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Homework

Homework due Aug 19, 2020 21:30 IST

The exercises below will count towards your grade. You have only one chance to answer these questions. Take your time, and think carefully before answering.

Problem 1

20.0/20.0 points (graded)

Answer the following questions using the coding system described in "Numberint Turing Machines", <u>above</u>.

Which natural number codes the Turing Machine with program 0 - l 0?

113190

Answer: 113190

113190

Explanation

In the relevant coding system, " $_{-}$ " is coded as 0, and "l" is coded as 2. So our Turing Machine corresponds to the sequence $\langle 0,0,0,2,0
angle$, which gets coded as

$$2^{0+1} \cdot 3^{0+1} \cdot 5^{0+1} \cdot 7^{2+1} \cdot 11^{0+1} = 113190$$

What does this Turing Machine do, on an empty input?

- Goes rightward on the tape forever, leaving the tape unchanged.
- Goes rightward on the tape forever, changing whatever is on the tape to a string of ones.
- Goes leftward on the tape forever, leaving the tape unchanged.

0	Homework Homework 24.118x Courseware edX			
Goes leftward on the tape forever, changing whatever is on the tape to a string of ones.				
✓				
Explanation When this Turing Machine ru cape unchanged.	uns on an empty input, it goes leftward forever, leaving the			
Which natural number code	s the Turing Machine with program 01_r0 ?			
6930	✓ Answer: 6930			
6930				
Machine corresponds to the	m, "_" is coded as 0 , and " r " is coded as 0 . So our Turing sequence $\langle 0,1,0,0,0 angle$, which gets coded as $7^{0+1}\cdot 11^{0+1}=6930$ ine do, on an empty input?			
It will go rightward on t	he tape forever.			
It will go leftward on the tape forever.				
It will halt immediately.				
✓				
•	oon as it reaches a cell with a blank in it, because it has no do when reading a blank in state zero.			

You have used 1 of 1 attempt Submit

1 Answers are displayed within the problem

Problem 2

10.0/10.0 points (graded) Here is a Turing Machine:

0 1 R 1

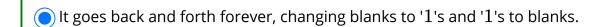
 $1 \quad 1 L 2$

 $21_{-}R3$

31 L0

What does this Turing Machine do, when run on an empty input?

It goes rightward forever, not changing anything.



It goes right and then left, back and forth forever, not changing anything.



Explanation

This Turing Machine starts in state 0, enters a '1' in the blank cell, goes right, and enters state 1. It now again enters a '1' in the blank cell, but then goes left. So now it is back at the cell at which it began. It changes the '1' back to a blank, and moves right, where it enters state 3. It then changes the second '1' it wrote back to a blank, goes left, and starts the whole process over again. So it goes right changing blanks into '1's, left changing '1's into blanks, over and over.

Submit

You have used 1 of 1 attempt

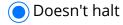
1 Answers are displayed within the problem

Problem 3

20.0/20.0 points (graded)

For each Turing Machine, say whether it halts on an empty input:

0 R 0



_	
	1151+6
()	Halts



Explanation

The machine just goes right indefinitely, so it doesn't halt.

$$0_{-}1R1$$

Doesn't halt





Explanation

This machine writes a 1 and then halts, since it goes to state 1 but there are no instructions for state 1.

 $0\,{-}\,1\,R\,1$

 $1_{-}1R2$

2 - 1R3

 $3 \,{ extstyle 1} \, R \, 4$

Doesn't halt



Halts



Explanation

This machine writes four '1's and then halts, since it goes to state 4 but there are no instructions for state 4.

 $0_{-}1R1$

 $1 \, _ \, 1 \, R \, 2$

2 - 1R3

 $3 \quad 1 R 0$

O Doesn't	halt		
Halts			

Explanation

This machine writes '1's indefinitely, since after writing four '1's it goes back to state 0 and starts again. (So it functions just as the machine " $0 - 1 \ R \ 0$ ".) So, it doesn't halt.

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You have used 1 of 1 attempt

1 Answers are displayed within the problem

Problem 4

20.0/20.0 points (graded)

For each of the following descriptions, determine whether there could be a Turing Machine satisfying that description.

A Turing Machine M such that given the code of a Turing Machine M' as input, Mbehaves as follows:

M outputs a 1 if M' halts when run on an empty input;

M outputs a 0 if M^\prime doesn't halt when run on an empty input.





Explanation

No, since such a machine would allow us to compute the halting function, which we know not to be Turing computable.

A Turing Machine M such that given the code of a Turing Machine M' as input, Mbehaves as follows:

M halts if M^\prime halts when run on an empty input;

M doesn't halt if M^\prime doesn't halt when run on an empty input.

Yes
○ No
✓
Explanation Yes. All one needs is a Universal Turing Machine. (See the exercises <u>here</u> .)
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Answers are displayed within the problem
Problem 5 10/10 points (graded) Could there be a function f such that, for some distinct numbers n and m , n and m both code Turing Machines that compute f ? Again, assume the coding system described in "Numbering Turing Machines", above.
Yes
○ No
Explanation Yes. One way to see this is to note that if a Turing Machine M with two or more command lines computes f , then any Turing Machine that results from changing the order of M 's command lines will also compute f , and is assigned a code different from the code assigned to M .
Submit You have used 1 of 1 attempt
Answers are displayed within the problem

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