1. Which of the following terms describes a parsing error recovery strategy? (mark one or more) (4 points)
   (a) Viable prefix
   (b) Error productions
   (c) Panic mode
   (d) Left factoring

2. Which of the following strings is recognized by this grammar? (mark one) (4 points)
   \[ S \rightarrow a S b b \mid \varepsilon \]
   (a) aabb
   (b) bb
   (c) aabbbb
   (d) aaaabb

3. Circle the language relationships between LL(1), LR(0), SLR, LR(1), and LALR(1) grammars in a diagram, i.e. which grammars are proper subsets of others or overlap? (7 points)
4. Consider the grammar:

\[ A \rightarrow aA \ b \ A \mid c \]

Give a leftmost derivation of the string `aacbcbc`. (10 points)
5. Consider the grammar:

\[
\begin{align*}
A & \rightarrow B \ a \ | \ C \ b \\
B & \rightarrow A \ A \\
C & \rightarrow B \ | \ a
\end{align*}
\]

(a) Eliminate left recursion (in general) from the grammar. (10 points)

(b) The original and modified grammars are \textbf{not} LL(1). Show this for both cases. (5 points)
6. Consider the following grammar:

<table>
<thead>
<tr>
<th></th>
<th>FIRST(α)</th>
<th>FOLLOW(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) start → decl stmt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) decl → type list ;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) type → int</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) string</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) list → id more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) more → , id more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) ε</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8) stmt → id := expr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9) expr → id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td>num</td>
<td></td>
</tr>
</tbody>
</table>

(a) For each production \( A \rightarrow \alpha \), determine \( \text{FIRST}(\alpha) \) and \( \text{FOLLOW}(A) \). (10 points)

(b) Construct the LL(1) parsing table. (10 points)
7. Consider the grammar:

\[
\begin{align*}
A & \rightarrow \ C \ a \ B \ a \\
A & \rightarrow \ B \\
B & \rightarrow \ C \\
C & \rightarrow \ b \\
\end{align*}
\]

(a) Disprove that the grammar is SLR. (10 points).
(b) Construct the LR(1) sets of items. (15 points).
(c) Construct the LR(1) parsing table. (15 points).