CS3311 Homework 10 Due date: Wednesday, November 12, 2014, in class

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The answers must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. Any other source must be specified clearly.

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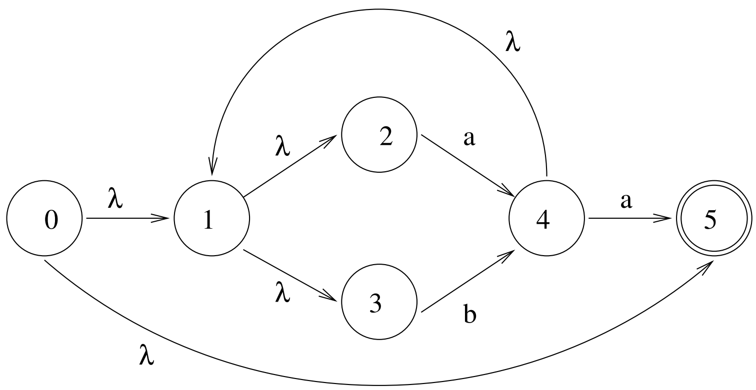
1. *(5+10 points)* Let N be the following NFA-λ:



(a) Give the transition function t for N in tabular form. Include a column for the λ-closure of each state.

(b) Use algorithm 5.6.3 to construct a state diagram of a DFA that is equivalent to N. Give the transition function and draw the state diagram of the equivalent DFA. Remember to mark the accepting states. **Show all your work.**

2. *(10+5 points)* Consider the grammar G from Example 4.5.2:

$S \to AT \mid AB$
$T \to XB$
$X \to AT \mid AB$
$A \to a$
$B \to b$

(a) Give the upper diagonal matrix produced by the CYK algorithm when run with G and the input string $abbb$. **Show all your work.**

(b) Is $abbb \in L(G)$? Why? Provide the reason based on the upper diagonal matrix you constructed.

Please turn the page over for additional questions.

3. *(10+5+10+5+5 points)* Consider the following grammar G. Note that G was obtained by transforming the grammar $S \to aSa \mid bSb \mid a \mid b \mid \lambda$ to Chomsky Normal Form.

$$
\begin{aligned}
&S \to AR \mid BX \mid AA \mid BB \mid a \mid b \mid \lambda\\
&T \to AR \mid BX \mid AA \mid BB \mid a \mid b\\
&R \to TA\\
&X \to TB\\
&A \to a\\
&B \to b
\end{aligned}
$$

(a) Give the upper diagonal matrix produced by the CYK algorithm when run with G and the input string $abba$. **Show all your work.**

(b) Is $abba \in L(G)$? Why? Provide the reason based on the upper diagonal matrix you constructed.

(c) Give the upper diagonal matrix produced by the CYK algorithm when run with G and the input string $abbb$. **Show all your work.**

(d) Is $abbb \in L(G)$? Why? Provide the reason based on the upper diagonal matrix you constructed.

(e) Is $bbb \in L(G)$? Why? Provide the reason based on the upper diagonal matrix you constructed.

4. *(5+5+5 points)* Consider the following grammar G:

$$
\begin{aligned}
&S \to AB \mid CB\\
&A \to aaAbb \mid aaaAbbb \mid Ae \mid e\\
&B \to Bd \mid d\\
&C \to Cee \mid Cff \mid gg
\end{aligned}
$$

(a) Construct a grammar G' that contains no left-recursive rules and is equivalent to G.

(b) Give a leftmost derivation on the string $aaebb\,ee\,ddd$ in grammar G.

(c) Give a leftmost derivation on the string $aaebb\,ee\,ddd$ in grammar G'.

5. *(10+5+5 points)* Consider the following grammar.

$$
\begin{aligned}
&S \to ABab \mid BAba\\
&A \to a \mid c\\
&B \to b \mid c \mid \lambda
\end{aligned}
$$

(a) Draw the graph of the above grammar.

(b) Give the lookahead sets for each variable and rule.

(c) What is the lookahead length needed to deterministically parse strings from this grammar? Explain your answer.