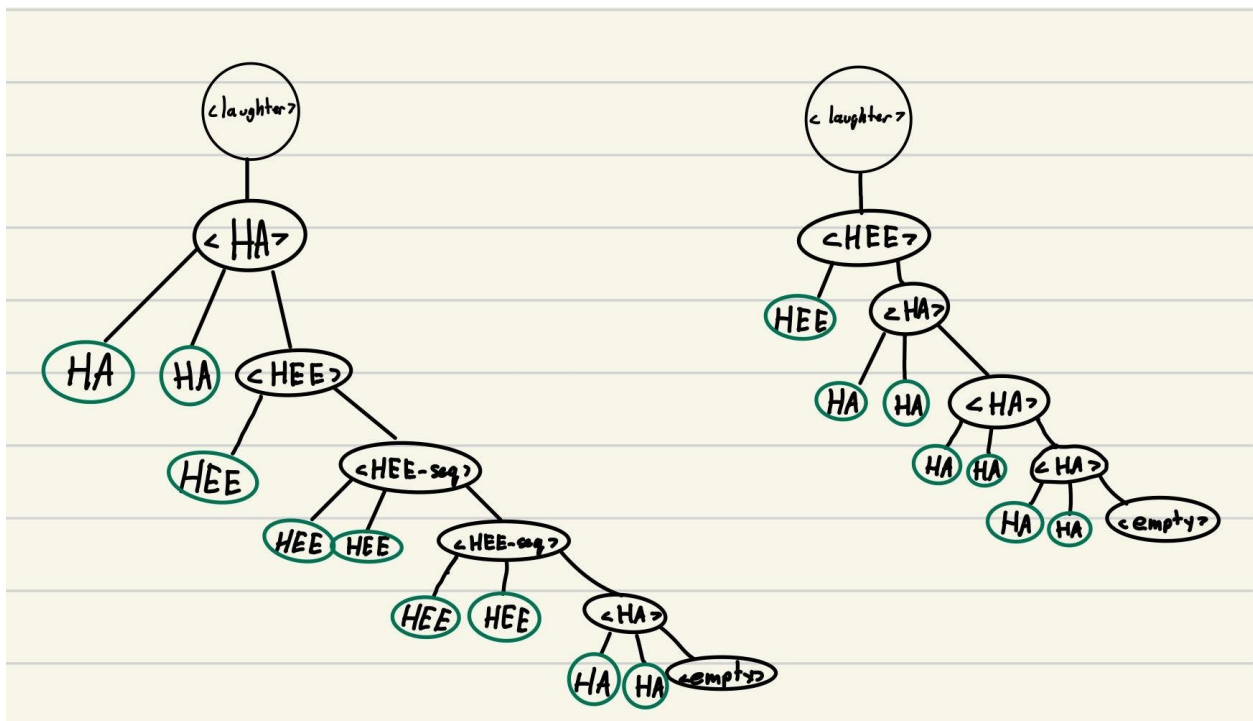


Abstract: I will construct the BNF grammar and tree in this assignment. The constructed grammar and tree were made by a language I made in the assignment and helps us build our ideas on the BNF definition.

Problem 1:

$$\langle \text{laughter} \rangle ::= \langle \text{HA} \rangle \mid \langle \text{HEE} \rangle \mid \langle \text{empty} \rangle$$
$$\langle \text{HA} \rangle ::= \text{HA HA } \langle \text{HEE} \rangle \mid \text{HA HA } \langle \text{empty} \rangle$$
$$\langle \text{HEE} \rangle ::= \text{HEE} \langle \text{HA} \rangle \mid \text{HEE} \langle \text{HEE-seq} \rangle \mid \text{HEE HE} \langle \text{empty} \rangle$$
$$\langle \text{HEE-seq} \rangle ::= \text{HEE HE} \langle \text{HEE-seq} \rangle \mid \text{HEE HE} \langle \text{HA} \rangle \mid \text{HEE HE} \langle \text{empty} \rangle$$


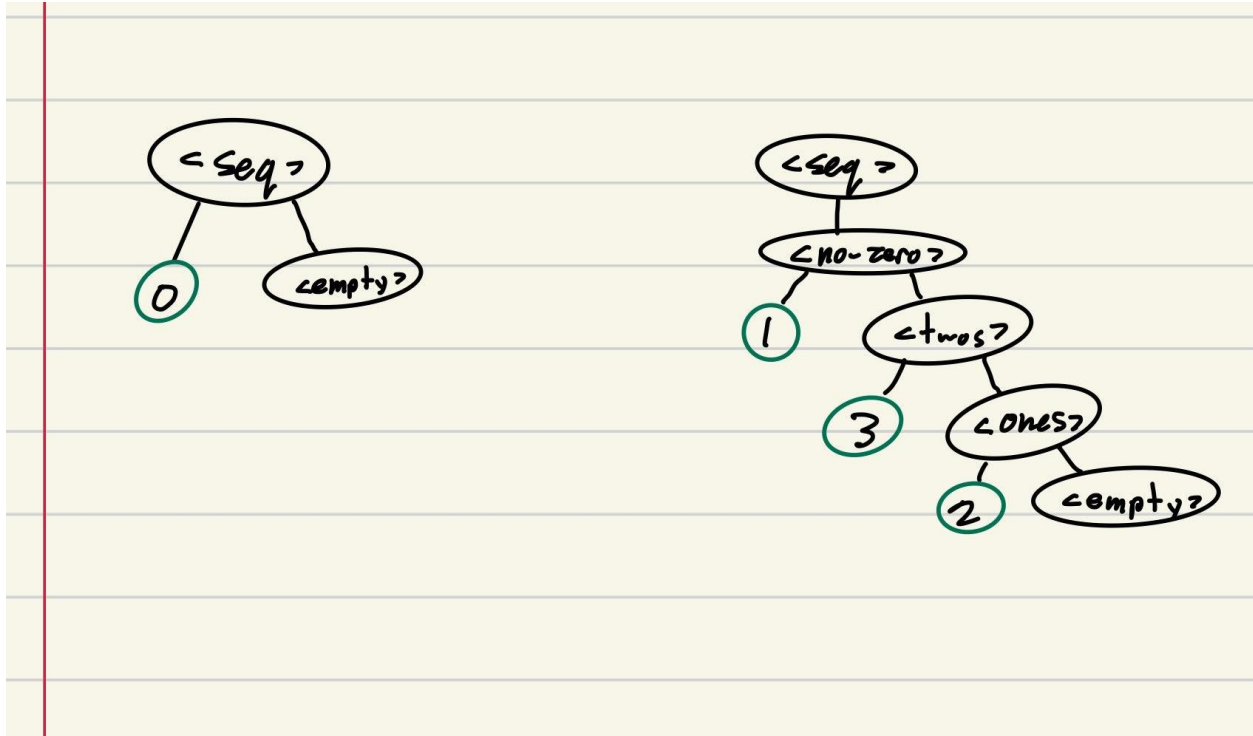
Problem 2:

$\langle \text{seq} \rangle ::= 0 \mid \langle \text{no-zero} \rangle \mid \langle \text{empty} \rangle$

$\langle \text{no-zero} \rangle ::= 1 \langle \text{ones} \rangle \mid 1 \langle \text{twos} \rangle \mid \langle \text{empty} \rangle$

$\langle \text{ones} \rangle ::= 2 \langle \text{seq} \rangle \mid 2 \langle \text{twos} \rangle \mid 2 \langle \text{empty} \rangle$

$\langle \text{twos} \rangle ::= 3 \langle \text{seq} \rangle \mid 3 \langle \text{ones} \rangle \mid \langle \text{empty} \rangle$



Problem 3:

$\langle \text{BXT} \rangle ::= \langle \text{op} \rangle \mid \text{empty}$

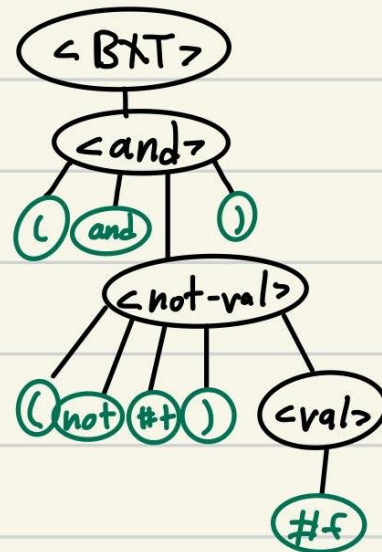
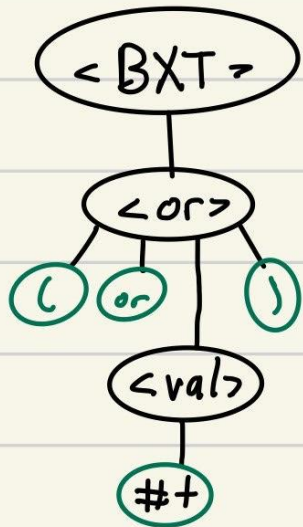
$\langle \text{op} \rangle ::= \langle \text{and} \rangle \mid \langle \text{or} \rangle$

$\langle \text{and} \rangle ::= (\text{and } \langle \text{val} \rangle) \mid (\text{and } \langle \text{not-val} \rangle) \mid \text{empty}$

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

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

$\langle \text{not-val} \rangle ::= (\text{not } \#t) \langle \text{val} \rangle \mid (\text{not } \#f) \langle \text{val} \rangle$



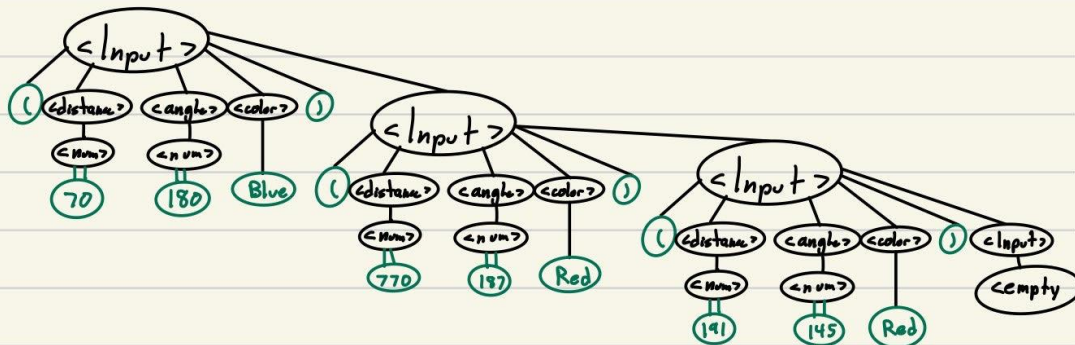
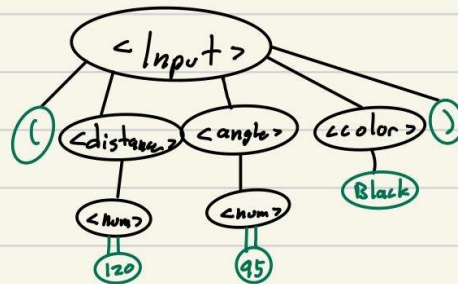
Problem 4:

$\langle \text{Input} \rangle ::= (\langle \text{distance} \rangle \langle \text{angle} \rangle \langle \text{color} \rangle) \mid \langle \text{input} \rangle \mid \langle \text{empty} \rangle$

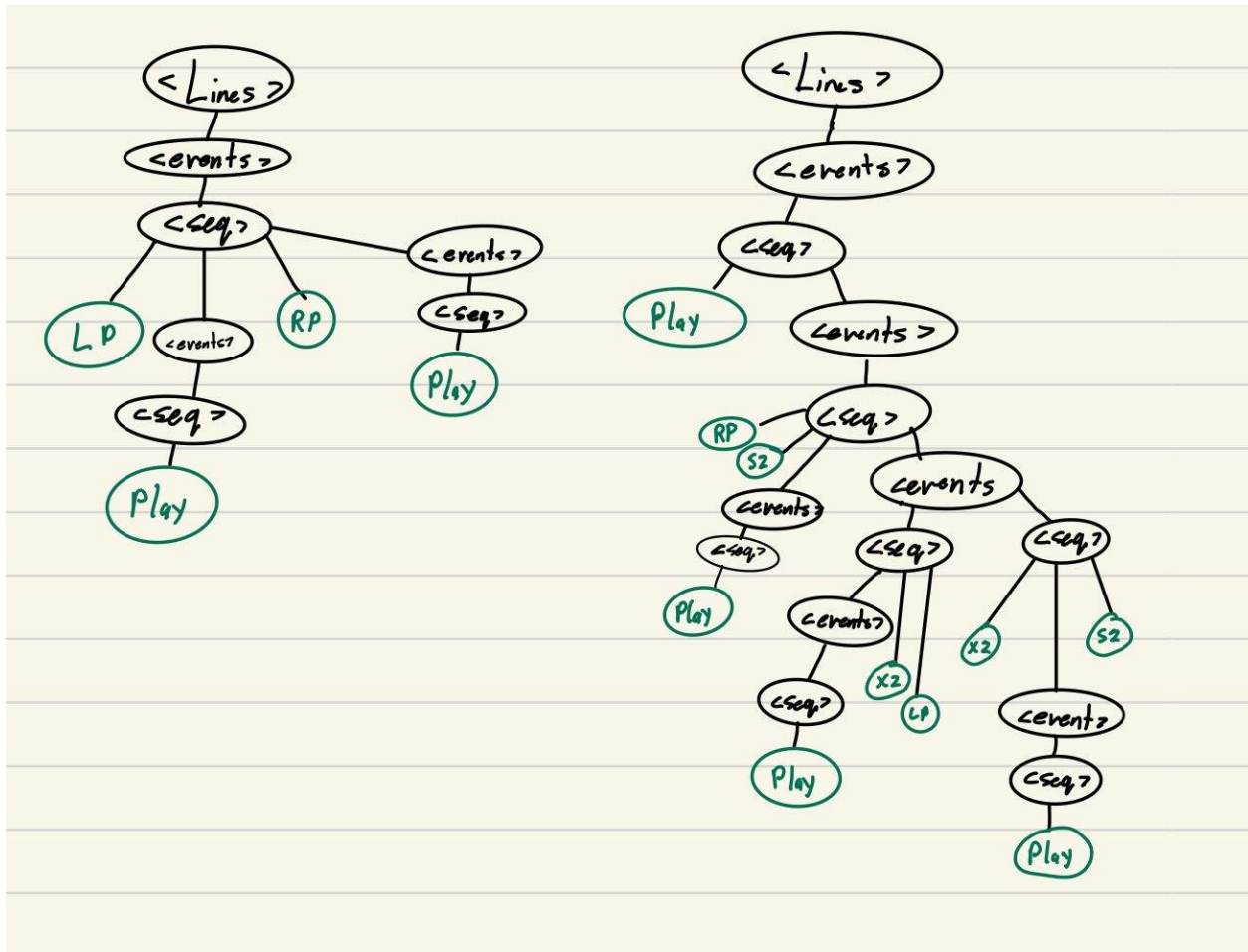
$\langle \text{distance} \rangle ::= \langle \text{input-num} \rangle$

$\langle \text{angle} \rangle ::= \langle \text{input-num} \rangle$

$\langle \text{color} \rangle ::= \text{Blue} \mid \text{Red} \mid \text{Black}$



Problem 5:

$$\langle \text{Lines} \rangle ::= \langle \text{events} \rangle \mid \langle \text{empty} \rangle$$
$$\langle \text{events} \rangle ::= \langle \text{seq} \rangle \mid \langle \text{seq} \rangle \langle \text{events} \rangle$$
$$\langle \text{seq} \rangle ::= \text{Play} \mid \text{Rest} \mid \text{LP} \langle \text{events} \rangle \text{RP} \mid \text{RP S2} \langle \text{events} \rangle \mid \text{X2} \langle \text{events} \rangle \text{S2} \mid \langle \text{events} \rangle \text{X2 LP}$$


Problem 6: BNF?

BNF is a way to describe how a programming language works. It helps make sure that everyone agrees on the rules of the language, so computers can understand it correctly. As a computer science major, it's useful to know BNF because it can help you learn how to design and write programming languages, and how to make sure your code is correct.