
First Problem Set: BNF

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Task 1 - BNF?

BNF is a useful to express and organize how the structure of a grammar is going. It is one of great way to visualize the functions in parse tree using by BNF description. It helps people to understand the syntax and semantics of programming language.

Task 2 - BNF Description of L1

P-P: Parenthesized Plus String M-P: Parenthesized Minus String

$\langle L1 \rangle ::= \langle P-P \rangle \langle L1 \rangle | \langle M-P \rangle \langle L1 \rangle | \langle \text{empty} \rangle$

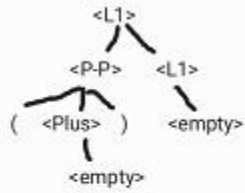
$\langle P-P \rangle ::= (\langle \text{Plus} \rangle)$

$\langle M-P \rangle ::= (\langle \text{Minus} \rangle)$

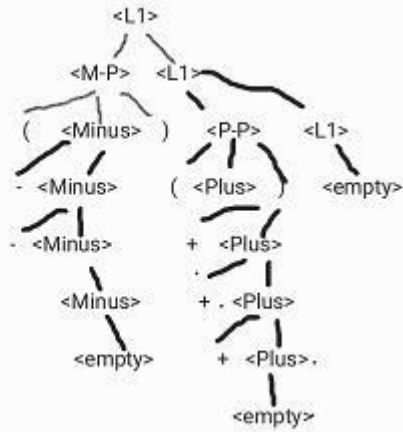
$\langle \text{Plus} \rangle ::= + \langle \text{Plus} \rangle | \langle \text{empty} \rangle$

$\langle \text{Minus} \rangle ::= - \langle \text{Minus} \rangle | \langle \text{empty} \rangle$

Task 3 - Parse Trees for L1



1.



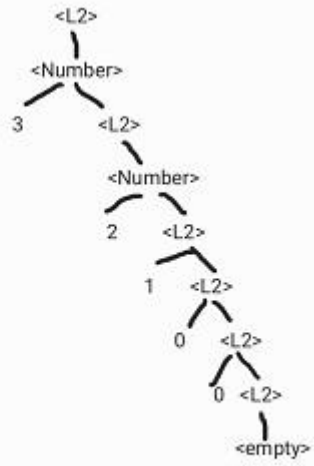
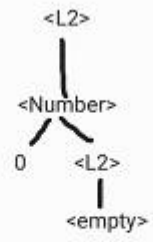
2.

Task 4 - BNF Description of L2

`<L2> ::= <Number> | <empty>`

`<Number> ::= 0 <L2> | 1 <L2> | 2 <L2> | 3 <L2>`

Task 5 - Parse Trees for L2



1.

2.

Task 6 - BNF Description of L3

$\langle L3 \rangle ::= \langle \text{and} \rangle \mid \langle \text{or} \rangle \mid \langle \text{not} \rangle \mid \langle \text{empty} \rangle \mid \#t \langle L3 \rangle \mid \#f \langle L3 \rangle$

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

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

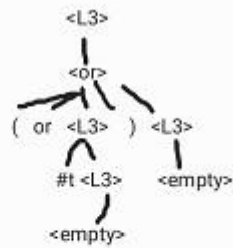
$\langle \text{not} \rangle ::= (\text{ not } \langle L3 \rangle) \langle L3 \rangle$

Write a BNF grammar for this language.

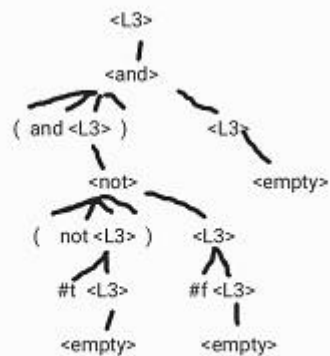
Task 7 - Parse Trees for L3

Draw a parse tree for each of the following sentences in the L3 language.

1.



2.



Task 8 - BNF Description of L4

$\langle L4 \rangle ::= \langle \text{hundreds} \rangle \langle L4 \rangle | \langle \text{tens} \rangle \langle L4 \rangle | \langle \text{teens} \rangle \langle L4 \rangle | \langle \text{ones} \rangle \langle L4 \rangle | \text{zero} | \langle \text{empty} \rangle$

$\langle \text{hundreds} \rangle ::= \langle \text{ones} \rangle \text{hundred} \langle L4 \rangle$

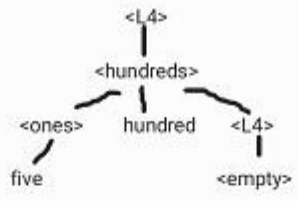
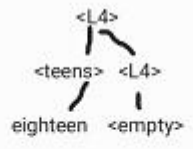
$\langle \text{tens} \rangle ::= \text{twenty} | \text{thirty} | \text{forty} | \text{fifty} | \text{sixty} | \text{seventy} | \text{eighty} | \text{ninety}$

$\langle \text{teens} \rangle ::= \text{ten} | \text{eleven} | \text{twelve} | \text{thirteen} | \text{fourteen} | \text{fifteen} | \text{sixteen} | \text{seventeen} | \text{eighteen} | \text{nineteen}$

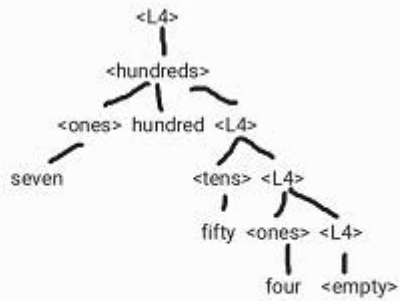
$\langle \text{ones} \rangle ::= \text{one} | \text{two} | \text{three} | \text{four} | \text{five} | \text{six} | \text{seven} | \text{eight} | \text{nine}$

Task 9 - Parse Trees for L4

Draw a parse tree for each of the following sentences in the L4 language.



1.



Task 10 - BNF Description of L5

```

<L5> ::= <add>|<describe>|<show>|<colors>|<exit>
<add> ::= add color<color_name>|add<color_num> <color_name>
<describe> ::= describe <color_name>
<show> ::= show <color_name>
<colors> ::= colors
<exit> ::= exit
<color_name> ::= <c_number>|<real_color>
<c_number> ::= c1|c2|c3|c4|...
<real_color> ::= red|blue|green|light-red|purple|...
<color_num> ::= (<N><N><N>)|(<N><N><N><N>)
<N> ::= 1|2|3|4|...|253|254|255
  
```

Task 11 - Parse Trees for L5

Draw a parse tree for each of the following L5 sentences.

