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FORMAL LANGUAGES AND GRAMMARS

ZAD. 1. Specify the elements that comprise a full formal definition of a grammar G of some language L:
a) ....(T),
b) ....(N),
c) ....(S),
d) ....(P).

ZAD. 2. Let's consider a language described by a regular expression 1+ = {1,11,111,...} and grammar {1;S;S;S->1,S->S1} defined for that language. Explain the functions of the elements of the grammar's definition:
1 - ....,
S - ....,
S - ....,
S->1,S->S1 - ....

ZAD. 3. Finish the definition by choosing correct answers. "A predicate is a finite non-empty sequence of words. The words comprising a predicate may consist of …" :
a)   Nonterminal symbols (e.g.: ...->SS->...),
b)   Terminal symbols (e.g.: ...->11->...),
c)   Both terminal and nonterminal symbols (e.g.: ...->S1->...).

ZAD. 4. Finish the definition by choosing correct answers. "A sentence is a finite non-emptysequence of words. The words comprising a predicate may consist of …":
a)   Nonterminal symbols (e.g.: ...->SS),
b)   Terminal symbols (e.g.: ...->11),
c)   Both terminal and nonterminal symbols (e.g.: ...->S1).

ZAD. 5. Choose correct answers:
a)   Initial form of sentence derivation process is a predicate,
b)   Final form of sentence derivation is a start symbol,
c)   Transitory forms of sentence derivation are sentences,
d)   Final form of sentence derivation is a sentence,
e)   Initial form of sentence derivation is a start symbol,
f)   Transitory forms of sentence derivation are predicates,
g)   Sentence derivation process starts from an start symbol, which is transformed (by means of productions) into successive predicates until a sentence to be derived is obtained,
h)   Sentence derivation process starts from a sentence to be derived, which is transformed into successive sentences until a start symbol of the grammar is obtained,
i)   Each sentence is a predicate, but not vice versa,
j)   Start symbol is not a predicate.

(*) gwiazdką oznaczone są zadania, które nie są realizowane na ćwiczeniach i są przeznaczone do wykonania jako zadania domowe.

ZAD. 6. Verification of correctness of a grammar describing a language is done by .... of correct and incorrect sentences.

ZAD. 7. Let's consider two linear grammars defined below. Which one is **left-recursive**? What is characteristic about both of them?

$$S \rightarrow A\ B \qquad\qquad S \rightarrow A\ B$$
$$A \rightarrow A\ a \qquad\qquad A \rightarrow a\ A$$
$$A \rightarrow a \qquad\qquad A \rightarrow a$$
$$B \rightarrow B\ b \qquad\qquad B \rightarrow b\ B$$
$$B \rightarrow b \qquad\qquad B \rightarrow b$$

....

For each .... there exist left-recursive and right-recursive grammars which describe the same language.

ZAD. 8. Let's consider two linear grammars defined below. Choose which one is **context-free** and which is a **context grammar**? How do they differ?

$$W \rightarrow S \qquad\qquad\qquad S \rightarrow a\ X\ Y$$
$$W \rightarrow W + S \qquad\qquad S \rightarrow a\ S\ X\ Y$$
$$S \rightarrow C \qquad\qquad\qquad a\ X \rightarrow a\ b$$
$$S \rightarrow S * C \qquad\qquad b\ X \rightarrow b\ b$$
$$C \rightarrow L \qquad\qquad\qquad c\ X \rightarrow c\ c$$
$$C \rightarrow (\ W\ ) \qquad\qquad b\ Y \rightarrow b\ c$$
$$L \rightarrow 1 \qquad\qquad\qquad c\ Y \rightarrow c\ c$$
$$L \rightarrow 2$$

....

(*) For each task **9** to **13** check your answers by analyzing the implemented grammars by Lex and Yacc tools.

ZAD. 9(*). Propose a grammar for a language described by regular expression $1^n 2^m 1^+ 2^m 1^n$, where m,n>0. Derive the following sentences:
a) 112221122211 – ....,
b) 1211 - ....,
c) 1212 - ....,
d) 1221221 - ....

ZAD. 10. Propose a grammar for a language described by regular expression 1+2*1+ and derive the following sentences:
a) 111221 – ....,
b) 221 - ....,
c) 122 - ....,
d) 122111 - ....

ZAD. 11. Propose a grammar for a language described by regular expression $a^n b + c + a^n$, where n>0 and derive the following sentences:
a) aabcaa – ....,
b) aabca - ....,
c) aaabaaa - ....,
d) aaabbcccaaa - ....

(*) gwiazdką oznaczone są zadania, które nie są realizowane na ćwiczeniach i są przeznaczone do wykonania jako zadania domowe.

ZAD. 12. Propose a grammar for a language described by regular expression $a^n b^{n+m} a^m$, where n,m>0 and derive the following sentences:

a)   aabbbbbaaa – ....,

b)   abbba - ....,

c)   aaaa - ....,

d)   aaabbbba - ....

ZAD. 13(*). Propose a grammar for a language described by regular expression $a^n b^* a^n$, where n>0 and derive the following sentences:

a)   aabbbbaa – ....,

b)   abbba - ....,

c)   aaaa - ....,

d)   aaabbbbbbaaa - ....

ZAD. 14. Backus-Naur Form (BNF) is another notation for ...., so a way of describing ....

BNF is a set of .... of the following structure:

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<symbol> ::= <expression containing symbols>
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ZAD. 15. Using the extended Backus-Naur Form (EBNF) describe the syntax of polish mail address:

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ZAD. 16(*). Using the extended Backus-Naur Form (EBNF) define EBNF notation.

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