CSE 355: Intro to Theoretical Computer Science
Recitation #9 Solution

1. [5 pts] Give the CFG that generates $L = \{a^i b^j \mid i = j \text{ or } i < j \text{ and } i, j \geq 0\}$

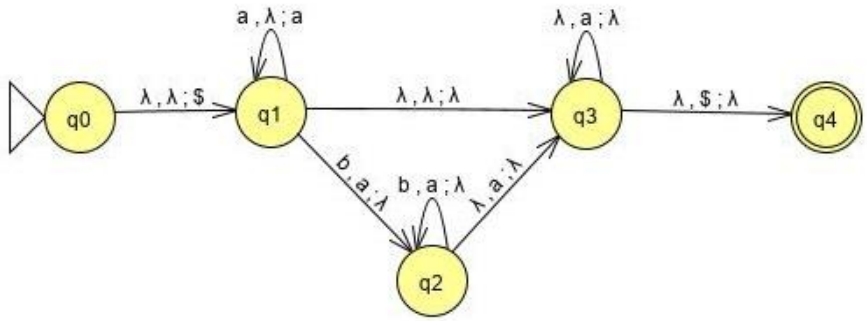
$S \rightarrow S_1 \mid S_2$
$S_1 \rightarrow aS_1b \mid \varepsilon$
$S_2 \rightarrow aS_2b \mid S_2b \mid b$

2. Let M be the PDA defined by:

$Q = \{q_0, q_1, q_2, q_3, q_4\}$, $\Sigma = \{a, b\}$, $\Gamma = \{a, \$\}$, $F = \{q_4\}$ and transition function is defined as below:

$$\delta(q_0, \varepsilon, \varepsilon) = (q_1, \$)$$
$$\delta(q_1, a, \varepsilon) = (q_1, a)$$
$$\delta(q_1, \varepsilon, \varepsilon) = (q_3, \varepsilon)$$
$$\delta(q_1, b, a) = (q_2, \varepsilon)$$
$$\delta(q_2, b, a) = (q_2, \varepsilon)$$
$$\delta(q_2, \varepsilon, a) = (q_3, \varepsilon)$$
$$\delta(q_3, \varepsilon, a) = (q_3, \varepsilon)$$
$$\delta(q_3, \varepsilon, \$) = (q_4, \varepsilon)$$

2.1) [3 pts] Use JFLAP (http://www.jflap.org), draw the state diagram of the PDA.



2.2) [2 pts] Uset set notation to describe the language accepted by M

$L = \{a^i b^j \mid i > j \geq 0\}$

3. [10 pts] Convert the following contest-free grammar into equivalent PDA using method presented in class (Theorem 2.20, pp.136). Draw the PDA's state diagram.

$$R \longrightarrow XRX \mid S$$
$$S \longrightarrow aTb \mid bTa$$
$$T \longrightarrow XTX \mid X \mid \varepsilon$$
$$X \longrightarrow a \mid b$$