

First Problem Set: BNF

Learning Abstract:

In this assignment I interpreted different languages, both in english and in Racket, and translated them into BNF grammars which were used to create parse trees for the given sequences below. This assignment allowed me to practice creating BNF grammars for more complex languages, as well as spend time developing parse trees to go along with these grammars.

Task 1 - What is BNF?

BNF, or Backus-Naur form, is a way to define languages and their syntax using nonterminal symbols, tokens, productions, and a start symbol. The start symbol, which is considered a nonterminal symbol, contains all other nonterminal symbols that are used to aid in defining the language. The tokens are the actual entities that make up the language, and the productions are rules where nonterminals and tokens are combined in a way that defines a specific language. BNF is so significant because it can define any number of languages in a way that can be easily interpreted.

Task 2 - BNF Description of L1

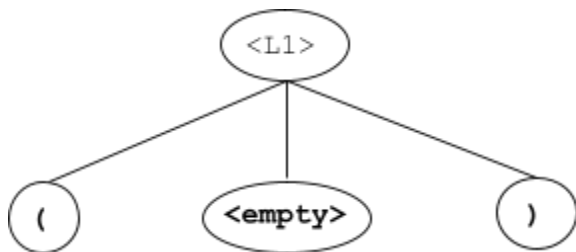
$\langle L1 \rangle ::= (\langle \text{plus-string} \rangle) \langle L1 \rangle \mid (\langle \text{minus-string} \rangle) \langle L1 \rangle \mid (\langle \text{empty} \rangle) \langle L1 \rangle \mid (\langle \text{empty} \rangle)$
 $\mid \langle \text{empty} \rangle$

$\langle \text{plus-string} \rangle ::= + \langle \text{plus-string} \rangle \mid +$

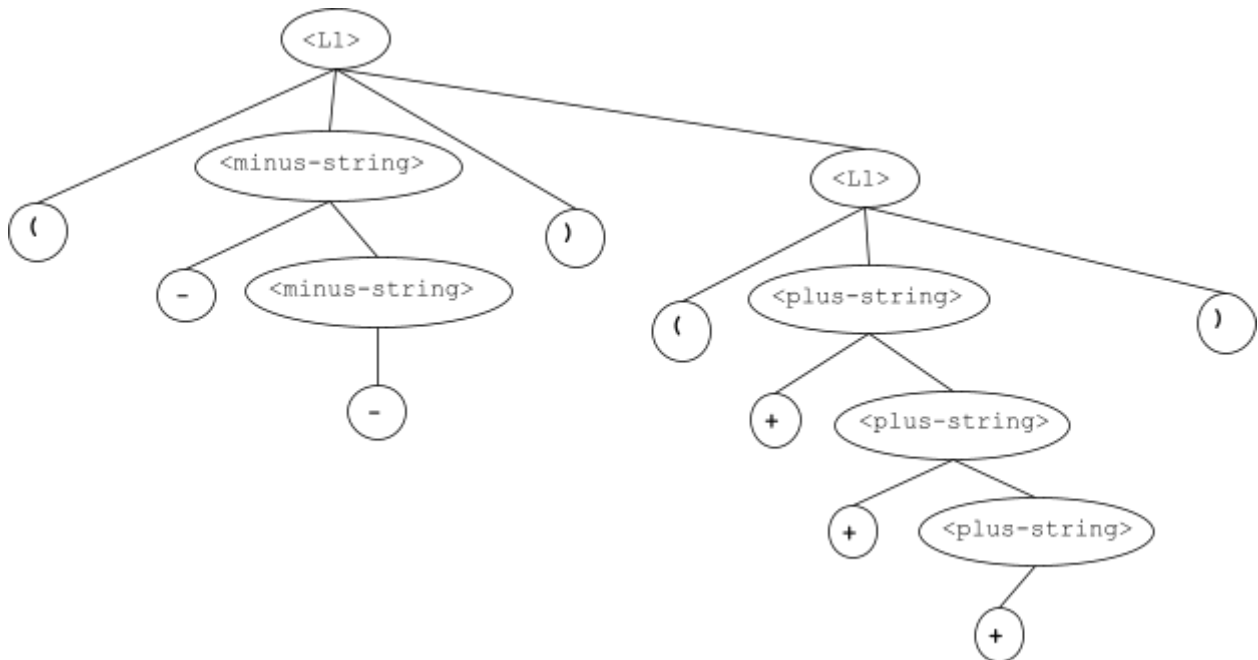
$\langle \text{minus-string} \rangle ::= - \langle \text{minus-string} \rangle \mid -$

Task 3 - Parse Trees for L1

1. ()



2. (- -)(+ + +)



Task 4 - BNF Description of L2

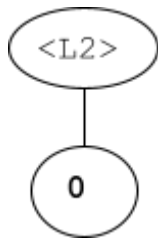
$\langle L2 \rangle ::= \langle \text{first-num} \rangle \langle \text{nums} \rangle \mid 0$

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

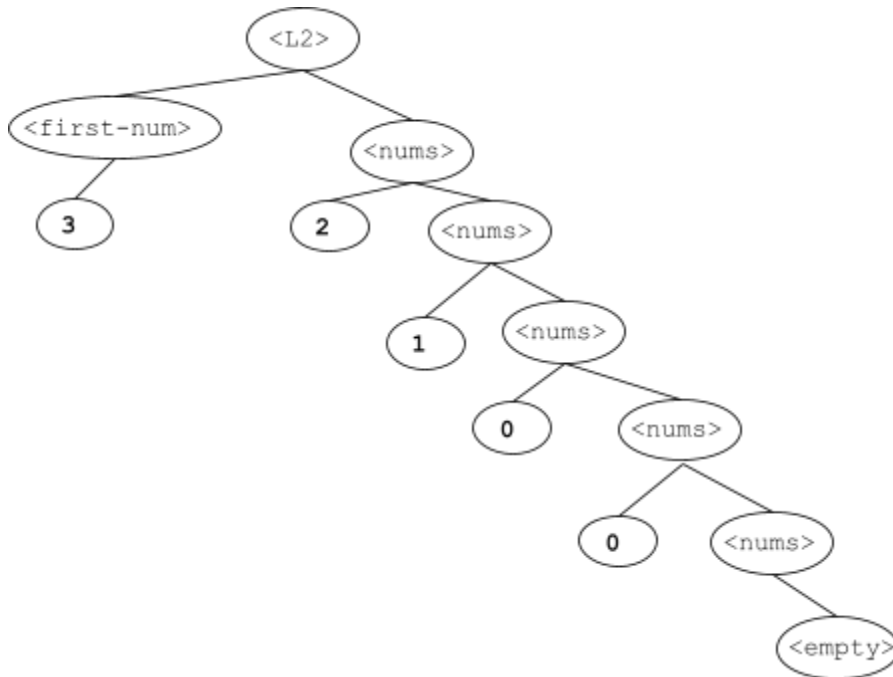
$\langle \text{nums} \rangle ::= 0 \langle \text{nums} \rangle \mid 1 \langle \text{nums} \rangle \mid 2 \langle \text{nums} \rangle \mid 3 \langle \text{nums} \rangle \mid \langle \text{empty} \rangle$

Task 5 - Parse Trees for L2

1. 0



2. 32100



Task 6 - BNF Description of L3

$\langle L3 \rangle ::= (\langle \text{and} \rangle \langle L3 \rangle) | (\langle \text{or} \rangle \langle L3 \rangle) | (\langle \text{not} \rangle \langle L3 \rangle) | \#t | \#f | \langle \text{tf} \rangle | \langle \text{empty} \rangle$

$\langle \text{and} \rangle ::= \text{and} \langle L3 \rangle$

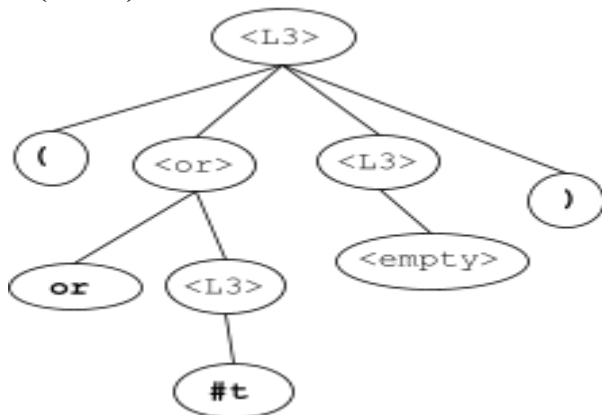
$\langle \text{or} \rangle ::= \text{or} \langle L3 \rangle$

$\langle \text{not} \rangle ::= \text{not} \langle L3 \rangle$

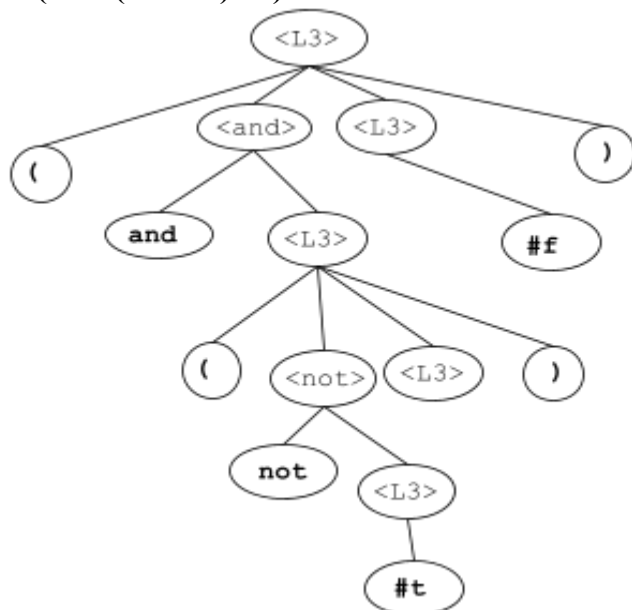
$\langle \text{tf} \rangle ::= \#t \langle L3 \rangle | \#f \langle L3 \rangle$

Task 7 - Parse Trees for L3

1. (or #t)



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



Task 8 - BNF Description of L4

$\langle L4 \rangle ::= \langle ones \rangle \mid \langle tens \rangle \mid \langle hundreds \rangle \mid zero$

$\langle ones \rangle ::= one \mid two \mid three \mid four \mid five \mid six \mid seven \mid eight \mid nine \mid \langle empty \rangle$

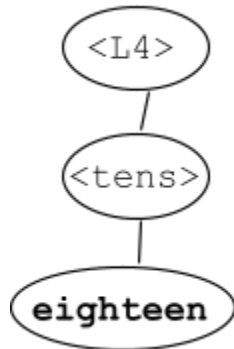
$\langle tens \rangle ::= ten \mid eleven \mid twelve \mid thirteen \mid fourteen \mid fifteen \mid sixteen \mid seventeen \mid eighteen \mid nineteen \mid twenty \mid twenty \langle ones \rangle \mid thirty \langle ones \rangle \mid forty \langle ones \rangle \mid fifty \langle ones \rangle \mid$

$sixty \langle ones \rangle \mid seventy \langle ones \rangle \mid eighty \langle ones \rangle \mid ninety \langle ones \rangle \mid \langle empty \rangle$

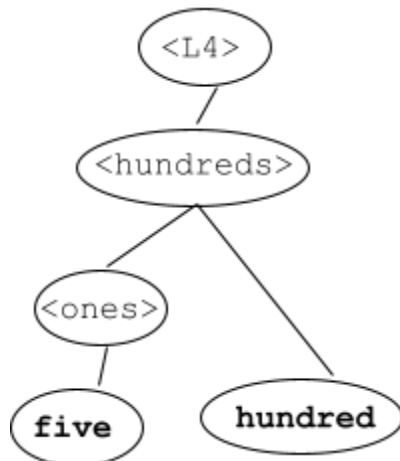
$\langle hundreds \rangle ::= \langle ones \rangle hundred \mid \langle ones \rangle hundred \langle ones \rangle \mid \langle ones \rangle hundred \langle tens \rangle$

Task 9 - Parse Trees for L4

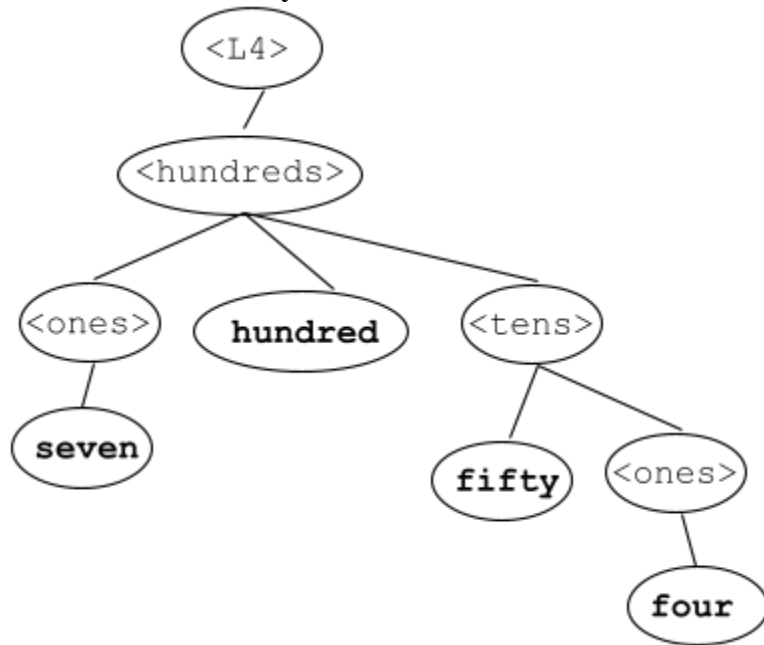
1. eighteen



2. five hundred



3. seven hundred fifty four



Task 10 - BNF Description of L5

$\langle L5 \rangle ::= \langle add \rangle \mid \langle show \rangle \mid \langle describe \rangle \mid \text{colors} \mid \text{exit}$

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

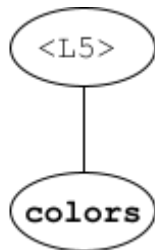
$\langle op\text{-value} \rangle) \langle color \rangle \mid \text{add color} \langle color \rangle$

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

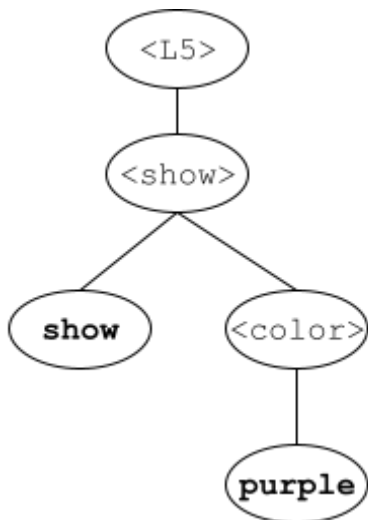
$\langle describe \rangle ::= \text{describe} \langle color \rangle$

Task 11 - Parse Trees for L5

1. colors



2. show purple



3. add (100 220 170) c28

