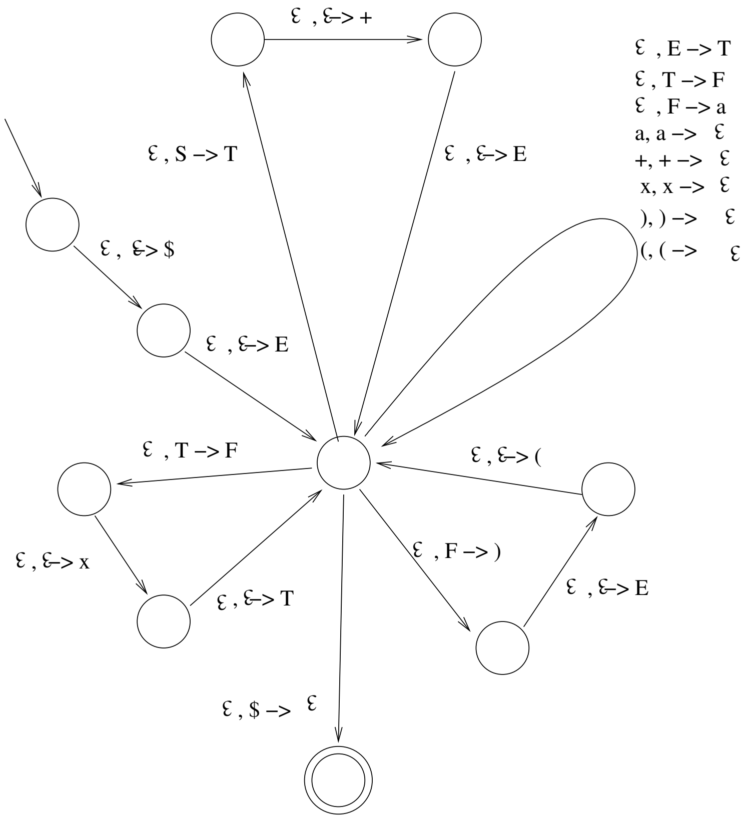
CSci 423 Homework 6

Due: 1:00 pm, Wednesday, 10/24
Eric Shih

1. (10 points) Exercise 2.11 on page 129.



2. (6 point) Problem 2.19 on page 130.
   $L(G)$ accepts all strings except a^ib^i. This means that the complement only accepts this string, thus the CFG for the complement of $L(G)$:

$$S \to aSb|\varepsilon$$

3. (6 points) Problem 2.21 on page 130. (No proof of correctness required)
   The CFG for Σ:

$$S \to aaSb|aSbSa|bSaa|SS|\varepsilon$$

4. (8 points) Problem 2.26 on page 130.
   First, the derivation involves the rules that follow the form $S \implies A_1A_2$. The derivation of w will require $n-1$ uses of this type because a variable will need to be added for the increase in size. Second, the terminals being derived will take the for $S \implies a$. Thus because the n number of derivations from each variable, $2n-1$ steps are required for any derivation of w.

5. (10 points) Problem 2.24 on page 130.
   We use 3 cases to show that E is context free.

   (a) $i < j$
       $S \rightarrow aSb|A$
       $A \rightarrow aA|a$

   (b) $i < j < 2i$
       $S \rightarrow aSb|aSbb|aabbb$

   (c) $2i < j$
       $S \rightarrow aSbb|B$
       $B \rightarrow bB|b$

   All three are CFLs, therefore the union of them is also a CFL.

Reading Summary 3

Context free grammars were originally conceived as a way to describe natural languages. Since then, context free grammars have also been used to define many other concepts within Computer Science. Grammars have been used to describe programming languages, namely, the act of turning a language description from a context free grammar into a parser. Another use of context free grammars can be seen in XML (Extensible Markup Language). Within XML the Document Type Definition is a context free grammar that describes the allowable tags. These tags are familiar keywords from HTML, however these tags do no deal with formatting, but instead describe the meaning of the text.

Regular expressions are how programming languages are structured. However, there are also some aspects of programming languages that cannot be represented using regular expressions. An example of this is the use of parentheses in a nested fashion. Each set of parentheses must be matched correctly, which means that the grammars written must also follow this balance. In this case, CFGs can be used to easily show that a grammar is able to use parentheses, but also have them be balanced. The YACC parser-generator shows how CFGs can be used to parse languages. in this parser-generator, the input into the YACC is a CFG which runs through the machine that eventually generates fragments of C code in response to the parse tree.

In markup languages, tags are the strings that are used to give information about the semantics of various strings within the document. In the case of HTML, its major functions of creating links between documents and describing the format of a document use CFGs to describe and guide the process of a document. Tags always have a beginning form and sometimes have an end form. If there is not an end form, then the tags are usually matched at the end of a paragraph. A CFG can be used to describe not only the syntax of HTML, but it can also be used to show the structure of the language. In more complex markup language, CFGs play a more important role. Document Type Definition is a CFG with its own notation, but the same principles for context-free grammars. It is essentially treated as a grammar that specifies to XML documents. Overall context-free grammars are a very useful application in a wide range of concepts.