Preparation Activity PA07 – Context-Free Grammars (CFGs)

1. Consider the CFG G1 of the lecture:

   E → I | E+E | E×E | (E)

   I → a | b | Ia | Ib | I0 | I1

   a) Why is this CFG ambiguous?
   b) Show a sequence of leftmost derivations and the resulting syntax tree when the input string is ((a)+(a×b))
2. In order to remove the ambiguity of G1 we must modify it, but we need to propose a modified CFG representing the same language of G1. Trying to remove the ambiguity, members of a team proposed different modified CFGs:
   a) One proposed the CFG G2 below. Is G2 ambiguous? Does G2 represent the same language of G1?

      E → I | E+I | E×I | (E)

      I → a | b | Ia | Ib | I0 | I1
   b) Another one proposed the CFG G3 below. Is G3 ambiguous? Does G3 represent the language of G1?

      E → F | E+F | E×F

      F → I | (E)

      I → a | b | Ia | Ib | I0 | I1
   c) Another one proposed the CFG G4 below. G4 is not ambiguous but seems to have a problem as it extends the language of G1. Indicate the problem.

      E → J | E×J

      J → I | J+I

      I → a | b | Ia | Ib | I0 | I1 | (E)
   d) Another one proposed the CFG G5 below. Besides the fact that G5 is not ambiguous and represent the same language of G1, it also respects the priority of the operators (considering that the input strings represent arithmetic expressions, where the symbol + identifies the addition and the symbol × identifies the multiplication). Explain why.

      E → T | E+T

      T → F | T×F

      F → I | (E)

      I → a | b | Ia | Ib | I0 | I1