Problem 2.3

(a) $V = \{R, S, T, X\}$

(b) $\Sigma = \{a, b\}$

(c) $S = R$

(d) aab $\quad R \Rightarrow S \Rightarrow aTb$

$\Rightarrow aXb \Rightarrow aab$

(e) b $\quad R \Rightarrow S \Rightarrow bTa \Rightarrow bXTXa$

bb $\quad \Rightarrow bbTXa \Rightarrow bbXa \Rightarrow \underline{\underline{bbaa}} \in L$

(f) false

(g) $T \Rightarrow XTX \Rightarrow aTX \Rightarrow aXX \Rightarrow abX \Rightarrow aba$

true

(h) false

(i) true

(j) true

(k) False $\quad X \Rightarrow a$ or $X \Rightarrow b$

(l) $T \Rightarrow XTX \Rightarrow XX$ true

(m) $T \Rightarrow XTX \Rightarrow XXX$ true

(n) false

(o) not a palindrome $\quad abaa$

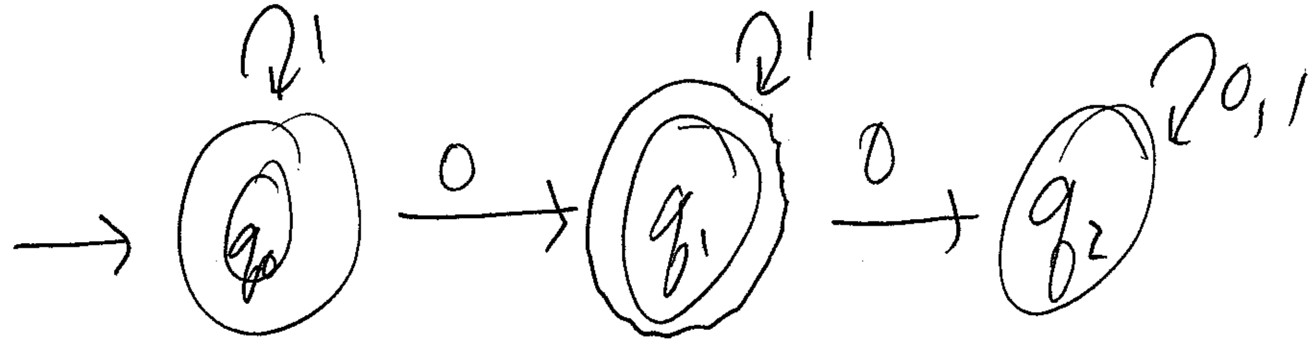
$$R \Rightarrow XRX \Rightarrow aRX$$

$$\Rightarrow aSX \Rightarrow abTaX$$

$$\cancel{abXaX \Rightarrow abaaX \Rightarrow}$$

$$\Rightarrow abaX \Rightarrow abaa$$

DFA



CFG

$$Q_0 \rightarrow 1Q_0 \mid 0Q_1 \mid \epsilon$$
$$Q_1 \rightarrow 1Q_1 \mid 0Q_2 \mid \epsilon$$
$$Q_2 \rightarrow 1Q_2 \mid 0Q_2$$

$$V = \{Q_0, Q_1, Q_2\}$$
$$\Sigma = \{0, 1\}$$
$$S = Q_0$$

Construct a CFG for $A = \{w \mid w$ contains either zero or one 0's$\}$ over $\Sigma = \{0,1\}$

$$S \to WX \to aWX \to aaWX \to aaX \to aabXc \to aabbXcc \to aabbcc$$

The above leftmost derivation is one way to produce aabbcc.

On your own: Show a second, leftmost derivation.