



Gradiance Online Accelerated Learning

Zayd

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based on Chapter 8 of HMU.

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	Move
	Symbol	
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) 0100
- b) 0101
- c) 00100
- d) 11010

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.

2. A 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	$(q_0, 1, R)$	$(q_1, 1, R)$	(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) $q_0 1010 \vdash^* 0101 B q_f$
- b) $q_0 1100 \vdash^* 1111 B q_f$
- c) $q_0 0011 \vdash^* 1101 B q_f$
- d) $q_0 0101 \vdash^* 1110 B q_f$

Answer submitted: **a)**

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:

$(q_0, 0 \dots 01w) \vdash^* 1 \dots 1 q_0 1w \vdash 1 \dots 11 q_1 w \vdash 1 \dots 1 q_2 1w \vdash 1 \dots 10 q_0 w$

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:

$\delta(q,a)$	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) $0111 q_2 1$
- b) $0 q_2 111$
- c) $011 q_2 1$

d) 011111q₁

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.

q₀1010 |- 0q₁010 |- 01q₁10 |- 011q₁0 |- 0111q₁ |- 01111q₁
 q₀1010 |- 0q₁010 |- 01q₁10 |- 011q₁0 |- 0111q₁ |- 011q₂1
 q₀1010 |- 0q₁010 |- 01q₁10 |- 011q₁0 |- 01q₂10 |- 0q₂110
 q₀1010 |- 0q₁010 |- 01q₁10 |- 0q₂110 |- q₂0110 |- 0q_f110
 q₀1010 |- 0q₁010 |- q₂0010 |- 0q_f010

4. 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
q₀	$\{(q_1,0,R)\}$	$\{(q_1,0,R)\}$	$\{(q_1,0,R)\}$
q₁	$\{(q_1,1,R), (q_2,0,L)\}$	$\{(q_1,1,R), (q_2,1,L)\}$	$\{(q_1,1,R), (q_2,B,L)\}$
q₂	$\{(q_f,0,R)\}$	$\{(q_2,1,L)\}$	$\{\}$
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 q₀101011001.

- a) 01111111111q₁
 b) q_f0111111111
 c) 01111q₂111111111
 d) 0q_f1111111111111

Answer submitted: **b)**

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 .

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	Move
	Symbol	

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) 0000q010
- b) 0000q110
- c) 101q0110
- d) 1p010110

Answer submitted: **b)**

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