
CSC 344 First BNF Problem Set Solution

Learning Abstract: This assignment contains multiple exercises pertaining to BNF grammar, which is defined in the first task. These exercises include writing BNF grammars based on given information, which might be given through simple text or a program, as well as creating parse trees for these grammars.

First Task: BNF?

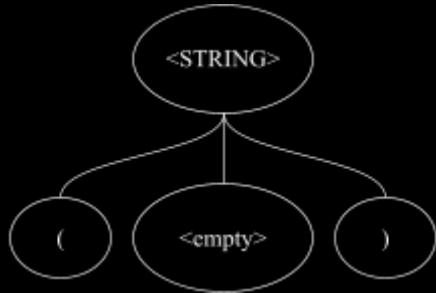
BNF, otherwise known as Backus-Naur form, is a way of notating context-free grammars. It consists of a start symbol, productions, nonterminals, and tokens. The start symbol is exactly what it says it is, your grammar begins with this symbol. Nonterminals are symbols that refer to any number of tokens associated with them, and productions are the list of these nonterminal to token transformations. Using these things, BNF can be used to represent any sort of language or grammar.

Second Task: BNF Description of L1

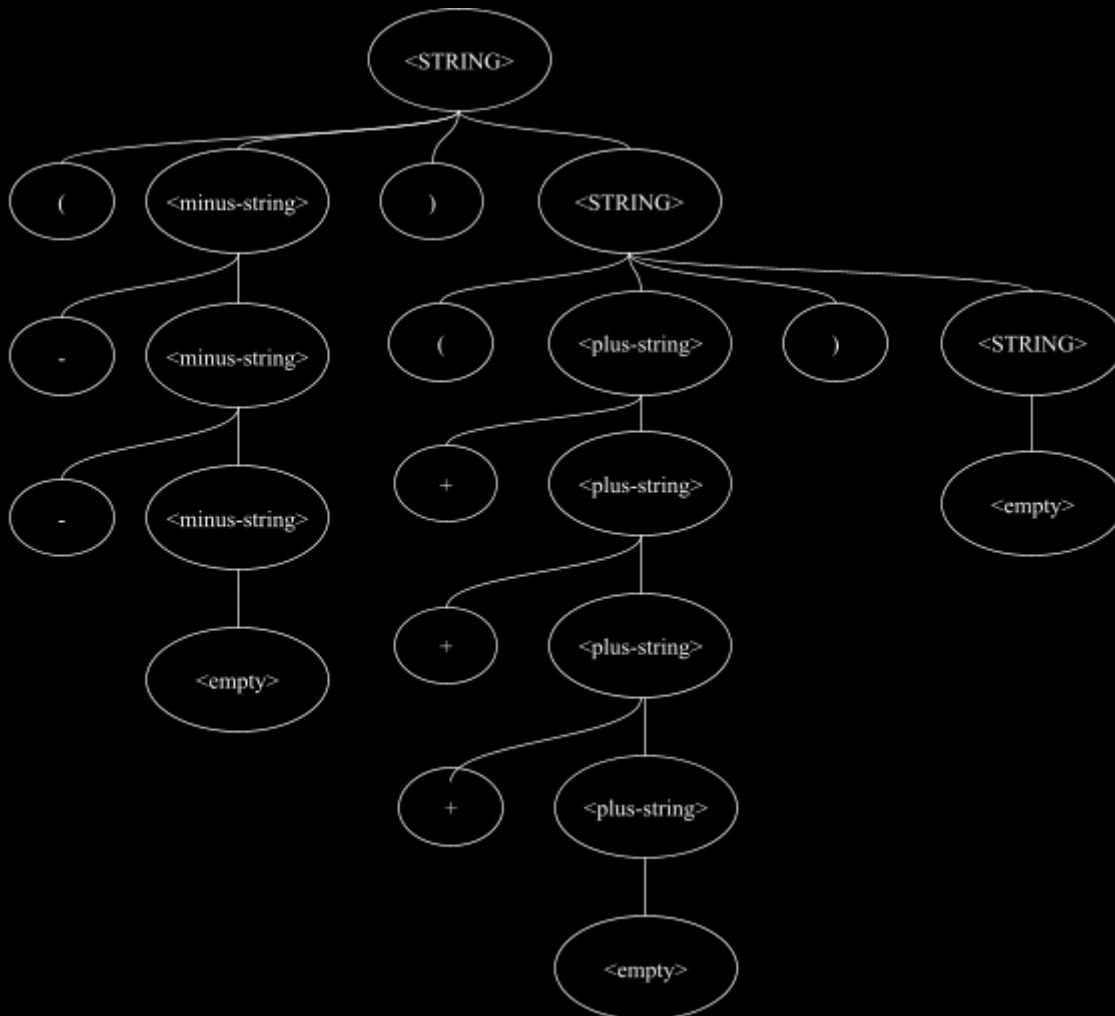
$$\begin{aligned} \langle \text{STRING} \rangle & ::= (\langle \text{plus-string} \rangle) \langle \text{STRING} \rangle \mid (\langle \text{minus-string} \rangle) \langle \text{STRING} \rangle \mid \\ & \quad (\langle \text{empty} \rangle) \langle \text{STRING} \rangle \mid \langle \text{empty} \rangle \\ \langle \text{plus-string} \rangle & ::= + \langle \text{plus-string} \rangle \mid \langle \text{empty} \rangle \\ \langle \text{minus-string} \rangle & ::= - \langle \text{minus-string} \rangle \mid \langle \text{empty} \rangle \end{aligned}$$

Third Task: Parse Trees for L1

1. ()



2. (--)(+++)



Fourth Task: BNF Description of L2

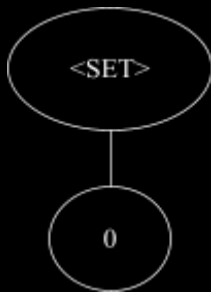
$\langle \text{SET} \rangle ::= \langle \text{nonzero-num} \rangle \langle \text{num-sequence} \rangle \mid 0$

$\langle \text{nonzero-num} \rangle ::= 1 \mid 2 \mid 3$

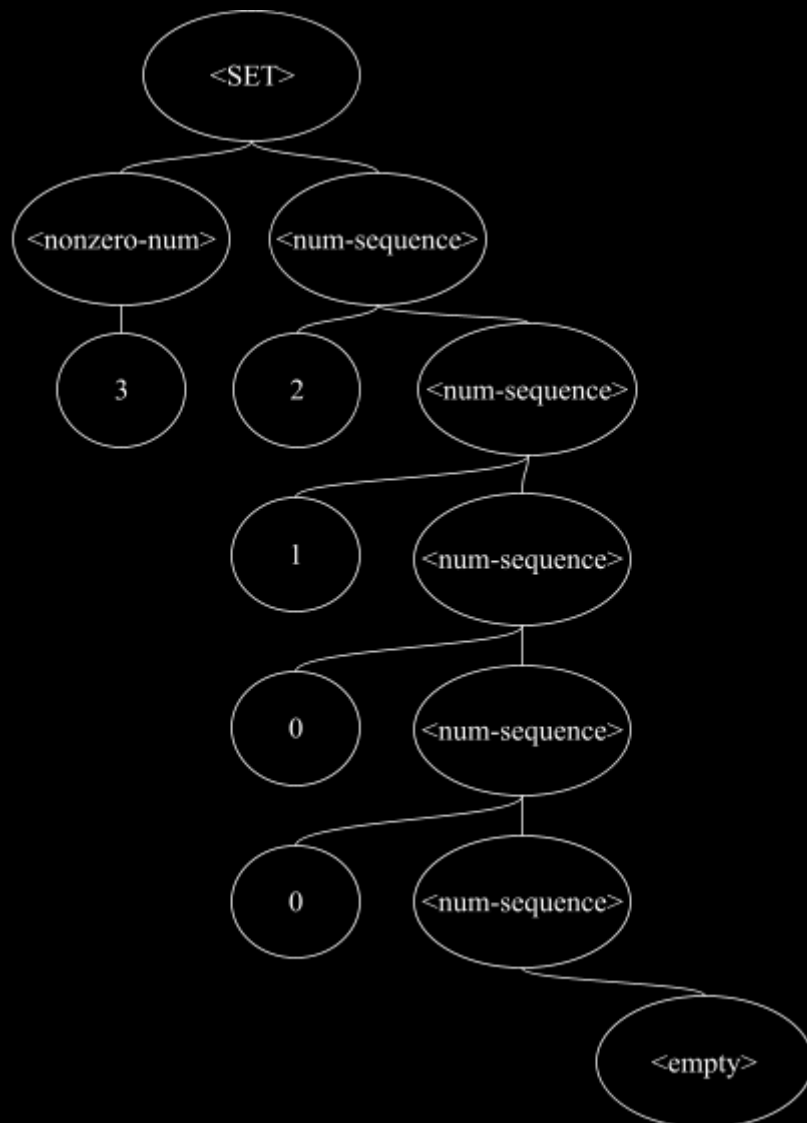
$\langle \text{num-sequence} \rangle ::= 0 \langle \text{num-sequence} \rangle \mid 1 \langle \text{num-sequence} \rangle \mid 2 \langle \text{num-sequence} \rangle \mid 3 \langle \text{num-sequence} \rangle \mid \langle \text{empty} \rangle$

Fifth Task: Parse Trees for L2

1. 0



2. 32100



Sixth Task: BNF Description of L3

$\langle \text{STATEMENT} \rangle ::= (\langle \text{and} \rangle) \langle \text{STATEMENT} \rangle \mid (\langle \text{or} \rangle) \langle \text{STATEMENT} \rangle \mid$
 $(\langle \text{not} \rangle) \langle \text{STATEMENT} \rangle \mid \#f \mid \#t \mid \langle \text{empty} \rangle$

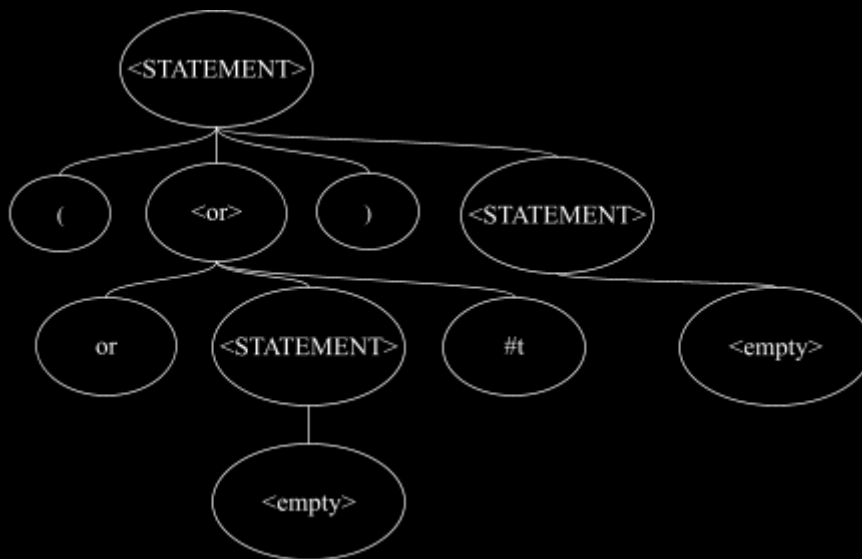
$\langle \text{and} \rangle ::= \text{and} \langle \text{STATEMENT} \rangle \#f \mid \text{and} \langle \text{STATEMENT} \rangle \#t$

$\langle \text{or} \rangle ::= \text{or} \langle \text{STATEMENT} \rangle \#f \mid \text{or} \langle \text{STATEMENT} \rangle \#t$

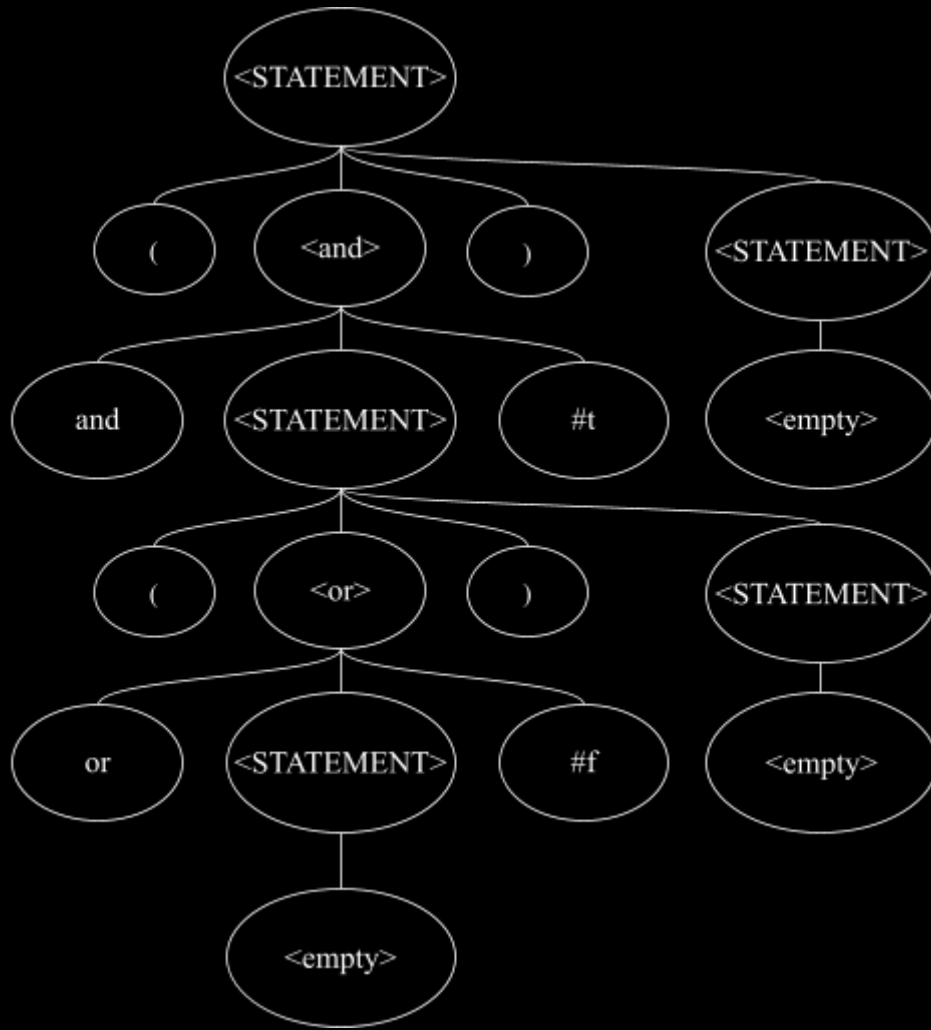
$\langle \text{not} \rangle ::= \text{not} \langle \text{STATEMENT} \rangle \#f \mid \text{not} \langle \text{STATEMENT} \rangle \#t$

Seventh Task: Parse Trees for L3

1. (or #t)



2. (and(not #t)#f)



Eighth Task: BNF Description of L4

<NUMBER> ::= <null> | <single> | <double> | <triple>

<null> ::= zero

<single> ::= one | two | three | four | five | six | seven | eight | nine | <empty>

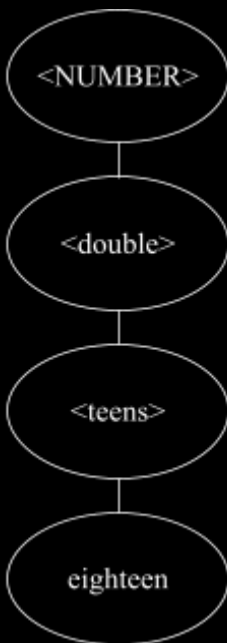
<double> ::= <teens> | twenty <single> | thirty <single> | forty <single> |
fifty <single> | sixty <single> | seventy <single> | eighty <single>
ninety <single> | <empty>

<teens> ::= eleven | twelve | thirteen | fourteen | fifteen | sixteen | seventeen |
eighteen | nineteen

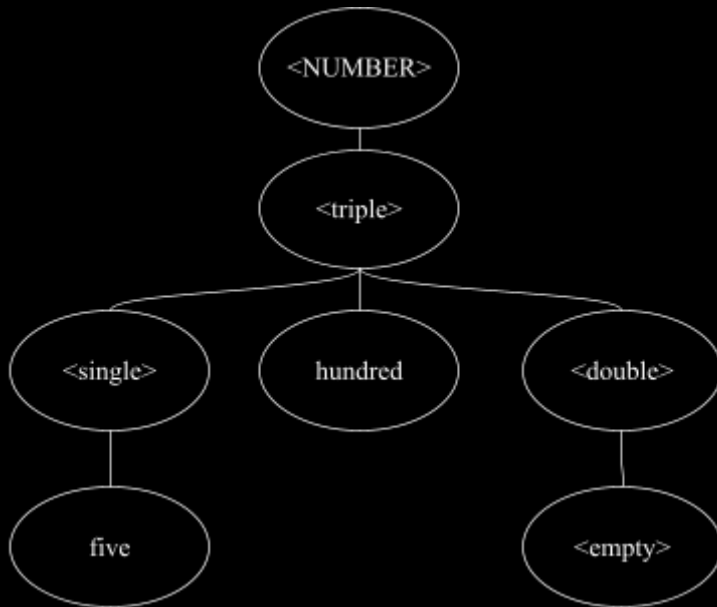
<triple> ::= <single> hundred <double> | <single> hundred <single>

Ninth Task: Parse Trees for L4

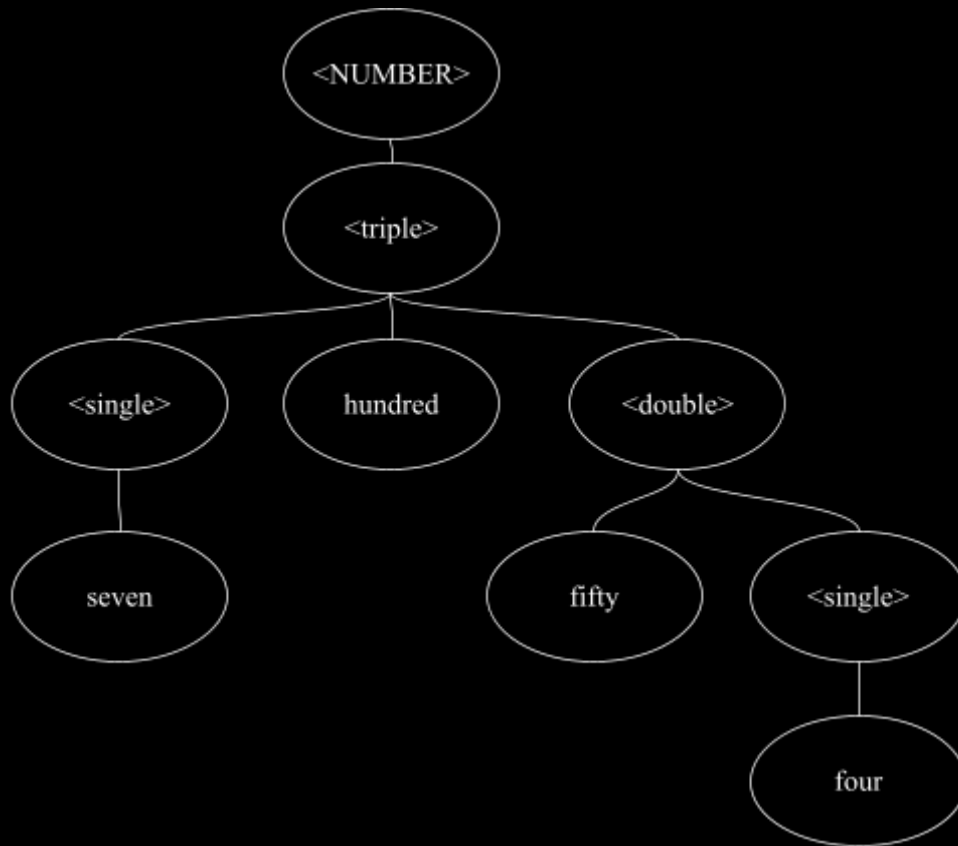
1. eighteen



2. five hundred



3. seven hundred fifty four



Tenth Task: BNF Description of L5

$\langle \text{COLOR} \rangle ::= \langle \text{add} \rangle \mid \langle \text{show} \rangle \mid \langle \text{describe} \rangle \mid \text{colors} \mid \text{exit}$

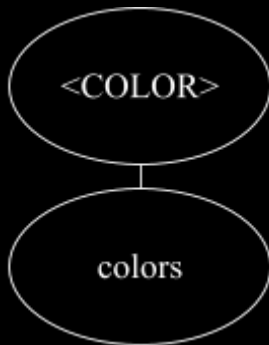
$\langle \text{add} \rangle ::= \text{add} (\langle \text{rgb} \rangle) \langle \text{name} \rangle \mid \text{add} (\langle \text{rgbo} \rangle) \langle \text{name} \rangle \mid \text{add color} \langle \text{name} \rangle$

$\langle \text{show} \rangle ::= \text{show} \langle \text{name} \rangle$

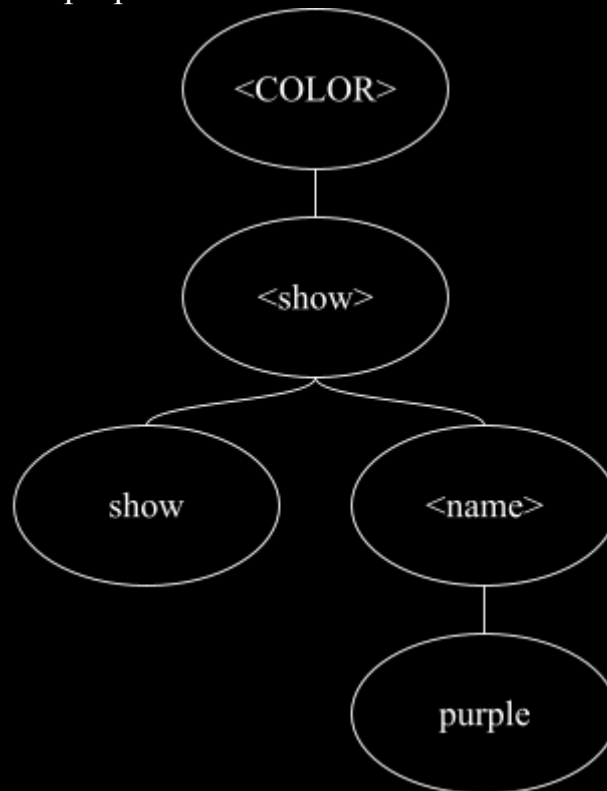
$\langle \text{describe} \rangle ::= \text{describe} \langle \text{name} \rangle$

Eleventh Task: Parse Trees for L5

1. colors



2. show purple



3 add (100 220 170) c28

