
Csc344 BNF Assignment

What's It All About?

This assignment is all about BNF. You will be asked to compose some BNF grammars for given languages. You will be asked to draw some BNF parse trees. You will be asked to describe BNF in English, in a straightforward, compelling manner.

Big picture task - Document Compilation/Posting

Craft a nicely structured document that contains:

1. A nice title, indicating that this is your first problem set assignment, and that it focusses on BNF.
2. A nice learning abstract, which artfully says something about what you will be doing in this problem set, and what you are learning in this problem set.
3. A section that provides your BNF grammar and associated work for Problem 1
4. A section that provides your BNF grammar and associated work for Problem 2
5. A section that provides your BNF grammar and associated work for Problem 3
6. A section that provides your BNF grammar and associated work for Problem 4
7. A section that provides your BNF grammar and associated work for Problem 5
8. A section that provides your work for Problem 6

Post your document to your web work site.

Problem 1 - Laughter

The Language

Consider language Laughter which consists of strings of any number of the symbols HA and HEE subject only to the constraint that strings of the HA symbol must be even in length and sequences of the HEE symbol must be odd in length. Examples:

1. HA HA

2. HEE
3. HA HA HEE HEE HEE HA HA HEE HA HA HA HA
4. HEE HA HA HEE HEE HEE HA HA HEE

Tasks

1. Write a BNF grammar for this language. Constraint: Refine all nonterminal symbols.
2. Draw a parse tree for the following sentence: HA HA HEE HEE HEE HEE HEE HA HA
3. Draw a parse tree for the following sentence: HEE HA HA HA HA HA HA

Problem 2 - SQN (Special Quaternary Numbers)

The Language

Consider the language SQN which consists of the set of all quaternary numbers with no leading zeros, and with no two adjacent occurrences of the same quaternary digit:

For example, the following are sentences in this language:

1. 0
2. 123012301230
3. 10121320212303132

The following strings, for example, are **not** sentences in this language:

1. 1233
2. 010
3. 12322221

Tasks

1. Write a BNF grammar description of the SQN language.
2. Draw a parse tree, consistent with the BNF grammar that you crafted, for the following sentence: 0
3. Draw a parse tree, consistent with the BNF grammar that you crafted, for the following sentence: 132
4. Explain, in precise terms, why you cannot draw a parse tree, consistent with the BNF grammar that you crafted, for the string: 1223

Problem 3 - BXR

The Language

Consider language BXR to be the set of Boolean valued expressions in **Racket** which are composed of the constants `#t` and `#f` and just the operators `and`, `or` and `not`. Here is a short Racket session that provides examples of BXR sentences:

```
Welcome to DrRacket, version 8.1 [cs].
Language: racket, with debugging; memory limit: 128 MB.
> ( and #t ( not #f ) ( or ( not #t ) #f #t #f #t ) )
#t
> ( or ( and #t #t #t ) ( or #f #f #t ) )
#t
> #f
#f
> #t
#t
> ( and #f )
#f
> ( or #t )
#t
> ( and )
#t
> ( or )
#f
> ( not )
not: arity mismatch;
the expected number of arguments does not match the given number
expected: 1
given: 0
> ( not #t )
#f
> ( not #f #f )
not: arity mismatch;
the expected number of arguments does not match the given number
expected: 1
given: 2
>
```

Tasks

1. Write a BNF grammar description of this language.
2. Draw a parse tree, consistent with the BNF grammar that you crafted, for the following sentence:
(or #t)
3. Draw a parse tree, consistent with the BNF grammar that you crafted, for the following sentence:
(and (not #t) #f)

Problem 4 - LSS (Line Segment Sequences)

The Language

Consider the language of strings of zero or more parenthesized triples, each consisting of a positive integer representing a distance, a positive integer representing an angle, and the name of a color, either RED or BLACK or BLUE. Examples:

1. (100 90 BLUE) (50 0 RED) (200 270 BLACK)
2. (5 270 BLACK) (10 280 BLACK) (15 290 BLACK) (20 300 BLACK)

Tasks

1. Write a BNF grammar for this language. Constraint: Refine all nonterminal symbols **except** the one corresponding to distance and the one corresponding to the angle.
2. Draw a parse tree for the following sentence: (120 95 BLACK)
3. Draw a parse tree for the following sentence: (70 180 BLUE) (770 187 RED) (191 145 RED)

Problem 5 - M-Lines

The Language

Consider the language called M-Lines consisting of an event sequence (0 or more events, where an event is the word PLAY or the word REST, or an event sequence sandwiched between RP and LP, or an event sequence sandwiched between LP and RP, or an event sequence sandwiched between S2 and X2, or an event sequence sandwiched between

X2 and X2, or an event sequence sandwiched between S3 and X3, or an event sequence sandwiched between S3 and X3. Examples:

1. PLAY PLAY REST PLAY
2. PLAY PLAY PLAY LP LP PLAY RP RP RP
3. RP RP PLAY LP PLAY LP X2 PLAY S2 RP RP LP LP

Tasks

1. Write a BNF grammar description of this language.
2. Draw a parse tree, consistent with the BNF grammar that you crafted, for the following sentence:
LP PLAY RP PLAY
3. Draw a parse tree, consistent with the BNF grammar that you crafted, for the following sentence:
PLAY RP S2 PLAY PLAY X2 LP X2 PLAY S2

Problem 6 - BNF?

Imagine that a freshman computer science major asks you the question: “What is BNF?” Please write an answer, **in natural language (English, please), without examples**, in a manner that you believe will serve to meaningfully inform the student about the **nature** and **significance** of BNF. Please do so in no more than 100 words.

Due Date

Tuesday, February 14, 2023