Exercise 1.19: Use the procedure described in Lemma 1.55 to convert the following regular expressions to nondeterministic finite automata.

b. $(((00)^*(11)) \cup 01)^*$

Exercise 1.21: Use the procedure described in Lemma 1.60 to convert the following finite automata to regular expressions.

b. [Given in tabular form (this is a DFA):]

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rightarrow$</td>
<td>*1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>*3</td>
<td>1</td>
</tr>
</tbody>
</table>

Exercise 1.29: Use the pumping lemma to show that the following languages are not regular.

a. $A_1 = \{0^n1^n2^n \mid n \geq 0\}$

b. $A_2 = \{www \mid w \in \{a, b\}^*\}$

c. $A_3 = \{a^{2^n} \mid n \geq 0\}$ (Here, $a^{2^n}$ means a string of $2^n$ a’s.)

Problem 1.40: Recall that a string $x$ is a prefix of string $y$ if a string $z$ exists where $xz = y$, and that $x$ is a proper prefix of $y$ if in addition $x \neq y$. In each of the following parts, we define an operation on a language $A$. Show that the class of regular languages is closed under that operation.

b. $\text{NOEXTEND}(A) = \{w \in A \mid w$ is not a proper prefix of any string in $A\}$. [Note: I have corrected the textbook’s wording, changing “the” to “a” because a string can have many proper prefixes.]
Problem 1.43: Let $A$ be any language. Define $DROP-OUT(A)$ to be the language containing all strings that can be obtained by removing one symbol from a string in $A$. Thus, 

$$DROP-OUT(A) = \{xz \mid xyz \in A \text{ where } x, z \in \Sigma^*, y \in \Sigma\}.$$ 

Show that the class of regular languages is closed under the $DROP-OUT$ operation. Give both a proof by picture and a more formal proof by construction as in Theorem 1.47.

Non-textbook exercise: Consider the following DFA $A$ over the alphabet $\{a, b\}$:

\begin{center}
\begin{tikzpicture}

\node[draw, circle] (A) at (0,0) {$A$};
\node[draw, circle] (B) at (1,1) {$B$};
\node[draw, circle] (C) at (2,2) {$C$};
\node[draw, circle] (D) at (1,-1) {$D$};
\node[draw, circle] (E) at (0,-2) {$E$};
\node[draw, circle] (F) at (2,-2) {$F$};

\path[->]
(A) edge [above] node {$a$} (B)
(B) edge [above] node {$a$} (C)
(B) edge [below] node {$b$} (D)
(D) edge [above] node {$a$} (E)
(D) edge [right] node {$b$} (F)
(E) edge [above] node {$a$} (F);

\end{tikzpicture}
\end{center}

1. (10 points) Give the table $T$ of distinguishabilities for $A$. Show only the proper lower triangle of $T$, that is, fill in the following table with $X$ in each entry corresponding to a pair of distinguishable states:

\begin{center}
\begin{tabular}{|c|c|c|c|c|}
\hline
& A & B & C & D & E \\
\hline
B & & & & & \\
C & & & & & \\
D & & & & & \\
E & & & & & \\
F & & & & & \\
\hline
\end{tabular}
\end{center}

2. (5 points) Draw the minimal (4-state) DFA equivalent to $A$. 

\begin{center}

\end{center}