Ex. 1

The two following grammars engender a subset of arithmetic expressions (for instance $1 + 3 \times 7$). What is the difference between the two?

$$E \to E + E \mid E \times E \qquad\qquad E \to E + T \mid T$$
$$E \to 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9 \qquad\qquad T \to T \times F \mid F$$
$$F \to 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$$

Propose 3 new grammars, taking inspiration from those two grammars:

1. One that engenders the same language but yields a structural decomposition that gives priority to addition over multiplication;
2. One that engenders a sub-language of the previous one: namely only arithmetic expressions completely parenthesized (expressions where there is a pair of parenthesis for each binary operator);
3. One that engenders postfix arithmeric expressions (reversed Polish notation, where $7 \times 2 + 3$ is written $7\ 2 \times 3+$).

Ex. 2

Let's consider the sentence (1), which is well-know for its being syntactically ambiguous.

(1) Sam saw a girl with his telescope.

1. Show the syntactic ambiguity by providing two distinct syntactic tree for the sentence (to avoid dealing with a lexicon, we can consider lexical categories (N, Det, Prep, V...) as terminal symbols).
2. Give an ambiguous CFG grammar capable of generating the two possible syntactic analyses.
3. Give a CFG in which the ambiguity is removed by assuming a systematic low attachment strategy, accoding to which prepositional phrases will get attached to the closest noun.