Lab Manual

OF

Compiler Design

Bachelor of Technology (CSE)

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1. Write a program to recognize the string starting from ‘a’ over {a,b}.

Code:

```
#include<stdio.h>
int main()
{
   char string[100];
   printf("Enter the string: ");
   scanf("%s", string);
   int i=0, state=0;
   while(string[i]!='\0')
   {
      switch(state)
      {
         case 0: if(string[i]=='a') state=1;
                 else if(string[i]=='b')state=2;
                 else state=3;
                 break;
         case 1: if(string[i]=='a')
                    state=1;
                 else if(string[i]=='b')
                    state=1;
                 else
                    state=3;
                 break;
         case 2: if(string[i]=='a')
                    state=2;
                 else if(string[i]=='b')
                    state=2;
                 else
                    state=3;
                 break;
         case 3: break;
      }
      i++;
   }
   if(state==1)
      printf("String accepted\n");
   else if(state==2)
      printf("String not accepted\n");
   else
      printf("String not recognized\n");
```

```
return 0;
}
```

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p1.exe
Enter the string: abbaab
String accepted

C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p1.exe
Enter the string: baab
String not accepted

C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p1.exe
Enter the string: aab4aab
String not recognized
```

2. Write a program to recognize the string ending on ‘a’ over {a,b}.

Code:

```
#include<stdio.h>
int main()
{
   char string[100];
   int state=0, i=0;
   printf("Enter a string: ");
   scanf("%s", string);

   while (string[i]!='\0')
   {
      switch(state)
      {
         case 0:
            if(string[i]=='a') state=1;
            else if(string[i]=='b') state=0;
            else state=2;
            break;
         case 1:
            if(string[i]=='a') state=1;
            else if(string[i]=='b') state=0;
            else state=2;
            break;
         case 2:
            break;
```

```
        }
        i++;
    }
    if(state==1)
        printf("String accepted\n");
    else if(state==0)
        printf("String not accepted\n");
    else
        printf("String not recognized\n");

return 0;
}
```

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p2.exe
Enter a string: abbaa
String accepted

C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p2.exe
Enter a string: aabbaab
String not accepted

C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p2.exe
Enter a string: aabaab5
String not recognized
```

3. Write a program to recognize strings end with ‘ab’. Take the input from text file.

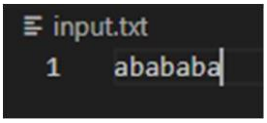
Code:

```
#include <stdio.h>

#include <string.h>


int main() {

    char string[100];

    FILE *file = fopen("input.txt", "r");

    if (file == NULL) {
```

```
    printf("Could not open file input.txt\n");
    return 1;
}
while (fgets(string, sizeof(string), file))
{
    int i = 0, state = 0;
    while (string[i] != '\0')
    {
        switch (state) {
            case 0:
                if (string[i] == 'a') state = 1;
                else if (string[i] == 'b') state = 0;
                else state = 3;
                break;
            case 1:
                if (string[i] == 'a') state = 1;
                else if (string[i] == 'b') state = 2;
                else state = 3;
                break;
            case 2:
                if (string[i] == 'a') state = 1;
                else if (string[i] == 'b') state = 0;
                else state = 3;
                break;
            case 3:
```

```
                state = 3;
                break;
            }
            i++;
        }
        if (state == 2)
            printf("String accepted: %s\n", string);
        else if (state == 0 || state == 1)
            printf("String not accepted: %s\n", string);
        else
            printf("String not recognized: %s\n", string);
    }
    fclose(file);
    return 0;
}
```

Input:



Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p33.exe
String not accepted: abababa
```

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p33.exe
String accepted: abababab
```

4. Write a program to recognize strings contains ‘ab’. Take the input from text file.

Code:

```
#include<stdio.h>
int main()
{
   char string[100];
   FILE *file = fopen("4th.txt", "r");
   if (file == NULL) {
      printf("Could not open file input.txt\n");
      return 1;
   }
   while(fgets(string, sizeof(string), file))
   {
      int i=0, state=0;
      while(string[i]!='\0')
      {
         switch(state)
         {
            case 0:
               if(string[i]=='a') state=1;
               else if(string[i]=='b') state=0;
               break;
            case 1:
               if(string[i]=='a') state=1;
               else if(string[i]=='b') state=2;
               break;
            case 2:
               if(string[i]=='a') state=1;
               else if(string[i]=='b') state=2;
               break;
         }
         i++;
      }
      if(state==2)
         printf("String accepted: %s\n", string);
      else if(state==0 || state==1)
         printf("String not accepted: %s\n", string);
      else
         printf("String not recognized: %s\n", string);
   }
```

}

Input:

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab>p4.exe
String accepted: aaababbbab
```

5. Single line comment

Code:

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

int main()
{
   char string[100];
   FILE *file = fopen("comment.txt", "r");
   if (file == NULL) {
      printf("Could not open file input.txt\n");
      return 1;
   }
   while (fgets(string, sizeof(string), file))
   {
      int i=0, state=0;
      while(string[i]!='\0')
      {
         switch(state)
         {
            case 0:
               if(string[i]=='/') state=1;
               else state=2;
               break;
            case 1:
               if(string[i]=='/') state=3;
               else state=2;
               break;
            case 2:
```

```
                break;
            case 3:
                break;
        }
        i++;
    }
    if(state==3)
        printf("Comment valid: %s\n", string);
    else
        printf("Comment not valid: %s\n", string);
  }

}
```

6. Multiline Comment Code:

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

int main()
{
   char string[1000];
   FILE *file = fopen("comment2.txt", "r");
   if (file == NULL) {
      printf("Could not open file input.txt\n");
      return 1;
   }
   while (fgets(string, sizeof(string), file))
   {
      int i=0, state=0;
      while(string[i]!='\0')
      {
         switch(state)
         {
            case 0:
               if(string[i]=='/') state=1;
```

```
            else state=2;
            break;
        case 1:
            if(string[i]=='/') state=3;
            else if (string[i]=='*') state=4;
            else state=2;
            break;
        case 2:
            break;
        case 3:
            break;
        case 4:
            if (string[i]=='*') state=5;
            else state=4;
        case 5:
            if(string[i]=='/') state=6;
            else state=4;
        case 6:
            break;
      }
      i++;
    }
    if(state==3)
      printf("Singleline Comment valid: %s\n", string);
    else if(state==6)
      printf("Multiline Comment valid: %s\n", string);
    else
      printf("Comment not valid: %s\n", string);
  }

}
```

2(a). Write a program to recognize the valid identifiers.
Code:

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

int main()
{
    char string[1000];
    printf("Enter the string: ");
    scanf("%s", string);  // Prevents buffer overflow
    int i = 0, state = 0;
    int num=1;
    while (num>0)
    {
        switch (state)
        {
            case 0: //A
                if (string[i] == 'i') state = 1;
                else if (isalpha(string[i]) || string[i] == '_') state = 5;
                break;

            case 1: //B
                if (string[i] == 'n') state = 2;
                else if (isalpha(string[i]) || string[i] == '_' ||
isdigit(string[i])) state = 5;
                else state = 6;
                break;

            case 2: //C
                if (string[i] == 't') state = 3;
                else if (isalpha(string[i]) || string[i] == '_' ||
isdigit(string[i])) state = 5;
                else state = 6;
                break;

            case 3: //D
                if (string[i] == '\0') state = 4;
                else if (isalpha(string[i]) || isdigit(string[i]) || string[i] ==
'_') state = 5;
                num--;
                break;
```

```
            case 4: //E
                // No transition needed, final accepting state
                break;

            case 5: //F
                if (isalpha(string[i]) || isdigit(string[i]) || string[i] == '_')
state = 5;
                else state = 6;  // No need for checking '\0' here, it will end
the loop
                break;

            case 6: //G
                // No transition needed, final rejecting state
                break;
        }
        i++;
    }
    if (state == 3 || state==4)
        printf("int is keyword.");
    else if (state == 6)
        printf("%s is valid identifier.", string);
    else
        printf("%s is invalid identifier.", string);

    return 0;
}
```

Output:

```
Enter the string: int a
int is keyword.
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab\lab2\output>
```

2(b). Write a program to recognize the valid operators.

Code:

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

int main()
{
    char string[1000];
    printf("Enter the string: ");
    scanf("%s", string);  // Prevents buffer overflow
    int i = 0, state = 0;
    int num=1;
    while (num>0)
    {
        switch(state)
        {
            case 0:
                if (string[i] == '+') state = 51;
                else if(string[i] == '*') state = 51;
                else if(string[i] == '/') state = 60;
                else if(string[i] == '=') state = 53;
                else if(string[i] == '-') state = 54;
                else if(string[i] == '?') state = 55;
                else if(string[i] == '<') state = 56;
                else if(string[i] == '>') state = 59;
                else if(string[i] == '!') state = 57;
                else if(string[i] == '&') state = 58;
                else if(string[i] == '|') state = 61;
                else if(string[i] == '~' || string[i] == '^') state = 62;
                break;

            case 51: // Arithmetic
                if (string[i] == '\0') state = 51;
                else if (string[i] == '+') state = 52;
                else if (string[i] == '=') state = 53;
                else state = 0;
                num--;
                break;

            case 52: // Unary
                break;

            case 53: // Assignment
```

```
            if(string[i] == '=') state = 56;
            else state = 0;
            num--;
            break;

        case 54: // -
            if (string[i] == '\0') state = 51;
            else if (string[i] == '-') state = 52;
            else if (string[i] == '=') state = 53;
            else state = 0;
            num--;
            break;

        case 55: // Ternary
            if (string[i] == ':') state = 55;
            else if(string[i] == '\0') state = 0;
            else state = 0;
            num--;
            break;

        case 56: //Relational
            if (string[i] == '=') state = 56;
            else if(string[i] == '<') state = 58;
            else state = 0;
            num--;
            break;

        case 59: // >
            if (string[i] == '>') state = 58;
            else if (string[i] == '=') state = 56;
            else state = 0;
            num--;
            break;

        case 57: // Logical
            if (string[i] == '=') state = 56;
            else if(string[i] == '\0') state = 57;
            else state = 0;
            num--;
            break;

        case 58: // Bitwise
            if (string[i] == '&') state = 57;
            else if(string[i] == '\0') state = 58;
            else state = 0;
```

```
                num--;
                break;

            case 60: // "/"
                if (string[i] == '\0') state = 51;
                else state = 0;
                num--;
                break;

            case 61: // "|"
                if (string[i] == '|') state = 57;
                else if(string[i] == '\0') state = 58;
                else state = 0;
                num--;
                break;

            case 62: // ~ ^
                if (string[i] == '\0') state = 58;
                else state = 0;
                num--;
                break;
        }
        i++;
    }

    if (state == 51) printf("%s is an Arithmatic operator.", string);
    else if(state == 52) printf("%s is an Unary operator.", string);
    else if(state == 53) printf("%s is an Assignment operator.", string);
    else if(state == 55) printf("%s is ternary or conditional operator.",
string);
    else if(state == 56) printf("%s is a Relational Operator.", string);
    else if(state == 57) printf("%s is a Logical operator.", string);
    else if(state == 58) printf("%s is a Bitwise operator.", string);
    else
        printf("Processing.....");

    return 0;


}
```

Output:

```
Enter the string: <=
<= is a Relational Operator.
```

2(c). Write a program to recognize the valid number.

Code:

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

int main() {
    FILE *file;
    char buffer[100];
    char lexeme[100];
    char c;
    int f, i, state;

    file = fopen("numbers.txt", "r");
    if (file == NULL) {
        printf("Error opening file.\n");
        return 1;
    }

    while (fgets(buffer, 100, file)) {
        buffer[strcspn(buffer, "\n")] = 0;
        f = 0;
        i = 0;
        state = 0;

        while (buffer[f] != '\0')
            switch (state) {
                case 0:
                    c = buffer[f];
                    if (isdigit(c)) { state = 40; lexeme[i++] = c; }
                    else { state = 0; }
                    break;

                case 40:
                    c = buffer[f];
                    if (isdigit(c)) { state = 40; lexeme[i++] = c; }
                    else if (c == '.') { state = 41; lexeme[i++] = c; }
                    else if (c == 'E' || c == 'e') { state = 43; lexeme[i++] = c;
}
                    else {
                        lexeme[i] = '\0';
                        printf("%s is a valid number\n", lexeme);
```

```
                        i = 0;
                        state = 0;
                        f--;
                    }
                    break;

                case 41:
                    c = buffer[f];
                    if (isdigit(c)) { state = 42; lexeme[i++] = c; }
                    else {
                        lexeme[i] = '\0';
                        printf("%s is an invalid number (expected digit after
decimal)\n", lexeme);
                        i = 0;
                        state = 0;
                        f--;
                    }
                    break;

                case 42:
                    c = buffer[f];
                    if (isdigit(c)) { state = 42; lexeme[i++] = c; }
                    else if (c == 'E' || c == 'e') { state = 43; lexeme[i++] = c;
}
                    else {
                        lexeme[i] = '\0';
                        printf("%s is a valid number\n", lexeme);
                        i = 0;
                        state = 0;
                        f--;
                    }
                    break;

                case 43:
                    c = buffer[f];
                    if (c == '+' || c == '-') { state = 44; lexeme[i++] = c; }
                    else if (isdigit(c)) { state = 45; lexeme[i++] = c; }
                    else {
                        lexeme[i] = '\0';
                        printf("%s is an invalid number (expected digit or sign
after 'E'/'e')\n", lexeme);
                        i = 0;
                        state = 0;
                        f--;
                    }
```

```
                    break;

                case 44:
                    c = buffer[f];
                    if (isdigit(c)) { state = 45; lexeme[i++] = c; }
                    else {
                        lexeme[i] = '\0';
                        printf("%s is an invalid number (expected digit after
sign in exponent)\n", lexeme);
                        i = 0;
                        state = 0;
                        f--;
                    }
                    break;

                case 45:
                    c = buffer[f];
                    if (isdigit(c)) { state = 45; lexeme[i++] = c; }
                    else {
                        lexeme[i] = '\0';
                        printf("%s is a valid number\n", lexeme);
                        i = 0;
                        state = 0;
                        f--;
                    }
                    break;
            }
            f++;
        }

        if (state == 40 || state == 41 || state == 42 || state == 45) {
            lexeme[i] = '\0';
            printf("%s is a valid number\n", lexeme);
        } else {
            printf("%s is an invalid number\n", buffer);
        }
    }

    fclose(file);
    return 0;
}
```

Output:

```
31.1e31 is a valid number
123.123 is a valid number
12.42e-2 is a valid number
3E+2 is a valid number
3e2 is a valid number
```

2(d). Write a program to recognize the valid comments.

Code:

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

int main()
{
    char string[1000];
    FILE *file = fopen("comment2.txt", "r");
    if (file == NULL) {
        printf("Could not open file input.txt\n");
        return 1;
    }
    while (fgets(string, sizeof(string), file))
    {
        int i=0, state=0;
        while(string[i]!='\0')
        {
            switch(state)
            {
                case 0:
                    if(string[i]=='/') state=1;
                    else state=2;
                    break;
                case 1:
                    if(string[i]=='/') state=3;
                    else if (string[i]=='*') state=4;
                    else state=2;
                    break;
                case 2:
                    break;
                case 3:
                    break;
```

```
                case 4:
                    if (string[i]=='*') state=5;
                    else state=4;
                case 5:
                    if(string[i]=='/') state=6;
                    else state=4;
                case 6:
                    break;
            }
            i++;
        }
        if(state==3)
            printf("Singleline Comment valid: %s\n", string);
        else if(state==6)
            printf("Multiline Comment valid: %s\n", string);
        else
            printf("Comment not valid: %s\n", string);
    }
return 0;
}
```

2(e). Program to implement Lexical Analyzer.

Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
#include <string.h>
#define BUFFER_SIZE 1000
void check(char *lexeme);

int main() {
    FILE *f1;
    char buffer[BUFFER_SIZE], lexeme[50]; // Static buffer for input and lexeme
storage
    char c;
    int f = 0, state = 0, i = 0;
    f1 = fopen("Input.txt", "r");
    fread(buffer, sizeof(char), BUFFER_SIZE - 1, f1);
    buffer[BUFFER_SIZE - 1] = '\0'; // Null termination
    fclose(f1);

    while (buffer[f] != '\0') {
        c = buffer[f];
        switch (state) {
            case 0:
                if (isalpha(c) || c == '_') {
                    state = 1;
                    lexeme[i++] = c;
                }
                else if (c == ' ' || c == '\t' || c == '\n') {
                    state = 0;
                }
                else if(isdigit(c)) {
                    state = 13;
                    lexeme[i++] = c;
                }
                else if (c == '/') {
                    state = 11;   // For comment
                }
                else if (c == ';' || c == ',' || c == '{' || c == '}') {
                    printf(" %c is a symbol\n", c);
                    state = 0;
                }
                else if (strchr("+-*/=%?<>!&|~^", c)) {
```

```
                    state = 50;
                    lexeme[i++] = c;
                }
                else {
                    state = 0;
                }
                break;

            case 1:
                if (isalpha(c) || isdigit(c) || c == '_') {
                    state = 1;
                    lexeme[i++] = c;
                } else {
                    lexeme[i] = '\0'; // Null-terminate the lexeme
                    check(lexeme);  // Check if it's a keyword or identifier
                    state = 0;
                    i = 0;
                    f--; // Step back to reprocess the current non-alphanumeric
character
                }
                break;

            case 13:
                if(isdigit(c)) {
                    state = 13;
                    lexeme[i++] = c;
                }
                else if(c=='.') {
                    state=14;
                    lexeme[i++]=c;
                }
                else if(c=='E'||c=='e') {
                    state=16;
                    lexeme[i++]=c;
                }
                else {
                    lexeme[i]='\0';
                    printf("%s is a valid number\n", lexeme);
                    i=0;
                    state=0;
                    f--;
                }
                break;

            case 50: // Operator Handling
```

```
            switch (lexeme[0]) {
                case '+':
                    if (c == '+') {
                        printf("%s is a Unary operator\n", lexeme);
                        state = 0;
                    }
                    else if (c == '=') {
                        printf("%s is an Assignment operator\n", lexeme);
                        state = 0;
                    }
                    else {
                        printf("%s is an Arithmetic operator\n", lexeme);
                        state = 0;
                        f--;
                    }
                    break;

                case '-':
                    if (c == '-') {
                        printf("%s is a Unary operator\n", lexeme);
                        state = 0;
                    }
                    else if (c == '=') {
                        printf("%s is an Assignment operator\n", lexeme);
                        state = 0;
                    }
                    else {
                        printf("%s is an Arithmetic operator\n", lexeme);
                        state = 0;
                        f--;
                    }
                    break;

                case '*':
                case '/':
                case '%':
                    if (c == '=') {
                        printf("%s is an Assignment operator\n", lexeme);
                        state = 0;
                    }
                    else {
                        printf("%s is an Arithmetic operator\n", lexeme);
                        state = 0;
                        f--;
                    }
```

```
            break;

        case '=':
            if (c == '=') {
                printf("%s is a Relational operator\n", lexeme);
                state = 0;
            }
            else {
                printf("%s is an Assignment operator\n", lexeme);
                state = 0;
                f--;
            }
            break;

        case '<':
        case '>':
            if (c == '=' || c == lexeme[0]) {
                printf("%s is a Relational operator\n", lexeme);
                state = 0;
            }
            else {
                printf("%s is a Relational operator\n", lexeme);
                state = 0;
                f--;
            }
            break;

        case '!':
        case '&':
        case '|':
            if (c == '=') {
                printf("%s is a Logical operator\n", lexeme);
                state = 0;
            }
            else if (c == lexeme[0]) {
                printf("%s is a Logical operator\n", lexeme);
                state = 0;
            }
            else {
                printf("%s is a Logical operator\n", lexeme);
                state = 0;
                f--;
            }
            break;
```

```
                    case '~':
                    case '^':
                        printf("%s is a Bitwise operator\n", lexeme);
                        state = 0;
                        f--;
                        break;

                    case '?':
                        if (c == ':') {
                            printf("%s is a Ternary or conditional operator\n",
lexeme);
                            state = 0;
                        }
                        else {
                            state = 0;
                            f--;
                        }
                        break;

                    default:
                        state = 0;
                        break;
                }
                lexeme[0] = '\0';
                i = 0;
                break;

            default:
                state = 0;
                break;
        }
        f++;
    }
}

void check(char *lexeme) {
    char *keywords[] = {
    "auto", "break", "case", "char", "const", "continue", "default", "do",
    "double", "else", "ef", "extern", "float", "for", "goto", "if",
    "inline", "int", "long", "register", "restrict", "return", "short", "signed",
    "sizeof", "static", "struct", "switch", "typedef", "union", "unsigned",
"void", "volatile", "while"
};
    for (int i = 0; i < 32; i++) {
        if (strcmp(lexeme, keywords[i]) == 0) {
```

```
            printf("%s is a keyword\n", lexeme);
            return;
        }
    }
    printf("%s is an identifier\n", lexeme);
}
```

Output:

```
int is a keyword
main is an identifier
 { is a symbol
int is a keyword
a is an identifier
= is an Assignment operator
10 is a valid number
 ; is a symbol
int is a keyword
b is an identifier
= is an Assignment operator
20 is a valid number
int is a keyword
sum is an identifier
=um is an Assignment operator
0 is a valid number
 ; is a symbol
sum is an identifier
=um is an Assignment operator
a is an identifier
+ is an Arithmetic operator
b is an identifier
 ; is a symbol
printf is an identifier
sum is an identifier
a is an identifier
+ is a Unary operator
 ; is a symbol
a is an identifier
+ is an Assignment operator
b is an identifier
 ; is a symbol
 } is a symbol
C is an identifier
```

4. Implement following programs using Lex.

a. Write a Lex program to take input from text file and count no of characters, no. of lines & no. of words.

Code:

```
%{

#include<stdio.h>

int words=0,characters=0,no_of_lines=0;

%}

%%

\n {no_of_lines++,words++;}

. characters++;

[\t ]+ words++;

%%

void main(){

yyin = fopen("4_1.txt","r");

yylex();

printf("This file is containing %d words.\n",words);

printf("This file is containing %d characters.\n",characters);

printf("This file is containing %d no_of_lines.\n",no_of_lines);

}

int yywrap(){ return(1);}
```

Output:

```
This file is containing 7 words.
This file is containing 57 characters.
This file is containing 7 no_of_lines.
```

b. Write a Lex program to take input from text file and count number of vowels and consonants.

Code:

```
%{

#include<stdio.h>

int vowels=0, consonant=0;

%}

%%

[aeiouAEIOU] vowels++;

[a-zA-Z] consonant++;

. ;

\n ;

%%

void main(){

yyin = fopen("input.txt","r");

yylex();

printf("This file is containing %d vowels.\n",vowels);

printf("This file is containing %d consonants.\n",consonant);

}

int yywrap(){ return(1);}
```

Output:

```
This file is containing 12 vowels.
This file is containing 22 consonants.
```

c. Write a Lex program to print out all numbers from the given file.

Code:

```
%{
  #include<stdio.h>
%}
%%
[0-9]+(.[0-9]+)?([eE][+-]?[0-9]+)?  printf("%s is valid number \n",yytext);
\n        ;
.         ;
%%

void main() {
yyin = fopen("input.txt","r");
yylex();
}
int yywrap(){return(1);}
```

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab\LEX\4\3>a.exe
45 is valid number
414 is valid number
37 is valid number
4 is valid number
```

d. Write a Lex program which adds line numbers to the given file and display the same into different file.

Code:

```
%{
int line_number = 1;
%}
%%
.+ {fprintf(yyout,"%d: %s",line_number,yytext);line_number++;}
%%
int main() {
yyin = fopen("input.txt","r");
yyout = fopen("op.txt","w");
yylex();
printf("Done");
return 0;
}
int yywrap(){return(1);}
```

Ouput:

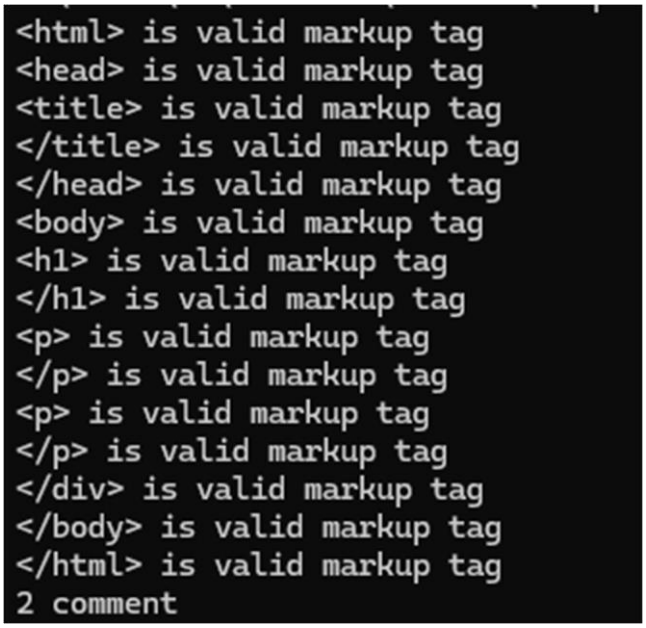
```
1: 45
2: 414
3: 37
4: 4a
5: My name is Pratham.
6: I live in Vadodara.
```

e. Write a Lex program to printout all markup tags and HTML comments in file.

Code:

```
%{
#include<stdio.h>
int num=0;
%}
%%
"<"[A-Za-z0-9]+">"|"<"[/A-Za-z0-9]+">" printf("%s is valid markup tag \n",yytext);
"<!--"[A-Za-z ]*"-->" num++;
.|\n ;
%%
int main() {
yyin = fopen("htmlfile.txt","r");
yylex();
printf("%d comment",num);
return 0;
}
int yywrap(){return(1);}
```

Output:



5(a). Write a Lex program to count the number of C comment lines from a given C program. Also eliminate them and copy that program into separate file.

Code:

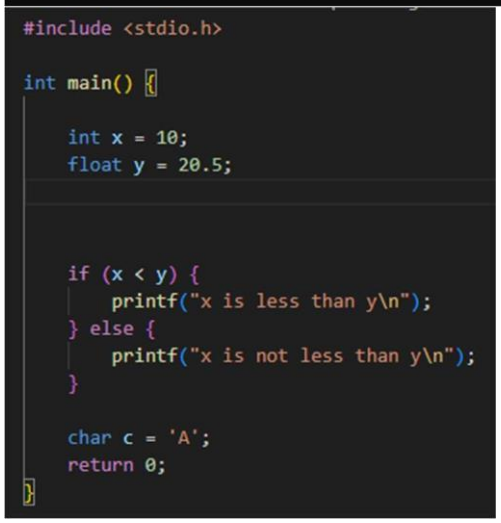
```
%{
#include <stdio.h>
int comment_count = 0;
FILE *outfile;
%}
%%
"//".*                          { comment_count++; /* Skip single-line comment */ }
"/*"([^*]*\*+)*?"/"             { comment_count++; /* Skip multi-line comment */ }
.|\n                            { fputc(yytext[0], outfile); }
%%
int main(int argc, char **argv) {
   if (argc < 2) {
      printf("Usage: %s <input_file>\n", argv[0]);
      return 1;
   }
   FILE *infile = fopen("sample.c", "r");
   if (!infile) {
      perror("Cannot open input file");
      return 1;
   }
   outfile = fopen("cleaned_code.c", "w");
   if (!outfile) {
      perror("Cannot open output file");
      return 1;
   }
   yyin = infile;
   yylex();
   fclose(infile);
   fclose(outfile);
   printf("Total number of comments: %d\n", comment_count);
   return 0;
}
int yywrap(){
   return 1;
}
```

Sample.c :

```
#include <stdio.h>

int main() {
   // This is a single-line comment
   int x = 10;
   float y = 20.5;

   /*
      This is a multi-line comment
      It should be removed
   */

   if (x < y) {
      printf("x is less than y\n");
   } else {
      printf("x is not less than y\n");
   }

   char c = 'A';  // Character literal
   return 0;
}
```

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab\LEX\5\a>a.exe sample.c
Total number of comments: 3
```



5(b). Write a Lex program to recognize keywords, identifiers, operators, numbers, special symbols, literals from a given C program.

Code:

```
%{
#include  <stdio.h>
#include <string.h>
#include <ctype.h>
FILE *outfile;
// C keywords list
char *keywords[] = {
   "int", "float", "return", "if", "else", "while", "for", "char", "double",
   "do", "switch", "case", "break", "continue", "void", "long", "short",
   "unsigned", "signed", "static", "struct", "union", "typedef", "const",
   "goto", "enum", "default", "sizeof", "volatile", "register", NULL
};
int is_keyword(const char *word) {
   for (int i = 0; keywords[i]; i++) {
      if (strcmp(keywords[i], word) == 0)
         return 1;
   }
   return 0;
}
%}
```

```
%%
\"([^"\\]|\\.)*\"        { fprintf(outfile, "String literal: %s\n", yytext); }
\'([^'\\]|\\.)\'         { fprintf(outfile, "Character literal: %s\n", yytext); }
[0-9]+\.[0-9]+           { fprintf(outfile, "Float number: %s\n", yytext); }
[0-9]+                   { fprintf(outfile, "Integer number: %s\n", yytext); }
[a-zA-Z_][a-zA-Z0-9_]*   {
                           if (is_keyword(yytext))
                              fprintf(outfile, "Keyword: %s\n", yytext);
                           else
                              fprintf(outfile, "Identifier: %s\n", yytext);
                         }
"=="|"!="|"<="|">="|"="|"+"|"-"|"*"|"/"|"<"|">"  {
                           fprintf(outfile, "Operator: %s\n", yytext);
                         }
[{}()[\];,]              { fprintf(outfile, "Special symbol: %s\n", yytext); }
[ \t\n]+                 ; // Skip whitespace
.                        { fprintf(outfile, "Unknown token: %s\n", yytext); }
%%
int main(int argc, char **argv) {
   if (argc < 2) {
      printf("Usage: %s <input_file>\n", argv[0]);
      return 1;
   }
```

```
    FILE *infile = fopen("sample.c", "r");
    if (!infile) {
        perror("Cannot open input file");
        return 1;
    }
    outfile = fopen("tokens.txt", "w");
    if (!outfile) {
        perror("Cannot open output file");
        return 1;
    }
    yyin = infile;
    yylex();
    fclose(infile);
    fclose(outfile);
    printf("Tokenization complete. Output written to tokens.txt\n");
    return 0;
}
int yywrap() {
    return 1;
}
```

Sample.c :

```c
#include <stdio.h>

int main() {
    int a = 10;
    float b = 20.5;
    char c = 'Z';
    const char *str = "Hello, World!";

    if (a < b) {
        printf("a is less than b\n");
    } else {
        printf("a is not less than b\n");
    }

    return 0;
}
```

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab\LEX\5\b>a.exe sample.c
Tokenization complete. Output written to tokens.txt
```

Unknown token: #

Identifier: include

Operator: <

Identifier: stdio

Unknown token: .

Identifier: h

Operator: >

Keyword: int

Identifier: main

Special symbol: (

Special symbol:)

Special symbol: {

Keyword: int

Identifier: a

Operator: =

Integer number: 10

Special symbol: ;

Keyword: float

Identifier: b

Operator: =

Float number: 20.5

Special symbol: ;

Keyword: char

Identifier: c

Operator: =

Character literal: 'Z'

Special symbol: ;

Keyword: const

Keyword: char

Operator: *

Identifier: str

Operator: =

String literal: "Hello, World!"

Special symbol: ;

Keyword: if

Special symbol: (

Identifier: a

Operator: <

Identifier: b

Special symbol:)

Special symbol: {

Identifier: printf

Special symbol: (

String literal: "a is less than b\n"

Special symbol:)

Special symbol: ;

Special symbol: }

Keyword: else

Special symbol: {

Identifier: printf

Special symbol: (

String literal: "a is not less than b\n"

Special symbol:)

Special symbol: ;

Special symbol: }

Keyword: return

Integer number: 0

Special symbol: ;

Special symbol: }

6.Program to implement Recursive Descent Parsing in C.

Code:

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

char inp[100];
int l = 0;

void match(char t) {
   if (inp[l] == t) {
      l++;
   } else {
      printf("Error\n");
      exit(0);
   }
}

void E();
void E_prime();

void E() {
   if (inp[l] == 'i') {
      match('i');
      E_prime();
   }
}
void E_prime() {
   if (inp[l] == '+') {
      match('+');
      match('i');
      E_prime();
   } else if (inp[l] == '-') {
      match('-');
      match('i');
      E_prime();
   } else {
      return; // epsilon case
```

```
    }
}
int main() {
    printf("Enter expression: ");
    scanf("%s", inp);

    E();

    if (inp[l] == '$') { // End of input
        printf("Success\n");
    } else {
        printf("Error\n");
    }

    return 0;
}
```

Output:

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab\CD_LAB_EndSem_22000794\Recursive Descent\output>G1.exe
Enter expression: ii
Error
```

```
C:\Users\HP\OneDrive\6th Sem\Compiler Design\Lab\CD_LAB_EndSem_22000794\Recursive Descent\output>G1.exe
Enter expression: i+i-i$
Success
```

7(a). To Study about Yet Another Compiler-Compiler(YACC).

YACC (Yet Another Compiler Compiler) is a parser generator tool used in compiler design to produce syntax analyzers for context-free grammars. It works closely with Lex, where Lex handles lexical analysis and YACC performs syntax analysis based on grammar rules. YACC generates efficient LALR(1) parsers and allows grammar specification in a structured format with declarations, grammar rules, and associated C actions. It interprets token streams from Lex to understand program structure and syntax. Widely used in building compilers and interpreters, YACC simplifies the implementation of parsing logic for programming languages.

7(b). Create Yacc and Lex specification files to recognizes arithmetic expressions involving +, -, * and / .

Code:

Lex:

```
%{
#include<stdlib.h>
void yyerror(char *);
#include "1.tab.h"
%}
%%
[0-9]+ return num;
[-/+*\n] return *yytext;
[ \t] ;
. yyerror("invalid");
%%
int yywrap(){
   return 1;
}
```

Yacc:

```
%{
#include<stdio.h>
int yylex(void);
void yyerror(char *);
%}
%token num
%%
S:E'\n' {printf("Valid syntax."); return 0;}
E:E'-'T {}
 |E'+'T {}
 |T {}
T:T'/'F {}
 |T'*'F {}
 |F {}
F:num {}
%%
void yyerror(char *s){
   printf("%s\n",s);
}
int main(){
   yyparse(); return 0;
}
```

Output:

```
C:\Users\HP\Desktop\Desktop\Try_Cd\Valid not valid on (minus, divide)>a.exe
5*4/3-4+2
Valid syntax.
```

7(c). Create Yacc and Lex specification files are used to generate a calculator which accepts integer type arguments.

Code:

Lex:

```
%{
#include<stdlib.h>
#include "1.tab.h"
void yyerror(char *);
%}
%%
[0-9]+ {yylval=atoi(yytext); return num;}
[-+*/\n] {return *yytext;}
[()/] {return *yytext;}
[ \t] ;
. {yyerror("invalid");}
%%
int yywrap(){
   return 1;
}
```

Yacc:

```
%{
#include<stdio.h>
void yyerror(char *);
int yylex(void);
%}
%token num
```

```
%%
S:E'\n' {printf("%d\n",$1); return 0;}
E:E'-'T {$$=$1-$3;}
 |T {$$=$1;}
T:T'+'F {$$=$1+$3;}
 |F {$$=$1;}
F:F'*'G {$$=$1*$3;}
 |G {$$=$1;}
G:G'/'H {$$=$1/$3;}
 |H {$$=$1;}
H:'('E')' {$$=$2;}
 |num {$$=$1;}
%%
void yyerror(char *s){
   printf("%s\n",s);
}
int main(){
   yyparse(); return 0;
}
```

Output:

```
C:\Users\HP\Desktop\Desktop\Try_Cd\cal>a.exe
100/20-1*3+2
0
```

7(d). Create Yacc and Lex specification files are used to convert infix expression to postfix expression.

Code:

Lex:

```
%{
#include<stdlib.h>
#include "1.tab.h"
void yyerror(char *);
%}
%%
[0-9]+ {yylval.num=atoi(yytext); return INTEGER;}
[A-Za-z_][A-Za-z_0-9]* {yylval.str=yytext; return ID;}
[-+*/\n] {return *yytext;}
[ \t] ;
. {yyerror("Invalid character.");}
%%
int yywrap(){
   return 1;
}
```

Yacc:

```
%{
#include<stdio.h>
int yylex(void);
void yyerror(char *);
%}
%union{
```

```
    char *str;
    int num;
}
%token <num> INTEGER
%token <str> ID
%%
S:E'\n' {printf("\n");}
E:E'-'T {printf("-");}
 |T {}
T:T'+'F {printf("+");}
 |F {}
F:F'*'G {printf("*");}
 |G {}
G:G'/'H {printf("/");}
 |H {}
H:INTEGER {printf("%d",$1);}
 |ID {printf("%s",$1);}
%%
void yyerror(char *s){
    printf("%s\n",s);
}
int main(){
    yyparse(); return 0;
}
```

Output:

```
C:\Users\HP\Desktop\Desktop\Try_Cd\postfix>a.exe
5*3+2
53*2+
```