LAB 7 – 8

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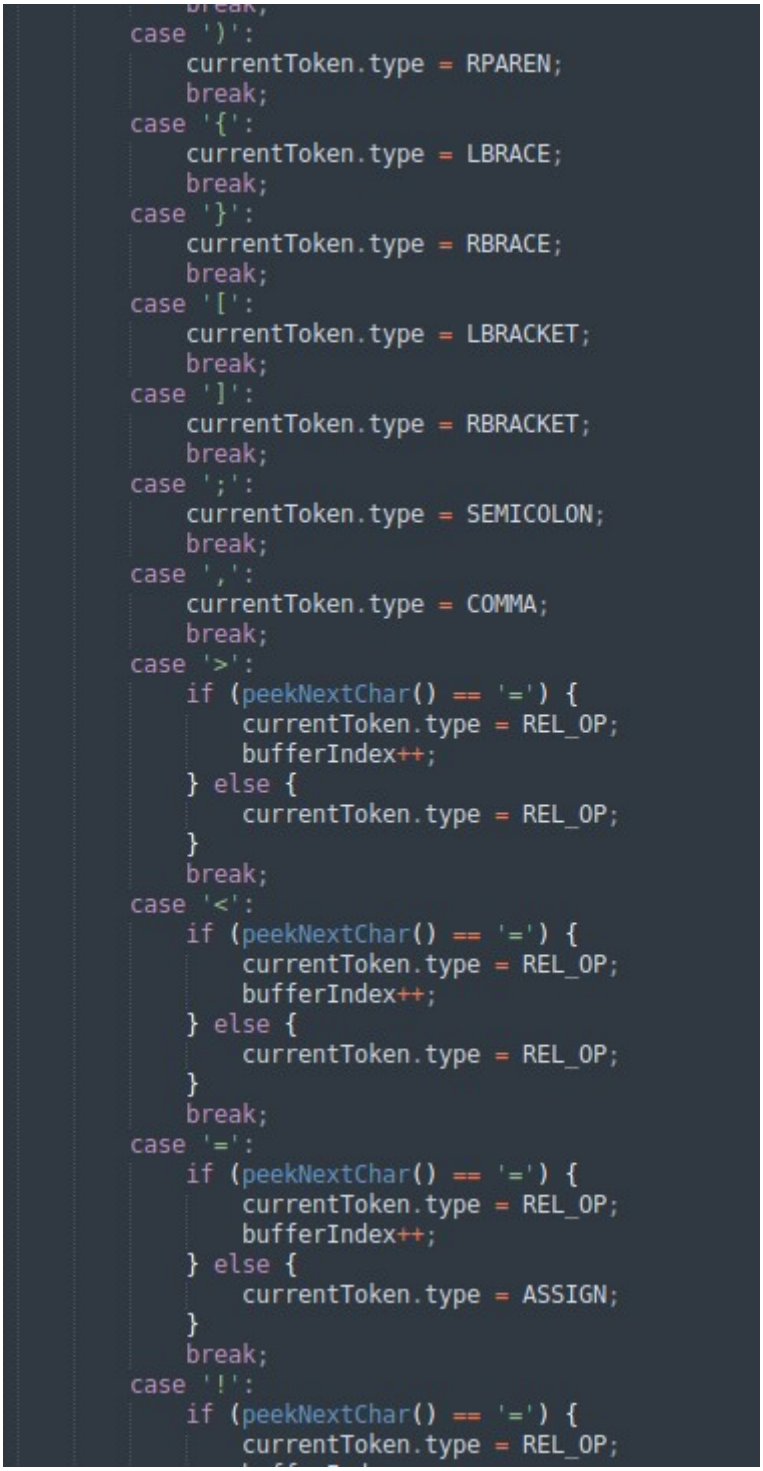
lab7) For given subset of grammar 7.1, design RD parser with appropriate error messages with expected
character and row and column number.
Lab8) Design the recursive descent parser to parse C program with variable declaration and decision statements
with error reporting of grammar 7.1.

CODE:

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>

typedef enum {
    MAIN, INT, CHAR, ID, NUM, LPAREN, RPAREN, LBRACE, RBRACE, LBRACKET, RBRACKET,SEMICOLON, COMMA, ASSIGN, IF, ELSE, REL_OP, ADD_OP, MUL_OP,END_OF_FILE,
    CHAR_LITERAL
} TokenType;

typedef struct Token {
    TokenType type;
    char* value;
    int row;
    int col;
} Token;

char* buffer;
int bufferIndex = 0;
int row = 1;
int col = 1;
void getNextToken(void);
void match(TokenType type);
void initTokenizer(char* buf);
Token currentToken;

char getNextChar() {
    if (bufferIndex >= strlen(buffer)) {
        return EOF;
    }
    char c = buffer[bufferIndex++];

    if (c == '\n') {
        row++;
        col = 1;
    } else {
        col++;
    }
    return c;
}
char peekNextChar() {
    if (bufferIndex >= strlen(buffer)) {
        return EOF;
    }
    return buffer[bufferIndex];
}
void getNextToken() {
    char c = getNextChar();
    while (isspace(c)) {
```

```
void getNextToken() {
    char c = getNextChar();
    while (isspace(c)) {
        c = getNextChar();
    }
    if (c == EOF) {
        currentToken.type = END_OF_FILE;
        return;
    }
    if (isdigit(c)) {
        currentToken.type = NUM;
        currentToken.value = malloc(10);
        currentToken.value[0] = c;
        int i = 1;
        while (isdigit(c = getNextChar())) {
            currentToken.value[i++] = c;
        }
        bufferIndex--;
        currentToken.value[i] = '\0';
        return;
    }
    if (isalpha(c)) {
        currentToken.type = ID;
        currentToken.value = malloc(10);
        currentToken.value[0] = c;
        int i = 1;
        while (isalnum(c = getNextChar())) {
            currentToken.value[i++] = c;
        }
        bufferIndex--;
        currentToken.value[i] = '\0';
        if (strcmp(currentToken.value, "main") == 0) {
            currentToken.type = MAIN;
        } else if (strcmp(currentToken.value, "int") == 0) {
            currentToken.type = INT;
        } else if (strcmp(currentToken.value, "char") == 0) {
            currentToken.type = CHAR;
        } else if (strcmp(currentToken.value, "if") == 0) {
            currentToken.type = IF;
        } else if (strcmp(currentToken.value, "else") == 0) {
            currentToken.type = ELSE;
        }
        return;
    }
    switch (c) {
        case '(':
            currentToken.type = LPAREN;
            break;
```



```
            if (peekNextChar() == '=') {
                currentToken.type = REL_OP;
                bufferIndex++;
            } else {
                printf("Error at line %d, column %d: Invalid character '!'\n", row, col);
                exit(1);
            }
            break;
        case '\'':
            c = getNextChar();
            if (c == '\\') {
                c = getNextChar();
                if (c == 'n' || c == 't' || c == 'r' || c == '\\' || c == '\'' || c == '\"') {
                    char escapedChar[3] = {'\\', c, '\0'};
                    currentToken.value = strdup(escapedChar);
                } else {
                    printf("Error at line %d, column %d: Invalid escape sequence\n", row, col);
                    exit(1);
                }
            } else if (c != '\'' && c != EOF) {
                char charLiteral[2] = {c, '\0'};
                currentToken.value = strdup(charLiteral);
            } else {
                printf("Error at line %d, column %d: Invalid or incomplete character literal\n", row, col);
                exit(1);
            }
            if (getNextChar() != '\'') {
                printf("Error at line %d, column %d: Missing closing single quote\n", row, col);
                exit(1);
            }
            currentToken.type = NUM;
            return;
        default:
            printf("Invalid character: %c\n", c);
            exit(1);
    }
}
void match(TokenType type) {
    if (currentToken.type != type) {
        printf("Error at line %d, column %d: Expected %d, but found %d\n", row, col, type, currentToken.type);
        printf("Token value: %s\n", currentToken.value);
        exit(1);
    }
    getNextToken();
}
void program() {
    if (currentToken.type != MAIN) {
```

```
    if (currentToken.type != MAIN) {
        printf("Error at line %d, column %d: Expected 'main'\n", row, col);
        exit(1);
    }
    match(MAIN);
    match(LPAREN);
    match(RPAREN);
    match(LBRACE);
    declarations();
    statement_list();
    if (currentToken.type != RBRACE) {
        printf("Error at line %d, column %d: Expected '}'\n", row, col);
        exit(1);
    }
    match(RBRACE);
    printf("Parsing successful!\n");
}
void declarations() {
    while (currentToken.type == INT || currentToken.type == CHAR) {
        if (currentToken.type == INT) {
            match(INT);
        } else {
            match(CHAR);
        }
        identifier_list();
        if (currentToken.type != SEMICOLON) {
            printf("Error at line %d, column %d: Expected ';'\n", row, col);
            exit(1);
        }
        match(SEMICOLON);
    }
}
void identifier_list() {
    if (currentToken.type != ID) {
        printf("Error at line %d, column %d: Expected identifier\n", row, col);
        exit(1);
    }
    match(ID);
    if (currentToken.type == LBRACKET) {
        match(LBRACKET);
        if (currentToken.type == NUM) {
            match(NUM);
        } else {
            printf("Error at line %d, column %d: Expected array size\n", row, col);
            exit(1);
        }
        match(RBRACKET);
    }
    while (currentToken.type == COMMA) {
```

```
    while (currentToken.type == COMMA) {
        match(COMMA);
        if (currentToken.type != ID) {
            printf("Error at line %d, column %d: Expected identifier\n", row, col);
            exit(1);
        }
        match(ID);
        if (currentToken.type == LBRACKET) {
            match(LBRACKET);

            if (currentToken.type == NUM) {
                match(NUM);
            } else {
                printf("Error at line %d, column %d: Expected array size\n", row, col);
                exit(1);
            }
            match(RBRACKET);
        }
    }
}
void statement_list() {
    while (currentToken.type == ID || currentToken.type == IF) {
        statement();
    }
}
void statement() {
    if (currentToken.type == ID) {
        assign_stat();

        if (currentToken.type != SEMICOLON) {
            printf("Error at line %d, column %d: Expected ';'\n", row, col);
            exit(1);
        }
        match(SEMICOLON);
    } else if (currentToken.type == IF) {
        decision_stat();
    }
}
void assign_stat() {
    if (currentToken.type == ID) {
        match(ID);

        if (currentToken.type == LBRACKET) {
            match(LBRACKET);

            if (currentToken.type == NUM) {
                match(NUM);
            } else {
                printf("Error at line %d, column %d: Expected array index\n", row, col);
```

```
            if (currentToken.type == NUM) {
                match(NUM);
            } else {
                printf("Error at line %d, column %d: Expected array index\n", row, col);
                exit(1);
            }

            match(RBRACKET);
        }
        if (currentToken.type != ASSIGN) {
            printf("Error at line %d, column %d: Expected '='\n", row, col);
            exit(1);
        }
        match(ASSIGN);
        expn();
    } else {
        printf("Error at line %d, column %d: Expected identifier\n", row, col);
        exit(1);
    }
}
void expn() {
    simple_expn();

    if (currentToken.type == REL_OP) {
        eprime();
    }
}
void eprime() {
    match(REL_OP);
    simple_expn();
}
void simple_expn() {
    term();
    while (currentToken.type == ADD_OP) {
        seprime();
    }
}
void seprime() {
    match(ADD_OP);
    term();
}
void term() {
    factor();
    while (currentToken.type == MUL_OP) {
        tprime();
    }
}
void tprime() {
    match(MUL_OP);
```

```
void tprime() {
    match(MUL_OP);
    factor();
}
void factor() {
    if (currentToken.type == ID) {
        match(ID);

        if (currentToken.type == LBRACKET) {
            match(LBRACKET);

            expn();

            match(RBRACKET);
        }
    } else if (currentToken.type == NUM || currentToken.type == CHAR_LITERAL) {
        match(currentToken.type);
    } else {
        printf("Error at line %d, column %d: Expected identifier or number\n", row, col);
        exit(1);
    }
}
void decision_stat() {
    match(IF);
    match(LPAREN);
    expn();
    match(RPAREN);
    match(LBRACE);

    statement_list();

    if (currentToken.type != RBRACE) {
        printf("Error at line %d, column %d: Expected '}'\n", row, col);
        exit(1);
    }
    match(RBRACE);

    dprime();
}
void dprime() {
    if (currentToken.type == ELSE) {
        match(ELSE);
        match(LBRACE);

        statement_list();

        if (currentToken.type != RBRACE) {
```

```
        if (currentToken.type != RBRACE) {
            printf("Error at line %d, column %d: Expected '}'\n", row, col);
            exit(1);
        }
        match(RBRACE);
    }
}
void initTokenizer(char* buf) {
    buffer = buf;
    bufferIndex = 0;
    row = 1;
    col = 1;
    getNextToken();
}
int main(int argc, char* argv[]) {
    if (argc != 2) {
        printf("Usage: %s filename\n", argv[0]);
        return 1;
    }
    FILE* file = fopen(argv[1], "r");
    if (!file) {
        printf("Could not open file %s\n", argv[1]);
        return 1;
    }
    fseek(file, 0, SEEK_END);
    long fileSize = ftell(file);
    rewind(file);
    char* inputBuffer = malloc(fileSize + 1);
    if (!inputBuffer) {
        printf("Memory allocation failed\n");
        fclose(file);
        return 1;
    }
    size_t bytesRead = fread(inputBuffer, 1, fileSize, file);
    inputBuffer[bytesRead] = '\0';
    fclose(file);
    initTokenizer(inputBuffer);
    program();
    free(inputBuffer);
    return 0;
}
```

INPUT:

test1.c

q1.c | test1.c

```
main() {
    int x, y[10];
    char z;

    x = 5;

    if (x > 10) {
        y[0] = 20;
    } else {
        z = 'a';
    }
}
```

OUTPUT:

```
student@oslab-02:~/220905128/lab8$ ./a.out test1.c
Parsing successful!
```

WRONG INPUT:

err1.c

err1.c

```
main() {
    int x[10];
    x[a] = 20;
}
```

```
student@oslab-02:~/220905128/lab8$ ./a.out err1.c
Error at line 3, column 10: Expected array index
```

LAB7 Inputs:

err1.c — lab7

```
main(){
    int a = 5, b ;
    a = a + 5;
    }
```

err2.c

```
main(){
```

OUTPUT:

```
student@oslab-02:~/220905128/lab7$ ./a.out err1.c
Error at line 2, column 11: Expected ';'
student@oslab-02:~/220905128/lab7$ ./a.out err2.c
Error at line 3, column 1: Expected '}'
```