**4.1 Give context-free grammars generating the following sets. [ a, c ]**

The set of palindromes (strings that read the same forward as backward) over the alphabet {a,b}.

The set of all strings over alphabet {a,b} with exactly twice as many a´s as b´s.

**4.8 Let G be the grammar. [ a, b, c ]**

S-> aB|bA

A-> a|aS|bAA

B-> b|bS|aBB

for the string aaabbabbba find a

a)leftmost derivation b) rightmost derivation c) parse tree

**a)**

*S-> a[B] -> aa[B]B -> aaa[B]BB -> aaab[B]B -> aaabb[B] -> aaabba[B]B -> aaabbab[B] -> aaabbabb[S] -> aaabbabbb[A] -> aaabbabbba*

**b)**

S -> a[B] -> aaB[B] -> aaBb[S] -> aaBbb[A] -> aa[B]bba -> aaaB[B]bba -> aaaBb[S]bba -> aaaBbaBbba -> aaa[B]babbba -> aaabbabbba

**c)**