474 HW 11 problems (highlighted problems are the ones to turn in)

11.12b Note that there are two things to show; **use induction for both:** (a) Every string in *Bal* can be derived from the grammar (easiest to show something more general by induction on the length of the string, and then use that to show this property); (b) every string that can be derived from the grammar is in *Bal* (easiest to show something more general by induction on the length of the derivation and then use that to show this property).

11.11	(#1)
11.12b	(#2) 6+6
11.13a	(#3) 6+6
11.14	(#4) 6
11.15	(#5)
11.17	(#6) 6+3+6
11.18	(#7)
12.1b	(#8) 6
12.1c	(#9) 6
12.1d	(#10) 6

11. In I.3.1, we present a simplified grammar for URIs (Uniform Resource Identifiers), the names that we use to refer to objects on the Web.

a. Using that grammar, show a parse tree for:

`https://www.mystuff.wow/widgets/fradgit#sword`

b. Write a regular expression that is equivalent to the grammar that we present.

12. Prove that each of the following grammars is correct:

a. The grammar, shown in Example 11.3, for the language PalEven.

b. The grammar, shown in Example 11.1, for the language Bal.

13. For each of the following grammars G, show that G is ambiguous. Then find an equivalent grammar that is not ambiguous.

a. $(\{S, A, B, T, \mathrm{a}, \mathrm{c}\}, \{\mathrm{a}, \mathrm{c}\}, R, S)$, where $R = \{S \rightarrow AB, S \rightarrow BA, A \rightarrow \mathrm{a}A, A \rightarrow \mathrm{ac}, B \rightarrow T\mathrm{c}, T \rightarrow \mathrm{a}T, T \rightarrow \mathrm{a}\}$.

14. Let G be any context-free grammar. Show that the number of strings that have a derivation in G of length n or less, for any $n > 0$, is finite.

15. Consider the fragment of a Java grammar that is presented in Example 11.20. How could it be changed to force each `else` clause to be attached to the outermost possible `if` statement?

problem?

17. Consider the grammar G' of Example 11.19.

a. Convert G' to Chomsky normal form.

b. Consider the string `id*id+id`.

i. Show the parse tree that G' produces for it.

ii. Show the parse tree that your Chomsky normal form grammar produces for it.

18. Convert each of the following grammars to Chomsky normal form:

a.
$S \rightarrow \mathrm{a}S\mathrm{a}$
$S \rightarrow B$
$B \rightarrow \mathrm{bb}C$
$B \rightarrow \mathrm{bb}$
$C \rightarrow \varepsilon$
$C \rightarrow \mathrm{c}C$

b.
$S \rightarrow ABC$
$A \rightarrow \mathrm{a}C \mid D$
$B \rightarrow \mathrm{b}B \mid \varepsilon \mid A$
$C \rightarrow A\mathrm{c} \mid \varepsilon \mid C\mathrm{c}$
$D \rightarrow \mathrm{aa}$

c.
$S \rightarrow \mathrm{a}TV\mathrm{a}$
$T \rightarrow \mathrm{a}T\mathrm{a} \mid \mathrm{b}T\mathrm{b} \mid \varepsilon \mid V$
$V \rightarrow \mathrm{c}V\mathrm{c} \mid \varepsilon$

1. Build a PDA to accept each of the following languages L:

a. BalDelim = $\{w$: where w is a string of delimiters: (,), [,], {, }, that are properly balanced$\}$.

b. $\{\mathrm{a}^i\mathrm{b}^j : 2i = 3j + 1\}$.

c. $\{w \in \{\mathrm{a}, \mathrm{b}\}^* : \#_{\mathrm{a}}(w) = 2 \cdot \#_{\mathrm{b}}(w)\}$.

d. $\{\mathrm{a}^n\mathrm{b}^m : m \leq n \leq 2m\}$.

e. $\{w \in \{\mathrm{a}, \mathrm{b}\}^* : w = w^R\}$.

f. $\{\mathrm{a}^i\mathrm{b}^j\mathrm{c}^k : i, j, k \geq 0 \text{ and } (i \neq j \text{ or } j \neq k)\}$.