Gradiance Online Accelerated Learning

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Help

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based on Chapter 8 of HMU.

1. A nondeterministic Turing machine *M* with start state q_0 and accepting state q_f has the following transition function:

$\delta(q,a)$	0	1	B
q_0	$\{(q_1,0,R)\}$	$\{(q_1,0,R)\}$	$\{(q_1,0,R)\}$
q_1	$\{(q_1,1,R), (q_2,0,L)\}$	$\{(q_1,1,R), (q_2,1,L)\}$	$\{(q_1,1,R), (q_2,B,L)\}$
q_2	$\{(q_f,0,R)\}$	$\{(q_2,1,L)\}$	$\{\}$
q_f	$\{\}$	$\{\}$	$\{\}$

Simulate all sequences of 5 moves, starting from initial ID $q_0 1010$. Find, in the list below, one of the ID's reachable from the initial ID in EXACTLY 5 moves.

a) $q_2 0110$

b) $0q_f 111$

c) $01111q_1$

d) $0111q_2 1$

Answer submitted: **c)**

You have answered the question correctly.

Question Explanation:

Here are all the possible sequences of ID's with up to 5 moves.

$q_0 1010$ |- $0q_1 010$ |- $01q_1 10$ |- $011q_1 0$ |- $0111q_1$ |- $01111q_1$
$q_0 1010$ |- $0q_1 010$ |- $01q_1 10$ |- $011q_1 0$ |- $0111q_1$ |- $011q_2 1$
$q_0 1010$ |- $0q_1 010$ |- $01q_1 10$ |- $011q_1 0$ |- $01q_2 10$ |- $0q_2 110$
$q_0 1010$ |- $0q_1 010$ |- $01q_1 10$ |- $0q_2 110$ |- $q_2 0110$ |- $0q_f 110$
$q_0 1010$ |- $0q_1 010$ |- $q_2 0010$ |- $0q_f 010$

2. A nondeterministic Turing machine *M* with start state q_0 and accepting state q_f has the following transition function:

δ(q,a)	0	1	B
q_0	$\{(q_1,0,R)\}$	$\{(q_1,0,R)\}$	$\{(q_1,0,R)\}$
q_1	$\{(q_1,1,R), (q_2,0,L)\}$	$\{(q_1,1,R), (q_2,1,L)\}$	$\{(q_1,1,R), (q_2,B,L)\}$
q_2	$\{(q_f,0,R)\}$	$\{(q_2,1,L)\}$	$\{\}$
q_f	$\{\}$	$\{\}$	$\{\}$

Deduce what *M* does on any input of 0's and 1's. Demonstrate your understanding by identifying, from the list below, the ID that CANNOT be reached on some number of moves from the initial ID $q_0100010001$.

a) $0q_f11111001$

b) $01111111111q_1$

c) $0q_2011011011$

d) $011q_2111001$

Answer submitted: **c)**

You have answered the question correctly.

Question Explanation:

M starts by replacing the first symbol by 0 and then enters state q_1, moving right. In state q_1, it moves right, changing all symbols, including blanks, to 1. However, at any time, it may also "guess" that it is time to enter q_2. In that branch, the symbol being scanned is left unchanged, and *M* moves left, over 1's, until it meets the initial 0. At that point, it moves right and enters state q_f.

3. The Turing machine M has:

- States q and p; q is the start state.
- Tape symbols 0, 1, and B; 0 and 1 are input symbols, and B is the blank.
- The following next-move function:

State	Tape Symbol	Move
q	0	(q,0,R)
q	1	(p,0,R)
q	B	(q,B,R)
p	0	(q,0,L)
p	1	none (halt)
p	B	(q,0,L)

Your problem is to describe the property of an input string that makes M halt. Identify a string that makes M halt from the list below.

a) 00001

b) 00100

c) 001010

d) 11010

Answer submitted: **a)**

Your answer is incorrect.

Hint: notice that the only way for M to halt is to enter state p and then see a 1 on the tape. How can that happen? In the case of this input, M does not halt; it enters the sequence of ID's: q00001 |- 0q0001 |- 00q001 |- 000q01 |- 0000q1 |- 00000pB |- 0000q0 |- 00000qB |- 00000BqB |- ...

The informal notion of the behavior of a Turing machine is in Section 8.2.2 (p. 326). The formal notion of moves of a TM as a sequence of instantaneous descriptions is in Section 8.2.3 (p. 327).

Question Explanation:

In state q, as long as M sees only 0's, it leaves its tape unchanged and continues moving right. The only way M can halt is by being in state p and seeing a 1. The only way that M gets to state p is by being in state q and seeing a 1. Since in state q, M moves right when it sees the 1, we conclude that M will halt if it ever finds two consecutive 1's.

We need to make sure that there are no other ways M could halt, say by seeing a single 1. However, if M enters state p, it will surely have 0 to its left, because it changes the 1 to a 0. If in state p, M sees 0 or B, it moves left, back to the 0 and enters state q again. At that point, M will proceed right, in state q, until it sees another 1.

The correct choice is: **d)**

4. A Turing machine *M* with start state q_0 and accepting state q_f has the following transition function:

δ(q,a)	**0**	**1**	**B**
q_0	$(q_0,1,R)$	$(q_1,1,R)$	(q_f,B,R)
q_1	$(q_2,0,L)$	$(q_2,1,L)$	(q_2,B,L)
q_2	-	$(q_0,0,R)$	-
q_f	-	-	-

Deduce what *M* does on any input of 0's and 1's. Hint: consider what happens when *M* is started in state q_0 at the left end of a sequence of any number of 0's (including zero of them) and a 1. Demonstrate your understanding by identifying the true transition of *M* from the list below.

a) $q_0 0011$ |-* $1100Bq_f$

b) $q_0 1100$ |-* $1111Bq_f$

c) $q_0 1100$ |-* $1101Bq_f$

d) $q_0 0101$ |-* $0100Bq_f$

Answer submitted: **b)**

Your answer is incorrect.

Here is a suggestion about what happens whenever *M* finds itself in state q_0 with zero or more 0's followed by a 1 to its right: $(q_0,0...01w)$ |-* $1...1q_0 1w$ |- $1...11q_1 w$ |- $1...1q_2 1w$. Try completing the sequence and see what the tape could look like after the state next returns to q_0. The informal notion of the behavior of a Turing machine is in Section 8.2.2 (p. 326). The formal notion of moves of a TM as a sequence of instantaneous descriptions is in Section 8.2.3 (p. 327).

Question Explanation:

M inverts all 0's and 1's on its input and then accepts. To see why, notice that for any string *w*, *M* makes the following sequence of transitions:

$(q_0,0...01w)$ |-* $1...1q_01w$ |- $1...11q_1w$ |- $1...1q_21w$ |- $1...10q_0w$

Also, started in state q_0 with only 0's to its right, *M* moves to the right, replacing the 0's by 1's, and accepts when it reaches a blank.

The correct choice is: **a)**

5. The Turing machine M has:

- States q and p; q is the start state.
- Tape symbols 0, 1, and B; 0 and 1 are input symbols, and B is the blank.
- The following next-move function:

State	Tape Symbol	Move
q	0	(q,0,R)
q	1	(p,0,R)
q	B	(q,B,R)
p	0	(q,0,L)
p	1	none (halt)
p	B	(q,0,L)

Simulate M on the input 1010110, and identify one of the ID's (instantaneous descriptions) of M from the list below.

a) 000000p0

b) 000p0110

c) 10101p10

d) 1p010110

Answer submitted: **a)**

Your answer is incorrect.

A possible error is that you have not noticed that in state p, scanning 1, M halts. The formal notion of moves of a TM as a sequence of instantaneous descriptions is in Section 8.2.3 (p. 327).

Question Explanation:

Here is the complete sequence of ID's after which M halts: q1010110 |- 0p010110 |- q0010110 |- 0q010110 |- 00q10110 |- 000p0110 |- 00q00110 |- 000q0110 |- 0000q110 |- 00000p10

The correct choice is: **b)**