

CIS 511 Homework 3

Stephen Phillips, Dagaen Golomb

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Problem 1

Show a Turing Machine that accepts the language $L = \{x \in a, b, c^* \mid x \text{ contains more } a\text{'s than } b\text{'s and } c\text{'s combined}\}$

Problem 2

Show that a language is recognizable by a queueing automaton if and only if it is recognizable by a Turing Machine.

- (\Leftarrow) If we have a Turing recognizable language, by definition there must be a Turing Machine that recognizes it. Therefore if we can make a queueing automaton replicate the actions of the Turing Machine we have show that Turing recognizable languages are recognized by queueing automata.

To do this, we simply the start and say that the queueing automaton pushes a 'start of tape' symbol followed by the entire string x into its queue before it starts computation. Now

Problem 3

Show that Turing recognizable languages are closed under Kleene Star.

To do this we consider the Turing recognizable language L , and the machine that recognizes it M . On a given input x , there are a large but finite number of ways to split the string into substrings. For a given partition, we can test if all the strings are in L using the following subroutine:

```
function A( $(x_1, x_2, \dots, x_n)$ )  
  for  $i = 1, \dots, \infty$  do  
  
    for  $j = 1, \dots, n$  do  
      Simulate the next step of  $M(x_j)$   
    end for  
  end for  
end function
```

Problem 4

Problem 5

Problem 6

Problem 7

Problem 8