

Homework 2
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1.) Give a BNF that describes the language that is strings of zeros and ones that contains exactly two ones or exactly three zeroes (not necessarily consecutive). You may use the empty string in your BNF description.

These strings are in the language: { 000,011,110, 101,0010,0001,0000000101000000 ...
111111110111101111... }

Answer:

**<string> => <ones> 0 <ones> 0 <ones> 0 <ones>
 | <zeroes> 1 <zeroes> 1 <zeroes>
<ones> => <empty> | 1 <ones>
<zeroes> => <empty> | 0 <zeroes>
<empty> =>**

2.) Given the following BNF, give a rightmost derivation for the string. $x+x*y*x$

$S \rightarrow E + S \mid E$
 $E \rightarrow F * E \mid F$
 $F \rightarrow x \mid y$

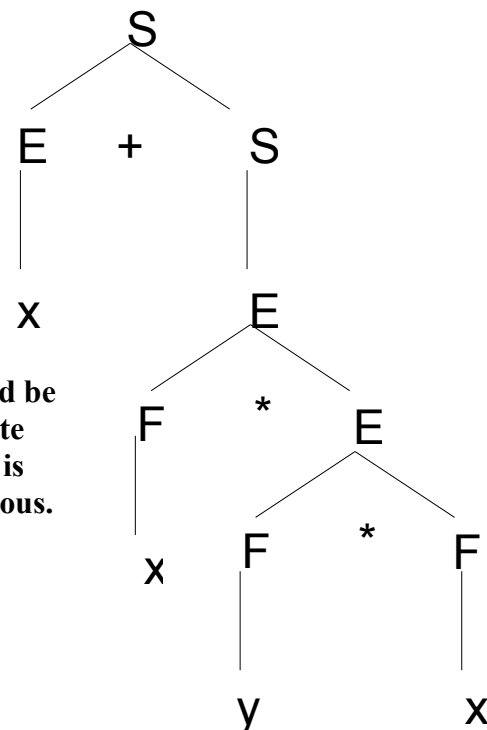
Answer:

**$S \Rightarrow E + S$
 $\Rightarrow E + E$
 $\Rightarrow E + F * E$
 $\Rightarrow E + F * F * E$
 $\Rightarrow E + F * F * F$
 $\Rightarrow E + F * F * x$
 $\Rightarrow E + F * y * x$
 $\Rightarrow E + x * y * x$
 $\Rightarrow x + x * y * x$**

3.) Draw a parse tree for the string $x+x*y*x$

4.) Is the grammar ambiguous?
If so explain the ambiguity.

Answer: No. If $S \Rightarrow S+E$ instead of $E+S$, it would be ambiguous, because the derivation could generate $(x+x)*y*x$ as well as the correct form. Since this is covered by the BNF's structure, it is not ambiguous.



5a) Given this EBNF give a BNF for the language that involves no |, { }, or [].

$S \rightarrow [a]B \mid aSB$
 $B \rightarrow b\{B\} \mid a$

Answer:

$S \Rightarrow aB$

$S \Rightarrow B$

$S \Rightarrow aSB$

$B \Rightarrow bL$

$B \Rightarrow a$

$L \Rightarrow B$

$L \Rightarrow BL$

5b) Given the grammar $S \rightarrow aS$

$S \rightarrow bS$

$S \rightarrow \epsilon$ (empty string)

give an equivalent grammar that does not involve the empty string in a rule.

Answer:

$S \Rightarrow a \mid aS$

$S \Rightarrow b \mid bS$

6.) What most distinguishes operational semantics from denotational or axiomatic semantic techniques?

Answer:

Denotational and Axiomatic Semantic analysis are theoretical and mathematical in nature, concerned with the mathematical relationships among variables and functions, while operational semantic analysis is concerned with the state of the computing machine after any given operation is executed.

7.) What is an attribute grammar?

Answer:

An attribute grammar is an extension of a context-free grammar that allows certain language rules to be conveniently described.

8.) Give the weakest precondition so that the following statement is true given the post condition.

$\{(z \leq 3 \text{ and } x < 4) \text{ or } (z > 3 \text{ and } x < 9)\} \Rightarrow \{x < 4\}$
if (z > 3) then
 y = -5;
 x = x + y;
end if { x < 4 }

9.) Write a Python function that returns a list with the second element removed.

```
>>> print removesecond([2,3,7]).
```

```
def removesecond(arr):  
    if len(arr) > 1:  
        arr.pop(1)  
    return arr
```

```
>>>  
[2, 7]  
>>>
```