1. Provide brief descriptions (20 words or less) of at least two of the following regular expressions over the alphabet \{a, b\}. Each regular expression performs a simple task. Do not simply rewrite the regular expression in English. Points will be divided equally among the problems you attempt.

(a) \((aa + b)^* + (a + bb)^*\)
(b) \((a + b + \lambda)(a + b + \lambda)(a + b + \lambda)(a + b + \lambda)\)
(c) \(b^* (a + bbb)^* aba (a + bbb)^* b^*\)
(d) \((aa + bb)^* (ab + ba) ((aa + bb)^* (ab + ba)(aa + bb)^* (ab + ba))^* (aa + bb)^*\)

2. (60 pts.) Consider the following CFG in Chomsky normal form:

\[
\begin{align*}
S & \rightarrow CE \\
C & \rightarrow AD \mid AB \\
D & \rightarrow CB \\
E & \rightarrow EE \mid a \mid b \\
A & \rightarrow a \\
B & \rightarrow b
\end{align*}
\]

(a) Show a derivation tree for \(aabbab\).
(b) Provide a string that is ambiguous, i.e., has at least two derivation trees.
(c) Show the values in the \(V\) table of the CYK algorithm for the string \(aabb\). Note: \(S\) cannot derive this string, so \(S\) will not be a member of \(V[1, 4]\).

3. Do Exercise 7.1.4d. Hint: While reading \(a\)'s, push \(a\)'s on the stack. While reading \(b\)'s, pop all the \(a\)'s off the stack. While there are any more \(b\)'s to read, push \(b\)'s on the stack. Finally, while reading \(c\)'s, pop \(b\)'s off the stack. Make sure the stack is empty when you are done. Make sure that at least one \(c\) is read.