Homework 4

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CS 611

**Exercise 1:**

We consider the BNF grammar below:

Sentence ::= Subject Verb Object .

Subject ::= I | a Noun | the Noun

Object ::= me | a Noun | the Noun

Noun ::= cat | mat | rat

Verb ::= like | is | see | sees

1. Show that **I like the cat.** is recognized by this BNF grammar using a rightmost derivation and, then, a parse tree.

Sentence => Subject Verb Object . => Subject Verb the Noun . => Subject Verb the cat . => Subject like the cat . => I like the cat .

Sentence

Subject Verb Object .

I like the Noun

cat

1. Provide an expression that is NOT recognized by the grammar.

You like the cat .

**Exercise 2:**

We consider the following grammar:

EXPRESSION ::= NUMERAL | ( EXPRESSION OPERATOR EXPRESSION )

NUMERAL ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

OPERATORS ::= + | -

Show that (4 - (3 + 2)) is a legal EXPRESSION using a leftmost derivation and, then, a parse tree.

EXPRESSION => ( EXPRESSION OPERATOR EXPRESSION ) => ( NUMERAL OPERATOR EXPRESSION ) => ( 4 OPERATOR EXPRESSION ) => ( 4 – EXPRESSION ) => ( 4 – ( EXPRESSION OPERATOR EXPRESSION ) ) => ( 4 – ( NUMERAL OPERATOR EXPRESSION ) ) => ( 4 – ( 3 OPERATOR EXPRESSION ) ) => ( 4 – ( 3 + EXPRESSION ) ) => ( 4 – ( 3 + NUMERAL ) ) => ( 4 – ( 3 + 2 ) )

EXPRESSION

( EXPRESSION OPERATOR EXPRESSION )

NUMERAL - ( EXPRESSION OPERATOR EXPRESSION )

4 NUMERAL + NUMERAL

3 2

**Exercise 3:**

Show that the following grammar is ambiguous:

X ­-> a | bX | bXcX (where a,b,c are terminals.)

For example, **bbaca** can be parsed into two parse trees show as below:

X

b X

b X c X

a a

X

b X c X

b X a

a

**Exercise 4:**

1. Design a BNF grammar that recognizes expressions of the form Ai where A is in {a,b,c} and i is a digit.

Expression -> A i

A -> a | b | c

i -> digit

digit -> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

1. Design a BNF grammar that recognizes lists of the form A1, A2, A3, …, An. Use question a).

List -> Expression | List, Expression

**Exercise 5:**

1. Write a JAY program that computes the sum of the *n* first numbers with a loop.

void main () {

int sum;

int n;

int i;

sum = 0;

n = 5;

i = 1;

while (i<=n) {

sum = sum + i;

i = i + 1;

}

}

1. Write a JAY program that assigns the minimum of two numbers in a variable called min.

void main () {

int min;

int a;

int b;

a = 10;

b = 20;

if (a>b) {

min = b;

} else {

min = a;

}

}

1. Provide 2 examples of lexical errors in JAY.

* 1. int n.
  2. n = 10^2;

1. Provide 2 examples of JAY programs with 2 different syntax errors.
2. int n
3. bolean foo;
4. Provide 2 examples of JAY programs with errors that are neither detected during the lexical analysis nor during the syntactic analysis.
5. **n is not declared**

void main () {

int sum;

int i;

sum = 0;

i = 1;

while (i<=n) {

sum = sum + i;

i = i + 1;

}

}

1. **logic error**

void main () {

int area;

int height;

int width;

height = 2;

width = 3;

area = height + width;

}