Homework #5

1. (5 Points) True or False**:**

a) The grammar, G: E → E + E | E * E | *x* is ambiguous True False

b) L(G) for the G in part a is ambiguous True False

c) A grammar is ambiguous if ∃ w such that w's right-most derivation differs from its left-most derivation True False

d) If r is a regular expression, then L(r) can be generated by a CFG True False

e) The language described by a*b* is context-free True False

2. (10 Points) Given the following grammar, G:

S → S A B | ε
A → 0 S 1 | C D | ε
B → 1 S 0 | ε
C → B C | A C | 0

Is *0 1 1 0* ε L(G)? Justify your answer.
Is *0 0 1 1 0 0* ε L(G)? Justify your answer.

#3. (10 Points) a) Create a grammar that generates the language L = $\{a^{2n}b^{3n} \mid n \geq 0\}$ Also b) construct a parse tree and c) leftmost derivation of *aabbb*. d) Is your grammar ambiguous? Why or why not?

#4. (10 Points) Consider the following DTD (XML grammar) for songs (from http://www.cafeconleche.org/slides/sd2004west/xmlfundamentals/22.html by Rusty Harold):

```
<!ELEMENT SONG (TITLE, COMPOSER+, PRODUCER*, PUBLISHER*,
                LENGTH?, YEAR?, ARTIST+)>

<!ELEMENT TITLE (#PCDATA)>

<!ELEMENT COMPOSER (#PCDATA)>
<!ELEMENT PRODUCER (#PCDATA)>
<!ELEMENT PUBLISHER (#PCDATA)>
<!ELEMENT LENGTH (#PCDATA)>
<!-- This should be a four digit year like "1999",
     not a two-digit year like "99" -->
<!ELEMENT YEAR (#PCDATA)>
```

```
<!ELEMENT ARTIST (#PCDATA)>
```

and the following song:

```
<?xml version="1.0"?>
<!DOCTYPE SONG SYSTEM "song.dtd">
<SONG>
  <TITLE>Hot Cop</TITLE>
  <COMPOSER>Jacques Morali</COMPOSER>
  <COMPOSER>Henri Belolo</COMPOSER>
  <COMPOSER>Victor Willis</COMPOSER>
  <PRODUCER>Jacques Morali</PRODUCER>
  <PUBLISHER>PolyGram Records</PUBLISHER>
  <LENGTH>6:20</LENGTH>
  <YEAR>1978</YEAR>
  <ARTIST>Village People</ARTIST>
</SONG>
```

a) Translate the grammar to a standard CFG. You may consider *#PCData* to be terminals (that can contain any character data).

b) Using your grammar, show a parse tree for the song.

#5. (5 Points) For the grammar G:

$S \rightarrow 0\ S\ 1 \mid 1\ S\ 0 \mid \varepsilon$

What is L(G)?

#6. (10 Points) For the grammar G: $S \rightarrow 0\ S\ 1 \mid \lambda$

a) show that $L(G) \subseteq \{0^n\ 1^n \mid n \geq 0\} = L$ (You need not do a formal induction)

(**Hint 1**: show that for all $w \in L(G)$, $w \in \{0^n\ 1^n \mid n \geq 0\}$ **Hint 2**: $w \in L(G)$ means $S \rightarrow w$)

b) show that $\{0^n\ 1^n \mid n \geq 0\} \subseteq L(G)$ (You need not do a formal induction)

c) show that $L(G) = \{w \mid w = w^R\}$