SCHOOL OF ENGINEERING & TECHNOLOGY

BACHELOR OF TECHNOLOGY

COMPILER DESIGN

6TH SEMESTER

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Laboratory Manual

Name: Kenil Patel

Enrollment no.: 22001012

Course: B.Tech Cse Sem 6

TABLE OF CONTENT

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

Practical-1

Aim1: Write a program to recognize strings starts with ‘a’ over {a, b}.

Procedure:

Source Code:

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

void main()
{
   int n, i = 0, state = 0;
   printf("Enter the length of the string: ");
   scanf("%d", &n);
   char input[n];
   printf("Enter the string: ");
   scanf("%s", &input);
   while (input[i] != '\0')
   {
      switch (state)
      {
      case 0:
         if (input[i] == 'a')
         {
            state = 1;
         }
         else if (input[i] == 'b')
         {
            state = 2;
```

```
        }
        else
            state = 3;
        break;
    case 1:
        if (input[i] == 'a' || input[i] == 'b')
            state = 1;
        else
            state = 3;
        break;
    case 2:
        if (input[i] == 'a' || input[i] == 'b')
            state = 2;
        else
            state = 3;
        break;
    case 3:
        state = 3;
        break;
    }
    i++;
}
if (state == 0 || state == 2)
{
    printf("String is invalid");
}
else if (state == 1)
```

```
    {
        printf("String is valid");
    }
    else
        printf("String is not recognized");
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>gcc first.c -o first

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>first
Enter the length of the string: 3
Enter the string: abb
String is valid
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>
```

Aim2: Write a program to recognize strings end with ‘a’.

Procedure:

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
void main()
{
    int n, i = 0, state = 0;
    printf("Enter the length of the string: ");
    scanf("%d", &n);
    char input[n];
    printf("Enter the string: ");
    scanf("%s", &input);
    while (input[i] != '\0')
```

```
{
   switch (state)
   {
   case 0:
      if (input[i] == 'a')
      {
         state = 1;
      }
      else
      {
         state = 0;
      }
      break;
   case 1:
      if (input[i] == 'a')
      {
         state = 1;
      }
      else
      {
         state = 0;
      }
      break;
   }
   i++;
}
if (state == 0)
```

```
    {
        printf("String is invalid");
    }
    else if (state == 1)
    {
        printf("String is valid");
    }
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>gcc second.c -o second

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>second
Enter the length of the string: 3
Enter the string: aba
String is valid
```

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>second
Enter the length of the string: 3
Enter the string: baa
String is valid
```

Aim3: Write a program to recognize strings end with ‘ab’. Take the input from text file.

Procedure:

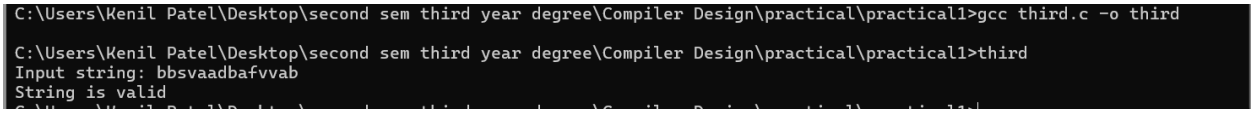
Source Code:

```
#include <stdio.h>
void main()
{
    int state = 0, i = 0;
    FILE *fptr;
    fptr = fopen("input.txt", "r");
    char input[100];
    fgets(input, 100, fptr);
    printf("Input string: %s", input);
    fclose(fptr);
```

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

```
            state = 1;
        }
        else
            state = 0;
        break;
    }
    i++;
}

if (state == 2)
{
    printf("\nString is valid");
}
else
{
    printf("\nString is invalid");
}
}
```

Output:



Aim4: Write a program to recognize strings contains ‘ab’. Take the input from text file.

Procedure:

Source Code:

```
#include <stdio.h>
void main()
{
   int state = 0, i = 0;
   FILE *fptr;
   fptr = fopen("input.txt", "r");
   char input[100];
   fgets(input, 100, fptr);
   printf("Input string: %s", input);
   fclose(fptr);
   while (input[i] != '\0')
   {
      switch (state)
      {
      case 0:
         if (input[i] == 'a')
         {
            state = 1;
         }
         else
            state = 0;
         break;
      case 1:
         if (input[i] == 'b')
```

```
            {
               state = 2;
            }
            else if (input[i] == 'a')
            {
               state = 1;
            }
            else
               state = 0;
            break;
         case 2:
            state = 2;
            break;
         }
         i++;
      }

      if (state == 2)
      {
         printf("\nString is valid");
      }
      else
      {
         printf("\nString is invalid");
      }
   }
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>gcc fourth.c -o fourth

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical1>fourth
Input string: bbsvaadbafvvab
String is valid
```

Practical-2

Aim1: Write a program to recognize the valid identifiers.

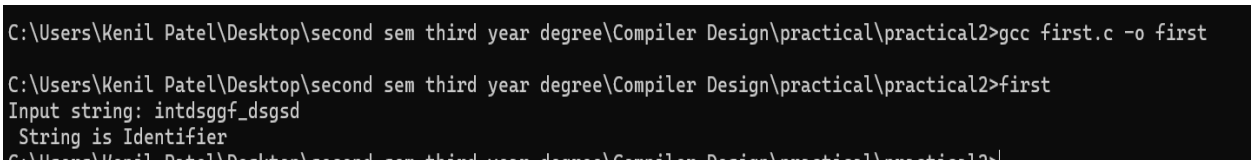
Procedure:
Source Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
void main()
{
   int state = 0, i = 0;
   FILE *fptr;
   fptr = fopen("input1.txt", "r");
   char input[100];
   fgets(input, 100, fptr);
   printf("Input string: %s", input);
   fclose(fptr);

   while (input[i] != '\0')
   {
      switch (state)
      {
      case 0:
         if (input[i] == 'i')
         {
            state = 1;
         }
         else if (input[i] == '_' || isalpha(input[i]))
         {
            state = 4;
         }
         else
         {
            state = 5;
         }
         break;
      case 1:
         if (input[i] == 'n')
         {
            state = 2;
         }
         else if (input[i] == '_' || isalpha(input[i]))
         {
```

```
            state = 4;
        }
        else
        {
            state = 5;
        }
        break;

    case 2:
        if (input[i] == 't')
        {
            state = 3;
        }
        else if (input[i] == '_' || isalpha(input[i]))
        {
            state = 4;
        }
        else
        {
            state = 5;
        }
        break;
    case 3:
        if (isalpha(input[i]) || isdigit(input[i]) || input[i] == '_')
        {
            state = 4;
        }
        else
        {
            state = 5;
        }
        break;
    case 4:
        if (isalpha(input[i]) || isdigit(input[i]) || input[i] == '_')
        {
            state = 4;
        }
        else
        {
            state = 5;
        }
        break;
    }
    i++;
}
```

```
    if (state == 4)
    {
       printf("\n String is Identifier");
    }
    else if (state == 3)
    {
       printf("\n String is a valid Keyword");
    }
    else if (state == 5)
    {
       printf("\n String is invalid string");
    }
    else
    {
       printf("\n String is empty");
    }
}
```

Output:



Aim2: Write a program to recognize the valid operators.

Procedure:
Source Code:

```
#include <stdio.h>

int main()
{
   char input[100];
   int state = 0, i = 0;

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

   fscanf(file, "%s", input);
```

```
fclose(file);

while (input[i] != '\0')
{
   switch (state)
   {
   case 0:
      if (input[i] == '+')
      {
         state = 1;
      }
      else if (input[i] == '-')
      {
         state = 5;
      }
      else if (input[i] == '*')
      {
         state = 9;
      }
      else if (input[i] == '/')
      {
         state = 12;
      }
      else if (input[i] == '%')
      {
         state = 15;
      }
      else if (input[i] == '&')
      {
         state = 18;
      }
      else if (input[i] == '|')
      {
         state = 21;
      }
      else if (input[i] == '<')
      {
         state = 24;
      }
      else if (input[i] == '>')
      {
         state = 28;
      }
      else if (input[i] == '!')
      {
```

```
        state = 32;
    }
    else if (input[i] == '~')
    {
        state = 34;
    }
    else if (input[i] == '^')
    {
        state = 35;
    }
    else if (input[i] == '=')
    {
        state = 36;
    }
    break;

case 1:
    if (input[i] == '+')
    {
        state = 2;
        printf("++ unary operator");
    }
    else if (input[i] == '=')
    {
        state = 3;
        printf("+= assignment operator");
    }
    else
    {
        state = 4;
        printf("+ arithmetic operator");
    }
    break;

case 5:
    if (input[i] == '-')
    {
        state = 6;
        printf("-- unary operator");
    }
    else if (input[i] == '=')
    {
        state = 7;
        printf("-= assignment operator");
    }
```

```
    else
    {
       state = 8;
       printf("+ arithmetic operator");
    }
    break;

case 9:
    if (input[i] == '=')
    {
       state = 10;
       printf("*= assignment operator");
    }
    else
    {
       state = 11;
       printf("* arithmetic operator");
    }
    break;

case 12:
    if (input[i] == '=')
    {
       state = 13;
       printf("/= assignment operator");
    }
    else
    {
       state = 14;
       printf("/ arithmetic operator");
    }
    break;

case 15:
    if (input[i] == '=')
    {
       state = 16;
       printf("%= assignment operator");
    }
    else
    {
       state = 17;
       printf("% arithmetic operator");
    }
    break;
```

```
case 18:
   if (input[i] == '&')
   {
      state = 19;
      printf("&& Logical operator");
   }
   else
   {
      state = 20;
      printf("% Bitwise operator");
   }
   break;

case 21:
   if (input[i] == '|')
   {
      state = 22;
      printf("|| Logical operator");
   }
   else
   {
      state = 23;
      printf("| Bitwise operator");
   }
   break;

case 24:
   if (input[i] == '<')
   {
      state = 25;
      printf("<< Bitwise operator");
   }
   else if (input[i] == '=')
   {
      state = 27;
      printf("<= Relational operator");
   }
   else
   {
      state = 26;
      printf("< Relational operator");
   }
   break;
```

```
    case 28:
        if (input[i] == '>')
        {
            state = 29;
            printf(">> Bitwise operator");
        }
        else if (input[i] == '=')
        {
            state = 30;
            printf(">= Relational operator");
        }
        else
        {
            state = 31;
            printf("> Relational operator");
        }
        break;

    case 32:
        if (input[i] == '=')
        {
            state = 33;
            printf("!= Assignment operator");
        }
        break;

    case 36:
        if (input[i] == '=')
        {
            state = 37;
            printf("== Relational operator");
        }
        break;

    default:
        break;
    }

    i++;
}

printf("\nState is %d\n", state);
if (state == 1)
{
    printf("+ arithmetic operator\n");
```

```
}
else if (state == 5)
{
   printf("- arithmetic operator\n");
}
else if (state == 9)
{
   printf("* arithmetic operator\n");
}
else if (state == 12)
{
   printf("/ arithmetic operator\n");
}
else if (state == 15)
{
   printf("% arithmetic operator\n");
}
else if (state == 18)
{
   printf("& Bitwise operator\n");
}
else if (state == 21)
{
   printf("| Bitwise operator\n");
}
else if (state == 24)
{
   printf("< Relational operator\n");
}
else if (state == 28)
{
   printf("> Relational operator\n");
}
else if (state == 32)
{
   printf("! Logical operator\n");
}
else if (state == 34)
{
   printf("~ Bitwise operator\n");
}
else if (state == 35)
{
   printf("^ Bitwise operator\n");
}
```

```
    else if (state == 36)
    {
        printf("= Assignment operator\n");
    }
    return 0;
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>gcc second.c -o second

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>second
++ unary operator
State is 2
```

Aim3: Write a program to recognize the valid number.

Procedure:
Source Code:

```
#include <stdio.h>
#include <ctype.h>
#include <stdlib.h>
#include <string.h>
void main()
{
    char c, buffer[1000], lexeme[1000];
    int i = 0, state = 0, f = 0, j = 0;
    FILE *fp = fopen("digitInput.txt", "r");
    while ((c = fgetc(fp)) != EOF && j < 1000)
    {
        buffer[j++] = c;
    }
    buffer[j] = '\0';
    fclose(fp);
    while (buffer[i] != '\0')
    {
        c = buffer[i];
        switch (state)
        {
        case 0:
            if (isdigit(c))
            {
                state = 1;
```

```
        lexeme[f++] = c;
    }
    else if (c == '+' || c == '-')
    {
        state = 0;
        lexeme[f++] = c;
    }
    else if (isspace(c))
    {
    }
    else
    {
        state = 99;
    }
    break;

case 1:
    if (isdigit(c))
    {
        state = 1;
        lexeme[f++] = c;
    }
    else if (c == '.')
    {
        state = 2;
        lexeme[f++] = c;
    }
    else if (c == 'e' || c == 'E')
    {
        state = 4;
        lexeme[f++] = c;
    }
    else
    {
        lexeme[f] = '\0';
        printf("The input %s is a valid integer.\n", lexeme);
        f = 0;
        state = 0;
        i--;
    }
    break;

case 2:
    if (isdigit(c))
    {
```

```
            state = 3;
            lexeme[f++] = c;
        }
        else
        {
            lexeme[f] = '\0';
            printf("%s is an invalid floating point input.\n", lexeme);
            f = 0;
            state = 0;
            i--;
        }
        break;

    case 3:
        if (isdigit(c))
        {
            state = 3;
            lexeme[f++] = c;
        }
        else if (c == 'e' || c == 'E')
        {
            state = 4;
            lexeme[f++] = c;
        }
        else
        {
            lexeme[f] = '\0';
            printf("The input %s is a valid floating-point number.\n", lexeme);
            f = 0;
            state = 0;
            i--;
        }
        break;

    case 4:
        if (isdigit(c))
        {
            state = 6;
            lexeme[f++] = c;
        }
        else if (c == '+' || c == '-')
        {
            state = 5;
            lexeme[f++] = c;
        }
```

```
    else
    {
        lexeme[f] = '\0';
        printf("%s is an invalid scientific notation.\n", lexeme);
        f = 0;
        state = 0;
        i--;
    }
    break;

case 5:
    if (isdigit(c))
    {
        state = 6;
        lexeme[f++] = c;
    }
    else
    {
        lexeme[f] = '\0';
        printf("%s is an invalid scientific notation.\n", lexeme);
        f = 0;
        state = 0;
        i--;
    }
    break;

case 6:
    if (isdigit(c))
    {
        state = 6;
        lexeme[f++] = c;
    }
    else
    {
        lexeme[f] = '\0';
        printf("The input %s is a valid scientific notation number.\n", lexeme);
        f = 0;
        state = 0;
        i--;
    }
    break;

default:
    printf("Invalid character encountered: %c\n", c);
    f = 0;
```

```
            state = 0;
            break;
        }
        i++;
    }

    // Final Token Check
    if (f != 0)
    {
        lexeme[f] = '\0';
        if (state == 1)
            printf("The input %s is a valid integer.\n", lexeme);
        else if (state == 3)
            printf("The input %s is a valid floating-point number.\n", lexeme);
        else if (state == 6)
            printf("The input %s is a valid scientific notation number.\n", lexeme);
    }
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>gcc third.c -o third

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>third
The input 100 is a valid integer.
```

Aim4: Write a program to recognize the valid comments.

Procedure:
Source Code:

```
#include <stdio.h>
void main()
{
    int state = 0, i = 0;
    FILE *fptr;
    fptr = fopen("input.txt", "r");
    char input[100];
    fgets(input, 100, fptr);
    printf("Input string: %s", input);
    fclose(fptr);
    while (input[i] != '\0')
    {
```

```
switch (state)
{
case 0:
   if (input[i] == '/')
   {
      state = 1;
   }
   else
   {
      state = 3;
   }
   break;
case 1:
   if (input[i] == '*')
   {
      state = 4;
   }
   else if (input[i] == '/')
   {
      state = 2;
   }
   else
   {
      state = 3;
   }
   break;

case 4:
   if (input[i] == '*')
   {
      state = 5;
   }
   else
   {
      state = 4;
   }
   break;
case 5:
   if (input[i] == '/')
   {
      state = 6;
   }
   else
   {
      state = 4;
```

```
            }
            break;
        case 6:
            if (input[i] != '\0')
            {
                state = 3;
            }
            break;
        }
        i++;
    }
    if (state == 2)
    {
        printf("\n String is valid single line comment");
    }
    else if (state == 6)
    {
        printf("\nString is a valid multiline comment");
    }
    else
    {
        printf("\n String is invalid comment ");
    }
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>gcc fourth.c -o fourth

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>fourth
Input string: /*ffddsagasg****ad*s*ag***231313146*/
String is a valid multiline comment
```

Aim5: Write a program to implement Lexical Analyzer

Procedure:
Source Code:

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

#define BUFFER_SIZE 1000
```

```
void check_keyword_or_identifier(char *lexeme);
void recognize_number(char *lexeme);
void recognize_operator(char *buffer, int *index);
void recognize_comment(char *buffer, int *index);

void main()
{
   FILE *f1;
   char *buffer;
   char lexeme[50];
   char c;
   int i = 0, f = 0, state = 0;

   f1 = fopen("input2.txt", "r");
   if (f1 == NULL)
   {
      printf("Error: Could not open input.txt\n");
      return;
   }

   fseek(f1, 0, SEEK_END);
   long file_size = ftell(f1);
   rewind(f1);

   buffer = (char *)malloc(file_size + 1);

   fread(buffer, 1, file_size, f1);
   buffer[file_size] = '\0';
   fclose(f1);

   while (buffer[f] != '\0')
   {
      c = buffer[f];
      switch (state)
      {
      case 0:
         if (isalpha(c) || c == '_')
         {
            state = 1;
            lexeme[i++] = c;
         }
         else if (isdigit(c))
         {
            state = 2;
```

```
            lexeme[i++] = c;
        }
        else if (c == '/' && (buffer[f + 1] == '/' || buffer[f + 1] == '*'))
        {
            recognize_comment(buffer, &f);
            state = 0;
        }
        else if (strchr("+-*/%=<>!", c))
        {
            recognize_operator(buffer, &f); // Pass buffer and index for operator handling
            state = 0;
        }
        else if (strchr(";,{}()", c))
        {
            printf("%c is a symbol\n", c);
            state = 0;
        }
        else if (isspace(c))
        {
            state = 0;
        }
        break;

    case 1:
        if (isalnum(c) || c == '_')
        {
            lexeme[i++] = c;
        }
        else
        {
            lexeme[i] = '\0';
            check_keyword_or_identifier(lexeme);
            lexeme[i] = '\0';
            i = 0;
            state = 0;
            f--; // Go back to recheck the current character
        }
        break;

    case 2:
        if (isdigit(c))
        {
            lexeme[i++] = c;
        }
        else if (c == '.')
```

```
    {
        state = 3;
        lexeme[i++] = c;
    }
    else if (c == 'E' || c == 'e')
    {
        state = 4;
        lexeme[i++] = c;
    }
    else
    {
        lexeme[i] = '\0';
        recognize_number(lexeme);
        i = 0;
        state = 0;
        f--; // Go back to recheck the current character
    }
    break;

case 3:
    if (isdigit(c))
    {
        lexeme[i++] = c;
    }
    else
    {
        lexeme[i] = '\0';
        recognize_number(lexeme);
        i = 0;
        state = 0;
        f--; // Go back to recheck the current character
    }
    break;

case 4:
    if (isdigit(c) || c == '+' || c == '-')
    {
        state = 5;
        lexeme[i++] = c;
    }
    else
    {
        lexeme[i] = '\0';
        recognize_number(lexeme);
        i = 0;
```

```
            state = 0;
            f--; // Go back to recheck the current character
        }
        break;

    case 5:
        if (isdigit(c))
        {
            lexeme[i++] = c;
        }
        else
        {
            lexeme[i] = '\0';
            recognize_number(lexeme);
            i = 0;
            state = 0;
            f--; // Go back to recheck the current character
        }
        break;
    }
    f++; // Move forward in the buffer
  }

  free(buffer);
}

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

  for (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);
```

```
}

void recognize_number(char *lexeme)
{
   printf("%s is a valid number\n", lexeme);
}

void recognize_operator(char *buffer, int *index)
{
   char operators[][3] = {"+", "-", "*", "/", "%", "=", "==", "!=", "<", ">", "<=", ">="};
   char op[3] = {buffer[*index], buffer[*index + 1], '\0'};
   int i = 0;

   // Handle two-character operators (e.g., "==" or ">=")
   for (i = 0; i < 12; i++)
   {
      if (strcmp(op, operators[i]) == 0)
      {
         printf("%s is an operator\n", op);
         (*index)++; // Skip the next character since we used two chars
         return;
      }
   }

   // Handle single-character operators
   printf("%c is an operator\n", buffer[*index]);
}

void recognize_comment(char *buffer, int *index)
{
   if (buffer[*index] == '/' && buffer[*index + 1] == '/')
   {
      printf("// is a single-line comment\n");
      while (buffer[*index] != '\n' && buffer[*index] != '\0')
         (*index)++;
   }
   else if (buffer[*index] == '/' && buffer[*index + 1] == '*')
   {
      printf("/* is the start of a multi-line comment\n");
      (*index) += 2;
      while (!(buffer[*index] == '*' && buffer[*index + 1] == '/') && buffer[*index] != '\0')
         (*index)++;
      if (buffer[*index] == '*' && buffer[*index + 1] == '/')
      {
         printf("*/ is the end of a multi-line comment\n");
```

```
            (*index) += 2;
        }
    }
}
```

Output:

input2.txt

```
1  int main(){
2      b=100, a = 10;
3      return 0;
4  }
```

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical2>fifth
int is a keyword
main is an identifier
( is a symbol
) is a symbol
{ is a symbol
b is an identifier
= is an operator
100 is a valid number
, is a symbol
a is an identifier
= is an operator
10 is a valid number
; is a symbol
return is a keyword
0 is a valid number
; is a symbol
} is a symbol
```

Practical-3

Aim1: To Study about Lexical Analyzer Generator (LEX) and Flex(Fast Lexical Analyzer)

Procedure:

When we write a program, the compiler has to first break it down into smaller parts like keywords, numbers, operators, and variable names. This process is called lexical analysis, and it's done by a component called the lexical analyzer. Instead of writing all the code ourselves to identify these parts, we can use a tool called LEX — or its faster version, Flex — to do the job for us. We simply define the patterns (like what a number looks like or what makes something a keyword), and LEX/Flex creates a C program that can recognize those patterns in any input.

In this experiment, we used LEX or Flex to build a small program that scans text and picks out specific tokens — for example, identifying numbers, keywords, or symbols. It helped me understand how a compiler starts its work by reading the raw code and making sense of it piece by piece. This experiment was really helpful because it showed me how regular expressions are used in real tools, and how compilers begin processing code from the very first line.

Practical-4

Aim1: Write a Lex program to take input from text file and count no of characters, no. of lines & no. of words.

Procedure:
Source Code:

```
%{
   #include<stdio.h>
   int l=0, w=0, c=0;
   int in_word=0;
%}
%%
[a-zA-Z]    {c++; in_word = 1;}
\n  {l++; if (in_word) {w++;in_word=0;}}
[ \t]+  {if (in_word){w++; in_word=0;}}
.   {if (in_word){w++; in_word = 0;}}
%%
void main(){
   yyin = fopen("input.txt", "r");
   yylex();
   printf("Number of characters: %d \nNumber of lines: %d \nNumber of words: %d", c, l,w);
}
int yywrap(){return (1);}
```

Output:

second.l | first.jpg | *input.txt* ×

input.txt

```
1   a gsgm dfmiom gommd mdfklb ml lkfbm klmkldfm bdfklm klf m blzxmbkl fm
2   \n SND FN adf haf HADF HDF HDSFH DSFH
3   \n
4   \n
5   f fdad ehg fds f asg sd h d dfg arg ar arrh
```

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>flex first.l

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>gcc lex.yy.c -o first

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>first
Number of characters: 118
Number of lines: 4
Number of words: 36
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>
```

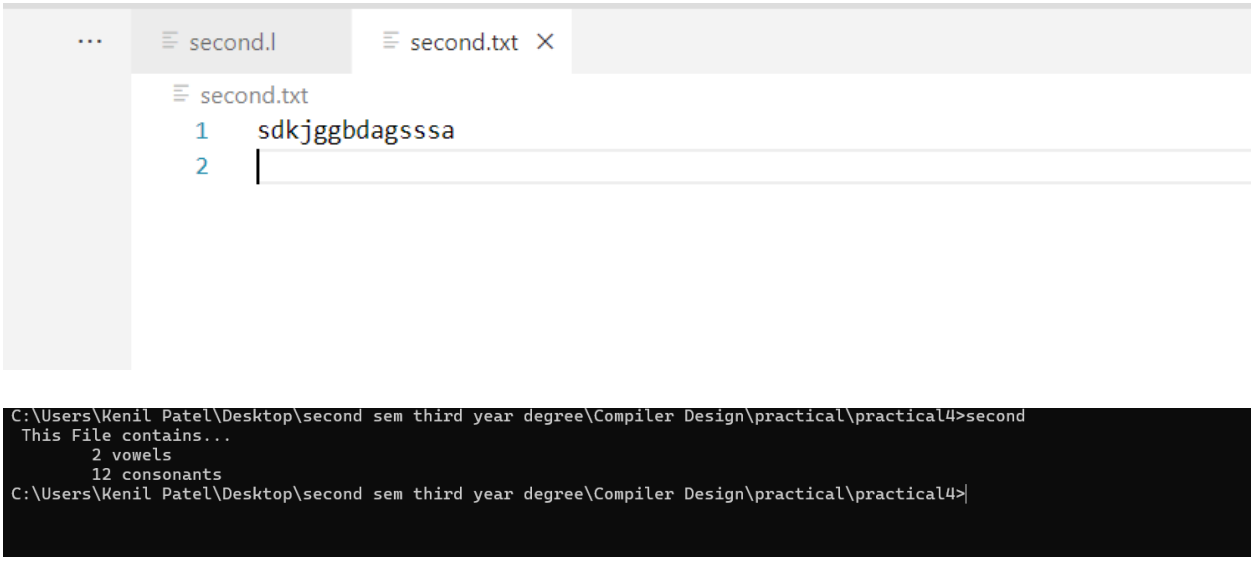
Aim2: Write a Lex program to take input from text file and count number of vowels and consonants.

Procedure:

Source Code:

```
%{
 #include<stdio.h>
 int consonants=0, vowels =0;
%}
%%
[aeiouAEIOU] {vowels++;}
[a-zA-Z]  {consonants++; }
\n
.
%%
int main() {
yyin = fopen("second.txt", "r");
yylex();
 printf(" This File contains...");
 printf("\n\t%d vowels",vowels);
 printf ("\n\t%d consonants",consonants);
return 0;
}
int yywrap() { return (1); }
```

Output:

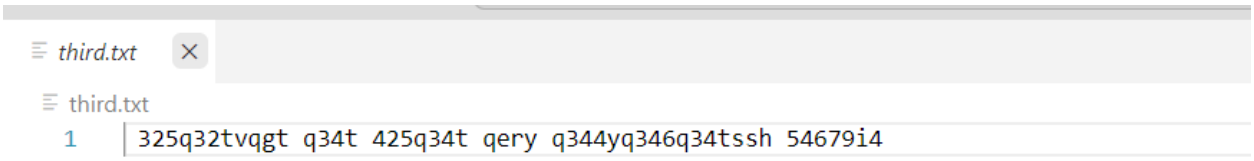


Aim3: Write a Lex program to print out all numbers from the given file.

Procedure:
Source Code:

```
%{
#include<stdio.h>
%}
%%
[0-9]+(\.[-9]+)?([eE][+-]?[0-9]+)? printf("%s is valid number \n", yytext);
\n  ;
.   ;
%%
int main()
{
   yyin = fopen("third.txt", "r");
   yylex();
   return 0;
}
int yywrap(){return (1);}
```

Output:




```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>third
325 is valid number
32 is valid number
34 is valid number
425 is valid number
34 is valid number
344 is valid number
346 is valid number
34 is valid number
54679 is valid number
4 is valid number
```

Aim4: Write a Lex program which adds line numbers to the given file and display the same into different file.

Procedure:
Source Code:

```
%{
#include<stdio.h>
int line_number = 1;
%}
%%
.+ {fprintf(yyout, "%d: %s", line_number, yytext);line_number++;}
%%
int main()
{
   yyin = fopen("fourth.txt", "r");
   yyout= fopen("fourth_output.txt", "w");
   yylex();
   printf("done");
   return 0;
}
int yywrap(){return (1);}
```

Output:

fourth.txt

```
1    fa g \n
2    \n fg af
3    ad \n
4    haf
5    adf ad
6    fgv ff
7    g dffg
8     fsg
9      afg
```

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>fourth
done
```

fourth_output.txt

```
1: fa g \n
2: \n fg af
3: ad \n
4: haf
5: adf ad
6: fgv ff
7: g dffg
8:  fsg
9:   afg
```

Aim5: Write a Lex program to printout all markup tags and HTML comments in file.

Procedure:
Source Code:

```
%{
#include<stdio.h>
int num=0;
%}
%%
"<"[A-Za-z0-9]+">"  printf("%s is a valid markup tag\n", yytext);
"<!--"[^-->]*"-->"  num++;
\n  ;
.   ;
%%
int main()
{
   yyin = fopen("fifth.txt", "r");
   yylex();
   printf("Number of comments are: %d", num);
   return 0;
}
int yywrap(){return (1);}
```

Output:

fifth.txt

```
1   <html>
2   <head>
3   </head>
4   <!-- this is html comment -->
5   </html>
6
```

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>fifth
<html> is a valid markup tag
<head> is a valid markup tag
Number of comments are: 1
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical4>
```

Practical-5

Aim1: 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.

Procedure:
Source Code:

```
%{
#include<stdio.h>
int cmt = 0;
%}
%%
"//".*    { fprintf(yyout, "\n"); cmt++;}
"/*"([^]|\+[^/])"*/"  { fprintf(yyout, "\n"); cmt++;}
.|\n   { fprintf(yyout, "%s", yytext);}
%%
void main(){
   yyin = fopen("input1.txt", "r");
   yyout = fopen("output1.txt", "w");
   yylex();
   printf("%d Comment ", cmt);
}
int yywrap(){return(1);}
```

Output:

input1.txt

```
1
2    // This is the single line comment
3    void main(){
4
5    }
```

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical5>first
1 Comment
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical5>
```

Aim2: Write a Lex program to recognize keywords, identifiers, operators, numbers, special symbols, literals from a given C program.

Procedure:
Source Code:

second.l

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

int is_keyword(const char *str);
%}

%option noyywrap

%%
"auto"|"break"|"case"|"char"|"const"|"continue"|"default"|"do"|"double"|\
"else"|"enum"|"extern"|"float"|"for"|"goto"|"if"|"inline"|"int"|"long"|\
"register"|"return"|"short"|"signed"|"sizeof"|"static"|"struct"|"switch"|\
"typedef"|"union"|"unsigned"|"void"|"volatile"|"while"    { printf("Keyword: %s\n", yytext); }


[ \t\n]+                    ;

"=="|"!="|"<="|">="|"="|"+"|"-"|"*"|"/"|"%"|"&&"|"||"|"!"|"<"|">"     { printf("Operator:
%s\n", yytext); }

[0-9]+(\.[0-9]+)?              { printf("Number: %s\n", yytext); }

\"([^\\\"]|\\.)*\"             { printf("String Literal: %s\n", yytext); }

\'.\'                       { printf("Character Literal: %s\n", yytext); }

[{}()\[\],;.]                 { printf("Special Symbol: %s\n", yytext); }

[a-zA-Z_][a-zA-Z0-9_]*          {
                              if (is_keyword(yytext))
                                 printf("Keyword: %s\n", yytext);
                              else
                                 printf("Identifier: %s\n", yytext);
                            }

.                           { printf("Unrecognized Character: %s\n", yytext); }
```

```
%%

int is_keyword(const char *str) {
    const char *keywords[] = {
        "auto", "break", "case", "char", "const", "continue", "default", "do", "double",
        "else", "enum", "extern", "float", "for", "goto", "if", "inline", "int", "long",
        "register", "return", "short", "signed", "sizeof", "static", "struct", "switch",
        "typedef", "union", "unsigned", "void", "volatile", "while", NULL
    };
    for (int i = 0; keywords[i] != NULL; i++) {
        if (strcmp(keywords[i], str) == 0)
            return 1;
    }
    return 0;
}

int main() {
    yylex();
    return 0;
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical5>second<input.c
Identifier: main
Special Symbol: (
Special Symbol: )
Special Symbol: {
Identifier: x
Operator: =
Number: 10.5
Special Symbol: ;
Identifier: ch
Operator: =
Character Literal: 'a'
Special Symbol: ;
Special Symbol: (
Identifier: x
Operator: >
Number: 5
Special Symbol: )
Special Symbol: {
Identifier: x
Operator: +
Operator: =
Number: 2
Special Symbol: ;
Special Symbol: }
Identifier: printf
Special Symbol: (
String Literal: "Hello World\n"
Special Symbol: )
Special Symbol: ;
Number: 0
Special Symbol: ;
Special Symbol: }
```

Practical-6

Aim1: Program to implement Recursive Descent Parsing in C.

Procedure:
Source Code:

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

char s[20];
int i = 1;
char l;
int match(char l);
int E1();
int E()
{
   if (l == 'i')
   {
      match('i');
      E1();
   }
   else
   {
      printf("Error parsing string");
      exit(1);
   }
   return 0;
}

int E1()
{
   if (l == '+')
   {
      match('+');
      match('i');
      E1();
   }
   else
   {
      return 0;
   }
}

int match(char t)
```

```
{
   if (l == t)
   {
      l = s[i];
      i++;
   }
   else
   {
      printf("Syntax Error");
      exit(1);
   }
   return 0;
}
void main()
{
   printf("Enter the string: ");
   scanf("%s", &s);
   l = s[0];
   E();
   if (l == '$')
   {
      printf("parsing successful");
   }
   else
   {
      printf("Error while parsing the string\n");
   }
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical5(RecursiveParser)>gcc firs
t.c -o first

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical5(RecursiveParser)>first
Enter the string: i+i+i$
parsing successful
```

Practical-7

Aim1: To Study about Yet Another Compiler-Compiler(YACC).

Procedure:

YACC, which stands for Yet Another Compiler-Compiler, is a tool that helps us write the part of a compiler that checks if a program follows the correct structure or grammar. Writing this part manually can be pretty complex, but YACC makes it much easier by letting us define grammar rules, and then it automatically creates the code to check those rules. It's often used with another tool called Lex, which reads the input and splits it into meaningful pieces called tokens — like numbers, symbols, or keywords.

In this experiment, we use YACC to build a small program that can read and evaluate simple math expressions like "2 + 3 * 4". First, we define the rules that describe how such expressions should be written. YACC takes those rules and creates a parser, which can then figure out if a given input is valid and even calculate the result. This experiment helped me understand how a compiler breaks down and understands code, and how Lex and YACC work together to make that process easier.

Aim2: Create Yacc and Lex specification files to recognizes arithmetic expressions involving +, -, * and / .

Procedure:
Source Code:

first.l

```
%{
#include <stdlib.h>
void yyerror(char *);
#include "b.tab.h"
%}
%%
[0-9]+ {yylval = atoi(yytext); return NUM;}
[a-zA-Z_][a-zA-Z_0-9]* {return id;}
[-+*\n] {return *yytext;}
[ \t] { }
. yyerror("invalid character");
%%
int yywrap() {
```

```
 return 0;
}
```

first.y

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

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\New folder>bison -d b.y

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\New folder>flex b.l

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\New folder>gcc lex.yy.c b.tab.c -o first

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\New folder>first
2+65
valid syntax
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\New folder>first
2-6
valid syntax
```

Aim3: Create Yacc and Lex specification files are used to generate a calculator which accepts integer type arguments.

Procedure:
Source Code:

lex.l

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

yacc.y

```
%{
 #include <stdio.h>
 int yylex(void);
 void yyerror(char *);
%}
%token NUM
%%
S: E '\n' { printf("%d\n", $1); return(0); }
E: E '+' T   { $$ = $1 + $3; }
 | E '-' T  { $$ = $1 - $3; }
 | T        { $$ = $1; }
T : T '*' F { $$ = $1 * $3; }
 | F        { $$ = $1; }
F:NUM   { $$ = $1; }
%%
void yyerror(char *s) {
 fprintf(stderr, "%s\n", s);
}
int main() {
 yyparse();
```

```
 return 0;
}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\calc_my\calc_my>bison -d yacc.y

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\calc_my\calc_my>flex lex.l

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\calc_my\calc_my>gcc yacc.tab.c lex.yy.c -o calc

C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7\calc_my\calc_my>calc
5+1
6
```

Aim4: Create Yacc and Lex specification files are used to convert infix expression to postfix expression.

Procedure:
Source Code:

fourth.l

```
%{
#include<stdio.h>
#include "first.tab.h"
void yyerror(char *);
%}

%%
[0-9]+ { yylval.num = atoi(yytext); return INTEGER; }
[A-Za-z_][A-Za-z0-9_]* { yylval.str = yytext; return ID; }
[-+;\n*] { return *yytext; }
[ \t] ;
. yyerror("invalid character");
%%

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

fourth.y

```
%{
   #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("+ "); }
 | E '-' T {printf("- "); }
 | T { }
T : T '*' F {printf("* "); }
 | F { }
F:INTEGER { printf("%d ", $1);}
 | ID { printf("%s ", $1);}
%%
void yyerror(char *s){
    printf("%s\n", s);
}
int main(){yyparse();return 0;}
```

Output:

```
C:\Users\Kenil Patel\Desktop\second sem third year degree\Compiler Design\practical\practical7>fourth
256+65+24-5
256 65 + 24 + 5 -
```