Gradiance Online Accelerated Learning

Zayd

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Help

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1. 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) 10101p10
b) 1010q110
c) 0000q010
d) 00000p10

Answer submitted: **d)**

You have answered the question correctly.

Question Explanation:

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

2. 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$1100 |-* 0011q_f

b) $q_0$0011 |-* 1100Bq_f

c) $q_0$0101 |-* 1010q_f

d) $q_0$0011 |-* 1100q_f

Answer submitted: **b)**

You have answered the question correctly.

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...1$q_0$1w |- 1...11q_1w |- 1...1$q_2$1w |- 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.

3. 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	{}	{}	{}

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) 01$q_2$10

b) 0$q_2$110

c) 0$q_2$111

d) 01111q_1

Answer submitted: **b)**

You have answered the question correctly.

Question Explanation:

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

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

4. 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) 0010

b) 00100

c) 10101

d) 010110

Answer submitted: **d)**

You have answered the question correctly.

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.

5. 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	{}	{}	{}

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_0$0011000.

a) $0q_2 0111001$

b) $011111111q_1$

c) $0q_f 11111111111$

d) $01111q_2 10$

Answer submitted: **a)**

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.