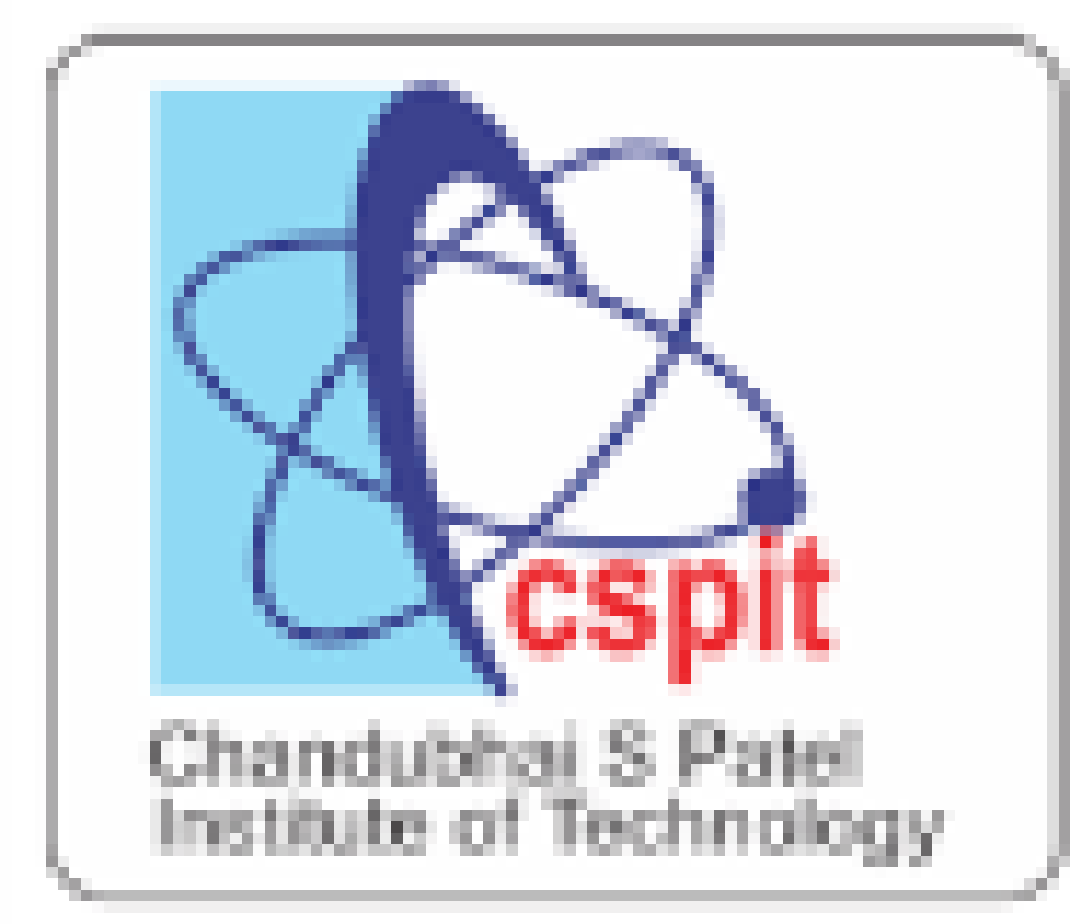
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**Faculty of Technology and Engineering**

**Computer Science and Engineering**

**Practical**

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| Academic Year | : | 2025-26 | Semester | : | 6 |
| Course code | : | CSE312 | Course name | : | Design of language processing |

**Practical - 3**

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| **1. Objective:**  Implementation of a Lexical Analyzer for C Language Compiler    **2. Program Code:**  #include <stdio.h>  #include <stdlib.h>  #include <string.h>  #include <ctype.h>  #define MAX\_IDENTIFIER\_LENGTH 100  #define MAX\_SYMBOL\_TABLE\_SIZE 1000  #define MAX\_TOKEN\_LENGTH 100  #define MAX\_ERRORS 100  // Token types  typedef enum {  TOKEN\_KEYWORD,  TOKEN\_IDENTIFIER,  TOKEN\_CONSTANT,  TOKEN\_STRING,  TOKEN\_PUNCTUATION,  TOKEN\_OPERATOR,  TOKEN\_COMMENT,  TOKEN\_WHITESPACE,  TOKEN\_ERROR  } TokenType;  // Token structure  typedef struct {  TokenType type;  char lexeme[MAX\_TOKEN\_LENGTH];  int line;  int column;  } Token;  // Symbol table entry  typedef struct {  char identifier[MAX\_IDENTIFIER\_LENGTH];  int count;  } SymbolTableEntry;  // Symbol table  typedef struct {  SymbolTableEntry entries[MAX\_SYMBOL\_TABLE\_SIZE];  int size;  } SymbolTable;  // Lexical error structure  typedef struct {  char message[256];  int line;  int column;  } LexicalError;  // Global variables  SymbolTable symbolTable = {.size = 0};  LexicalError errors[MAX\_ERRORS];  int errorCount = 0;  int currentLine = 1;  int currentColumn = 1;  // C keywords  const char \*keywords[] = {  "auto", "break", "case", "char", "const", "continue", "default", "do",  "double", "else", "enum", "extern", "float", "for", "goto", "if",  "int", "long", "register", "return", "short", "signed", "sizeof", "static",  "struct", "switch", "typedef", "union", "unsigned", "void", "volatile", "while"  };  const int keywordCount = sizeof(keywords) / sizeof(keywords[0]);  // Function prototypes  int isKeyword(const char \*str);  void addToSymbolTable(const char \*identifier);  void addError(const char \*message, int line, int column);  void printToken(Token token);  void printSymbolTable();  void printErrors();  Token getNextToken(FILE \*file);  void processFile(const char \*filename);  void resetAnalyzer();  // Check if a string is a keyword  int isKeyword(const char \*str) {  for (int i = 0; i < keywordCount; i++) {  if (strcmp(str, keywords[i]) == 0) {  return 1;  }  }  return 0;  }  // Add identifier to symbol table  void addToSymbolTable(const char \*identifier) {  // Check if identifier already exists  for (int i = 0; i < symbolTable.size; i++) {  if (strcmp(symbolTable.entries[i].identifier, identifier) == 0) {  symbolTable.entries[i].count++;  return;  }  }    // Add new identifier  if (symbolTable.size < MAX\_SYMBOL\_TABLE\_SIZE) {  strcpy(symbolTable.entries[symbolTable.size].identifier, identifier);  symbolTable.entries[symbolTable.size].count = 1;  symbolTable.size++;  }  }  // Add lexical error  void addError(const char \*message, int line, int column) {  if (errorCount < MAX\_ERRORS) {  sprintf(errors[errorCount].message, "%s", message);  errors[errorCount].line = line;  errors[errorCount].column = column;  errorCount++;  }  }  // Print token  void printToken(Token token) {  const char \*typeNames[] = {  "Keyword", "Identifier", "Constant", "String",  "Punctuation", "Operator", "Comment", "Whitespace", "Error"  };    if (token.type != TOKEN\_WHITESPACE && token.type != TOKEN\_COMMENT) {  printf("%s: %s\n", typeNames[token.type], token.lexeme);  }  }  // Print symbol table  void printSymbolTable() {  printf("\n========================================\n");  printf("SYMBOL TABLE ENTRIES\n");  printf("========================================\n");  if (symbolTable.size == 0) {  printf("(No identifiers found)\n");  } else {  for (int i = 0; i < symbolTable.size; i++) {  printf("%d) %s\n", i + 1, symbolTable.entries[i].identifier);  }  }  printf("========================================\n");  }  // Print lexical errors  void printErrors() {  if (errorCount > 0) {  printf("\n========================================\n");  printf("LEXICAL ERRORS\n");  printf("========================================\n");  for (int i = 0; i < errorCount; i++) {  printf("%s\n", errors[i].message);  }  printf("========================================\n");  } else {  printf("\n========================================\n");  printf("No lexical errors found!\n");  printf("========================================\n");  }  }  // Reset analyzer state  void resetAnalyzer() {  symbolTable.size = 0;  errorCount = 0;  currentLine = 1;  currentColumn = 1;  }  // Get next token from file  Token getNextToken(FILE \*file) {  Token token;  token.line = currentLine;  token.column = currentColumn;  int c = fgetc(file);    // Skip whitespace  while (c != EOF && isspace(c)) {  if (c == '\n') {  currentLine++;  currentColumn = 1;  } else {  currentColumn++;  }  c = fgetc(file);  }    if (c == EOF) {  token.type = TOKEN\_ERROR;  strcpy(token.lexeme, "EOF");  return token;  }    token.line = currentLine;  token.column = currentColumn;    // Handle comments  if (c == '/') {  int next = fgetc(file);  if (next == '/') {  // Single-line comment  token.type = TOKEN\_COMMENT;  int idx = 0;  token.lexeme[idx++] = c;  token.lexeme[idx++] = next;  while ((c = fgetc(file)) != EOF && c != '\n') {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  }  token.lexeme[idx] = '\0';  if (c == '\n') {  currentLine++;  currentColumn = 1;  }  return token;  } else if (next == '\*') {  // Multi-line comment  token.type = TOKEN\_COMMENT;  int idx = 0;  token.lexeme[idx++] = c;  token.lexeme[idx++] = next;  currentColumn += 2;    int prev = 0;  while ((c = fgetc(file)) != EOF) {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  if (c == '\n') {  currentLine++;  currentColumn = 1;  }  if (prev == '\*' && c == '/') {  break;  }  prev = c;  }  token.lexeme[idx] = '\0';  return token;  } else {  ungetc(next, file);  }  }    // Handle identifiers and keywords  if (isalpha(c) || c == '\_') {  int idx = 0;  token.lexeme[idx++] = c;  currentColumn++;    while ((c = fgetc(file)) != EOF && (isalnum(c) || c == '\_')) {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  }  token.lexeme[idx] = '\0';    if (c != EOF) {  ungetc(c, file);  }    if (isKeyword(token.lexeme)) {  token.type = TOKEN\_KEYWORD;  } else {  token.type = TOKEN\_IDENTIFIER;  addToSymbolTable(token.lexeme);  }  return token;  }    // Handle numbers (constants)  if (isdigit(c)) {  int idx = 0;  token.type = TOKEN\_CONSTANT;  token.lexeme[idx++] = c;  currentColumn++;    int hasDecimal = 0;  int hasError = 0;    while ((c = fgetc(file)) != EOF) {  if (isdigit(c)) {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  } else if (c == '.' && !hasDecimal) {  hasDecimal = 1;  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  } else if (isalpha(c)) {  // Invalid: number followed by letter (like 7H)  hasError = 1;  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  // Continue reading the invalid token  while ((c = fgetc(file)) != EOF && (isalnum(c) || c == '\_')) {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  }  if (c != EOF) {  ungetc(c, file);  }  break;  } else {  break;  }  }    token.lexeme[idx] = '\0';    if (hasError) {  token.type = TOKEN\_ERROR;  char errorMsg[100];  sprintf(errorMsg, "%s invalid lexeme", token.lexeme);  addError(errorMsg, token.line, token.column);  }    if (c != EOF && !hasError) {  ungetc(c, file);  }  return token;  }    // Handle string literals  if (c == '"') {  int idx = 0;  token.type = TOKEN\_STRING;  token.lexeme[idx++] = c;  currentColumn++;    while ((c = fgetc(file)) != EOF && c != '"') {  if (c == '\\') {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  c = fgetc(file);  if (c == EOF) break;  }  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  if (c == '\n') {  currentLine++;  currentColumn = 1;  }  }    if (c == '"') {  token.lexeme[idx++] = c;  currentColumn++;  }  token.lexeme[idx] = '\0';  return token;  }    // Handle character literals  if (c == '\'') {  int idx = 0;  token.type = TOKEN\_STRING;  token.lexeme[idx++] = c;  currentColumn++;    while ((c = fgetc(file)) != EOF && c != '\'') {  if (c == '\\') {  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  c = fgetc(file);  if (c == EOF) break;  }  if (idx < MAX\_TOKEN\_LENGTH - 1) {  token.lexeme[idx++] = c;  }  currentColumn++;  }    if (c == '\'') {  token.lexeme[idx++] = c;  currentColumn++;  }  token.lexeme[idx] = '\0';  return token;  }    // Handle operators and punctuation  const char \*twoCharOps[] = {"==", "!=", "<=", ">=", "&&", "||", "++", "--",  "+=", "-=", "\*=", "/=", "%=", "->", "<<", ">>"};  const int twoCharOpsCount = sizeof(twoCharOps) / sizeof(twoCharOps[0]);    int next = fgetc(file);  char twoChar[3] = {c, next, '\0'};  int isTwoChar = 0;    for (int i = 0; i < twoCharOpsCount; i++) {  if (strcmp(twoChar, twoCharOps[i]) == 0) {  isTwoChar = 1;  break;  }  }    if (isTwoChar) {  token.type = TOKEN\_OPERATOR;  strcpy(token.lexeme, twoChar);  currentColumn += 2;  return token;  } else {  if (next != EOF) {  ungetc(next, file);  }  }    // Single character operators and punctuation  if (strchr("+-\*/%=<>!&|^~", c)) {  token.type = TOKEN\_OPERATOR;  token.lexeme[0] = c;  token.lexeme[1] = '\0';  currentColumn++;  return token;  }    if (strchr("(){}[];,.:?", c)) {  token.type = TOKEN\_PUNCTUATION;  token.lexeme[0] = c;  token.lexeme[1] = '\0';  currentColumn++;  return token;  }    // Invalid character  token.type = TOKEN\_ERROR;  sprintf(token.lexeme, "%c", c);  char errorMsg[100];  sprintf(errorMsg, "%c invalid lexeme", c);  addError(errorMsg, currentLine, currentColumn);  currentColumn++;  return token;  }  // Process file  void processFile(const char \*filename) {  FILE \*file = fopen(filename, "r");  if (!file) {  printf("Error: Cannot open file '%s'\n", filename);  printf("Please make sure the file exists in the current directory.\n");  return;  }    resetAnalyzer();    printf("\n========================================\n");  printf("TOKENS\n");  printf("========================================\n");    Token token;  do {  token = getNextToken(file);  if (strcmp(token.lexeme, "EOF") != 0) {  printToken(token);  }  } while (strcmp(token.lexeme, "EOF") != 0);    fclose(file);    printSymbolTable();  printErrors();  }  int main() {  char filename[256];  char choice;    printf("==========================================\n");  printf(" LEXICAL ANALYZER\n");  printf("==========================================\n");  printf(" DEBDOOT MANNA 23CS043\n");  printf("==========================================\n\n");    do {  printf("Enter the C source file name: ");  scanf("%s", filename);    processFile(filename);    printf("\nDo you want to analyze another file? (y/n): ");  scanf(" %c", &choice);  printf("\n");    } while (choice == 'y' || choice == 'Y');    printf("Thank you for using the Lexical Analyzer!\n");    return 0;  }  **3.Output:** |