This homework will be collected in class on 20 September.

1. (4.8 in text) Let \( G \) be the grammar

\[
S \rightarrow aB \mid bA \\
A \rightarrow a \mid aS \mid bAA \\
B \rightarrow b \mid bS \mid aBB
\]

For the string \( aaabbaabba \) find,

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

2. (*4.9) Is the grammar \( G \) above unambiguous?

Justify your answer. A justification requires a proof (by induction on the length of the words).

3. Give an example of an ambiguous CFG.

4. Prove, or disprove, that the language

\[
L = (0 + 1)^* - \{ww^T \mid w \in (0 + 1)^*\}
\]

is a CFL. Here \( w^T = w_nw_{n-1} \cdots w_1 \), if \( w = w_1w_2 \cdots w_n \).

\( L \) is the complement of the set of even-length palindromes.

5. Prove that the language

\[
L = \{w \mid w \text{ is a prime number in binary representation}\}
\]

is not a CFL.

(Hint: Use Pumping Lemma – the proof is very similar to Example 3.2 in H&U, 1st edition.)