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Practical No. 1

Theory

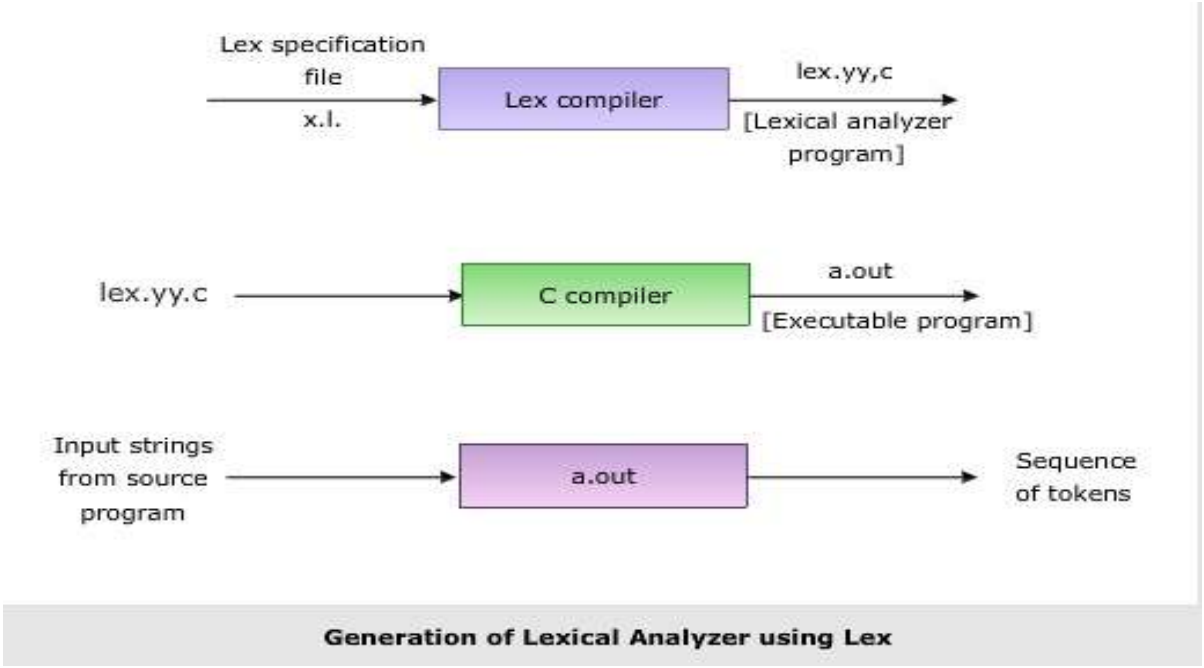
LEX:

Lex is a program generator designed for lexical processing of character input streams. It accepts a high level, problem-oriented specification for character string matching, and produces a program in a general-purpose language which recognizes regular expressions. The regular expressions are specified by the user in the source specifications given to Lex. The Lex written code recognizes these expressions in an input stream and partitions the input stream into strings matching the expressions. At the boundaries between strings program sections provided by the user are executed. The Lex source file associates the regular expressions and the program fragments. As each expression appears in the input to the program written by Lex, the corresponding fragment is executed.

Lex is not a complete language, but rather a generator representing a new language feature which can be added to different programming languages, called ``host languages." Just as general purpose languages can produce code to run on different computer hardware, Lex can write code in different host languages.

Lex turns the user's expressions and actions (called source in this pic) into the host general-purpose language; the generated program is named yylex. The yylex program will recognize expressions in a stream (called input in this pic) and perform the specified actions for each expression as it is detected.

Diagram of LEX



Generation of Lexical Analyzer using Lex

Format for Lex file

The general format of Lex source is:

```
{definitions}
%%
{rules}
%%
{user subroutines}
```

where the definitions and the user subroutines are often omitted. The second %% is optional, but the first is required to mark the beginning of the rules. The absolute minimum Lex program is thus %% (no definitions, no rules) which translates into a program which copies the input to the output unchanged.

Regular Expression

A regular expression (or RE) specifies a set of strings that matches it; the functions in this module let you check if a particular string matches a given regular expression (or if a given regular expression matches a particular string, which comes down to the same thing).

Regular expressions can be concatenated to form new regular expressions; if A and B are both regular expressions, then AB is also a regular expression. In general, if a string p matches A and another string q matches B, the string pqwill match AB. This holds unless A or B contain low precedence operations; boundary conditions between A and B; or have numbered group references. Thus, complex expressions can easily be constructed from simpler primitive expressions. Regular expressions can contain both special and ordinary characters. Most ordinary characters, like "A", "a", or "0", are the simplest regular expressions; they simply match themselves. You can concatenate ordinary characters, so last matches the string 'last'. (In the rest of this section, we'll write RE's in this special style, usually without quotes, and strings to be matched 'in single quotes'.)

Some characters, like "|" or "(", are special. Special characters either stand for classes of ordinary characters or affect how the regular expressions around them are interpreted.

Lex Library Routines

Lex library routines are those functions which have a detailed knowledge of the lex functionalities and which can be called to implement various tasks in a lex program.

The following table gives a list of some of the lex routines.

Lex Routine	Description
Main ()	Invokes the lexical analyzer by calling the yylex subroutine.
yywrap ()	Returns the value 1 when the end of input occurs.
yymore ()	Appends the next matched string to the current value of the yytext array rather than replacing the contents of the yytext array.
yyless (int n)	Retains n initial characters in the yytext array and returns the remaining

	characters to the input stream.
yyreject	Allows the lexical analyzer to match multiple rules for the same input string. (The yyreject subroutine is called when the special action REJECT is used.)
yylex ()	The default main () contains the call of yylex ()

Answer the Questions:

1. Why is –ll option used for running lex.yy.c?

   The file *lex.yy.c* may be compiled and linked in the same way as any C program. The **-ll** option is used to link the object file created from this C source with **lex** library: **cc lex.yy.c -ll**

2. Use of yywrap

   Function **yywrap** is called by lex when input is exhausted. Return 1 if you are done or 0 if more processing is required. Every C program requires a main function. In this case we simply call yylex that is the main entry-point for lex.

3. Use of yylex function

   Implies the main entry point for lex, reads the input stream generates tokens, returns zero at the end of input stream. It is called to invoke the lexer (or scanner) and each time yylex () is called, the scanner continues processing the input from where it last left off.

4. What does lex.yy.c. do?

   The **lex** command stores the yylex function in a file named **lex**. **yy**.c
   You **can** use the yylex function alone to recognize simple one-word input, or you **can** use it with other **C** language programs to perform more difficult input analysis functions.

Practical No. 1 (A)

Aim: Design a lexical analyzer to identify the tokens such as keywords, identifiers, operators, constants, symbols and strings for C language using LEX.

Program:

```
%{
#include<stdio.h>
int functions=0, logicaloperators=0, assignmentoperators=0, arithmeticoperators=0
,relationaloperators=0, keywords=0, integerconstants=0, floatingconstants=0, char
constants=0, identifiers=0, symbol=0, strings=0, lines=0;
%}

%%
"#include".* {printf("\n%s is HEADER\n",yytext);}

scanf|printf {printf("\n%s is FUNCTION\n",yytext); functions++;}

[&&]|[!]|[||] {printf("\n%s is LOGICAL OPERATOR\n",yytext);logicaloperators++;}

[-+%/*] {printf("\n%s is ARITHMETIC OPERATOR\n",yytext);arithmeticoperators++;}

[=]|[-
=]|[+=] {printf("\n%s is ASSIGNMENT OPERATOR\n",yytext);assignmentoperators++;}

[==]|[!=]|[<=]|[>=]|[<>] {printf("\n%s is RELATIONAL OPERATOR\n",yytext);relation
aloperators++;}

int|float|void|main|char|if|while {printf("\n%s is KEYWORD\n",yytext); keywords++
;}

[0-9]+ {printf("\n%s is INTEGER CONSTANT\n ",yytext);integerconstants++;}

[0-9]+[.][0-
9]+ {printf("\n%s is FLOATING CONSTANT\n ",yytext);floatingconstants++;}

['][a-zA-z]+['] {printf("\n%s is CHAR CONSTANT\n",yytext);charconstants++;}

[A-Za-z][A-Za-z0-9]* {printf("\n%s is IDENTIFIER\n",yytext);identifiers++;}

[{}#()@$:;,?] {printf("\n%s is SPECIAL SYMBOL",yytext);symbol++;}

\".*\" {printf("\n%s is STRING\n",yytext);strings++;}

\n lines++;
%%
```

```
int main(void)
{
yyin = fopen("expt1a.txt","r");
yylex();
printf("\n-----------------------------------------------");
printf("\n%d KEYWORDS IN C FILE", keywords);
printf("\n%d FUNCTIONS IN C FILE", functions);
printf("\n%d ASSIGNMENT OPERATORS IN C FILE", assignmentoperators);
printf("\n%d RELATIONAL OPERATORS IN C FILE", relationaloperators);
printf("\n%d LOGICAL OPERATORS IN C FILE", logicaloperators);
printf("\n%d ARITHMETIC OPERATORS IN C FILE", arithmeticoperators);
printf("\n%d INTEGER CONSTANTS IN C FILE", integerconstants);
printf("\n%d CHAR CONSTANTS IN C FILE", charconstants);
printf("\n%d FLOATING CONSTANTS IN C FILE", floatingconstants);
printf("\n%d IDENTIFIERS IN C FILE", identifiers);
printf("\n%d STRINGS IN C FILE", strings);
printf("\n%d SYMBOLS IN C FILE", symbol);
printf("\n-----------------------------------------------");
printf("\n%d LINES IN C FILE", lines);
}
int yywrap(){
return(1);
}
```

Input:

```
#include <stdio.h>
int main() {
    int b = 10.0;
    char ch='c' ;
    int t1 = 0, t2 = 1, nextTerm = 0, n;
    printf("Enter a positive number: ");
    scanf("%d", &n);
    printf("Fibonacci Series: %d, %d, ", t1, t2);
    nextTerm = t1 + t2;
    while (nextTerm <= n) {
        printf("%d, ", nextTerm);
        t1 = t2;
        t2 = nextTerm;
        nextTerm = t1 + t2;
    }

  return 0;
}
```

Output:

```
#include <stdio.h> is HEADER

int is KEYWORD

main is KEYWORD

( is SPECIAL SYMBOL
) is SPECIAL SYMBOL
{ is SPECIAL SYMBOL
int is KEYWORD

b is IDENTIFIER

= is ASSIGNMENT OPERATOR

10.0 is FLOATING CONSTANT

; is SPECIAL SYMBOL
char is KEYWORD

ch is IDENTIFIER

= is ASSIGNMENT OPERATOR

'c' is CHAR CONSTANT

; is SPECIAL SYMBOL
int is KEYWORD

t1 is IDENTIFIER

= is ASSIGNMENT OPERATOR

0 is INTEGER CONSTANT

, is SPECIAL SYMBOL
t2 is IDENTIFIER

= is ASSIGNMENT OPERATOR

1 is INTEGER CONSTANT

, is SPECIAL SYMBOL
nextTerm is IDENTIFIER

= is ASSIGNMENT OPERATOR

0 is INTEGER CONSTANT
```

```
, is SPECIAL SYMBOL
n is IDENTIFIER

; is SPECIAL SYMBOL
printf is FUNCTION

( is SPECIAL SYMBOL
"Enter a positive number: " is STRING

) is SPECIAL SYMBOL
; is SPECIAL SYMBOL
scanf is FUNCTION

( is SPECIAL SYMBOL
"%d" is STRING

, is SPECIAL SYMBOL
& is LOGICAL OPERATOR

n is IDENTIFIER

) is SPECIAL SYMBOL
; is SPECIAL SYMBOL
printf is FUNCTION

( is SPECIAL SYMBOL
"Fibonacci Series: %d, %d, " is STRING

, is SPECIAL SYMBOL
t1 is IDENTIFIER

, is SPECIAL SYMBOL
t2 is IDENTIFIER

) is SPECIAL SYMBOL
; is SPECIAL SYMBOL
nextTerm is IDENTIFIER

= is ASSIGNMENT OPERATOR

t1 is IDENTIFIER

+ is ARITHMETIC OPERATOR

t2 is IDENTIFIER

; is SPECIAL SYMBOL
while is KEYWORD
```

```
( is SPECIAL SYMBOL
nextTerm is IDENTIFIER

< is RELATIONAL OPERATOR

= is ASSIGNMENT OPERATOR

n is IDENTIFIER

) is SPECIAL SYMBOL
{ is SPECIAL SYMBOL
printf is FUNCTION

( is SPECIAL SYMBOL
"%d, " is STRING

, is SPECIAL SYMBOL
nextTerm is IDENTIFIER

) is SPECIAL SYMBOL
; is SPECIAL SYMBOL
t1 is IDENTIFIER

= is ASSIGNMENT OPERATOR

t2 is IDENTIFIER

; is SPECIAL SYMBOL
t2 is IDENTIFIER

= is ASSIGNMENT OPERATOR

nextTerm is IDENTIFIER

; is SPECIAL SYMBOL
nextTerm is IDENTIFIER

= is ASSIGNMENT OPERATOR

t1 is IDENTIFIER

+ is ARITHMETIC OPERATOR

t2 is IDENTIFIER

; is SPECIAL SYMBOL
} is SPECIAL SYMBOL
return is IDENTIFIER

0 is INTEGER CONSTANT
```

```
; is SPECIAL SYMBOL
} is SPECIAL SYMBOL
---------------------------------------------
6 KEYWORDS IN C FILE
4 FUNCTIONS IN C FILE
10 ASSIGNMENT OPERATORS IN C FILE
1 RELATIONAL OPERATORS IN C FILE
1 LOGICAL OPERATORS IN C FILE
2 ARITHMETIC OPERATORS IN C FILE
4 INTEGER CONSTANTS IN C FILE
1 CHAR CONSTANTS IN C FILE
1 FLOATING CONSTANTS IN C FILE
23 IDENTIFIERS IN C FILE
4 STRINGS IN C FILE
35 SYMBOLS IN C FILE
---------------------------------------------
18 LINES IN C FILE
```

Practical No. 1 (B)

Aim: Create a txt file to containing the following without heading: Name of Student, Company Placed in (TCS, Infosys, Wipro, Accenture, Informatica), Male/female, CGPA (floating point number), Department (CSE, IT, EC), Package (floating point number), mail id, mobile number (integer exactly 10 digits). At least 25 records must be present.

Program:

```
%{
    #include<stdio.h>
    #include<string.h>
    int male=0,female=0,tcs=0,infsys=0,wipro=0,acc=0,infmat=0,n=0,it=0,ec=0,cs=0;
%}

%%
[a-z.0-9]+@[a-z]+.[a-z]+ {n++;printf("\nEMAIL : %s", yytext);}

Male|Female {printf("\nGENDER : %s", yytext);
    if(strcmp(yytext,"Male")==0) male++;
    else if(strcmp(yytext,"Female")==0) female++;
}

CSE|EC|IT {printf("\nBRANCH : %s", yytext);
    if(strcmp(yytext,"CSE")==0) cs++;
    else if(strcmp(yytext,"IT")==0) it++;
    else if(strcmp(yytext,"EC")==0) ec++;
}

TCS|Infosys|Wipro|Accenture|Informatica {printf("\nCOMPANY : %s", yytext);
    if(strcmp(yytext,"TCS")==0) tcs++;
    else if(strcmp(yytext,"Infosys")==0) infsys++;
    else if(strcmp(yytext,"Wipro")==0) wipro++;
    else if(strcmp(yytext,"Accenture")==0) acc++;
    else if(strcmp(yytext,"Informatica")==0) infmat++;
}

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

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

[8-9]{1}[0-9]{9} {n++;printf("\nMOBILE NO. : %s", yytext);}

[a-zA-Z_]+ {n++;printf("\nNAME : %s", yytext);}

. ;
%%
```

```
int main(void)
{
    yyin=fopen("data.txt","r");
    yylex();
    printf("\n");
    printf("\n==============PLACEMENT STATISTICS==================\n");
    printf("\nSTUDENTS PLACED IN TCS = %d\n",tcs);
    printf("\nSTUDENTS PLACED IN INFOSYS = %d\n",infsys);
    printf("\nSTUDENTS PLACED IN WIPRO = %d\n",wipro);
    printf("\nSTUDENTS PLACED IN ACCENTURE = %d\n",acc);
    printf("\nSTUDENTS PLACED IN INFORMATICA = %d\n",infmat);
    printf("\n================STUDENTS STATISTICS====================\n");
    printf("\nFEMALE STUDENTS PLACED = %d\n",female);
    printf("\nMALE STUDENTS PLACED = %d\n",male);
    printf("\n================BRANCH STATISTICS====================\n");
    printf("\nSTUDENTS PLACED FROM CSE = %d\n",cs);
    printf("\nSTUDENTS PLACED FROM IT = %d\n",it);
    printf("\nSTUDENTS PLACED FROM EC = %d\n",ec);
}

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

Input:

```
Atharva Informatica Male 9.1 CSE 1400000.0 paliwalap@rknec.edu 9809101421
Rishikesh Informatica Male 9.4 CSE 60000.0 kale@rknec.edu 9851407159
Rohit Infosys Male 8.4 EC 800000.0 chandani@rknec.edu 952502339252
Rahul Wipro Male 9.6 CSE 700000.0 agrawal@rknec.edu 083 8835605442
Riya Infosys Female 8.7 IT 1400000.0 riya@rknec.edu 9893674960
Monica TCS Female 9.9 IT 300000.0 monica@rknec.edu 9899625904
Anjali TCS Male 9.7 CSE 700000.0 rajendran@rknec.edu 8879917599
Simran Infosys Female 9.2 CSE 600000.0 baheti@rknec.edu 8289563742
Ankita Wipro TCS Female 8.9 EC 600000.0 ankita@rknec.edu 8356145169
Ayushi Infosys Female 9.4 CSE 200000.0 ayushi@rknec.edu 9328571185
Riddhi Informatica Female 6.4 CSE 900000.0 lele@rknec.edu 9028422193
Muskan Infosys Female 8.5 EC 1700000.0 gupta@rknec.edu 8432104405
Keshubh Wipro Male 9.8 IT 400000.0 sharma@rknec.edu 9060213371
Gaurav Infosys Male 9.4 CSE 200000.0 shukla@rknec.edu 9767840563
Ritik Accenture Male 7.1 EC 800000.0 parashar@rknec.edu 1009520064
Yaman Accenture Male 9.9 IT 1700000.0 kushwaha@rknec.edu 9861889583
Nikhil Wipro Male 9.2 CSE 900000.0 tiwari@rknec.edu 8671206472
Yash Informatica Male 8.4 EC 1400000.0 roy@rknec.edu 9692086015
Paritosh Wipro Male 9.5 CSE 100000.0 dandekar@rknec.edu 8954205715
```

Output:

```
NAME : Atharva
COMPANY : Informatica
GENDER : Male
CGPA : 9.1
BRANCH : CSE
PACKAGE : 1400000.0
EMAIL : paliwalap@rknec.edu
MOBILE NO. : 9809101421

NAME : Rishikesh
COMPANY : Informatica
GENDER : Male
CGPA : 9.4
BRANCH : CSE
PACKAGE : 60000.0
EMAIL : kale@rknec.edu
MOBILE NO. : 9851407159

NAME : Rohit
COMPANY : Infosys
GENDER : Male
CGPA : 8.4
BRANCH : EC
PACKAGE : 800000.0
EMAIL : chandani@rknec.edu
MOBILE NO. : 9525023392

NAME : Rahul
COMPANY : Wipro
GENDER : Male
CGPA : 9.6
BRANCH : CSE
PACKAGE : 700000.0
EMAIL : agrawal@rknec.edu
MOBILE NO. : 8835605442

NAME : Riya
COMPANY : Infosys
GENDER : Female
CGPA : 8.7
BRANCH : IT
PACKAGE : 1400000.0
EMAIL : riya@rknec.edu
MOBILE NO. : 9893674960

NAME : Monica
COMPANY : TCS
GENDER : Female
```

```
CGPA : 9.9
BRANCH : IT
PACKAGE : 300000.0
EMAIL : monica@rknec.edu
MOBILE NO. : 9899625904

NAME : Anjali
COMPANY : TCS
GENDER : Male
CGPA : 9.7
BRANCH : CSE
PACKAGE : 700000.0
EMAIL : rajendran@rknec.edu
MOBILE NO. : 8879917599

NAME : Simran
COMPANY : Infosys
GENDER : Female
CGPA : 9.2
BRANCH : CSE
PACKAGE : 600000.0
EMAIL : baheti@rknec.edu
MOBILE NO. : 8289563742

NAME : Ankita
COMPANY : Wipro
COMPANY : TCS
GENDER : Female
CGPA : 8.9
BRANCH : EC
PACKAGE : 600000.0
EMAIL : ankita@rknec.edu
MOBILE NO. : 8356145169

NAME : Ayushi
COMPANY : Infosys
GENDER : Female
CGPA : 9.4
BRANCH : CSE
PACKAGE : 200000.0
EMAIL : ayushi@rknec.edu
MOBILE NO. : 9328571185

NAME : Riddhi
COMPANY : Informatica
GENDER : Female
CGPA : 6.4
BRANCH : CSE
PACKAGE : 900000.0
EMAIL : lele@rknec.edu
```

```
MOBILE NO. : 9028422193

NAME : Muskan
COMPANY : Infosys
GENDER : Female
CGPA : 8.5
BRANCH : EC
PACKAGE : 1700000.0
EMAIL : gupta@rknec.edu
MOBILE NO. : 8432104405

NAME : Keshubh
COMPANY : Wipro
GENDER : Male
CGPA : 9.8
BRANCH : IT
PACKAGE : 400000.0
EMAIL : sharma@rknec.edu
MOBILE NO. : 9060213371

NAME : Gaurav
COMPANY : Infosys
GENDER : Male
CGPA : 9.4
BRANCH : CSE
PACKAGE : 200000.0
EMAIL : shukla@rknec.edu
MOBILE NO. : 9767840563

NAME : Ritik
COMPANY : Accenture
GENDER : Male
CGPA : 7.1
BRANCH : EC
PACKAGE : 800000.0
EMAIL : parashar@rknec.edu

NAME : Yaman
COMPANY : Accenture
GENDER : Male
CGPA : 9.9
BRANCH : IT
PACKAGE : 1700000.0
EMAIL : kushwaha@rknec.edu
MOBILE NO. : 9861889583

NAME : Nikhil
COMPANY : Wipro
GENDER : Male
CGPA : 9.2
```

```
BRANCH : CSE
PACKAGE : 900000.0
EMAIL : tiwari@rknec.edu
MOBILE NO. : 8671206472

NAME : Yash
COMPANY : Informatica
GENDER : Male
CGPA : 8.4
BRANCH : EC
PACKAGE : 1400000.0
EMAIL : roy@rknec.edu
MOBILE NO. : 9692086015

NAME : Paritosh
COMPANY : Wipro
GENDER : Male
CGPA : 9.5
BRANCH : CSE
PACKAGE : 100000.0
EMAIL : dandekar@rknec.edu
MOBILE NO. : 8954205715

==============PLACEMENT STATISTICS===================

STUDENTS PLACED IN TCS = 3

STUDENTS PLACED IN INFOSYS = 6

STUDENTS PLACED IN WIPRO = 5

STUDENTS PLACED IN ACCENTURE = 2

STUDENTS PLACED IN INFORMATICA = 4

================STUDENTS STATISTICS====================

FEMALE STUDENTS PLACED = 7

MALE STUDENTS PLACED = 12

================BRANCH STATISTICS=====================

STUDENTS PLACED FROM CSE = 10

STUDENTS PLACED FROM IT = 4

STUDENTS PLACED FROM EC = 5

-----------------------------------------------END-----------------------------------------------
```