

Theory of Computation

Turing Machine Recursively Enumerable

DPP 01

[MCQ]

1. Let M be a turing machine having $Q = \{q_0, q_1, q_2, q_3, q_4\}$ a set of states, input alphabet $\{0, 1\}$. The tape alphabets $\{0, 1, B, x, y\}$. The symbol B is used to represent the end input string. The initial and final states are q_0 and q_4 respectively. The transitions are as follows:

- | | |
|-----------------------------|------------------------------|
| 1. $(q_0, 0) = (q_1, x, R)$ | 2. $(q_0, y) = (q_3, y, R)$ |
| 3. $(q_1, 0) = (q_1, 0, R)$ | 4. $(q_1, 1) = (q_2, y, L)$ |
| 5. $(q_1, y) = (q_1, y, R)$ | 6. $(q_2, 0) = (q_2, 0, L)$ |
| 7. $(q_2, x) = (q_0, x, R)$ | 8. $(q_2, y) = (q_2, y, L)$ |
| 9. $(q_3, y) = (q_3, y, R)$ | 10. $(q_3, B) = (q_4, B, R)$ |

Which of the following statement is true about M ?

- (a) M accepts on $L = \{0^n 1^m \mid n, m \geq 0\}$.
 (b) M accepts 010 as a substring.
 (c) M accepts on $L = \{0^n 1^n \mid n \geq 0\}$.
 (d) M accepts on 011 as a substring.

[MCQ]

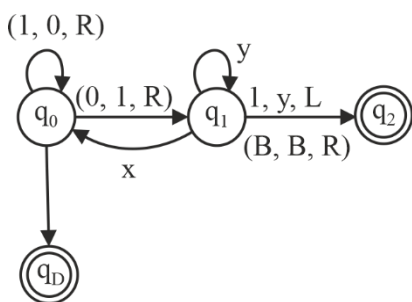
2. Consider the following turing machines:
- Single-tape TM
 - Multi-tape TM
 - Universal TM

Which of the above TM's are equivalent?

- (a) (i) and (ii) (b) (ii) and (iii)
 (c) (i) and (iii) (d) (i), (ii), and (iii)

[MSQ]

3. If the following turing machine accepts $L = \{(0 + 1)^*\}$, then what will the value of x and y ?



- (a) $x = (1, 1, R); y = (0, 0, R)$
 (b) $x = (1, 0, R); y = (0, 1, R)$
 (c) $x = (1, 1, R); y = (1, 1, R)$
 (d) $x = (0, 1, R); y = (1, 0, R)$

[MCQ]

4. Which of the following statement is/are correct regarding tuples of turing machine

- (a) TM has six tuples which are $\{Q, T, \Sigma, \delta, q_0, F\}$.
 (b) Σ is the input alphabet.
 (c) T is the tape alphabet.
 (d) Q is finite set of states.

[MCQ]

5. Consider a Turing machine with following restrictions
- Head can only read and cannot write.
 - Head can move only in one direction.

The Turing machine with above restrictions is known as _____.

- (a) Turing machine
 (b) Linear bounded automata
 (c) Push down automata
 (d) Finite Automata

[MCQ]

6. Consider the given grammar:

$$S \rightarrow aASccc \mid \epsilon$$

$$Aa \rightarrow aA$$

$$Ac \rightarrow bbc$$

$$Ab \rightarrow bbb$$

Which of the following language is derived by the above grammar?

- (a) $L = \{a^n b^n c^n \mid n \geq 0\}$
 (b) $L = \{a^n b^{2n} c^n \mid n \geq 0\}$
 (c) $L = \{a^n b^{2n} c^{3n} \mid n \geq 0\}$
 (d) $L = \{a^{4n} b^{3n} c^{2n} \mid n \geq 0\}$

[MCQ]

7. Consider the following transitions of a turing machine M:

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

$\delta(q_0, b) = (q_1, B, R)$

$\delta(q_0, B) = (q_3, B, R)$

$\delta(q_1, b) = (q_2, B, R)$

$\delta(q_1, a) = (q_2, B, R)$

$\delta(q_2, a) = (q_0, B, R)$

$\delta(q_2, b) = (q_0, B, R)$

The language derived by the equivalent turing machine defined as?

- (a) $L = \{w: |w| \text{ is even}\}$
- (b) $L = \{w: |w| \text{ is odd}\}$
- (c) $L = \{w: |w| \text{ is multiple of } 3\}$
- (d) None of these

[MCQ]

8. Minimum number of stacks required by push down automata to behave like a turing machine.

- (a) 1
- (b) 2
- (c) 3
- (d) None of these



Answer Key

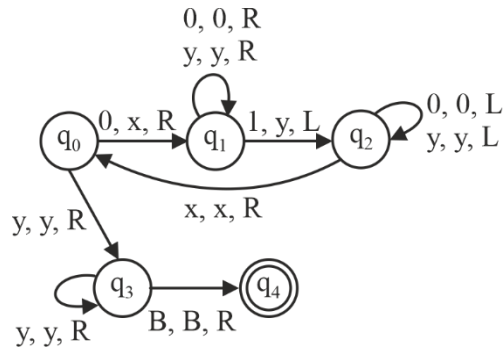
- | | |
|--------------|--------|
| 1. (c) | 5. (d) |
| 2. (d) | 6. (c) |
| 3. (a, b, d) | 7. (c) |
| 4. (b, c, d) | 8. (b) |



Hints & Solutions

1. (c)

Turing machine for the given transitions



The above turing machine M accepts on $L = \{0^n 1^n \mid n \geq 0\}$

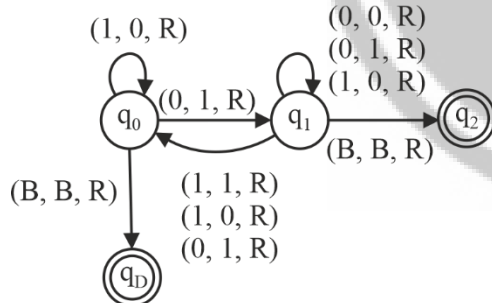
\therefore option (c) is correct.

2. (d)

All turing machine can solve same set of problem. However, complexity of solving a problem may differ.

3. (a, b, d)

Turing machine for accepting $(0 + 1)^*$ is as follows:



So, clearly option (a), (b) and (d) are correct.

4. (b, c, d)

TM has seven tuples which are $(Q, T, B, \Sigma, \delta, q_0, F)$.

Σ is the input alphabet. Correct.

T is the tape alphabet. Correct.

Q is the finite set of states. Correct.

\therefore (b), (c), (d) are correct.

5. (d)

If a turing machine has unidirectional and read only head so it can only accept regular languages and acts like a finite automata.

6. (c)

String derived by given grammar are:

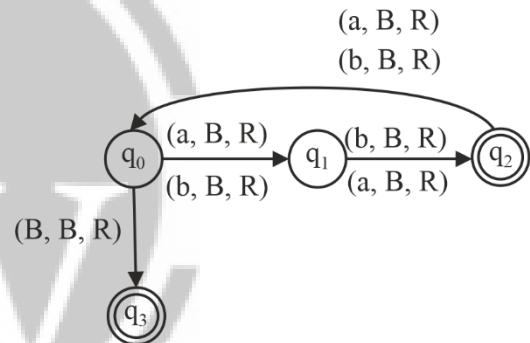
$\{\epsilon, abcccc, aabbbbcccccc, \dots\}$

So, the $L = \{a^n b^{2n} c^{3n} \mid n \geq 0\}$

\therefore Option (c) is correct.

7. (c)

The equivalent turing machine for given transitions is:



It can be seen the language contain strings whose length is multiple of 3.

8. (b)

Push down automata with 2 or more stacks is equivalent to turing machine.



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