CS 3313
Foundations of Computing:

Lab 6

Turing Machine Transition Function

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  - A state in Q
  - A tape input in Γ

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  - y – value to write on the tape
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  - A tape input in Γ
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  - y – value to write on the tape
  - D – direction to move the head – Left or Right
- 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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- Composing TMs
    - Just like we compose algorithms
    - Design TM for step 1, and then step 2 and call one after the other

Now you need to turn this into a TM algorithm

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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