CS 3313
Foundations of Computing:

Lab 7

Turing Machine Transition Function

Takes two arguments

- A state in Q
- A tape input in Γ

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Convention

- Just as with NFAs and PDAs, if transition is undefined TM goes to reject state
- If TM enters reject state it halts and rejects
- If TM enters accept state, it halts and accepts

Church-Turing Thesis

Anything that can be computed by an algorithm can be computed by a Turing Machine

Three Steps to Build a TM

1. Write an algorithm
   - Describe at a high-level the logic for recognizing L
   - By Church-Turing thesis, this describes a TM
2. Write a Turing-Machine algorithm
   - Specify what happens to the tape (i.e., scan the tape until the first 1 and write a 0)
   - Don’t need to specify the control states
   - This is usually enough – unless asked for the formal specification
3. Write the full specification
   - Includes full specification of transition function and states of control machine (remember that this is a DFA/NFA)

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1. Find the midpoint of the input
2. Check that the string before and after the midpoint are the same

Question(s):

- How do we find the midpoint?
- How do we check the two strings are equal?

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Composing TMs

- Just like we compose algorithms
- Design TM for step 1, and then step 2 and call one after the other

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Step 2: Write a Turing-Machine Algorithm

- Describe what how to manipulate the tape

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Step 3 (OPTIONAL): Write a full description

- Give the transition diagram for the TM

Exercise 2: $L = \{ a^i b^j c^i d^j \mid i,j>0 \}$

Build TM to decide L – do Steps 1+2, 3 is optional