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//Sam Dressler
//Header for Lex

//Includes
#include <iostream>
#include <fstream>
#include <string>
#include <string.h>
#include <stdio.h>
#include <vector>
#include <regex>
#include <iomanip>

//Namepsace
using namespace std;
//Definitions
string make_lowercase(string in);
regex regex_identifier ("([_a-zA-Z])([a-zA-Z0-9]*)(\133[0-9+]\135)*{20}");
regex regex_number ("([0-9]*)");
string symbols = ".,:;()[]{}";
string operators = "+-*/";
int num_char=0;

struct symbol_type{
    //Lexeme
    string token_type;
    //Spelling
    string value;
};
typedef struct symbol_type symbol;

//Function definitions
char * load_file(ifstream& );
vector <string> generate_symbols(char *);
vector<symbol> classify_symbols(vector<string>, vector<symbol>);

/**
 * Function load_file
 * Description: Takes in a file and parses the characters into a dynamic
 * allocated array
 * Parameters: ifstream
 * Return char*
 */
char * load_file(ifstream &file){

    char temp_char;
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char* char_array = NULL;
while(!file.eof())
{
    file.get(temp_char);
    //process the characters
    if(!(temp_char == '\n'))
    {
        if(char_array == NULL)
        {
            char_array = new char[1];
            //cout << temp_char <<"+"<<num_char <<endl;
            char_array[num_char] = temp_char;
            num_char++;
        }
        else
        {
            char * temp_char_array = char_array;
            char_array = new char[num_char+1];
            for(int i = 0; i < num_char; i++)
            {
                char_array[i] = temp_char_array[i];
            }
            //cout << temp_char <<"+"<<num_char <<endl;
            char_array[num_char] = temp_char;
            num_char++;
            delete [] temp_char_array;
        }
    }
    //process \n
    else
    {
        if(char_array == NULL)
        {
            char_array = new char[1];
            char_array[0] = temp_char;
            num_char++;
        }
        else
        {
            char * temp_char_array = char_array;
            char_array = new char[num_char+1];
            for(int i = 0; i < num_char; i++)
            {
                char_array[i] = temp_char_array[i];
            }
            char_array[num_char] = temp_char;
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            num_char++;
            delete [] temp_char_array;
        }
    }
  }
  //cout << "Size of input file: "<< num_char << endl;
  return char_array;
}

/**
 * Function generate generate_symbols
 * Description: take raw character output input and generate list of symbols
 * Parameters: char *
 * Return void
 */
vector <string> generate_symbols(char * raw_input){
  int width = 15;
  symbol curr_sym;
  vector<string> symbol_vec;
  //go through the raw input and split it up by spaces or by a token
  char temp;
  char temp_look_ahead;
  string temp_word;
  string temp_print_string;
  for (int i = 0; i < num_char; i ++){
    temp = raw_input[i];
    // cout << temp << endl;
    if((i+1) < num_char){
      temp_look_ahead = raw_input[i+1];
      //cout << temp_look_ahead << endl;
    }
    if(temp == '\"'){
      temp_print_string += temp;
      i++;
      temp = raw_input[i];
      while(temp != '\"'){
        temp_print_string += temp;
        i++;
        temp = raw_input[i];
      }
      temp_print_string += temp;
      symbol_vec.push_back(temp_print_string);
      temp_print_string.clear();
      continue;
    }
    if(temp == '\'){
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            temp_print_string += temp;
            i++;
            temp = raw_input[i];
            while(temp != '\''){
                temp_print_string += temp;
                i++;
                temp = raw_input[i];
            }
            temp_print_string += temp;
            symbol_vec.push_back(temp_print_string);
            temp_print_string.clear();
            continue;
        }
        if(temp == ' ' || temp == '\n'){
            // cout <<"t:"<< temp<<":t";
            if(temp_word != " " && temp_word != ""){
                // cout << temp_word << endl;
                symbol_vec.push_back(temp_word);
            }
            temp_word = "";
        }
        //check if temp is in the set of the special characters
        else if(symbols.find(temp) != std::string::npos){
            if(temp_word != " " && temp_word != ""){
                // cout <<"TEMP1 : : "<< temp_word << endl;
                // cout << "TEMP1 LA: " << temp_look_ahead << endl;
                // if(temp_look_ahead == '['){
                //  cout << temp_look_ahead << endl;
                // }

                symbol_vec.push_back(temp_word);
            }
            if(temp == ':' && temp_look_ahead == '='){
                string temp_string ({temp ,temp_look_ahead});
                //cout << temp_string << endl;
                symbol_vec.push_back(temp_string);
                i += 1;
                temp_word = "";
                temp_string = "";
                continue;
            }
            else if(temp != ' ') {

                // cout <<"TEMP2 : : "<< temp << endl;
                // cout << "TEMP2 LA: " << temp_look_ahead << endl;
                string temp_string ({temp});
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            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
        }
        temp_word = "";
    }
    else if(operators.find(temp) != std::string::npos){
        if(temp_word != " " && temp_word != ""){
            //cout << temp_word << endl;
            symbol_vec.push_back(temp_word);
        }
        if(temp != ' ') {
            string temp_string ({temp});
            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
        }

        temp_word = "";
    }
    else if(temp == '='){
        if(temp_word != " " && temp_word != ""){
            //cout << temp_word << endl;
            symbol_vec.push_back(temp_word);
        }
        if(temp != ' '){
            string temp_string ({temp});
            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
        }
        temp_word = "";
    }
    else if(temp == '<'){
        if(temp_word != " " && temp_word != ""){
            //cout << temp_word << endl;
            symbol_vec.push_back(temp_word);
        }
        if(temp_look_ahead == '='){
            string temp_string ({temp ,temp_look_ahead});
            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
            i+=1;
            temp_word = "";
            temp_string = "";
            continue;
        }
        else if(temp_look_ahead == '>'){
            string temp_string ({temp ,temp_look_ahead});
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            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
            i+=1;
            temp_word = "";
            temp_string = "";
            continue;
        }
        else if(temp != ' '){
            string temp_string ({temp});
            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
        }
        temp_word = "";
    }
    else if(temp == '>'){
        if(temp_word != " " && temp_word != ""){
            //cout << temp_word << endl;
            symbol_vec.push_back(temp_word);
        }
        if(temp_look_ahead == '='){
            string temp_string ({temp ,temp_look_ahead});
            //cout << temp_string << endl;
            symbol_vec.push_back(temp_string);
            i+=1;
            temp_word = "";
            temp_string = "";
            continue;
        }
        else if(temp != ' '){
            string temp_string ({temp});
            // cout <<"LAST ELIF: " << temp_string << endl;
            symbol_vec.push_back(temp_string);
        }
        temp_word = "";
    }
    else{
        temp_word += temp;
    }
}
//Print the string vector for verification
// for(vector<string>::iterator it = symbol_vec.begin(); it != symbol_vec.end(); ++it){
//  string temp = *it;
//  cout << temp << endl;
// }
return symbol_vec;
}
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string trim(string string)
 {
   size_t pos = string.find_first_not_of(" ");
   string.erase(0, pos);

   pos = string.find_last_not_of(" ");
   if (string::npos != pos)
     string.erase(pos+1);
   return string;
 }


/**
 *  Function: classify_symbols - determine what tokentype
 *                        each of the symbols are and create an
 *                        entry in the symbol table with tokentype and then
 *                        include what the value of the token is.
 */
vector<symbol> classify_symbols(vector<string> symbol_array, vector<symbol> symbol_table)
{
   int i = 0;
   // int k = 0;
   int width = 12;
   int size = symbol_array.size();
   string value;
   string temp;
   string value_look_ahead;
   string value_look_behind;
   for(vector<string>::iterator it = symbol_array.begin(); it != symbol_array.end()-1; ++it)
   {
      value_look_behind = *(it-1);
      value = *it;
      // cout << "sym array i = "<< i << " : " <<symbol_array[i] << endl;
      string entry = symbol_array[i];
      // cout << "value : " << value <<"!"<< endl;
      value_look_ahead = *(it+1);
      symbol s;
      s.value = value;
      symbol_array[i] = make_lowercase(symbol_array[i]);
      //cout <<"s val :"<< s.value << "!" << endl;

         if(symbol_array[i].compare("") == 0){
            i++;
            continue;
         }
         else if(symbol_array[i].compare(" ")== 0){
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            i++;
            continue;
        }
        else if(symbol_array[i].find("\"") != std::string::npos){
            s.token_type = "quotestring";
            symbol_table.push_back(s);
        }
        else if(symbol_array[i].find("\'") != std::string::npos){
            if((strlen(symbol_array[i].c_str())-2) == 1){
                s.token_type = "quotechar";
                symbol_table.push_back(s);
            }else{
                s.token_type = "quotestring";
                symbol_table.push_back(s);
            }
        }
        else if (symbol_array[i].compare("and") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "and_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }

        else if(symbol_array[i].compare("array") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "array_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].find("begin") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "begin_sym";
            symbol_table.push_back(s);
            // cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].find("true") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "true_sym";
            symbol_table.push_back(s);
            // cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].find("false") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "false_sym";
            symbol_table.push_back(s);
            // cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
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        }
        else if(symbol_array[i].find("end") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "end_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("char") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "char_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("chr") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "chr";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("do") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "do_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].find("else") == 0){
            s.value = make_lowercase(s.value);
            if(value_look_ahead.find("if")==0){
                s.value = "else if";
                s.token_type = "else_if_sym";
                it++;
                i++;
            }
            else{
                s.token_type = "else_sym";
            }
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("if") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "if_sym";

            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
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```
        else if(symbol_array[i].compare("int") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "integer_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("integer") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "integer_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("real") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "real_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("mod") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "mod_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("not") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "not_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        //what is this
        else if(symbol_array[i].compare("of") == 0){
            s.value = make_lowercase(s.value);
            s.token_type = "of_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("or") == 0){
            s.token_type = "or_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        //what is this
        else if(symbol_array[i].compare("ord") == 0){
            s.token_type = "ord_sym";
            symbol_table.push_back(s);
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        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    else if(symbol_array[i].compare("procedure") == 0){
        s.value = make_lowercase(s.value);
        s.token_type = "procedure_sym";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    else if(symbol_array[i].compare("function") == 0){
        s.value = make_lowercase(s.value);
        s.token_type = "function_sym";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    else if(symbol_array[i].compare("program") == 0){
        s.value = make_lowercase(s.value);
        s.token_type = "program_sym";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    else if(symbol_array[i].compare("read") == 0){
        s.value = make_lowercase(s.value);
        s.token_type = "read_sym";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare("readln") == 0){
        s.value = make_lowercase(s.value);
        s.token_type = "readln_sym";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].find("then") == 0){
        s.token_type = "then_sym";
        s.value = make_lowercase(s.value);
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare("var") == 0){
        s.token_type = "var_sym";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
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        else if(symbol_array[i].compare("while") == 0){
            s.token_type = "while_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("write") == 0){
            s.token_type = "write_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("writeln") == 0){
            s.token_type = "writeln_sym";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("+") == 0){
            s.token_type = "plus";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }

        else if(symbol_array[i].compare("-") == 0){
            s.token_type = "minus";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }

        else if(symbol_array[i].compare("*") == 0){
            s.token_type = "times";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("/") == 0){
            s.token_type = "div";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(symbol_array[i].compare("<") == 0){
            s.token_type = "less";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;;
        }
        else if(symbol_array[i].compare("<=") == 0){
            s.token_type = "lessequal";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
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    }

    else if(symbol_array[i].compare("<>") == 0){
        s.token_type = "notequal";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(">") == 0){
        s.token_type = "greater";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(">=") == 0){
        s.token_type = "greaterequal";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare("=") == 0){
        s.token_type = "equals";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(":=") == 0){
        s.token_type = "assign";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(":") == 0){
        s.token_type = "colon";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(";") == 0){
        s.token_type = "semicolon";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(",") == 0){
        s.token_type = "comma";
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        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(".") == 0){
        s.token_type = "period";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare("(") == 0){
        s.token_type = "lparen";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare(")") == 0){
        s.token_type = "rparen";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    else if(symbol_array[i].compare("[") == 0){
        s.token_type = "lbrack";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare("]") == 0){
        s.token_type = "rbrack";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }

    else if(symbol_array[i].compare("{") == 0){
        s.token_type = "lbrace";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    else if(symbol_array[i].compare("}") == 0){
        s.token_type = "rbrace";
        symbol_table.push_back(s);
        //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
    }
    //Handle the identifier, number, quotestring, litchar, eofsym, and
    //illegal tokens
    //check if the string is a valid identifier
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        else if(regex_match(value, regex("[a-zA-Z]{1}"))){
            s.token_type = "litchar";
            symbol_table.push_back(s);
            ////cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }

        else if(regex_match(value, regex_identifier)){
            string temp_id = value;
            if(value_look_ahead == "["){
                temp_id.append(value_look_ahead);
                it++;i++;
                value_look_ahead = *(it+1);
                if(regex_match(value_look_ahead, regex("([0-9]*)"))){
                    temp_id.append(value_look_ahead);
                    it++;i++;
                    value_look_ahead = *(it+1);
                    if(value_look_ahead == "]"){
                        temp_id.append(value_look_ahead);
                        cout << temp_id << endl;
                        it++;i++;
                        s.value = temp_id;
                        s.token_type = "identifier";
                        symbol_table.push_back(s);
                    }
                }
                if(regex_match(value_look_ahead,regex_identifier)){
                    temp_id.append(value_look_ahead);
                    it++;i++;
                    value_look_ahead = *(it+1);
                    if(value_look_ahead == "]"){
                        temp_id.append(value_look_ahead);
                        cout << temp_id << endl;
                        it++;i++;
                        s.value = temp_id;
                        s.token_type = "identifier";
                        symbol_table.push_back(s);
                    }
                }
            }
            else{
                s.token_type = "identifier";
                symbol_table.push_back(s);
            }
            ////cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;;
        }
        else if(regex_match(value, regex_number)){
```

```
            s.token_type = "number";
            symbol_table.push_back(s);
            ////cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(regex_match(value, regex("\"([a-zA-Z0-9]+)\"") )){
            s.token_type = "quotestring";
            symbol_table.push_back(s);
            ////cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(regex_match(value, regex("\'([a-zA-Z0-9]+)\'") )){
            s.token_type = "quotestring";
            symbol_table.push_back(s);
            //cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else if(i == size-1){
            s.token_type = "eofsym";
            symbol_table.push_back(s);
            ////cout << left << setw(width) << s.token_type <<  " -->    " << s.value << endl;
        }
        else{
            if(regex_match(value, regex(".*"))){

                //cout <<"Error recognizing symbol: " <<value << endl;
                s.token_type = "illegal";
                symbol_table.push_back(s);
            }
        }
      i++;
   }

   return symbol_table;
}

string make_lowercase(string in){
   string out;
   transform(in.begin(), in.end(), back_inserter(out),::tolower);
   return out;
}
```