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| جامعة الملك سعود King Saud University | **King Saud University**<br>College of Computer and Information Sciences<br>Computer Science Department |

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| **CSC 339: Theory of Computation** | **Homework: First Semester 2020** |
| Due Date: December 15, 2020 at 11:59 PM | |

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|---|---|---|---|---|---|
| Name: | Shahad Saad Ibrahem Alfouzan | ID: | [redacted] | Section: | 44229 |

| Question 1 [2 pts] | Question 2 [2 pts] | Question 3 [2 pts] | Question 4 [2 pts] | Question 5 [2 pts] |
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| | | | | |
| **Total [10 pts]** | | | | |

## Instructions

- This homework **should** be solved **individually**.
- All questions **should** be answered on this homework paper.
- Write your **full information** (name, ID, and section) on the specified above table.
- You **should** follow these **submission instructions**:
  - Late submission is **NOT** acceptable.
  - Save your homework as **(.pdf)** file and name it **[Your Section]_[Your ID]_[Your Full Name in Arabic]**.
  - Through LMS, go to **\Assignments\Homework** and submit your paper.

**Good Luck** ☺

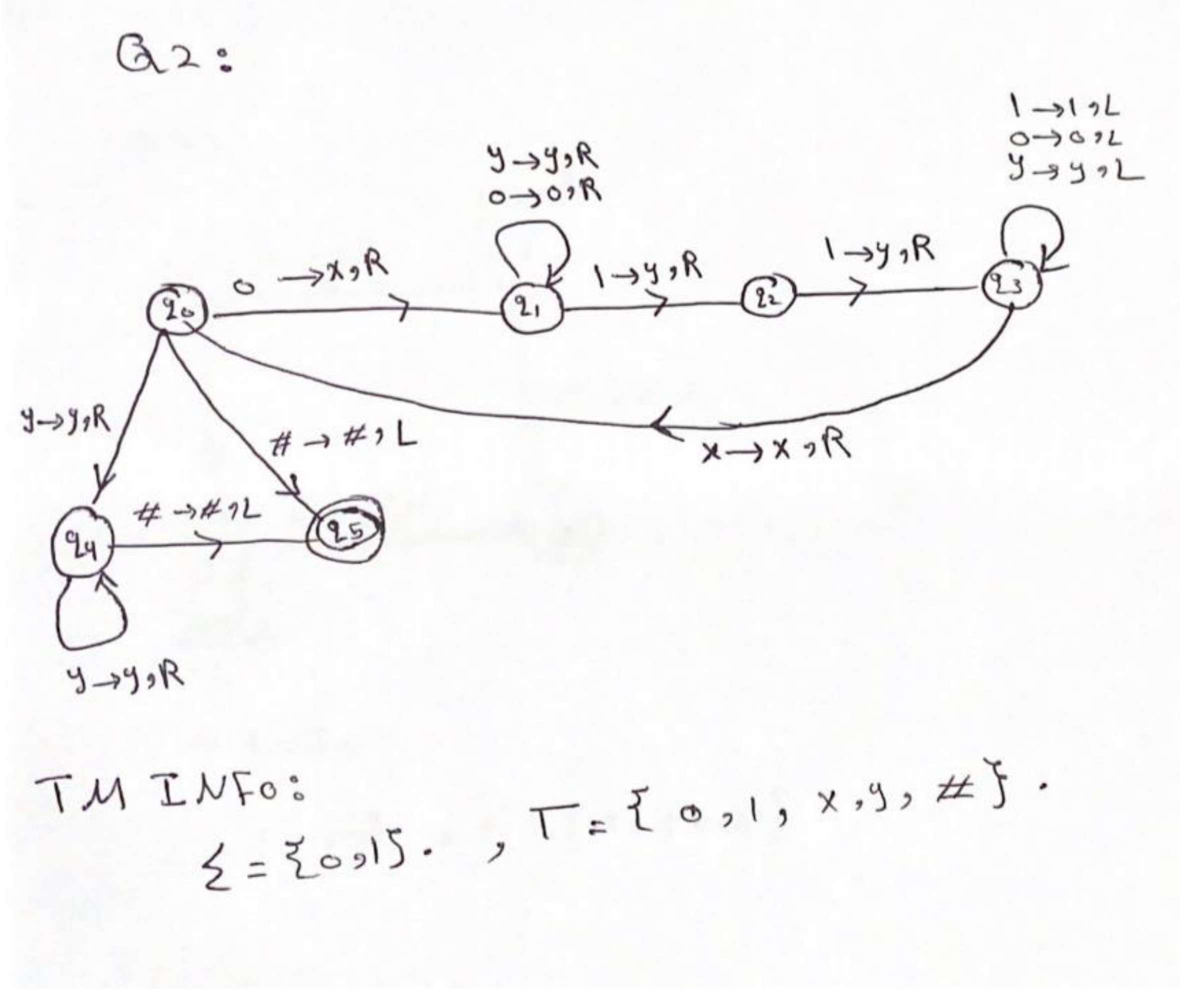
### Question 1 [2 pts]

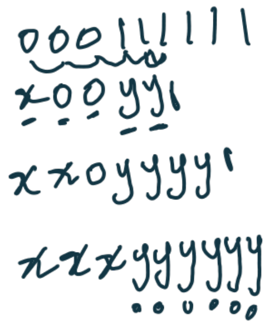
For each of the following statements state if it is true, false or unknown:

| | |
|---|---|
| 1. If $L$ is a regular language; then $L \in P$. | **True** |
| 2. There exists some deterministic $TM$ that can decide $3SAT$ in polynomial time. | **Unknown** |
| 3. A language is in $NP$ if and only if it is decided by some non-deterministic polynomial time $TM$. | **True** |
| 4. $3SAT$ is polynomial time reducible to $CLIQUE$. | **True** |

### Question 2 [2 pts]

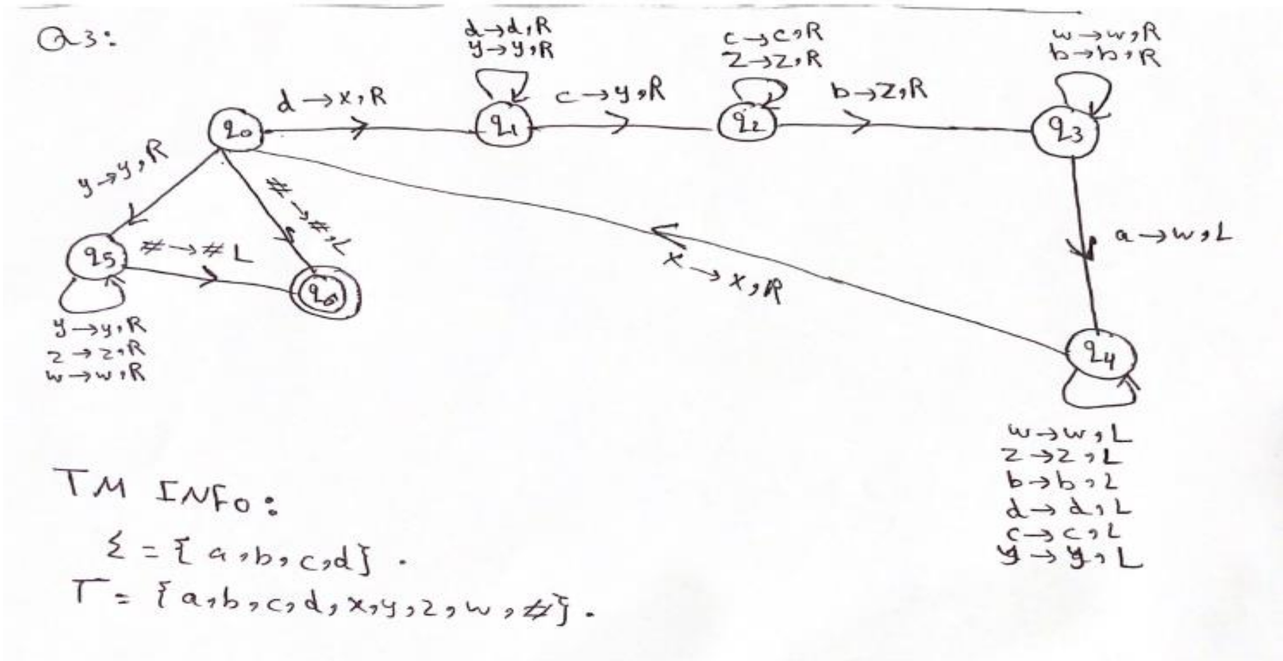
Design a Turing machine with input alphabet $\Sigma = \{0,1\}$ that accepts the language $L = \{0^i 1^{2i} \mid i \geq 0\}$.



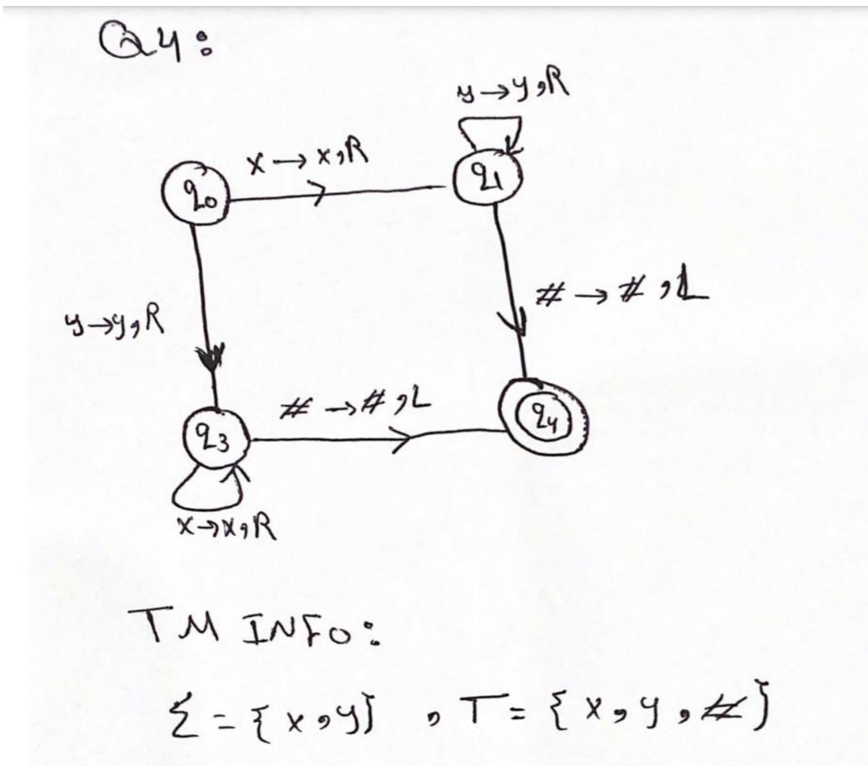
## Question 3 [2 pts]

Design a deterministic Turing machine with input alphabet $\Sigma = \{a, b, c, d\}$ that accepts the language $L = \{d^n c^n b^n a^n \mid n \geq 0\}$.




## Question 4 [2 pts]

Design a deterministic Turing machine with input alphabet $\Sigma = \{x, y\}$ that accept the regular language $L = \{xy^* + yx^*\}$. In other words, $L$ is the set of strings in which the first symbol does not appear again on the input.



**Question 5 [2 pts]**

Let $M$ be a Turing machine that defined by:

| **δ** | a | b | <> | # |
|---|---|---|---|---|
| q0 | q1, b, S | q1, a, S | q0, <>, R | q2, #, S |
| q1 | q0, a, R | q0, b, R | q1, <>, R | q0, #, R |
| q2 | - | - | - | - |

1. Trace the computation of $M$ starting from the configuration (**q0**, <> ***aaabbba***).

# q0 <>aaabbba# ≻ #<> q0 aaabbba# ≻ #<> q1 baabbba# ≻ #<>b q0 aabbba# ≻ #<>b q1 babbba# ≻ #<>bb q0 abbba# ≻ #<> bb q1 bbbba# ≻ #<>bbb q0 bbba# ≻ #<>bbb q1 abba# ≻ #<>bbba q0 bba# ≻ #<>bbba q1 aba# ≻ #<>bbbaa q0 ba# ≻ #<>bbbaa q1 aa# ≻ #<>bbbaaa q0 a# ≻ #<>bbbaaa q1 b# ≻ #<>bbbaaab q0# ≻ #<>bbbaaab q2#

2. Describe informally what $M$ does when it starts from state $q0$ and the read\write head points to any cell in the tape.

In state q0 , when the machine read **<>** the write **<>** and stay in state **q0** , move the head to the **right** . when read **a** then write **b** and go to state **q1** and stay in that head(i.e stay don't move neither left or right ), then in q1 when read b write b and go to state q0 and move right.in q0 when read **b** write **a** and go to state **q1** and stay in that head (i.e stay don't move neither left or right ), then in q1 when read a write a and go to state q0 and move right . in q0 when read **#** write **#** , go to state **q2** and stay in that head( i.e stay don't move neither left or right ).
**In other word this Turing machine change every a to b and vice versa .**