

**KING SAUD UNIVERSITY**  
**COLLEGE OF COMPUTER AND INFORMATION SCIENCES**  
**Computer Science Department**

**CSC 339**  
**Theory of Computation**

**Tutorial # 8**  
 Complexity

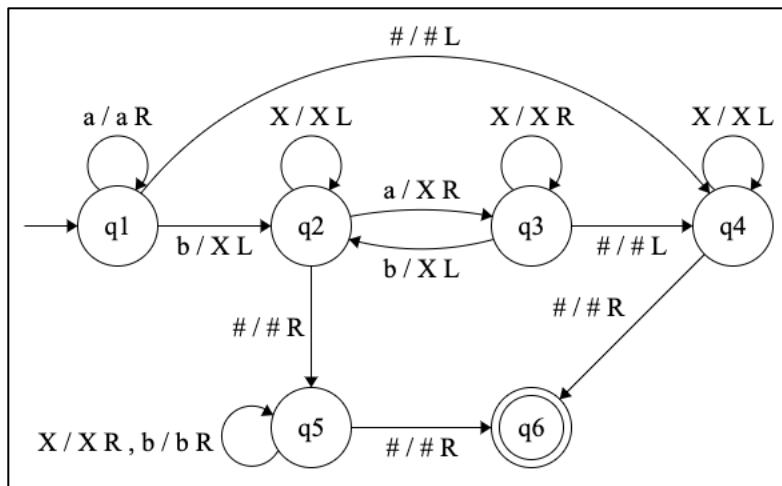
**2<sup>nd</sup> Semester 1443-2022**

## Exercise 1

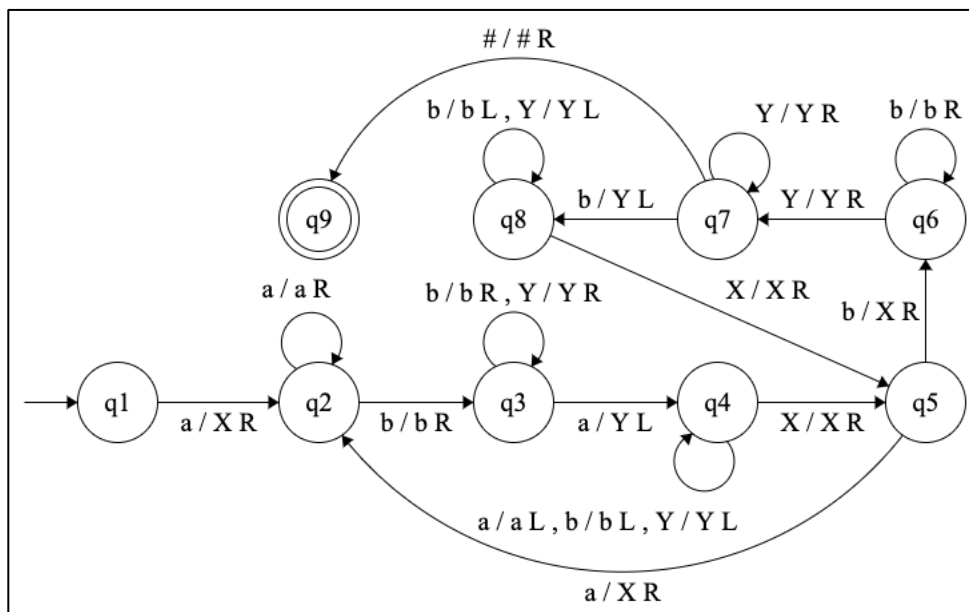
For each of the following Turing machine with input alphabet  $\{a, b\}$ , give:

- Accepted language
- The time complexity and its corresponding class
- The space complexity and its corresponding class

1.



2.



## Exercise 2

Which of the following statements about the class **P** are correct?

1. **P** is the class of all languages that are decidable by deterministic single-tape Turing machines running in polynomial time.
2. **P** is the class of all languages such that  $w \in P$  then there is a deterministic single-tape Turing machine which accepts the string  $w$  in polynomial time.
3. **P** is the class of all languages that are decidable by deterministic multi-tape Turing machines running in polynomial time.
4. A language  $L$  belongs to **P** if there is a constant  $k$  and a decider  $M$  running in time  $O(n^k)$  such that  $L = L(M)$ .
5. A language  $L$  belongs to **P** if  $L \in TIME(2^n)$ .

## Exercise 3

Below are some definitions of the class **NP**, Which ones are correct?

1. **NP** is the class of languages which have polynomial time verifiers.
2. **NP** is the class of languages that cannot be decided in polynomial time using a deterministic Turing machine.
3. **NP** is the class of languages that have non-deterministic verifiers.
4. **NP** is the class of languages that can be decided in polynomial time on a non-deterministic Turing machine.