Mini Language

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Mini language

- A simple programming language
- Implemented in PLY
- You will modify it for PA3

Grammar

- At the top level, we define a program

```
program -> stmt_list
stmt_list -> stmt SEMICOLON stmt_list | stmt
stmt ->
    assign_stmt |
    while_stmt |
    if_stmt |
    define_stmt
```

Grammar

- What kind of statements can be used to write a program

```
assign_stmt -> INDENT ASSIGNOP expr
while_stmt -> WHILE expr DO stmt_list OD
if_stmt -> IF expr THEN stmt_list ELSE stmt_list FI
define_stmt ->
    DEFINE IDENT PROC
    LPAREN param_list RPAREN stmt_list END
```

Grammar

- Expressions are commands that can actually be evaluated

```
expr -> expr PLUS term | term
expr -> expr MINUS term | term
term -> term TIMES fact | fact
fact -> NUMBER | ( expr ) | IDENT | func_call
```

- Basic Elements are numbers or Variable Names

```
Number -> [0-9]+
Ident -> [a-z]+ except reserved words
```

Grammar

- Function calls and definitions need inputs

```
func_call -> IDENT LPAREN expr_list RPAREN
expr_list -> expr COMMA expr_list | expr
param_list -> IDENT COMMA param_list | IDENT
```

Parsing

- Instead of evaluating as we parse
- Step 1: Build a Parse Tree
- Step 2: Evaluate the Parse Tree

```
def p_add( p ) :
    'expr : expr PLUS term'
    p[0] = Plus( p[1], p[3] )

def p_assn( p ) :
    'assign_stmt : IDENT ASSIGNOP expr'
    p[0] = AssignStmt( p[1], p[3] )
```

Parse Tree

- Parse Tree Objects
  - Constructor Creates a Tree
  - eval walks the tree and evaluates the expression
  - Display is for debugging

```
class Plus( Expr ) :

    def __init__( self, lhs, rhs ) :

        self.lhs = lhs
        self.rhs = rhs

    def eval( self, nt, ft ) :

        return self.lhs.eval( nt, ft )
        + self.rhs.eval( nt, ft )

    def display( self, nt, ft, depth=0 ) :

        ...
```

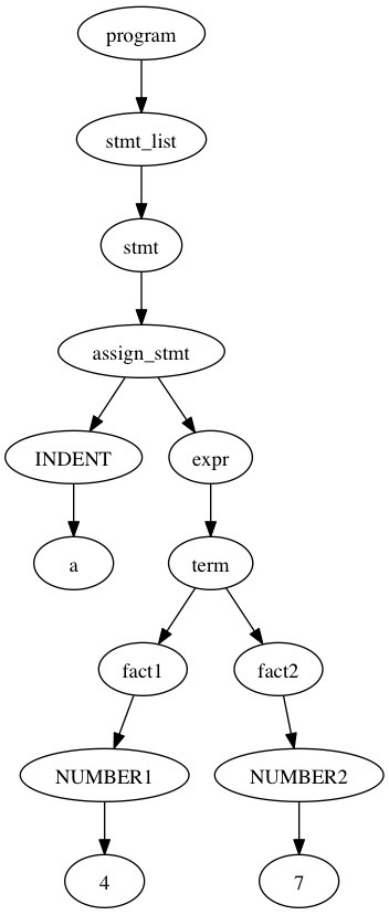
Evaluating

- Evaluating the Parse Tree

```
def eval( self, nt, ft ) :
    return self.lhs.eval( nt, ft )
    + self.rhs.eval( nt, ft )
```

- nt - The name table, stores the names of variables and values
- ft - function table, stores the defined functions

Parse Tree



Parse Tree for a := 4 * 7

An Example Program

- A program to find the factorial of n

```
n := 0 - 5;
if n then i := n else i := 0 - n fi;
fact := 1;
while i do fact := fact * i; i := i - 1 od
```

- For while and if, false means <=0 and true means >0

Running a Program

```
$ python interpreterext.py < TestInput/fact.p
[42]
Running Program
Dump of Symbol Table
Name Table

    i -> 0
    fact -> 120
    n -> -5

Function Table
```

- The program has no print command
- We can see the final symbol table and look for answers

PA3

- Mini Language Question of PA3
- Add the comparison operators: $<$ $>$ $<=$ $>=$ $==$ $!=$
- Currently:
  - true means > 0
  - false means $<= 0$
- You can make the operators return 0 or 1
- $(4 < 5)$ returns 1 for true
- $(5 == 7)$ return 0 for false