Quiz 2

Week 14- May 18th

The answer is to be submitted online through Blackboard under the Assignments' section'

Due date: May 27th, 2022

Dr. Sultan E. Almaghthawi

Department of Computer Science

College of Computer Science and Engineering

Taibah University

:Students names and ID's

Answer Quiz 2

Question 1:

1.1 Write a Turing machine for the language:

- $a^n x b^n x c^n$

Answer 1:

The transitions can be broken into several parts.

The set:

$$\delta(q_0, a) = (q_1, A, R)$$

$$\delta(q_0, x) = (q_1, X, R)$$

$$\delta(q_0, X) = (q_2, X, R)$$

$$\delta(q_0, B) = (q_0, B, R)$$

$$\delta(q_0, C) = (q_6, C, R)$$

replaces the leftmost a with an A, then causes the read-write head to travel right to the first x, replacing it with a X, then causes the read-write head to travel right to the first b, replacing it with a B.

The set:

$$\delta(q_1, a) = (q_1, a, R)$$

$$\delta(q_1, x) = (q_2, X, R)$$

$$\delta(q_1, X) = (q_1, X, R)$$

replaces the first x with X, then causes the read-write head to travel right to the first b.

The set:

$$\delta(q_2, b) = (q_3, B, R)$$

$$\delta(q_2, B) = (q_2, B, R)$$

$$\delta(q_2, X) = (q_2, X, R)$$

$$\delta(q_2, \square) = (q_7, \square, R)$$

replaces the leftmost b with B, then causes the read-write head to travel right to the second x.

The set:

$$\delta(q_3, b) = (q_3, b, R)$$

$$\delta(q_3, x) = (q_4, X, R)$$

$$\delta(q_3, X) = (q_3, X, R)$$

replaces the second x with X, then causes the read-write head to travel right to first c.

The set:

$$\delta(q_4, c) = (q_5, C, R)$$

$$\delta(q_4, C) = (q_4, C, R)$$

$$\delta(q_4, X) = (q_4, X, R)$$

replaces the leftmost c with C.

The set:

$$\delta(q_5, a) = (q_5, a, L)$$

$$\delta(q_5, A) = (q_0, A, R)$$

$$\delta(q_5, b) = (q_5, b, L)$$

$$\delta(q_5, B) = (q_5, B, L)$$

$$\delta(q_5, C) = (q_5, C, L)$$

$$\delta(q_5, X) = (q_5, X, L)$$

We are now back in the initial state q_0, repeat until no more a, b or c.

The final set:

$$\delta(q_6, C) = (q_6, C, R)$$

$$\delta(q_6, \square) = (q_7, \square, R)$$

So, this is a complete solution for which:

$$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\},$$

$$F = \{q_7\},$$

$$\Sigma = \{a, b, c, x\},$$

$$\Gamma = \{a, b, c, x, A, B, C, X, \square\}.$$

1.2 Computation Algorithm:

• Write an algorithm to accept the language using two-tape Turing machine.

Answer:

Acceptance algorithm using a two-tape Turing machine:

1. Copy the a on tape 2 until x.
2. Compare b in tape 1 with a in tape 2.
3. Copy the b to tape 2 until x.
4. Compare b in tape 2 with c in tape 1.
5. End

1.3 Computation Complexity:

What is the time complexity of the language?

Answer:

Time needed:

1. Copy the a on the second tape = O (n)
2. Compare b in tape 1 with a in tape 2 = O (n)
3. Copy the b to tape 2 until x = O (n)
4. Compare b in tape 2 with c in tape 1 = O (n)

Time complexity: O(n)

- Which class of time complexity does your algorithm belongs to?

Answer:

Language class is:

DTIME(T(n))