

## CENG111 (2023-2024 Fall) ANSWERS OF FINAL EXAM

**1) (AI)** Analyze an ATM machine as an agent. What are its sensors? What are its actuators? What level of response (reflex, knowledge based, goal based) does it exhibit?

**Answer:**

- Sensors: Camera, card readers, touchscreen sensor, fingerprint scanner
- Actuators: Motors to take in and give out card/money, monitor to print on, receipt printer
- It exhibits a reflex level of response.

**2) (Theory)** Explain the difference between row-major order versus column major order in two dimensional arrays and show it using array A below.

Array A

1	2	3
4	5	6

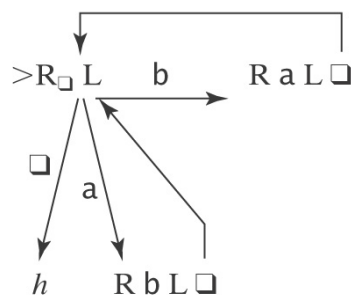
**Answer:**

In row-major order, the memory layout would be: 1 2 3 4 5 6

In column-major order, the memory layout would be: 1 4 2 5 3 6

Give a short English description of what the following Turing machine does:

$\Sigma_M = \{a, b\}$ .  $M =$



**Answer:** Shift the input string one character to the right and replace each b with an a and each a with a b.

**3) (SE)** Explain how does a layered architecture achieves separation of concerns. Briefly explain a set of layers that might be present in a mobile application.

**Answer:** By designing the software using several layers, we can decompose it into cohesive components that are loosely coupled. Since each layer has a well defined role within the system, this helps to separate different concerns from each other.

For example, a mobile application might have a frontend/client/presentation layer that is composed of views that enable user interaction, a application/business logic layer that ensures that the domain/business rules are followed, and a persistence/database layer that interacts with a local or remote database to ensure that data is stored and retrieved in a reliable manner.

**4) (Database)** In terms of the relations below, what are the appearances of the relation Q1, Q2 and Q3 after executing the given instructions:

Relation R		
A	B	C
X	P	2
Y	Q	4
Z	R	6

Relation S	
D	E
6	7
4	3
4	1

- a)  $Q1 \leftarrow \text{SELECT from } S \text{ where } D = 9$
- b)  $Q2 \leftarrow \text{PROJECT } A, C \text{ from } R$
- c)  $Q3 \leftarrow \text{JOIN } R \text{ and } S \text{ where } R.C = S.D$

**SOLUTION:**

- a)  $Q1 \leftarrow \text{SELECT from } S \text{ where } D = 6 \text{ or } E = 3$

D	E
6	7
4	3

- b)  $Q2 \leftarrow \text{PROJECT } A, C \text{ from } R$

A	C
X	2
Y	4
Z	6

$Q3 \leftarrow \text{JOIN } R \text{ and } S \text{ where } R.C = S.D$

A	B	R.C	S.D	E
Y	Q	4	4	3
Y	Q	4	4	1
Z	R	6	6	7

**5) (Manipulation)** Perform each of the following additions assuming the bit strings represent values in **two's complement** notation. Write the results **in the answer table in hexadecimal form** accordingly. Identify each case in which the answer is incorrect if there is an overflow.

Operation 1	Operation 2	Operation 3	Operation 4	Operation 5
11100101	10010111	10111010	01101001	00000101
10100000	00000110	01010111	10100111	01100000
+-----	+-----	+-----	+-----	+-----

	Result (in HEX form)	Overflow? (Yes/No)
Operation 1	<b>85H</b>	<b>NO</b>
Operation 2	<b>9DH</b>	<b>NO</b>
Operation 3	<b>11H</b>	<b>NO</b>
Operation 4	<b>10H</b>	<b>NO</b>
Operation 5	<b>65H</b>	<b>NO</b>