Theory of Machines and Languages

Fatemeh Deldar

1403-1404

Turing Machines as Language Accepters

- **Example**

For $\Sigma = \{a, b\}$, design a Turing machine that accepts

$$L = \{a^n b^n : n \geq 1\}.$$

$Q = \{q_0, q_1, q_2, q_3, q_4\}, F = \{q_4\}, \Sigma = \{a, b\}, \Gamma = \{a, b, x, y, \square\}$. The transitions can be broken into several parts.

$$\begin{aligned}
&\delta(q_0, a) = (q_1, x, R), && \delta(q_2, y) = (q_2, y, L), && \delta(q_0, y) = (q_3, y, R),\\
&\delta(q_1, a) = (q_1, a, R), && \delta(q_2, a) = (q_2, a, L), && \delta(q_3, y) = (q_3, y, R),\\
&\delta(q_1, y) = (q_1, y, R), && \delta(q_2, x) = (q_0, x, R). && \delta(q_3, \square) = (q_4, \square, R).\\
&\delta(q_1, b) = (q_2, y, L)
\end{aligned}$$

Turing Machines as Language Accepters

- **Example (Cont.)**
  - The particular input *aabb* gives the following successive instantaneous descriptions:

$$
\begin{aligned}
q_0aabb &\vdash xq_1abb \vdash xaq_1bb \vdash xq_2ayb \\
&\vdash q_2xayb \vdash xq_0ayb \vdash xxq_1yb \\
&\vdash xxyq_1b \vdash xxq_2yy \vdash xq_2xyy \\
&\vdash xxq_0yy \vdash xxyq_3y \vdash xxyyq_3\Box \\
&\vdash xxyy\Box q_4\Box.
\end{aligned}
$$

Turing Machines as Language Accepters

- **Example**
  - Design a Turing machine that accepts $L = \{a^n b^n c^n : n \geq 1\}$