Theory of Machines and Languages

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Other Models of Turing Machines

- **Multitape Turing Machines**
  - **Example**
    - Consider the language $\{a^n b^n\}$
    - Using a two-tape machine:
      - Assume that the initial string is written on tape 1
      - We then read all the a's, copying them onto tape 2
      - When we reach the end of the a's, we match the b's on tape 1 against the copied a's on tape 2

$$\delta(q0,a,B)=(q1,a,a,R,R)$$

$$\delta(q1,a,B)=(q1,a,a,R,R)$$

$$\delta(q1,b,B)=(q2,b,B,S,L)$$

$$\delta(q2,b,a)=(q2,b,a,R,L)$$

$$\delta(q2,B,B)=(qf,B,B,L,R)$$

  - **Exercise**
    - $L = \{a^n b^n c^n\}, n \geq 1$

Other Models of Turing Machines

- **Nondeterministic Turing Machines**

$$\delta : Q \times \Gamma \rightarrow 2^{Q \times \Gamma \times \{L,R\}}$$

  - **Example**

$$\delta(q_0, a) = \{(q_1, b, R), (q_2, c, L)\}$$

$$q_0aaa \vdash bq_1aa$$

$$q_0aaa \vdash q_2\Box caa$$

  - **The class of deterministic Turing machines and the class of nondeterministic Turing machines are equivalent.**

Turing Machines

- **Exercise**
  - **Design a Turing machine that accepts the following language**
    $L = \{ww : w \in \{0,1\}^+\}$