5 Homework

Due: Thursday, February 21, 2013.

Instructions

- Please, review the homework grading policy outlined in the course information page.
- On the *first page* of your solution write-up you *must* make explicit which problems are to be graded for regular credit, which problems are to be graded for extra credit, and which problems you did not attempt. Use a table that looks like this:

Problem	1	2	3	4	5	6	7	8	9	...
Credit	RC	RC	RC	EC	RC	EC	NA	NA	EC	...

  where "RC" denotes "regular credit", "EC" denotes "extra credit", and "NA" denotes "not attempted". Failure to include such a table will result in an arbitrary set of problems being graded for regular credit, no problems being graded for extra credit, and a 5% penalty assessment.
- You must also write down with whom you worked on the assignment. If this varies from problem to problem, write down this information separately with each problem.

Problems

Required: 5 of the following 6 problems
Points: 20 points per problem

1. Do Problem 2.14

   Convert the following CFG into an equivalent CFG in Chomsky normal form, using the procedure given in Theorem 2.9.

   $A \rightarrow BAB|B|\epsilon$

   $B \rightarrow 00|\epsilon$

2. Do Problem 2.26

   Show that if G is a CFG in Chomsky Normal Form, then for any string $w \in L(G)$ of length $n \geq 1$, exactly $2n - 1$ steps are required for any derivation of w.

3. Do the following:

   (a) Do Problem 2.15

   Let A be a CFL that is generated by the CFG $G = (V, \Sigma, R, S)$. Add the new rule $S \rightarrow SS$ and call the resulting grammar G'. This grammar is supposed to generate A^*.

   Give a counterexample to show that this construction fails to prove that the class of context-free languages is closed under the $*$ operation.

   (b) Do Problem 2.20

   Let $A/B = \{w | wx \in A \text{ for some } x \in B\}$. Show that is A is context free and B is regular, then A/B is context free.

4. Do the following:

   (a) Do Problem 2.16

   Show that the class of context-free languages is closed under the regular operations, union, concatenation, and star.

   (b) Do Problem 2.17

   Use the results of exercise 2.16 to give another proof that every regular language is context free, by showing how to convert a regular expression directly to an equivalent context-free grammar.

5. Convert each of the CFGs below to an equivalent PDA, using the procedure given in Theorem 2.20:

   (a) The grammar from the Problem 2.4 (e)

   (b) The grammar from the Problem 2.6 (b)

6. Do the following:

   Problem 2.27: Let $G = (V, \Sigma, R, S)$ be the following grammar:

   $S \rightarrow A|T|E$

   $T \rightarrow$ `if condition then` S

   $E \rightarrow$ `if condition then` S `else` S

   $A \rightarrow$ `a:=1`

   $\Sigma = \{$ `if, condition, then, else, a:=1` $\}$

   $V = \{S, T, E, A\}$

   Note: we used abbreviated names for the variables.

   (a) Show that G is ambiguous.

   (b) Give a new unambiguous grammar for the same language.