Preparation Activity PA07 – Context-Free Grammars (CFGs)

1. Present a CFG for each of the following languages:
   a) $L = \{a^n b^m a^n \mid n \geq 0 \wedge m \geq 0\}$
   b) $L = \{c^k a^n b^m a^n \mid n \geq 0 \wedge m \geq 0 \wedge k \geq 0\}$
   c) $L = \{w \in \{a,b\}^* \mid n_a(w) \neq n_b(w)\}$
      Note: $n_b(w)$ represents the number of *b* symbols in w, and $n_a(w)$ represents the number of *a* symbols in w
   d) $L = \{a^n b^m c^k \mid k = n + m\}$
   e) $L = \{a^n b^m c^k \mid k = n + 2m\}$
2. For the CFG given in 1a) for $L = \{a^n b^m a^n \mid n \geq 0 \wedge m \geq 0\}$:
   a) Show the formal definition using the tuple representing the CFG
   b) Show the leftmost derivations to accept the string: aabaa
   c) Show the syntax tree for the string: aabaa