CMSC430 Spring 2014 Quiz 1

Name ________________________________

Instructions
• You have 20 minutes for to take this quiz.
• This is a closed book exam. No notes or other aids are allowed.
• Answer essay questions concisely using 1-2 sentences. Longer answers are not necessary and a penalty may be applied.
• Write neatly. Credit cannot be given for illegible answers.

1. (15 pts) LL(1) predictive parsing

   a. (6 pts) Consider the following grammar, where $\varepsilon$ is the empty string. Compute FIRST and FOLLOW for S and A:

   \[
   \begin{align*}
   S &\rightarrow A c \mid d \\
   A &\rightarrow a B A \mid \varepsilon \\
   B &\rightarrow b
   \end{align*}
   \]

<table>
<thead>
<tr>
<th></th>
<th>FIRST</th>
<th>FOLLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. (5 pts) Using the FIRST and FOLLOW information provided, construct the LL(1) parse table for the following grammar.

   \[
   \begin{align*}
   S &\rightarrow a A a \mid \varepsilon \\
   A &\rightarrow b \mid \varepsilon
   \end{align*}
   \]

   \[
   \begin{array}{|c|c|c|}
   \hline
   & \text{FIRST} & \text{FOLLOW} \\
   \hline
   S & a, \varepsilon & \$ \\
   A & b, \varepsilon & a \\
   \hline
   \end{array}
   \]

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
c. (4 pts) Using the following LL(1) parse table, parse the input “bb”. Show the stack and remaining input at each stage of the parse.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>$S</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>$S \rightarrow ba$</td>
<td>$S \rightarrow ABB$</td>
<td>$S \rightarrow bb$</td>
</tr>
<tr>
<td>A</td>
<td>$A \rightarrow C$</td>
<td>$A \rightarrow \varepsilon$</td>
<td>$A \rightarrow \varepsilon$</td>
</tr>
<tr>
<td>B</td>
<td>$B \rightarrow \varepsilon$</td>
<td>$B \rightarrow b$</td>
<td>$B \rightarrow a$</td>
</tr>
<tr>
<td>C</td>
<td>$C \rightarrow ab$</td>
<td>$C \rightarrow bb$</td>
<td>$C \rightarrow \varepsilon$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
<th>ACTION</th>
<th>GOTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Shift 2</td>
<td>Reduce $S \rightarrow Bb$</td>
</tr>
<tr>
<td>1</td>
<td>Shift 3</td>
<td>Shift 1</td>
</tr>
<tr>
<td>2</td>
<td>Shift 1</td>
<td>Shift 2</td>
</tr>
<tr>
<td>3</td>
<td>Reduce $S \rightarrow Bb$</td>
<td>Reduce $B \rightarrow b$</td>
</tr>
<tr>
<td>4</td>
<td>Reduce $B \rightarrow a$</td>
<td>Shift 3</td>
</tr>
</tbody>
</table>

2. (15 pts) LR(0) bottom-up parsing

a. (5 pts) Given the ACTION/GOTO table above, show the parse if the current stack contents are 0 b 2 B 1 (i.e., current state is 1) and the remaining input is “b$”.

<table>
<thead>
<tr>
<th>Stack</th>
<th>Input</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 b 2 B 1</td>
<td>b $</td>
<td></td>
</tr>
</tbody>
</table>
b. (5 pts) Given the following grammar, derive its canonical sets of LR(0) items.

\[
\begin{align*}
S & \rightarrow \ aA \\
A & \rightarrow \ a
\end{align*}
\]
c. (5 pts) Given the following (incomplete) sets of LR(0) items and FOLLOW, construct the corresponding entries in the LR(0) Action/Goto parse table.

<table>
<thead>
<tr>
<th>FOLLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
</tbody>
</table>

State 1
[S → • AB ]
[A → • ac ]
[B → • a ]

State 2
[S → A • B ]
[B → • a ]

State 3
[A → a • c ]
[B → a • ]

State 4
[S → AB • ]

State 5
[A → ac • ]

<table>
<thead>
<tr>
<th>State</th>
<th>ACTION</th>
<th>GOTO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>c</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>