eleven commands (MOV, ADD, SUB, MUL, DIV, CMP, SHL, SHR, DEF, MSK and IF) are provided for instructing the above circuit. The syntax and the descriptions of these commands are depicted in Table 1.

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	$OUT = b_1 b_2 b_3 b_4 b_5 b_6 b_7 b_8$.
	$b_i = 0$ 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.

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)

   For example, if

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

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

3. 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, $M1 = 00001100$.

4. 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".

5. The "IF-ELSE" command is an advanced level command. It is for conditional statement. Once it is executed, the CPU will performs 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
------------------------
```

Program A

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

```
/****************************************************************************
winnerloser.cpp
****************************************************************************/
#include<stdio.h>
#include<stdlib.h>

main(int argc, char *argv[])
{
    int A[256]; /* Define integer array. */
    int i,j; /* Define indices. */
    int tmp; /* Define dummy variable for sorting. */
    char Opt = 'c';
    int SNUM, POS;

    /* Step 1: Read input from the command line. */
    SNUM = argc - 3;
    Opt = argv[1][0];
    POS = atoi(argv[2]);

    if (POS <= SNUM)
    {
      if((Opt == 'w')||(Opt == 'l'))
      {
        for(i = 0; i<SNUM; i++)
            A[i] = atoi(argv[i+3]);

        /* Step 2: Sorting the numbers */
        if(Opt == 'l')
        {
          for(i=0; i<SNUM-1; i++)
          for(j=0; j<SNUM-i-1; j++)
          {
                if(A[j] > A[j+1])
                {
                tmp = A[j];
                A[j] = A[j+1];
                A[j+1] = tmp;
                }
          }
          printf("The value of the %d loser is %d.", POS, A[POS-1]);
        }
        if(Opt == 'w')
        {
          for(i=0; i<SNUM-1; i++)
          for(j=0; j<SNUM-i-1; j++)
          {
                if(A[j] < A[j+1])
                {
                tmp = A[j];
                A[j] = A[j+1];
                A[j+1] = tmp;
                }
          }
          printf("The value of the %d winner is %d.", POS, A[POS-1]);
        }
```

```
    }
    else
        printf("Something wrong in your inputs.");
    }
    else
        printf("The position %d is larger than %d.", POS, SNUM);
}
```

Program B

```c
#include<stdio.h>
main()
{
    int A[5], i, j, tmp;
    char OPT[8], Opt = 'c';

    printf("This program demonstrates how to do sorting.\n\n");
    while((Opt != 'a')&&(Opt != 'd'))
    {
    printf("Select a sorting style, 'a' for ascending and 'd' for descending.\n");
    printf("Option : ");
    scanf("%s", OPT);
    Opt = OPT[0];
    }
    printf("\n");
    printf("Please enter five numbers.\n");

    for(i=0; i<5; i++)
    {
    printf("Enter the %d number: ", i+1);
    scanf("%d", &A[i]);
    }

    if(Opt == 'a')
    {
        for(i=0; i<4; i++)
        for(j=0; j<4-i; j++)
                if(A[j] > A[j+1])
                {
                tmp = A[j];
                A[j] = A[j+1];
                A[j+1] = tmp;
                }
        printf("The sorted numbers are");
        for(i=0; i<5; i++)
            printf(" %d", A[i]);
        printf(".");
    }
    else
    {
        for(i=0; i<4; i++)
        for(j=0; j<4-i; j++)
                if(A[j] < A[j+1])
                {
                tmp = A[j];
                A[j] = A[j+1];
                A[j+1] = tmp;
                }
        printf("The sorted numbers are");
        for(i=0; i<5; i++)
            printf(" %d", A[i]);
        printf(".");
    }
}
```

Program C

The filename of the following program is "poker02.cpp".

```cpp
/***************************************************
poker02.cpp
***************************************************/
#include<stdio.h>
#include<stdlib.h>
#include<time.h>

main()
{
      int MAX = 10000, RANGE = 52;
      int CARD[52], PLAYER[2][5], HAND, NUMBER;
      int i, j, tmp, tmp1, tmp2;

      /* Step 1: Card Initialization */
      for(i=0; i<RANGE; i++)
        CARD[i] = i;

      /* Step 2: Card shuffling */
      printf("The card are being shuffled now.\n");
      for(i=0; i<MAX; i++)
      {
              tmp1 = rand() % RANGE;
              tmp2 = rand() % RANGE;
              tmp = CARD[tmp1];
              CARD[tmp1] = CARD[tmp2];
              CARD[tmp2] = tmp;
      }

      /* Step 3: Card Assignment */
      for(i=0; i<2; i++)
        for(j=0; j<5; j++)
          PLAYER[i][j] = CARD[i*4+j];

      printf("Here are the cards.\n");
      for(i=0; i<2; i++)
      {
          printf("Player %2d: ", i+1);
          for(j=0; j<5; j++)
            {
              tmp = PLAYER[i][j];
              HAND = tmp/13;
              NUMBER = tmp % 13;

              switch ( HAND )
              {
                      case 0: printf("S%2d   ", NUMBER+1); break;
                      case 1: printf("H%2d   ", NUMBER+1); break;
                      case 2: printf("C%2d   ", NUMBER+1); break;
                      case 3: printf("D%2d   ", NUMBER+1); break;
              }
            }
          printf("\n");
      }
      /* END */
}
```

Program D

```
/**************************************************************************
random_number_03.cpp

Description: This program shows the distribution of z = (x + y),
    where x and y are uniform distributed random variables in
    {0, 1, 2, 3, 4, 5}. So, there are 11 possible outcomes of z.
    z = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10}.

**************************************************************************/
#include<stdio.h>
#include<stdlib.h>
#include<time.h>

main()
{
    int MAX = 100000;
    int RANGE = 6;
    float S[2*RANGE-1];
    int i, tmp, tmp1, tmp2;

    srand(time(NULL));
    for(i=0; i<2*RANGE-1; i++)
            S[i] = 0;

    printf("%d random numbers from [1:%d] are generated.\n", MAX, RANGE);
    for(i=0; i<MAX; i++)
    {
            tmp1 = rand() % RANGE;
            tmp2 = rand() % RANGE;
            tmp = tmp1 + tmp2;
            S[tmp] = S[tmp] + 1;
    }

    printf("\n");
    printf("The statistics of the random numbers are listed below.\n");
    for(i=0; i<2*RANGE-1; i++)
    {
      printf("Proportion of %d is %0.4f. (%4.0f %d)\n", i, S[i]/MAX, S[i], MAX);
    }
}
```

Program E

```
/*************************************************************
bisection01.cpp
*************************************************************/
#include<stdio.h>
#include<math.h>

float nlfunction(float xtmp);

main()
{
    float ERR; /* Error for stopping criteria */
    float a; /* Step size */
    float x, y, tmp;   /* variable for iteration */
    float fx, fy, ft;
    float precision;
    int k = 0;

    printf("Finding the root of tanh(0.5(x-1)) - 0.1.\n");
    printf("Bisection method is applied.\n");
    printf("Enter the initial guess of x (< 0): ");
    scanf("%f", &x);
    printf("Enter the initial guess of y (> 2): ");
    scanf("%f", &y);
    printf("Precision: ");
    scanf("%f", &precision);

    /* Bisection Method */
    ERR = y - x;
    fx = nlfunction(x);
    fy = nlfunction(y);
    while((ERR > precision)&&(fx*fy < 0))
    {
     tmp = (x + y)/2;
     ft = nlfunction(tmp);
     if(fx*ft < 0)
{
y = tmp;
fy = ft;
}
if(ft*fy < 0)
{
x = tmp;
fx = ft;
}
     ERR = y - x;
     k = k + 1;
     printf("Step %d: [%0.8f, %0.8f]\n", k, x, y);
    }

    /* Output the results on screen */
    printf("The root of f(x) is at %0.8f.\n", x);
}

float nlfunction(float xtmp)
{
float ftmp;
```

```
ftmp = tanh(0.5*(xtmp-1)) - 0.1;

return ftmp;
}
```