ECE 573

Problem Set 2: Context free grammars and recursive descent parsers

1. The grammar produces strings of the form: $a^n cdb^n$, where $n \geq 0$.

2. The language cannot be expressed as a regular expression. This is a generalization of languages of the form $a^n b^n$, which, as we showed in the last problem set, is not a regular language.

3. The terminals of this language are: $V_t = \{a, b, c, d\}$, and the non-terminals are $V_n = \{S, X, Y\}$.

4. The derivation of the string "*aacdbb*" proceeds as follows:

$$
\begin{aligned}
S &\Rightarrow X & \text{Production 1} \\
&\Rightarrow aXb & \text{Production 2} \\
&\Rightarrow aaXbb & \text{Production 2} \\
&\Rightarrow aaYbb & \text{Production 3} \\
&\Rightarrow aacdbb & \text{Production 4}
\end{aligned}
$$

The parse tree for the derivation is given below.
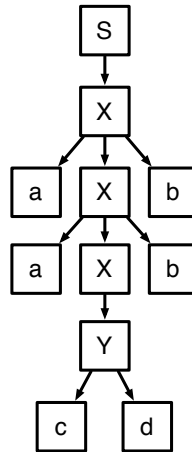
5. Code follows:

```
1 S() { //start here
2     X();
3 }
4
5 X() {
6     token next = peek();
7     if (next == 'a') { //use production 2
```

1

```
 8          match('a');
 9          X();
10          match('b');
11      } else if (next == 'c') { //use production 3
12          Y();
13      } else {
14          error();
15      }
16 }
17
18 Y() {
19     match('c');
20     match('d');
21 }
```