LAB EXERCISES:

1. For given subset of grammar 7.1, design RD parser with appropriate error messages with expected character and row and column number.

Program → main () { declarations assign_stat }
declarations→ data-type identifier-list; declarations | ∈
data-type → int | char
identifier-list → id | id, identifier-list
assign_stat → id=id; | id = num;

Program:

//Parser.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>
#include "la.h"

void program();
void declarations();
void data_type();
void identifier_list();
void assign_stat();


struct token curr;
FILE *f1;
void invalid(){
  printf("error");
  exit(0);
}
void program()
{

  if(strcmp(curr.lexeme,"main")==0)
  {
    curr=getnexttoken(f1);
    if(strcmp(curr.lexeme,"(")==0)
    {
      curr=getnexttoken(f1);
      if(strcmp(curr.lexeme,")")==0)
      {
```

```
        curr=getnexttoken(f1);;
        if(strcmp(curr.lexeme,"{")==0)
        {
          curr=getnexttoken(f1);
          declarations();
          assign_stat();
          if(strcmp(curr.lexeme,"}")==0)
          {
            return;
          }
          else
        {
          printf("\nMissing } at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
        }
        else
        {
          printf("\nMissing { at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
      }
      else
        {
          printf("\nMissing ) at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
    }
    else
        {
          printf("\nMissing ( at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
  }
  else
        {
          printf("\nMissing main function\n\n");
          exit(0);
        }
}


void declarations()
{

  if(isdatatype(curr.lexeme)==0)
  {
    return;
```

```
  }
  data_type();
  identifier_list();
  if(strcmp(curr.lexeme,";")==0)
  {
    curr=getnexttoken(f1);
    declarations();
  }
  else {printf("\nMissing ; at row:%d and col:
%d.\n\n",curr.row,curr.col); exit(0);}



}


void data_type()
{
  if(strcmp(curr.lexeme,"int")==0)
  {
    curr=getnexttoken(f1);
    return;
  }
  else if(strcmp(curr.lexeme,"char")==0)
  {
    curr=getnexttoken(f1);
    return;
  }
  else
        {
          printf("\nMissing data type at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
}


void identifier_list()
{
  if(strcmp(curr.type,"identifier")==0)
  {
    curr=getnexttoken(f1);
    if(strcmp(curr.lexeme,",")==0)
    {
      curr=getnexttoken(f1);
      identifier_list();
    }
    else return;
  }


  else
```

```
    {
      printf("\nMissing identifier at row:%d and col:
%d.\n\n",curr.row,curr.col);
      exit(0);
    }
}


void assign_stat()
{
  if(strcmp(curr.type,"identifier")==0)
  {
    curr=getnexttoken(f1);
    if(strcmp(curr.lexeme,"=")==0)
    {
      curr=getnexttoken(f1);
      if(strcmp(curr.type,"identifier")==0)
      {
        curr=getnexttoken(f1);
        if(strcmp(curr.lexeme,";")==0)
        {
          curr=getnexttoken(f1);
          return;
        }
      }


    else if(strcmp(curr.type,"number")==0)
    {
      curr=getnexttoken(f1);
        if(strcmp(curr.lexeme,";")==0)
        {
          curr=getnexttoken(f1);
          return;
        }
        else
        {
          printf("\nMissing ; at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }


    }
    else
        {
          printf("\nMissing identifier at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
    }
    else
```

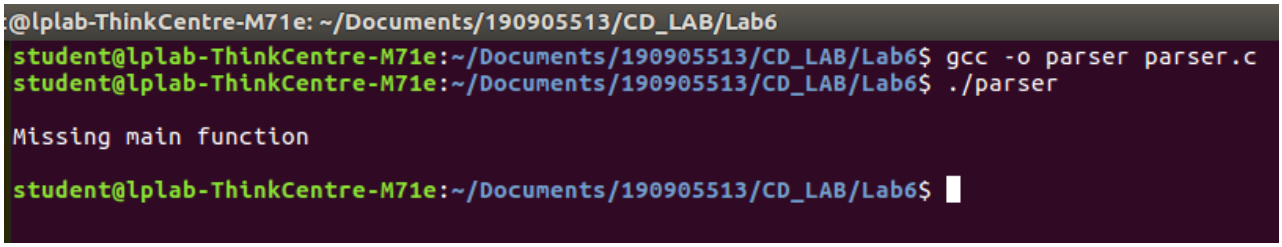
```
        {
          printf("\nMissing = at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
  }
  else
        {
          printf("\nMissing identifier at row:%d and col:
%d.\n\n",curr.row,curr.col);
          exit(0);
        }
}


int main()
{
  FILE *fa, *fb;
  int ca, cb;
  fa = fopen("input1.c", "r");
  if (fa == NULL){
    printf("Cannot open file \n");
    return 0;
  }
  fb = fopen("input2.c", "w");
  ca = getc(fa);
  while (ca != EOF){
    if(ca==' ')
    {
      putc(ca,fb);
      while(ca==' ')
        ca = getc(fa);
    }
    if (ca=='/')
    {
      cb = getc(fa);
      if (cb == '/')
      {
        while(ca != '\n')
          ca = getc(fa);
      }
      else if (cb == '*')
      {
        do
        {
          while(ca != '*')
            ca = getc(fa);
          ca = getc(fa);
        } while (ca != '/');
      }
      else{
        putc(ca,fb);
```

```
        putc(cb,fb);
      }
    }
    else putc(ca,fb);
    ca = getc(fa);
  }
  fclose(fa);
  fclose(fb);
  fa = fopen("input2.c", "r");
  if(fa == NULL){
    printf("Cannot open file");
    return 0;
  }
  fb = fopen("input1.c", "w");
  ca = getc(fa);
  while(ca != EOF){
    if(ca == '#'){
      while(ca != '\n'){
        ca = getc(fa);
      }
    }
    ca = getc(fa);
    if(ca != EOF && ca != '#'){
      putc(ca, fb);
    }
  }
  fclose(fa);
  fclose(fb);

  fa = fopen("input1.c", "r");
  fb = fopen("input2.c", "w");
  ca = getc(fa);
  while(ca != EOF){
    putc(ca, fb);
    ca = getc(fa);
  }
  fclose(fa);
  fclose(fb);
  f1=fopen("input2.c","r");
  if(f1==NULL)
   {
     printf("Error! File cannot be opened!\n");
     return 0;
   }
  struct token tkn;
  curr=getnexttoken(f1);
  program();
  printf("\nCompiled\n\n");
fclose(f1);
}
```

Output:



//La.h

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


struct token{
    char lexeme[64];
    int row,col;
    char type[20];
};


static int row=1,col=1;
char buff[2048];
const char specialsymbols[]={'?',';',':',','};
const char
*keywords[]={"const","char","int","return","for","while","do","swi
tch","if","else","unsigned","case","break"};
const char *datatypes[]={"int","char","void","float","bool"};


const char arithmeticsymbols[]={'*'};


int isdatatype(char *w){
    int i;
    for(i=0;i<sizeof(datatypes)/sizeof(char *);i++){
        if(strcmp(w,datatypes[i])==0){
            return 1;
        }
    }
    return 0;
}


int iskeyword(char *str){
    for(int i=0;i<sizeof(keywords)/sizeof(char *);i++){
        if(strcmp(str,keywords[i])==0){
            return 1;
```

```
        }
    }
    return 0;
}


int charbelongsto(int c, const char *arr){
    int len;
    if(arr==specialsymbols){
        len=sizeof(specialsymbols)/sizeof(char);
    }else if(arr==arithmeticsymbols){
        len=sizeof(arithmeticsymbols)/sizeof(char);
    }
    for(int i=0;i<len;i++){
        if(c==arr[i]){
            return 1;
        }
    }
    return 0;
}



void filltoken(struct token *tkn, char c, int row, int col, char
*type){
    tkn->row=row;
    tkn->col=col;
    strcpy(tkn->type,type);
    tkn->lexeme[0]=c;
    tkn->lexeme[1]='\0';
}


void newline(){
    row++;
    col=1;


}


struct token getnexttoken(FILE *f1){
    int c;
    struct token tkn={
        row=-1
    };
    int gottoken=0;


    while(!gottoken &&(c=fgetc(f1))!=EOF){
        if(charbelongsto(c,specialsymbols)){
            filltoken(&tkn,c,row,col,"specialsymbols");
```

```
    gottoken=1;
    col++;
}


else if(charbelongsto(c,arithmeticsymbols)){
    filltoken(&tkn,c,row,col,"arithmeticoperator");
    gottoken=1;
    col++;
}


else if(c=='('){
    filltoken(&tkn,c,row,col,"leftbracket");
    gottoken=1;
    col++;
}
else if(c==')'){
    filltoken(&tkn,c,row,col,"rightbracket");
    gottoken=1;
    col++;
}
else if(c=='{'){
    filltoken(&tkn,c,row,col,"left curly");
    gottoken=1;
    col++;
}
else if(c=='}'){
    filltoken(&tkn,c,row,col,"right curly");
    gottoken=1;
    col++;
}
else if(c=='+'){
    int d=fgetc(f1);
    if(d!='+'){
        filltoken(&tkn,c,row,col,"arithmeticoperator");
        gottoken=1;
        col++;
        fseek(f1,-1,SEEK_CUR);
    }else{
        filltoken(&tkn,c,row,col,"unary coperator");
        strcpy(tkn.lexeme,"++");
        gottoken=1;
        col+=2;

    }
}
else if(c=='+'){
    int d=fgetc(f1);
    if(d!='-'){
        filltoken(&tkn,c,row,col,"arithmeticoperator");
        gottoken=1;
```

```
        col++;
        fseek(f1,-1,SEEK_CUR);
    }else{
        filltoken(&tkn,c,row,col,"unary operator");
        strcpy(tkn.lexeme,"--");
        gottoken=1;
        col+=2;

    }
}
else if(c=='='){
    int d=fgetc(f1);
    if(d!='-'){
        filltoken(&tkn,c,row,col,"arithmeticoperator");
        gottoken=1;
        col++;
        fseek(f1,-1,SEEK_CUR);
    }else{
        filltoken(&tkn,c,row,col,"relational operator");
        strcpy(tkn.lexeme,"==");
        gottoken=1;
        col+=2;

    }
}
else if(isdigit(c)){
    tkn.row=row;
    tkn.col=col;
    tkn.lexeme[0]=c;
    int k=1;
    while((c=fgetc(f1))!=EOF&&isdigit(c)){
        tkn.lexeme[k++]=c;
        col++;
    }
    tkn.lexeme[k]='\0';
    strcpy(tkn.type,"number");
    gottoken=1;
    fseek(f1,-1,SEEK_CUR);
}


else if(c=='#'){
    while((c=fgetc(f1))!=EOF&&c!='\n');
    newline();

}


else if(c=='\n'){
    newline();
    c=fgetc(f1);
    if(c=='#'){
```

```
        while((c=fgetc(f1))!=EOF&&c!='\n');
        newline();

    }


    else if(c!=EOF){
        fseek(f1,-1,SEEK_CUR);
    }
}


else if(isspace(c)){
    col++;
}


else if(isalpha(c)||c=='_'){
    tkn.row=row;
    tkn.col=col++;
    tkn.lexeme[0]=c;
    int k=1;
    while((c=fgetc(f1))!=EOF && isalnum(c)){
        tkn.lexeme[k++]=c;
        col++;
    }
    tkn.lexeme[k]='\0';
    if(iskeyword(tkn.lexeme)){
        strcpy(tkn.type,"keyword");
    }else{
        strcpy(tkn.type,"identifier");
    }
    gottoken=1;
    fseek(f1,-1,SEEK_CUR);
}


else if(c=='/'){
    int d=fgetc(f1);
    col++;
    if(d=='/'){
        while((c=fgetc(f1))!=EOF&&c!='\n'){
            col++;
        }
        if(c=='\n'){
            newline();
        }
    }else if(d=='*'){
        do{
            if(d=='\n'){
                newline();
            }
```

```
            while((c=fgetc(f1))!=EOF &&c!='*'){
                col++;
                if(c=='\n'){
                    newline();
                }
            }
            col++;
        }
        while((d=fgetc(f1))!=EOF &&d!='/' &&col++);
            col++;



    }else{
        filltoken(&tkn,c,row,col--,"arithmeticoperator");
        gottoken=1;
        fseek(f1,-1,SEEK_CUR);
    }
}
else if(c=='"'){
    tkn.row=row;
    tkn.col=col;
    strcpy(tkn.type,"String literal");
    int k=1;
    tkn.lexeme[0]='"';
    while((c=fgetc(f1))!=EOF &&c!='"'){
        tkn.lexeme[k++]=c;
        col++;
    }
    tkn.lexeme[k]='"';
    gottoken=1;
}


else if(c=='<' || c=='>' || c=='!'){
    filltoken(&tkn,c,row,col,"relational operator");
    col++;
    int d=fgetc(f1);
    if(d=='='){
        col++;
        strcat(tkn.lexeme,"=");
    }
    else{
        if(c=='!'){
            strcpy(tkn.type,"logical operator");
        }
        fseek(f1,-1,SEEK_CUR);
    }
        gottoken=1;

}
```

```
        else if(c=='&'||c=='|'){
            int d=fgetc(f1);
            if(c==d){
                tkn.lexeme[0]=tkn.lexeme[1]=c;
                tkn.lexeme[2]='\0';
                tkn.row=row;
                tkn.col=col;
                col++;
                gottoken=1;
                strcpy(tkn.type,"logical operator");
            }else{
                fseek(f1,-1,SEEK_CUR);
            }
            col++;
        }
        else{
            col++;
        }
    }
        return tkn;


}
```