Test 2 for CS 3350 Automata, Fall 2024

1–4. Let us consider the grammar with the starting variable F and rules $F \to pN$, $N \to kN$, and $N \to \varepsilon$. The word pkk is generated by this grammar as $\underline{F} \to p\underline{N} \to pk\underline{N} \to pkk\underline{N} \to pkk$.

1. Show how the word pkk will be represented as $uvxyz$ according to the Pumping Lemma for context-free grammars.

2. Use a general algorithm to construct a (non-deterministic) pushdown automaton that corresponds to this grammar.

3. Show, step by step, how the word pkk will be accepted by this automaton.

4. Transform this grammar into Chomsky normal form.

5. Give an example of an ambiguous grammar and explain, on an example, why this grammar is ambiguous, why this is not good for compiling.

6. Show, step by step:

1. how the stack-based algorithm will transform the expression $(2-0)\cdot(2-4)$ into a postfix expression, and then

2. how a second stack-based algorithm will compute the value of this expression (use integer operations in Java).

(Turn over, please)

7–8. Let us consider the following pushdown automaton:
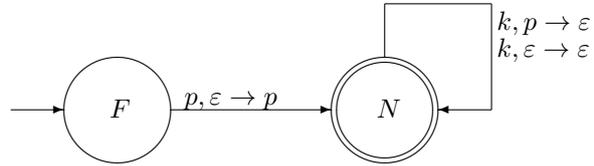
This pushdown automaton accepts the word pkk as follows:

	p	k	k
F	N	N	N
	p		

Use the general algorithm to show how this word will be generated in the corresponding context-free grammar.

9-10. In the old days, farmers would eat, at breakfast (B), twice more calories than at lunch (L), and at lunch, twice more calories than at dinner (D). For example, the sequence $BBBBLLD$ would fit this pattern, as well as the sequence $BBBBBBBBLLLLDD$. Prove that the language S of all such sequences is not context-free.