**An Implementation of a Recursive Descent Parser**

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# Introduction

A recursive descent parser is a [top-down](http://en.wikipedia.org/wiki/Top-down_parsing) [parser](http://en.wikipedia.org/wiki/Parsing) built from a set of [mutually-recursive](http://en.wikipedia.org/wiki/Mutual_recursion) procedures (or a non-recursive equivalent) where each such [procedure](http://en.wikipedia.org/wiki/Procedure_(computer_science)) usually implements one of the production rules of the [grammar](http://en.wikipedia.org/wiki/Formal_grammar). Thus the structure of the resulting program closely mirrors that of the grammar it recognizes. ‎[REF1]

# Problem Specification

In this project, I develop a recursive-descent parser and it will handle syntax errors for the C- grammar of ‎[REF2], appendix A.2. Some modifications were made to the grammar. The syntactic rules related to function declaration, local declaration and function call are removed from the grammar. The deleted rules are 6 ,11,14,17,27,28,29. The modified rules are:

1 *- program*  *type-specifier* **ID (** *params* **) {***declaration list compound statement***}.**

3- As is but remove *fun-declaration*

5- *type-specifier*  *int | float|***void**

10- compound-stmt  **{***statement*-list**}**

13**-** *statement*  *assignment-stmt| compound-stmt| selection-stmt| iteration-stmt*

18- assignment-stmt  *var* ***=*** *expression*

20- *expression*  *expression relop additive-expression| additive-expression*

26- As is but remove *call*

## Error Handling

If a syntax error occurs while parsing, an error message is reported specifying the line number, the look-ahead token that caused the error, and the expected token. Compilation does not terminate at the first syntax error, but rather continues until the end of file is encountered, generating an error at every unmatched token afterwards. Error recovery is not used.

## Output

The output is a text file(specified by the user) showing the parsing details. Syntactic errors appear in cygwin’s shell after the parsing is completed.

# Procedure

The figure below shows an outline for the procedure I used to achieve the recursive decent parser.

(PARSER)

(SCANNER)

File1.in  
[src code]

Out.txt  
[tokens]

Max.txt  
[syntax tree]

Figure - An outline showing the organization of my recursive descent parser

Below are the steps in detail of how this was done:

1- I used MS Visual Studio to create a C++ program for the recursive descent parser. After ensuring it has no errors, I saved the executable as the parser.exe.

2-To test my program, I scanned a sample C- program(file1.in) in my scanner that I made earlier. The result of scanning is a list of tokens representing the code in file1.in and I called this as out.txt.

3- After that, I passed the scanner’s result; output.txt as an input for my recursive descent parser that I wrote in step 1. The result of this step is a text file containing the sequence of the function calls and returns of my parser with the token value displayed at each call and return. This file is called max.txt. If any syntactic errors were discovered while parsing, they are reported directly into cygwin, with the token causing the error and the expected token and the line number.

# Results and Conclusion

After trying my parser on several code samples, I chose to include the example of a program to peform eqlides algorithm to compute gcd(whatever that is); file1.in. This C- program will be parsed twice below; once to discover the errors generated at the first run, and then, a second run to show the successful parsing completed after fixing the errors.

## The First Run of File1.in:

* The following is the contents of the source file file1.in:

### File1.in Contents

/\* a program to peform eqlides algorithm to compute gcd \*/

int gcd(int u, int v)

{

float x;

{

if (v == 0) return u;

else return gcd(v,u-u/v);

/\* u-u/v\*v == u mod v \*/

}}

void main(void #)

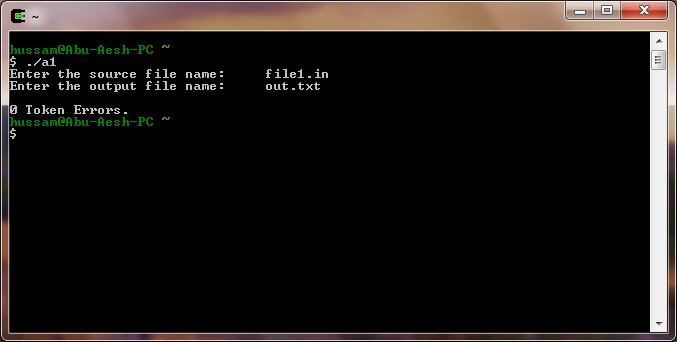
{ int x; int y;

x= input (); y = input90;

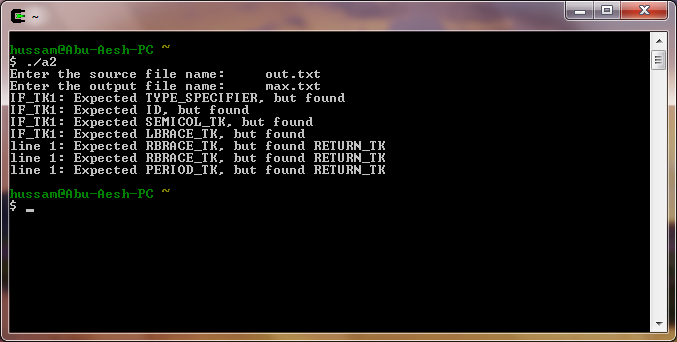
output(gcd(x,y));

}

* Scanning file1.in , we get:



* Passing the resulting file out.txt into the parser we get:



What happened here is a compound problem that I haven’t been lucky with for 2 days ☹ Cygwin appears to be unstable with stderr messaging because what it does here is that it returns the feed back to the beginning of the line before printing the fount token, which overwrites the line number. This is the first part of the problem. The second part is, it always shows the line number as 1, which is obvious in the console at the top. For some reason, the variable “line” remains the same after it is initialized, despite the code I wrote to update it whenever a newline is encountered during scanning. Below is an excerpt of the scan() function responsible for keeping track of the line number, which seems to be never accessed:

if(c == '\n'){

fprintf(outfile, "\n\nNEWLINE SEEN!\n\n");

line++;

continue;

}

As a result of this un-recognition of new lines in my scan(), ‘\n’ becomes part of the scanned token and is probably what’s causing the line return in the error reports back in the cygwin shell.

Anyway, going back to the results, we see an error occurring because an IF token is encountered instead of a semicolon. Because the error report is not giving enough detail about the error position, I made the parsing file show where exactly in the parsing process did the mismatching happen.

Taking a look at the resulting file, we find the following:

### Excerpt of max.txt:

PROGRAM:Enter Next =

TYPE\_SPECIFIER

params:Enter Next = TYPE\_SPECIFIER

param\_list:Enter Next = TYPE\_SPECIFIER

param:Enter Next = TYPE\_SPECIFIER

param:Leave Next = COMMA\_TK

param:Enter Next = TYPE\_SPECIFIER

param:Leave Next = RPARA\_TK

param\_list:Leave Next = RPARA\_TK

params:Leave Next = RPARA\_TK

declaration\_list:Enter Next =

IF\_TK

declaration:Enter Next =

IF\_TK

var\_declaration:Enter Next =

IF\_TK

PROBLEM: does not match :(

Next =

IF\_TK

PROBLEM: does not match :(

Next =

IF\_TK

…

The bottom line, production rule 1(defining program) forces a non-empty list of declarations before starting the compound statement. I fixed this error by adding a simple declaration statement before the if statement to conform with rule 1.

Similarly, other grammar violations were detected in file1.in and were fixed. The main clashes with the grammar causing errors were:

* Return statements- eliminated as rule 17 was deleted per the statement of the assignment.
* Function calls and declarations- eliminated as well because their rules were deleted(rule 6 and rule 27)
* Statements in the program are grouped as 1 compound statement as modified in rule 1.
* Semicolons do not follow statements, only declarations have semicolons at the end.

The final version of file1.in, renamed to file2.in, that does not generate any errors is shown below:

### File2.in (File1.in after correction):

/\* a program to peform eqlides algorithm to compute gcd \*/

int gcd(int u, int v)

{

float x;

{

if (v == 0) x = u

else x = v

/\* u-u/v\*v == u mod v \*/

}}

### The resulting max.txt(will be pretty long but no mismatches ☺):

PROGRAM:Enter Next =

TYPE\_SPECIFIER

params:Enter Next = TYPE\_SPECIFIER

param\_list:Enter Next = TYPE\_SPECIFIER

param:Enter Next = TYPE\_SPECIFIER

param:Leave Next = COMMA\_TK

param:Enter Next = TYPE\_SPECIFIER

param:Leave Next = RPARA\_TK

param\_list:Leave Next = RPARA\_TK

params:Leave Next = RPARA\_TK

declaration\_list:Enter Next =

TYPE\_SPECIFIER

declaration:Enter Next =

TYPE\_SPECIFIER

var\_declaration:Enter Next =

TYPE\_SPECIFIER

var\_declaration:Leave Next =

LBRACE\_TK

declaration:Leave Next =

LBRACE\_TK

declaration\_list:Leave Next =

LBRACE\_TK

compound\_stmt:Enter Next =

LBRACE\_TK

statement\_list:Enter Next =

IF\_TK

statement:Enter Next =

IF\_TK

selection\_stmt:Enter Next =

IF\_TK

expression:Enter Next = ID

additive\_expression:Enter Next = ID

term:Enter Next = ID

factor:Enter Next = ID

var:Enter Next = ID

var:Leave Next = RELOP

factor:Leave Next = RELOP

term:Leave Next = RELOP

additive\_expression:Leave Next = RELOP

additive\_expression:Enter Next = NUM

term:Enter Next = NUM

factor:Enter Next = NUM

factor:Leave Next = RPARA\_TK

term:Leave Next = RPARA\_TK

additive\_expression:Leave Next = RPARA\_TK

expression:Leave Next = RPARA\_TK

statement:Enter Next = ID

assignment\_stmt:Enter Next = ID

var:Enter Next = ID

var:Leave Next = ASGNOP

expression:Enter Next = ID

additive\_expression:Enter Next = ID

term:Enter Next = ID

factor:Enter Next = ID

var:Enter Next = ID

var:Leave Next = SEMICOL\_TK

factor:Leave Next = SEMICOL\_TK

term:Leave Next = SEMICOL\_TK

additive\_expression:Leave Next = SEMICOL\_TK

expression:Leave Next = SEMICOL\_TK

assignment\_stmt:Leave Next = SEMICOL\_TK

statement:Leave Next = SEMICOL\_TK

selection\_stmt:Leave Next = SEMICOL\_TK

statement:Leave Next = SEMICOL\_TK

statement\_list:Leave Next = SEMICOL\_TK

PROBLEM: does not match :(

Next = SEMICOL\_TK

compound\_stmt:Leave Next = SEMICOL\_TK

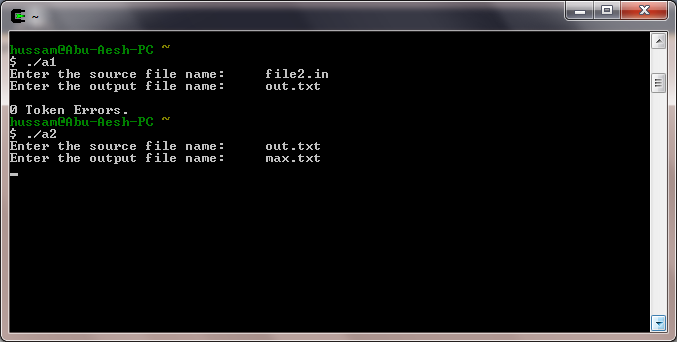
PROBLEM: does not match :(

Next = SEMICOL\_TK

PROBLEM: does not match :(

Next = SEMICOL\_TK

PROGRAM:Leave Next = SEMICOL\_TK



As seen above, the file file2.in was parsed successfully without producing errors ☺

# References

1. Wikipedia Definition of Recursive Descent Parser: <http://en.wikipedia.org/wiki/Recursive_descent_parser>
2. Kenneth Louden, Compiler Construction: Principles and Practice, Course Technology.

# Appendix A

## A2.c

#include <stdio.h>

//#include <stdlib.h>

#include <string.h>

//#include<string>

//#include "scan.h"

/\*global vars:\*/

enum TokenType {ELSE\_TK=0, IF\_TK, INT\_TK, FLOAT\_TK, RETURN\_TK, VOID\_TK, TYPE\_SPECIFIER, WHILE\_TK, SEMICOL\_TK,

COMMA\_TK, PERIOD\_TK, LPARA\_TK, RPARA\_TK, LBRACKET\_TK, RBRACKET\_TK, LBRACE\_TK,

RBRACE\_TK, LCOMMENT\_TK, RCOMMENT\_TK, ADDOP, MULOP, RELOP, ASGNOP, ID, NUM};

char\* tokens[]={"ELSE\_TK", "IF\_TK", "INT\_TK", "FLOAT\_TK", "RETURN\_TK", "VOID\_TK", "TYPE\_SPECIFIER", "WHILE\_TK", "SEMICOL\_TK",

"COMMA\_TK", "PERIOD\_TK", "LPARA\_TK", "RPARA\_TK", "LBRACKET\_TK", "RBRACKET\_TK", "LBRACE\_TK",

"RBRACE\_TK", "LCOMMENT\_TK", "RCOMMENT\_TK", "ADDOP", "MULOP", "RELOP", "ASGNOP", "ID", "NUM"};

char token[20] = "";

int line = 1;

FILE \*srcfile;

FILE \*outfile;

//int srcfile\_marker = 0; //marks the position that scan has reached so far

/\*function prototypes\*/

void program();

void declaration\_list();

void declaration();

void var\_declaration();

//void type\_specifier();

void params();

void param\_list();

void param();

void compound\_stmt();

void statement\_list();

void statement();

void selection\_stmt();

void iteration\_stmt();

void assignment\_stmt();

void var();

void expression();

//void relop();

void additive\_expression();

//void addop();

void term();

//void mulop();

void factor();

void lex\_print(char \*);

void syn\_err(char \*, char \*);

void match(TokenType);

void scan();

//char\* token2string(TokenType);

//TokenType string2token(char\*);

//======PROGRAM================================================================

void program()

{

lex\_print("PROGRAM:Enter\t");

//{type\_specifier}{blank\_str}{identifier}"("{params}")"{blank\_str}"{"{declaration\_list}{blank\_str}{compound\_stmt}"}""."

match(TYPE\_SPECIFIER);

//match(BLANK\_STR);

match(ID);

match(LPARA\_TK);

params();

match(RPARA\_TK);

//match(BLANK\_STR);

match(LBRACE\_TK);

declaration\_list();

//match(BLANK\_STR);

compound\_stmt();

match(RBRACE\_TK);

match(PERIOD\_TK);

lex\_print("PROGRAM:Leave");

}

//======DECLARATION\_LIST=========================================================

void declaration\_list()

{

lex\_print("declaration\_list:Enter\t");

//({declaration\_list}{blank\_str}{declaration})|{declaration}

declaration();

while(strstr(token, tokens[TYPE\_SPECIFIER]) != 0){

//match(BLANK\_STR);

declaration();

}

lex\_print("declaration\_list:Leave");

}

//======DECLARATION==============================================================

void declaration()

{

lex\_print("declaration:Enter\t");

//{var\_declaration}

var\_declaration();

lex\_print("declaration:Leave");

}

//======VAR\_DECLARATION==========================================================

void var\_declaration()

{

lex\_print("var\_declaration:Enter\t");

//{type\_specifier}{blank\_str}{identifier}";"|{type\_specifier}{blank\_str}{identifier}"["number"]";

match(TYPE\_SPECIFIER);

match(ID);

if(strstr(token, tokens[LBRACKET\_TK]) != '\0'){

match(LBRACKET\_TK);

match(NUM);

match(RBRACKET\_TK);

}

match(SEMICOL\_TK);

lex\_print("var\_declaration:Leave");

}

/\*//======TYPE\_SPECIFIER===========================================================

void type\_specifier()

{

//[iI][nN][tT]|[fF][lL][oO][aA][tT]|[vV][oO][iI][dD]

case token is

"i","I": match(INT\_TK);

"f","F": match(FLOAT\_TK);

"v","V": match(VOID\_TK);

others: syn\_err("a type specifier: int, float or void", token);

}\*/

//======PARAMS===================================================================

void params()

{

lex\_print("params:Enter\t");

//{param\_list}|[vV][oO][iI][dD]

/\*case token is

TYPE\_SPECIFIER: param\_list();

"v","V": match(VOID);

others: syn\_err("parameters list or void", token);

\*/

param\_list();

lex\_print("params:Leave");

}

//======PARAM\_LIST===============================================================

void param\_list()

{

lex\_print("param\_list:Enter\t");

//{param\_list}","{param}|{param}

//This means it accepts for example a param list like: void x, void, int y

param();

while(strstr(token, tokens[COMMA\_TK]) != '\0'){

match(COMMA\_TK);

param();

}

lex\_print("param\_list:Leave");

}

//======PARAM====================================================================

void param()

{

lex\_print("param:Enter\t");

//{type\_specifier}{blank\_str}{identifier}|{type\_specifier}{blank\_str}{identifier}"[""]"

match(TYPE\_SPECIFIER);

//match(BLANK\_STR);

match(ID);

if(strstr(token, tokens[LBRACKET\_TK]) != '\0'){

match(LBRACKET\_TK);

match(RBRACKET\_TK);

}

lex\_print("param:Leave");

}

//======COMPOUND\_STMT============================================================

void compound\_stmt()

{

lex\_print("compound\_stmt:Enter\t");

//"{"{statement\_list}"}"

match(LBRACE\_TK);

statement\_list();

match(RBRACE\_TK);

lex\_print("compound\_stmt:Leave");

}

//======STATEMENT\_LIST===========================================================

void statement\_list()

{

lex\_print("statement\_list:Enter\t");

//{statement\_list} {statement}|""

//if(token == ID || token == LBRACE\_TK || token == IF\_TK || token == WHILE\_TK)

statement(); //put in mind that a statement can be nothing, which grants 0+ statements in a statement list

lex\_print("statement\_list:Leave");

}

//======STATEMENT================================================================

void statement()

{

lex\_print("statement:Enter\t");

//{assignment\_stmt}|{compound\_stmt}|{selection\_stmt}|{iteration\_stmt} or nothing.

/\*switch(token){

case ID://assignment statement

assignment\_stmt();

case LBRACE\_TK://compound statement

compound\_stmt();

case IF\_TK://selection statement

selection\_stmt();

case WHILE\_TK://iteration statement

iteration\_stmt();

default://null statement to fix the nullable rule for statement\_list, ignore

return; //ignore

}\*/

if(strstr(token, tokens[ID]) != '\0') assignment\_stmt(); else{

if(strstr(token, tokens[LBRACE\_TK]) != '\0') compound\_stmt(); else{

if(strstr(token, tokens[IF\_TK]) != '\0') selection\_stmt(); else{

if(strstr(token, tokens[WHILE\_TK]) != '\0') iteration\_stmt(); //else return;

}

}

}

lex\_print("statement:Leave");

}

//======SELECTION\_STMT===========================================================

void selection\_stmt()

{

lex\_print("selection\_stmt:Enter\t");

//[iI][fF]{blank\_str}"("{expression}")"{statement}|[iI][fF]{blank\_str}"("{expression}")"{statement}{blank\_str}[eE][lL][sS][eE]{blank\_str}{statement}

match(IF\_TK);

match(LPARA\_TK);

expression();

match(RPARA\_TK);

statement();

if(strstr(token, tokens[ELSE\_TK]) != '\0'){

match(ELSE\_TK);

statement();

}

lex\_print("selection\_stmt:Leave");

}

//======ITERATION\_STMT===========================================================

void iteration\_stmt()

{

lex\_print("iteration\_stmt:Enter\t");

//[wW][hH][iI][lL][eE]{blank\_str}"("{expression}")"{statement}

match(WHILE\_TK);

match(LPARA\_TK);

expression();

match(RPARA\_TK);

statement();

lex\_print("iteration\_stmt:Leave\t");

}

//======ASSIGNMENT\_STMT==========================================================

void assignment\_stmt()

{

lex\_print("assignment\_stmt:Enter\t");

//{var}"="{expression}

var();

match(ASGNOP);

expression();

lex\_print("assignment\_stmt:Leave\t");

}

//======VAR======================================================================

void var()

{

lex\_print("var:Enter\t");

//{identifier}|{identifier}"["{expression}"]"

match(ID);

if(strstr(token, tokens[LBRACKET\_TK]) != '\0'){

match(LBRACKET\_TK);

expression();

match(RBRACKET\_TK);

}

lex\_print("var:Leave\t");

}

//======EXPRESSION===============================================================

void expression()

{

lex\_print("expression:Enter\t");

//{expression}{relop}{additive\_expression}|{additive\_expression}

additive\_expression();

while(strstr(token, tokens[RELOP]) != '\0'){

match(RELOP);

additive\_expression();

}

lex\_print("expression:Leave\t");

}

//======RELOP====================================================================

/\*void relop()

{

//"<="|"<"|">="|">"|"=="|"!="

}\*/

//======ADDITIVE\_EXPRESSION======================================================

void additive\_expression()

{

lex\_print("additive\_expression:Enter\t");

//{additive\_expression}{addop}{term}|{term}

term();

while(strstr(token, tokens[ADDOP]) != '\0'){

match(ADDOP);

term();

}

lex\_print("additive\_expression:Leave\t");

}

//======ADDOP====================================================================

/\*void addop()

{

//"+"|"-"

}\*/

//======TERM=====================================================================

void term()

{

lex\_print("term:Enter\t");

//{term}{mulop}{factor}|{factor}

factor();

while(strstr(token, tokens[MULOP]) != '\0'){

match(MULOP);

factor();

}

lex\_print("term:Leave\t");

}

//======MULOP====================================================================

/\*void mulop()

{

//"\*"|"/"

}\*/

//======FACTOR===================================================================

void factor()

{

lex\_print("factor:Enter\t");

//"("{expression}")"|{var}|{number}

/\*switch(token){

case LPARA\_TK:

{match(LPARA\_TK);

expression();

match(RPARA\_TK);

}

case ID: var();

case NUM: match(NUM);

default: syn\_err("left paranthesis, variable or a number", token);

}\*/

if(strstr(token, tokens[LPARA\_TK]) != '\0'){

match(LPARA\_TK);

expression();

match(RPARA\_TK);

} else{

if(strstr(token, tokens[ID]) != '\0') var(); else{

if(strstr(token, tokens[NUM]) != '\0') match(NUM); else

syn\_err("left paranthesis, variable or a number", token);

}

}

lex\_print("factor:Leave\t");

}

//===============================================================================

//======MATCH====================================================================

//===============================================================================

void match(TokenType expected\_token)

{

//fprintf(stderr, "matching %s... ", tokens[expected\_token]);

if(strstr(token, tokens[expected\_token]) != '\0'){

//lex\_print("matched successfully :)\n");

//strcpy(token,scan());

scan();

}

else{

lex\_print("PROBLEM: does not match :(\n");

//syntax error

syn\_err(tokens[expected\_token], token);

}

if(strcmp(token, "") == 0) //end of file reached--useless

return;

}

//===============================================================================

void scan(){

//returns next token, keeps track and increments the line number,

//remembers the position it has reached reading since last call(s)

char t[50] = "";

char c;

int i = 0;

//for(int i = 0; i <= srcfile\_bookmark; i++) fscanf(srcfile, "%c", &c);

//fscanf(srcfile, "%c", &c);

//fprintf(outfile, "\nJust scanned: %c\n\n", c);

//convert c from character into string

//string str; str.append(1, c);

//concat the result to t

//append(t, c);

//srcfile\_bookmark++;

while(c != EOF){

fscanf(srcfile, "%c", &c);

//fprintf(outfile, "\nJust scanned: %c\n\n", c);

if(c == '\n'){

fprintf(outfile, "\n\nNEWLINE SEEN!\n\n");

line++;

continue;

}

if(c == ' ') {

//fprintf(outfile, "\n\nSPACE SEEN!\n\n");

if(i == 0)

continue;

else break;

}

//append c to t

//t = t + c;

t[i] = c;

i++;

//srcfile\_bookmark++;

}

t[i] = '\0';

//fprintf(outfile, "\n\nt is now = %s\n", t);

strcpy(token, t);

//fprintf(outfile, "FROM SCAN: token is now = %s\nline %d", token, line);

//return t;

}

//===============================================================================

char\* token2string(TokenType t)

{

/\*enum TokenType {ELSE\_TK=300, IF\_TK, INT\_TK, FLOAT\_TK, RETURN\_TK, VOID\_TK, TYPE\_SPECIFIER, WHILE\_TK, SEMICOL\_TK,

COMMA\_TK, PERIOD\_TK, LPARA\_TK, RPARA\_TK, LBRACKET\_TK, RBRACKET\_TK, LBRACE\_TK,

RBRACE\_TK, LCOMMENT\_TK, RCOMMENT\_TK, ADDOP, MULOP, RELOP, ASGNOP, ID, NUM};\*/

char\* map[] = {"else", "if", "int", "float", "return", "void", "type specifier",

"while", ";", ",", ".", "(", ")", "[", "]", "{", "}", "/\*", "\*/", "+ or -",

"\* or /", "relational operator", "identifier", "number"};

return map[t];

}

//===============================================================================

/\*TokenType string2token(char\* s)

{

TokenType t;

switch(s){

case "ELSE\_TK": t = ELSE\_TK;

case "IF\_TK": t = IF\_TK;

case "TYPE\_SPECIFIER": t = TYPE\_SPECIFIER;

case "RETURN\_TK": t = RETURN\_TK;

case "WHILE\_TK": t = WHILE\_TK;

case "SEMICOL\_TK": t = SEMICOL\_TK;

case "COMMA\_TK": t = COMMA\_TK;

case "PERIOD\_TK": t = PERIOD\_TK;

case "LPARA\_TK": t = LPARA\_TK;

case "RPARA\_TK": t = RPARA\_TK;

case "LBRACKET\_TK": t = LBRACKET\_TK;

case "LBRACE\_TK": t = LBRACE\_TK;

case "RBRACE\_TK": t = RBRACE\_TK;

case "LCOMMENT\_TK": t = LCOMMENT\_TK;

case "RCOMMENT\_TK": t = RCOMMENT\_TK;

case "ADDOP": t = ADDOP;

case "MULOP": t = MULOP;

case "RELOP": t = RELOP;

case "ASGNOP": t = ASGNOP;

case "ID": t = ID;

case "NUM": t = NUM;

//default:

}

return t;

}\*/

//===============================================================================

void syn\_err(char\* s1, char\* s2){

fprintf(stderr, "line %d:\tExpected %s, but found %s", line, s1, s2);

fprintf(stderr, "\n");

//total\_errors++;

}

//===============================================================================

void lex\_print(char\* str){

fprintf(outfile, "%s\tNext = %s", str, token);

fprintf(outfile, "\n");

}

/\*//===============================================================================

void lex\_err(char\* s1, char\* s2){

fprintf(stderr, "line %d, character %d:\t%s%s\n", line, epos, s1, s2);

total\_errors++;

}

/\*int yywrap(){

return 1;

}\*/

//===============================================================================

bool lex\_init(char\* src, char\* out){

srcfile = fopen(src, "r");

outfile = fopen(out, "w");

bool done = true;

if(srcfile == 0){

printf("Can't open %s\n", src);

done = false;

}else //read the file name

if(outfile == false){

printf("Can't write to %s", out);

done = false;

}

return done;

}

//===============================================================================

//===============================================================================

int main(int argc, char \*\*argv) {

++argv; --argc;

/\* if (argc > 0) {

srcfile = fopen(argv[0], "r");

} else {

srcfile = stdin;

}\*/

//char\* srcfile;

//char\* outfile;

char f1[50]="";

char f2[50]="";

printf("Enter the source file name:\t");

scanf("%s", f1);

//gets(srcfile);

printf("Enter the output file name:\t");

scanf("%s", f2);

//gets(outfile);

if(lex\_init(f1,f2) == true){

//yylex();

//strcpy(token,scan());

scan();

//fprintf(outfile, "\n\nFROM MAIN: t is now = %s\n", token);

program();

}

else printf("Cannot initialize files.\n");

//printf("\n%d Token Errors.", total\_errors);

return 0;

}

## A1.l(minor changes made)

%{

#include <stdio.h>

//global static int line = 1;

//global static int position = 1;

//global int error\_count =0;

//int errors\_list[100][3] ; //type, line , character position

//static bool unclosed\_comment\_err = false;

const char\* errors\_catalog[] ={

"Unclosed comment encountered. Expected end of comment, found end of file.",

"Nested comments are not allowed.",

"Undefined symbol. Use only the characters defined by the language.",

"Wrong identifier. Identifiers must start with a letter and end with a letter or a digit.",

"Wrong number. Numbers must end with a digit."

};

static int line = 1;

static int position = 1;

static int error\_count =0;

static int error\_list[100][3] ;

static bool unclosed\_comment\_err = false;

%}

%%

[eE][lL][sS][eE] printf("ELSE");

[iI][fF] printf("IF");

[iI][nN][tT] printf("INT");

[rR][eE][tT][uU][rR][nN] printf("RETURN");

[vV][oO][iI][dD] printf("VOID");

[wW][hH][iI][lL][eE] printf("WHILE");

\+ printf("ADDOP: ADDITION");

\- printf("ADDOP: SUBTRACTION");

\\* printf("MULOP: MULTIPLICATION");

\/ printf("MULOP: DIVISION");

\< printf("RELOP: LESS THAN");

\<= printf("RELOP: LESS OR EQUAL");

\> printf("RELOP: GREATER THAN");

\>= printf("RELOP: GREATER OR EQUAL");

== printf("RELOP: EQUAL");

!= printf("RELOP: NOT EQUAL");

= printf("ASSIGNMENT OPERATOR");

; printf("SEMICOLON ");

\, printf("COMMA");

\( printf("OPEN PARANTHESIS");

\) printf("CLOSE PARANTHESIS");

\[ printf("OPEN BRACKET");

\] printf("CLOSE BRACKET");

\{ printf("OPEN BRACE");

\} printf("END BRACE");

"\/\\*"([^"\\*\/"])\*"\\*\/" printf("COMMENT");

"\/\\*"[^\\*]\*"\/\\*"([^"\\*\/"])\*"\\*\/" printf("NESTED COMMENTS"); error\_list[error\_count][0]=1; error\_list[error\_count][1]=line; error\_list[error\_count][2]=position; error\_count++;

\/\\*([^"\\*\/"])\* printf("UNCLOSED COMMENT"); printf("UNCLOSED COMMENT"); error\_list[error\_count][0]=0; error\_list[error\_count][1]=line; error\_list[error\_count][2]=position; error\_count++;

\n line++; position=1;

[^\n] position ++;

[ \t]+ {//ignore whitespace};

[^symbol] error\_list[error\_count][0] = 2; error\_list[error\_count][1]=line; error\_list[error\_count][2] = position; error\_count++;

%%

int main(int argc, char \*\*argv) {

++argv; --argc; /\* skip over program name \*/

if (argc > 0) { yyin = fopen(argv[0], "r"); } else { yyin = stdin; }

yylex();

}