Introduction to Computer Science: Mid-Term Exam

April 17, 2026. 14:30 - 16:30

Name: _____

Student ID: _____

Instructions (Must Read):

(1) Please fill in your name and student ID.

(2) This paper consists of 50 multiple choice questions. Section A consists of 20 logical questions and Section B consists of 30 normal questions. You need to answer all of them. Each question has only ONE correct answer.

(3) Each question carries 2 marks. If you answer is correct, you will get 2 marks. If you answer is wrong, you will get -1 mark. If you leave you answer blank, you will get 0 mark. That is to say,

$$\text{Score} = \begin{cases} 2 & \text{if the answer is correct,} \\ 0 & \text{if the answer is blank,} \\ -1 & \text{if the answer is wrong.} \end{cases}$$

(4) For each question, please write down your answer (i.e. the option) on the somewhere beside the question number, by a blue or black ball pen. Writing the answer by pencil is allowed but not preferred.

(5) Some questions have an option '**None of the above.**' meaning that none of the above options. If you have found that options (a), (b), (c) and so on are not correct, you should select this option. Let say a question has five options, in which option (e) is 'None of the above.'. You should opt (e) if you have found that options (a), (b), (c) and (d) are all incorrect.

(6) Put all your belongings, except those necessary accessories and cell phone, to the front stage. Cell phone has to be set to silent mode. If you are waiting for an urgent call, please inform Professor John Sum before the examination starts.

(7) Dictionary, cell phone, computer, pad and other electronic devices are not allowed to use during the exam.

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

SECTION A : Logical Questions

Instructions: The questions below are logical questions. In each question, two statements X and Y are given. You have to identify from the following options what is their relation.

(a) Both statements are not true.

(b) Statement X is true. Statement Y is not true.

(c) Statement X is not true. Statement Y is true.

(d) Statement X is true. Statement Y is true. Statement X and Statement Y have no logical implication.

(e) Statement X is true. Statement Y is true. Statement X is a cause (resp. reason) of Statement Y. In other words, X implies Y but not in reverse.

(f) Statement X is true. Statement Y is true. Statement Y is a cause (resp. reason) of Statement X. In other words, Y implies X but not in reverse.

Question 1

X: Vacuum tube was invented before 1930s.

Y: Electronic computer was not made before 1900.

Question 2

X: The electronic computer in the 1940s had already had a hard disk drive for permanent memory storage.

Y: Hard disk drive was invented in the 1940s.

Question 3

X: The first computing machine was made after 1930s.

Y: UK did not have a computing machine before 1930s.

Question 4

X: The first conceptual computing machine model using the idea of logic gates (equivalently, logical operations) was proposed by Alan Turing.

Y: The architecture of all modern processors consists of numerous logic gates.

Question 5

X: Students are not allowed to freely access their notebook computers and cell phones during the lectures by Professor John Sum.

Y: Students have to attend all lectures by Professor John Sum.

Question 6

X: The medium of instruction of the course 'Introduction to Computer Science' instructed by Professor John Sum is English.

Y: The mother language of Professor John Sum is English.

Question 7

X: The textbook of this course is titled 'Introduction of Computer Science' which is authored by John Sum.

Y: The teaching materials of this course are prepared by Professor John Sum.

Question 8

X: A student can skip any lecture as he/she wishes.

Y: A student will get 'zero' final score if he/she has skipped lectures more than three times without proper reason.

Question 9

X: Today, a smart phone like iPhone and android phone can be hand held.

Y: Today, semiconductor fabrication technology has been advanced to nanometer level.

Question 10

X: In the 1970s, Xerox mass produced Xerox Alto to the computer market.

Y: In the 1970s, Xerox developed a computer called Xerox Alto with graphical user interface for a computer user to interact with an application software called Xerox Star to edit documents.

Question 11

X: The memory device of the main memory in a smart phone today is a hard disk drive.

Y: Hard disk drive is a memory device for the main memory in many notebook computers of today.

Question 12

X: ENIAC was a computer made in the 1940s in US.

Y: Colossus was a computer made in the 1940s in UK.

Question 13

X: In UK, her first commercial electronic computer was made by Lyon.

Y: In US, her first commercial electronic computer was made by IBM.

Question 14

X: The unit Mi stands for the number 2^{20}.

Y: The unit M stands for the number 10^6.

Question 15

X: The basic unit of a memory is in byte, i.e. 8-bit.

Y: The coding of a positive integer is in a 8-bit format only.

Question 16

X: If the BIOS is corrupted, a computer cannot be started even if its power is on.

Y: The first instruction to be executed by the CPU is stored in the BIOS.

Question 17

X: The time for the CPU to read a data from the RAM is shorter than the CPU to read a data from the hard disk drive (HD).

Y: The time for the CPU to read a data from the RAM is longer than the CPU to read a data from the solid state drive (SSD).

Question 18

X: Each file must have a file extension, like .exe and .pdf.

Y: The operating system of a computer must be Windows only.

Question 19

X: Without a browser, a computer cannot connect to the Internet.

Y: Today, only iPhone can connect to the Internet.

Question 20

X: $Mi < Ki$.

Y: $Mi = 2^{20}$ and $Ki = 2^{30}$.

SECTION B: Normal Questions

Question 21

Imagine that you are now standing in front of two doors, say X and Y. One of them leads you to heaven and the other leads you to hell. In each door, there is a doorman. Let the doorman standing in front of the door X is A and the doorman standing in front of the door Y is B. For the doormen, it is known that one of them always lies and the other always tells the truth. Besides, the doormen only answer 'Yes' or 'No' to you. For instance, if you ask to a doorman 'the current president of Taiwan is a lady', the liar doorman will answer 'No' and the truth teller doorman will answer 'Yes'.

Now, you can only ask two questions. Which of the following combinations of questions will help you make the right decision on the door to heaven?

(i) The first question is to ask Doorman X, '$1+1=2$'. The second question is to ask Doorman Y, 'Door X is the door to heaven'.

(ii) The first question is to ask Doorman X, 'You are a liar'. The second question is to ask Doorman Y, 'Door X is the door to heaven'.

(iii) The first question is to ask Doorman Y, '$1+1=2$'. The second question is to ask Doorman X, 'Door Y is the door to heaven'.

Answer:

(a) (i) and (ii).

(b) (ii) and (iii).

(c) (i) and (iii).

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

(e) None of the above.

Question 22

Imagine that you are now standing in front of two doors, say X and Y. One of them leads you to heaven and the other leads you to hell. In each door, there is a doorman. Let the doorman standing in front of the door X is A and the doorman standing in front of the door Y is B. For the doormen, it is known that one of them always lies and the other always tells the truth. Besides, the doormen only answer 'Yes' or 'No' to you. For instance, if you ask to a doorman 'the current president of Taiwan is a lady', the liar doorman will answer 'No' and the truth teller doorman will answer 'Yes'.

Now, you can only ask one doorman one question. If you have asked the Doorman X the following question: *If I ask Doorman Y, 'Door Y will lead me to heaven', Doorman Y will say 'YES'.*. Which of the following decision(s) you should made so that you can walk to the door to heaven?

(i) If the Doorman X says 'YES', you walk to the Door X.

(ii) If the Doorman X says 'YES', you walk to the Door Y.

(iii) If the Doorman X says 'NO', you walk to the Door X.

(iv) If the Doorman X says 'NO', you walk to the Door Y.

Answer:

(a) (i) only.

(b) (ii) only.

(c) (iii) only.

(d) (iv) only.

(e) (i) or (iv) only.

(f) (ii) or (iii) only.

Table of Question 23-26

The following table depicts the meaning of the notations in an equation performing logical operation.

Logical Operations	Descriptions
$\neg A$	NOT A
AB	AND A B
$A+B$	OR A B
$A \oplus B$	XOR A B
$\neg(AB)$	NAND A B

Question 23

Which of the following truth table is for the logical operation given below?

$$Z = (\neg A) \oplus (\neg B).$$

Answer:

(a)

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

(b)

A	B	Z
0	0	1
0	1	0
1	0	1
1	1	1

(c)

A	B	Z
0	0	1
0	1	1
1	0	0
1	1	1

(d)

A	B	Z
0	0	1
0	1	1
1	0	1
1	1	0

(e) None of the above.

Question 24

Which of the following truth table is for the logical operation given below?

$$Z = A \oplus (\neg B).$$

Answer:

(a)

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

(b)

A	B	Z
0	0	1
0	1	0
1	0	1
1	1	1

(c)

A	B	Z
0	0	1
0	1	1
1	0	0
1	1	1

(d)

A	B	Z
0	0	1
0	1	1
1	0	1
1	1	0

(e) None of the above.

Question 25

Which of the following truth table is for the logical operation given below?

$$Z = (A \oplus B) + B.$$

Answer:

(a)

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

(b)

A	B	Z
0	0	1
0	1	0
1	0	1
1	1	1

(c)

A	B	Z
0	0	1
0	1	1
1	0	0
1	1	1

(d)

A	B	Z
0	0	1
0	1	1
1	0	1
1	1	0

(e) None of the above.

Question 26

Which of the following truth table is for the logical operation given below?

$$Z = (\neg A) + (A \oplus B).$$

Answer:

(a)

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

(b)

A	B	Z
0	0	1
0	1	0
1	0	1
1	1	1

(c)

A	B	Z
0	0	1
0	1	1
1	0	0
1	1	1

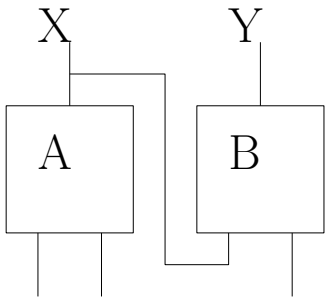
(d)

A	B	Z
0	0	1
0	1	1
1	0	1
1	1	0

(e) None of the above.

Diagram for Questions 27-30

The following schematic diagram is for Question 27 to Question 30. It is a circuit consisting of two logic gates.



Question 27

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 28

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 29

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 30

What are the output values X and Y if A is an XOR gate, B is an XOR 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 31

Suppose an integer is represented in the following 8-bit sign-magnitude fix-point format.

`sxxxxxxx`

Here,

$$s = \begin{cases} 0 & \text{if the number is positive,} \\ 1 & \text{if the number is negative;} \end{cases}$$

and $xxxxxxx$ is the integer part. What is the minimum number that can be represented by this format?

Answer:

(a) 2^7.

(b) $2^7 - 1$.

(c) 0.

(d) $1 - 2^7$.

(e) None of the above.

Question 32

Suppose an integer is represented in the following 8-bit sign-magnitude fix-point format.

`sxxxxxxx`

Here,

$$s = \begin{cases} 0 & \text{if the number is positive,} \\ 1 & \text{if the number is negative.} \end{cases}$$

$xxxxxxx$ is the integer part. What is the maximum number that can be represented by this format?

Answer:

(a) 2^7.

(b) $2^7 - 1$.

(c) 0.

(d) $1 - 2^7$.

(e) None of the above.

Question 33

Suppose an integer is represented in the following 8-bit sign-magnitude fix-point format.

`sxxxxxxx`

Here,

$$s = \begin{cases} 0 & \text{if the number is positive,} \\ 1 & \text{if the number is negative;} \end{cases}$$

and $xxxxxxx$ is the integer part. The range of a number format is defined as the difference between the maximum number and the minimum number that can be represented. What is the range of this number format? [Note: -0 is ignored.]

Answer:

(a) 2^7.

(b) $2^7 - 1$.

(c) 2^8.

(d) $2^8 - 1$.

(e) None of the above.

Question 34

For a number represented by $(n + m + 1)$-bit sign-magnitude fixed point format, the binary number has one sign-bit s, n bits for integral part and m bits for the fractional part.

$$sx_{n-1} \cdots x_1 x_0 y_1 y_2 \cdots y_m.$$

The value of the above binary number in decimal form can be obtained as follows :

$$Value = (-1)^s \left(\sum_{i=0}^{n} x_i 2^i + \sum_{j=1}^{m} y_j 2^{-j} \right).$$

That is to say,

$$s = \begin{cases} 0 & \text{if the number is positive,} \\ 1 & \text{if the number is negative.} \end{cases}$$

Now, there are three different sign-magnitude fixed point number presentation formats.

(i) 8-bit sign-magnitude format.

`sxxxyyyy`

(ii) 8-bit sign-magnitude format.

`sxxxxyyy`

(iii) 8-bit sign-magnitude format.

`sxxxxxyy`

The range of a number format is defined as the difference between the maximum number and the minimum number that can be represented. In term of the range, from the longest to the shortest, which of the following is the correct order?

Answer:

(a) (i) > (ii) > (iii).

(b) (i) > (iii) > (ii).

(c) (ii) > (i) > (iii).

(d) (iii) > (ii) > (i).

(e) None of the above.

Question 35

Which of the following component(s) is(are) non-volatile memory device(s)?

(i) BIOS.

(ii) Hard disk drive.

(iii) USB flash drive.

Answer:

(a) (i) only.

(b) (ii) only.

(c) (iii) only.

(d) (i) and (ii) only.

(e) (i) and (iii) only.

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

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

Question 36

If a memory device with its memory address of 20 bits long, what is the memory size of this device?

Answers:

(a) Ki bytes.

(b) (Ki - 1) bytes.

(c) Mi bytes.

(d) (Mi - 1) bytes.

(e) None of the above.

Question 37

If the data transfer rate of a local area network (LAN) is $100M$, what is the minimum time for transferring a file of $10M$ bytes from a computer to another computer in the LAN?

Answers:

(a) 0.1 second.

(b) 0.8 second.

(c) 1 second.

(d) 8 seconds.

(e) None of the above.

Question 38

Which of the following organizations proposed the technology for Ethernet?

Answers:

(a) Massachusetts Institute of Technology.

(b) Stanford University.

(c) Xerox PARC.

(d) University of Cambridge.

(e) None of the above.

Question 39

Which of the following events happened in the 1970s?

(i) Electronic calculator was available for the market.

(ii) Application software with graphical user interface was available.

(iii) IBM sold electronic computers.

Answer:

(a) (i) and (ii).

(b) (ii) and (iii).

(c) (i) and (iii).

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

(e) None of the above.

Question 40

Which of the following events happened in the 1970s?

(i) Acer released her first desktop (equi. personal) computer.

(ii) Apple released her first desktop (equi. personal) computer.

(iii) Apple released her first operating system for her first desktop (equi. personal) computer.

Answer:

(a) (i) and (ii).

(b) (ii) and (iii).

(c) (i) and (iii).

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

(e) None of the above.

Question 41

In the late 1990s, Apple switched to use Intel processor for her Macintosh computers. Under such change, what changes had been done for all Apple computers?

(i) The operating system MacOS of a Macintosh computer had to be re-designed.

(ii) The mother board of a Macintosh computer had to be re-designed.

(iii) The application systems running on the MacOS have to be re-designed.

Answer:

(a) (i) and (ii).

(b) (ii) and (iii).

(c) (i) and (iii).

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

(e) None of the above.

Question 42

Which of the following factor(s) will affect the processing time of an instruction?

(i) Clock frequency of a processor.

(ii) Architecture of a processor.

(iii) Micro-program design for an instruction.

Answer:

(a) (i) and (ii).

(b) (ii) and (iii).

(c) (i) and (iii).

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

(e) None of the above.

Question 43

Figure 1 shows a logic circuit with four full adders. If $A_3A_2A_1A_0 = 0101$, what is the output $Z_4Z_3Z_2Z_1Z_0$?

Answer:

(a) $Z_4Z_3Z_2Z_1Z_0 = 10100$.

(b) $Z_4Z_3Z_2Z_1Z_0 = 10110$.

(c) $Z_4Z_3Z_2Z_1Z_0 = 01010$.

(d) $Z_4Z_3Z_2Z_1Z_0 = 01011$.

(e) None of the above.

Question 44

With reference to the simple processor as shown in the Appendix, Figure 2, suppose that the registers are preset as $RA = 1$, $RB = 0$, $RZ = 0$, $R1 = R2 = R3 = R4 = 1$. What will be the contents of the registers RA and RB after the following micro-instructions (S1, S2, S3 and S4) 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: $S_2 = S_5 = S_9 = 1$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

S4: $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. 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 45

With reference to the simple processor as shown in the Appendix, Figure 2, suppose that the registers are preset as $RA = 1$, $RB = 0$, $RZ = 0$, $R1 = R2 = R3 = R4 = 1$. What will be the contents of the registers $R1$ and $R2$ after the following micro-instructions (S1, S2, S3 and S4) 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: $S_2 = S_5 = S_9 = 1$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

S4: $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. 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) $R1 = 1, R2 = 0$.

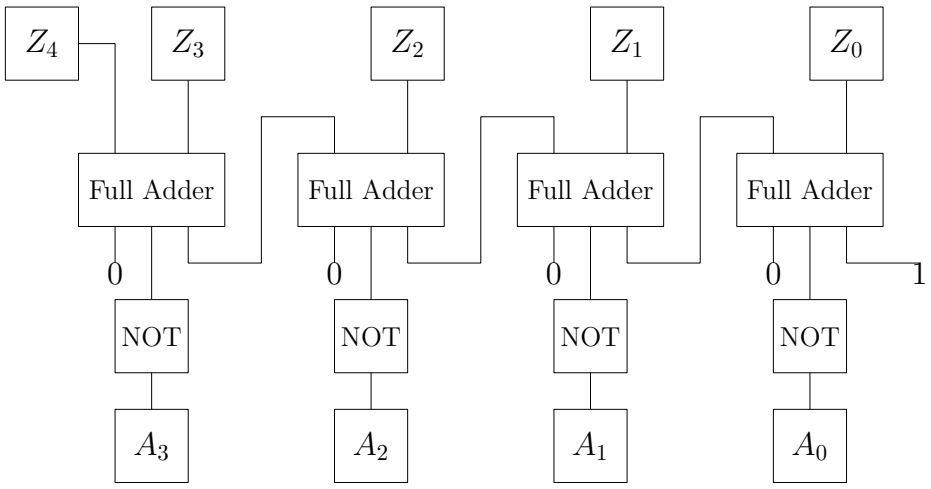
(d) $R1 = 1, R2 = 1$.

Question 46

With reference to the simple processor as shown in the Appendix, Figure 2, suppose that the registers are preset as $RA = 1$, $RB = 0$, $RZ = 0$, $R1 = R2 = R3 = R4 = 1$. What will be the contents of the registers $R3$ and $R4$ after the following micro-instructions (S1, S2, S3 and S4) 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.



A	B	C_{in}	C_{out}	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	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Figure 1: A logic circuit with four full adders. The rightmost input C_{in} of the rightmost full adder is always connected to logical '1'. The truth table for the full adder is given in the table. For each full adder, we let the inputs from left to right are denoted by A, B and C_{in}. The outputs from left to right are denoted by Z and C_{out}.

S3: $S_2 = S_5 = S_9 = 1$. The control signals to other connectors are set to 0. The signals to other two-way switches are set to 00.

S4: $S_{12} = 10$. $S_{14} = 01$. $S_{16} = 10$. 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 47

With reference to the figure as shown in Figure 3, the initial conditions of the processor is set to be following.

$$S_1 = S_2 = S_3 = 0.\ S_{12} = S_{13} = S_{14} = 00.$$

$$A1 = A2 = 0.\ R/W = 00.$$

$$R1 = R2 = R3 = R4 = 0.$$

$$RA = 1.\ RB = 0.\ RZ = 0.$$

What will be the content of RZ and $R1$ if the following micro-program has been executed?

S1: $S_1 = S_2 = S_3 = 1$. $S_{12} = S_{13} = S_{14} = 00$. $A1 = A2 = 0$. $R/W = 00$.

S2: $S_1 = S_2 = S_3 = 0$. $S_{12} = S_{13} = 10$. $S_{14} = 01$. $A1 = A2 = 0$. $R/W = 00$.

S3: $S_1 = S_2 = S_3 = 1$. $S_{12} = S_{13} = S_{14} = 00$. $A1 = A2 = 0$. $R/W = 00$.

S4: $S_1 = S_2 = S_3 = 0$. $S_{12} = S_{13} = 00$. $S_{14} = 01$. $A1 = A2 = 0$. $R/W = 10$.

Answer :

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

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

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

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

Question 48

With reference to the figure as shown in Figure 3, the initial conditions of the processor is set to be following.

$$S_1 = S_2 = S_3 = 0.\ S_{12} = S_{13} = S_{14} = 00.$$

$$A1 = A2 = 0.\ R/W = 00.$$

$$R1 = R2 = R3 = R4 = 0.$$

$$RA = 0.\ RB = 1.\ RZ = 0.$$

What will be the content of $R1$ and $R2$ if the following micro-program has been executed?

S1: $S_1 = S_2 = S_3 = 0$. $S_{12} = 00$. $S_{13} = 01$. $S_{14} = 00$. $A1 = 0$. $A2 = 0$. $R/W = 10$.

S2: $S_1 = S_2 = S_3 = 0$. $S_{12} = 01$. $S_{13} = 10$. $S_{14} = 00$. $A1 = 0$. $A2 = 0$. $R/W = 00$.

S3: $S_1 = S_2 = S_3 = 1$. $S_{12} = 00$. $S_{13} = 00$. $S_{14} = 00$. $A1 = 0$. $A2 = 0$. $R/W = 00$.

S4: $S_1 = S_2 = S_3 = 0$. $S_{12} = 00$. $S_{13} = 00$. $S_{14} = 01$. $A1 = 0$. $A2 = 1$. $R/W = 10$.

S5: $S_1 = S_2 = S_3 = 0$. $S_{12} = 10$. $S_{13} = 10$. $S_{14} = 00$. $A1 = 0$. $A2 = 0$. $R/W = 01$.

S6: $S_1 = S_2 = S_3 = 1$. $S_{12} = 00$. $S_{13} = 00$. $S_{14} = 00$. $A1 = 0$. $A2 = 0$. $R/W = 00$.

S7: $S_1 = S_2 = S_3 = 0$. $S_{12} = 00$. $S_{13} = 10$. $S_{14} = 01$. $A1 = 0$. $A2 = 0$. $R/W = 00$.

S8: $S_1 = S_2 = S_3 = 0$. $S_{12} = 10$. $S_{13} = 00$. $S_{14} = 00$. $A1 = 0$. $A2 = 1$. $R/W = 01$.

S9: $S_1 = S_2 = S_3 = 1$. $S_{12} = 00$. $S_{13} = 00$. $S_{14} = 00$. $A1 = 0$. $A2 = 0$. $R/W = 00$.

S10: $S_1 = S_2 = S_3 = 0$. $S_{12} = 00$. $S_{13} = 00$. $S_{14} = 01$. $A1 = 1$. $A2 = 0$. $R/W = 10$.

Answer :

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

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

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

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

Question 49

With reference to the figure as shown in Figure 3, the initial conditions of the processor is set to be following.

$$S_1 = S_2 = S_3 = 0.\ S_{12} = S_{13} = S_{14} = 00.$$

$$A1 = A2 = 0.\ R/W = 00.$$

$$R1 = R2 = R3 = R4 = 0.$$

$$RA = 0.\ RB = 1.\ RZ = 0.$$

What will be the content of $R1$ and $R2$ if the following micro-program has been executed?

S1: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 01.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 10.$

S2: $S_1 = S_2 = S_3 = 0.\ S_{12} = 01.\ S_{13} = 10.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S3: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S4: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S5: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 01.\ A1 = 0.\ A2 = 1.\ R/W = 10.$

S6: $S_1 = S_2 = S_3 = 0.\ S_{12} = 10.\ S_{13} = 10.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 01.$

S7: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S8: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S9: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 10.\ S_{14} = 01.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S10: $S_1 = S_2 = S_3 = 0.\ S_{12} = 10.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 1.\ R/W = 01.$

S11: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S12: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 01.\ A1 = 1.\ A2 = 0.\ R/W = 10.$

Answer :

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

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

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

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

Question 50

With reference to the figure as shown in Figure 3, the initial conditions of the processor is set to be following.

$$S_1 = S_2 = S_3 = 0.\ S_{12} = S_{13} = S_{14} = 00.$$

$$A1 = A2 = 0.\ R/W = 00.$$

$$R1 = R2 = R3 = R4 = 0.$$

$$RA = 0.\ RB = 1.\ RZ = 0.$$

What will be the content of RA and RB if the following micro-program has been executed?

S1: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 01.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 10.$

S2: $S_1 = S_2 = S_3 = 0.\ S_{12} = 01.\ S_{13} = 10.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S3: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S4: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S5: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 01.\ A1 = 0.\ A2 = 1.\ R/W = 10.$

S6: $S_1 = S_2 = S_3 = 0.\ S_{12} = 10.\ S_{13} = 10.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 01.$

S7: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S8: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S9: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 10.\ S_{14} = 01.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S10: $S_1 = S_2 = S_3 = 0.\ S_{12} = 10.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 1.\ R/W = 01.$

S11: $S_1 = S_2 = S_3 = 1.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 00.\ A1 = 0.\ A2 = 0.\ R/W = 00.$

S12: $S_1 = S_2 = S_3 = 0.\ S_{12} = 00.\ S_{13} = 00.\ S_{14} = 01.\ A1 = 1.\ A2 = 0.\ R/W = 10.$

Answer :

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

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

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

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

APPENDIX

In this appendix, you will find the architectures of (A) the processor with 4 logic gates and (B) the processor with one logic gate.

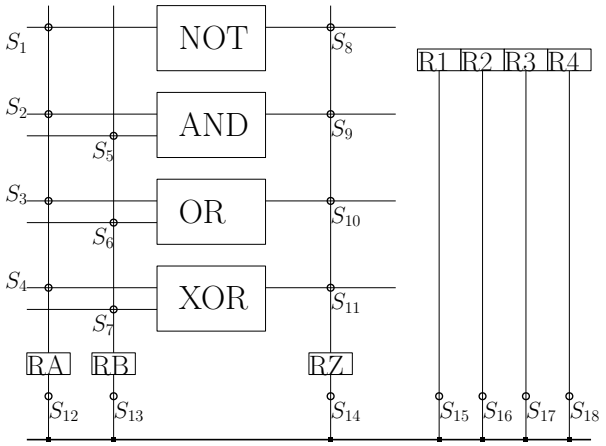
A. Processor with 4 Logic Gates

A simple processor, with a sector of four logic gates and a sector of four registers, shown in Figure 2. 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 2: 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.

B. Processor with a NAND Gate

Figure 3 shows a simple processor with single NAND gate inside. Switches S_1, S_2 and S_3 are simple switches (i.e. connectors). S_{12}, S_{13} and S_{14} are two-way switches. The signals sending to $A1$, $A2$ and R/W together with the corresponding actions are depicted in the following table.

$A1$	$A2$	R/W	Action
0	0	01	Read data from $R1$
0	1	01	Read data from $R2$
1	0	01	Read data from $R3$
1	1	01	Read data from $R4$
0	0	10	Write data to $R1$
0	1	10	Write data to $R2$
1	0	10	Write data to $R3$
1	1	10	Write data to $R4$
x	x	00	Disconnection

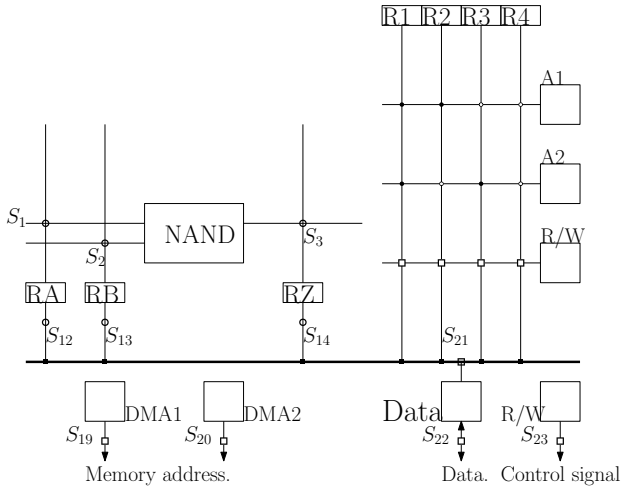


Figure 3: A processor with single NAND gate.