1. a). Write a LEX program to recognize valid *arithmetic expression.* Identifiers in the expression could be only integers and operators could be + and *. Count the identifiers & operators present and print them separately.

```
%{
#include<stdio.h>
int v=0,op=0,id=0,flag=0;
%}

%%
[0-9][0-9]* {id++;printf("\nIdentifier:");ECHO;}
[\+\-\*\/\=] {op++;printf("\nOperartor:");ECHO;}
"(" {v++;}
")" {v--;}
";" {flag=1;}
.|\n {return 0;}
%%

int main()
{
        printf("Enter the expression:\n");
        yylex();
        if((op+1) ==id && v==0 && flag==0)
        {
                printf("\n\nIdentifiers are:%d\nOperators are:%d\n",id,op);
                printf("\nExpression is Valid\n");
        }
        else
                printf("\nExpression is Invalid\n");
        return 1;
}
```

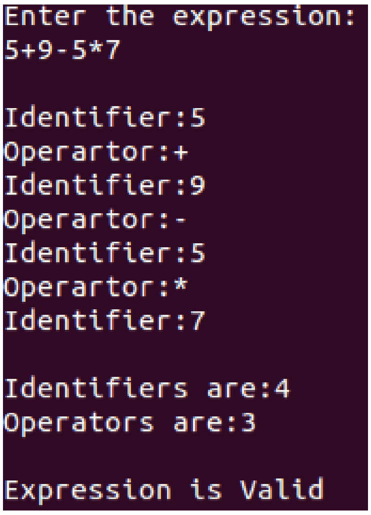
```
int yywrap()
{
        return 1;
}
```

Sample Output

lex 1a.l

cc lex.yy.c

./a.out



```
Enter the expression:
5+9-5*7

Identifier:5
Operartor:+
Identifier:9
Operartor:-
Identifier:5
Operartor:*
Identifier:7

Identifiers are:4
Operators are:3

Expression is Valid
```

1b). Write YACC program to evaluate *arithmetic expression* involving operators: +, -, *, and /.

(Lex Part)

```
%{
#include "y.tab.h"
extern yylval;
%}


%%
[0-9]+          {yylval=atoi(yytext);return num;}
[\+\-\*\/]      {return yytext[0];}
[)]             {return yytext[0];}
[(]             {return yytext[0];}
.                       {;}
\n                      {return 0;}
%%
```

(Yacc Part)

```
%{
#include<stdio.h>
#include<stdlib.h>
%}

%token num
%left '+' '-'
%left '*' '/'

%%
input:exp {printf("%d\n",$$);exit(0);}
exp:    exp'+'exp {$$=$1+$3;}
                |exp'-'exp{$$=$1-$3;}
                |exp'*'exp{$$=$1*$3;}
                |exp'/'exp { if($3==0){printf("Divide by Zero. Invalid expression.\n");exit(0);}
                else $$=$1/$3;}
```

```
                    |'('exp')'{$$=$2;}
                    |num{$$=$1;};
%%

int yyerror()
{
          printf("Error. Invalid Expression.\n");
          exit(0);
}
int main()
{
          printf("Enter an expression:\n");
          yyparse();
```

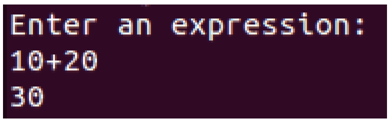
Sample Output

lex 1b.l

yacc –d 1b.y

cc lex.yy.c y.tab.c –ll

./a.out



```
Enter an expression:
10+20
30
```

---

2. Develop, Implement and Execute a program using YACC tool to recognize all strings ending with *b* preceded by *n a's* using the grammar *an b* (note: input *n* value).

Lex Part

```
%{
#include "y.tab.h"
%}
%%
a {return A;}
b {return B;}
[\n] return '\n';
%%
```

YACC Part

```
%{
#include<stdio.h>
#include<stdlib.h>
%}
%token A B
%%
input:s'\n' {printf("Successful Grammar\n");exit(0);}

s: A s1 B| B s1: ; | A s1


%%
main()
{
printf("Enter A String\n");
 yyparse();
}
int yyerror()
{
printf("Error \n");
exit(0);
```

}

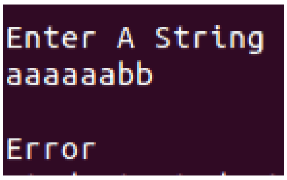
Sample Output

lex 2.l

yacc –d 2.y

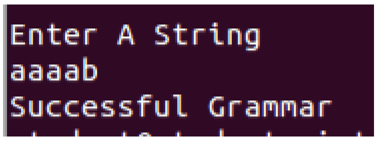
cc lex.yy.c y.tab.c –ll

./a.out



```
Enter A String
aaaaaabb

Error
```

./a.out



```
Enter A String
aaaab
Successful Grammar
```

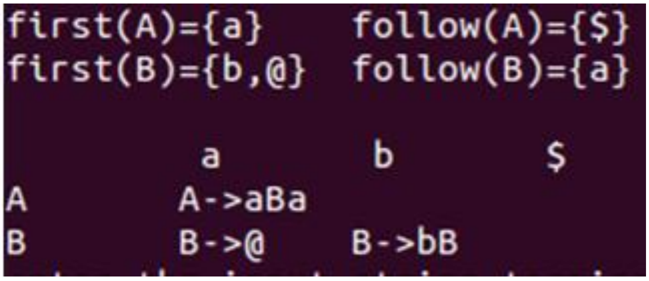
----

3. Design, develop and implement YACC/C program to construct *Predictive / LL(1) Parsing Table* for the grammar rules: ***A →aBa ,*** ***B →bB* | ε.** Use this table to parse the sentence: ***abba$***

```
#include<stdlib.h>
#include<string.h>
#include<stdio.h>
char prod[3][10]={"A->aBa","B->bB","B->@"}, input[10],stack[25];
int top=-1; int j=0,k,l;
void push(char item)
{
        stack[++top]=item;
}
void pop()
{
        top=top-1;
}
void display()
{
        int j;
        for(j=top;j>=0;j--)
                printf("%c",stack[j]);
}
void stackpush(char p)
{
        if(p=='A')
        {
                pop();
                for(j=strlen(prod[0])-1;j>=3;j--)
                        push(prod[0][j]);
        }
        else
        {
                pop();
                for(j=strlen(prod[1])-1;j>=3;j--)
                        push(prod[1][j]);
        }
}
void main()
{
        char c; int i;
        printf("first(A)={a}\t");
        printf("follow(A)={$}\n");
        printf("first(B)={b,@}\t");
        printf("follow(B)={a}\n\n");
        printf("\t a \t b \t $ \n");
        printf("A\t%s\n",prod[0]);
        printf("B\t%s\t%s\n",prod[2],prod[1]);
        printf("enter the input string terminated with $ to parse:-");
        scanf("%s",input);
        for(i=0;input[i]!='\0';i++)
        {
                if((input[i]!='a')&&(input[i]!='b')&&(input[i]!='$'))
                {
                        printf("invalid string");
                        exit(0);
                }
        }
        if(input[i-1]!='$')
        {
                printf("\n\nInput string entered without end marker $");
                exit(0);
        }
        push('$');
        push('A');
        i=0;
        printf("\n\n");
        printf("stack\tInput\taction");
        printf("\n---------\n");
        while(i!=strlen(input)&&stack[top]!='$')
        {
                printf("\n");
                for(l=top;l>=0;l--)
                        printf("%c",stack[l]);
                printf("\t");
                for(l=i;l<strlen(input);l++)
                        printf("%c",input[l]);
                printf("\t");
                if(stack[top]=='A')
                {
                        printf("A->aBa");
                        stackpush('A');
                }
                else if(stack[top]=='B')
                {
                        if(input[i]!='b')
                        {
                                printf("B->@");
                                printf("\t matched @");
                                pop();
                        }
                        else
                        {
                                printf("B->bB");
                                stackpush('B');
                        }
                }
                else
```

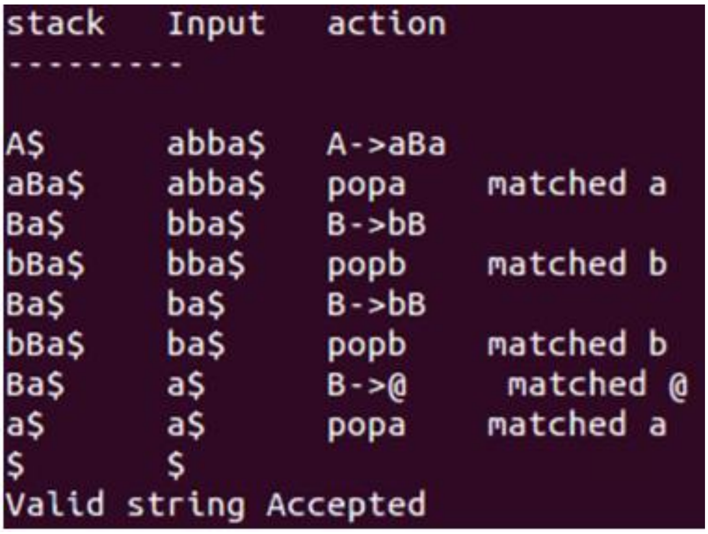
```
                {
                        if(stack[top]==input[i])
                        {
                                printf("pop%c",input[i]);
                                printf("\tmatched %c",input[i]);
                                pop();
                                i++;
                        }
                        else
                                break;
                }
        }
        if(stack[top]=='$' && input[i]=='$')
        {
                printf("\n$\t$");
                printf("\nValid string Accepted\n");
        }
        else
                printf("\nInvalid string rejected\n");
}
```

Sample Output
cc 3.c
./a.out



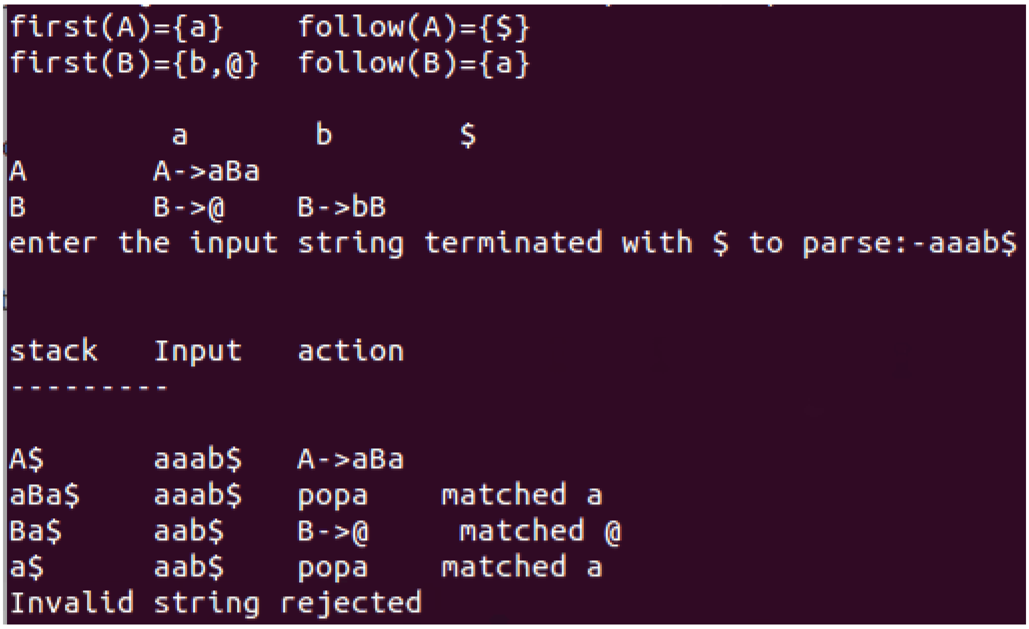
```
first(A)={a}    follow(A)={$}
first(B)={b,@}  follow(B)={a}

          a        b        $
A        A->aBa
B        B->@     B->bB
```

enter the input string terminated with $ to parse :abba$



```
stack   Input   action
---------

A$      abba$   A->aBa
aBa$    abba$   popa    matched a
Ba$     bba$    B->bB
bBa$    bba$    popb    matched b
Ba$     ba$     B->bB
bBa$    ba$     popb    matched b
Ba$     a$      B->@     matched @
a$      a$      popa    matched a
$       $
Valid string Accepted
```

```
./a.out
```



```
first(A)={a}    follow(A)={$}
first(B)={b,@}  follow(B)={a}

         a       b       $
A       A->aBa
B       B->@    B->bB
enter the input string terminated with $ to parse:-aaab$


stack   Input   action
---------

A$      aaab$   A->aBa
aBa$    aaab$   popa    matched a
Ba$     aab$    B->@     matched @
a$      aab$    popa    matched a
Invalid string rejected
```

4.Design, develop and implement YACC/C program to demonstrate *Shift Reduce Parsing* technique for the grammar rules: *E →E+T* | *T, T →T*F* | *F, F →(E)* | *id* and parse the sentence: *id + id * id*.

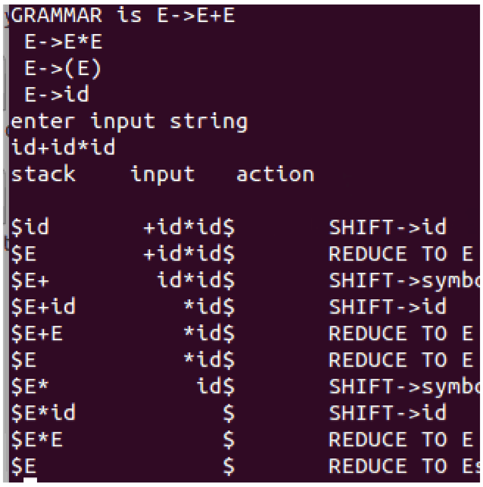
```
#include<stdio.h>
#include<string.h>
int k=0,z=0,i=0,j=0,c=0;
char a[16],ac[20],stk[15],act[10];
void check();
void main()
{
        puts("GRAMMAR is E->E+E \n E->E*E \n E->(E) \n E->id");
        puts("enter input string ");
        gets(a);
        c=strlen(a);
        strcpy(act,"SHIFT->");
        puts("stack \t input \t action");
        for(k=0,i=0; j<c; k++,i++,j++)
        {
                if(a[j]=='i' && a[j+1]=='d')
                {
                        stk[i]=a[j];
                        stk[i+1]=a[j+1];
                        stk[i+2]='\0';
                        a[j]=' ';
                        a[j+1]=' ';
                        printf("\n$%s\t%s$\t%sid",stk,a,act);
                        check();
                }
                else
                {
                        stk[i]=a[j];
                        stk[i+1]='\0';
                        a[j]=' ';
```

```
            printf("\n$%s\t%s$\t%ssymbols",stk,a,act);
            check();
        }
    }
}
void check()
{
    strcpy(ac,"REDUCE TO E");
    for(z=0; z<c; z++)
        if(stk[z]=='i' && stk[z+1]=='d')
        {
            stk[z]='E';
            stk[z+1]='\0';
            printf("\n$%s\t%s$\t%s",stk,a,ac);
            j++;
        }
    for(z=0; z<c; z++)
        if(stk[z]=='E' && stk[z+1]=='+' && stk[z+2]=='E')
        {
            stk[z]='E';
            stk[z+1]='\0';
            stk[z+2]='\0';
            printf("\n$%s\t%s$\t%s",stk,a,ac);
            i=i-2;
        }
    for(z=0; z<c; z++)
        if(stk[z]=='E' && stk[z+1]=='*' && stk[z+2]=='E')
        {
            stk[z]='E';
            stk[z+1]='\0';
            stk[z+1]='\0';
            printf("\n$%s\t%s$\t%s",stk,a,ac);
            i=i-2;
        }
        for(z=0; z<c; z++)
                if(stk[z]=='(' && stk[z+1]=='E' && stk[z+2]==')')
                {
                        stk[z]='E';
                        stk[z+1]='\0';
                        stk[z+1]='\0';
                        printf("\n$%s\t%s$\t%s",stk,a,ac);
                        i=i-2;
                }
}
```

Sample output

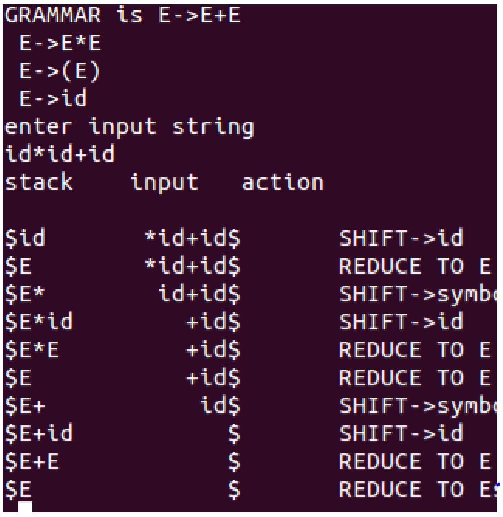
cc 4.c

./a.out



```
GRAMMAR is E->E+E
 E->E*E
 E->(E)
 E->id
enter input string
id+id*id
stack    input   action

$id       +id*id$       SHIFT->id
$E        +id*id$       REDUCE TO E
$E+        id*id$       SHIFT->symb
$E+id        *id$       SHIFT->id
$E+E         *id$       REDUCE TO E
$E           *id$       REDUCE TO E
$E*           id$       SHIFT->symb
$E*id           $       SHIFT->id
$E*E            $       REDUCE TO E
$E              $       REDUCE TO E
```

./a.out



```
GRAMMAR is E->E+E
 E->E*E
 E->(E)
 E->id
enter input string
id*id+id
stack    input   action

$id       *id+id$       SHIFT->id
$E        *id+id$       REDUCE TO E
$E*        id+id$       SHIFT->symb
$E*id        +id$       SHIFT->id
$E*E         +id$       REDUCE TO E
$E           +id$       REDUCE TO E
$E+           id$       SHIFT->symb
$E+id           $       SHIFT->id
$E+E            $       REDUCE TO E
$E              $       REDUCE TO E
```

5. Design, develop and implement a C/Java program to generate the machine code using *Triples* for the statement *A = -B * (C +D)* whose intermediate code in three-address form:

T1 = -B
T2 = C + D
T3 = T1 + T2
A = T3

```
#include<stdio.h>
#include<stdlib.h>
#include<ctype.h>
char op[2],arg1[5],arg2[5],result[5];
void main()
{
	FILE *fp1,*fp2;
	fp1=fopen("input.txt","r");
	fp2=fopen("output.txt","w");
	while(!feof(fp1))
	{
		fscanf(fp1,"%s%s%s%s",result,arg1,op,arg2);
		if(strcmp(op,"+")==0)
		{
			fprintf(fp2,"\nMOV R0,%s",arg1);
			fprintf(fp2,"\nADD R0,%s",arg2);
			fprintf(fp2,"\nMOV %s,R0",result);
		}
		if(strcmp(op,"*")==0)
		{
			fprintf(fp2,"\nMOV R0,%s",arg1);
			fprintf(fp2,"\nMUL R0,%s",arg2);
			fprintf(fp2,"\nMOV %s,R0",result);
		}
		if(strcmp(op,"-")==0)
		{
			fprintf(fp2,"\nMOV R0,%s",arg1);
			fprintf(fp2,"\nSUB R0,%s",arg2);
			fprintf(fp2,"\nMOV %s,R0",result);
		}
		if(strcmp(op,"/")==0)
		{
			fprintf(fp2,"\nMOV R0,%s",arg1);
			fprintf(fp2,"\nDIV R0,%s",arg2);
			fprintf(fp2,"\nMOV %s,R0",result);
		}
		if(strcmp(op,"=")==0)
		{
			fprintf(fp2,"\nMOV R0,%s",arg1);
			fprintf(fp2,"\nMOV %s,R0",result);
		}
	}
	fclose(fp1);
	fclose(fp2);
}
```

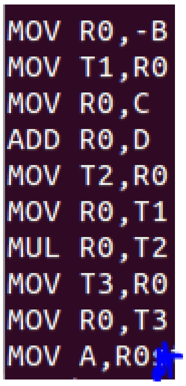
Create a file input.txt and write the below expressions and save it.

```
T1 -B = ?
T2 C + D
T3 T1 * T2
A T3 = ?
```

cc 5.c
./a.out

This will create the file **output.txt**. To see the output execute the following command.

cat output.txt



```
MOV R0,-B
MOV T1,R0
MOV R0,C
ADD R0,D
MOV T2,R0
MOV R0,T1
MUL R0,T2
MOV T3,R0
MOV R0,T3
MOV A,R0
```

6a.Write a LEX program to eliminate *comment lines* in a *C* program and copy the resulting program into a separate file.

```
%{
#include<stdio.h>
int sl=0;
int ml=0;
%}
%%
"/*"[a-zA-Z0-9' '\t\n]+"*/"      ml++;
"//".*    sl++;
%%

main()
{
        yyin=fopen("f1.c","r");
        yyout=fopen("f2.c","w");
        yylex();
        fclose(yyin);
        fclose(yyout);
        printf("\n Number of single line comments are = %d\n",sl); printf("\nNumber of
multiline comments are =%d\n",ml);
}
```

---

f1.c file(Input)

```
#include<stido.h>

int main()
{
        // this is a comment
        printf("hello");
        /* this is another comment */
}
```

f2.c file(Output)

```
#include<stido.h>

int main()
{
        printf("hello");
}
```

6b.Write YACC program to recognize valid *identifier, operators and keywords* in the given text (*C program*) file.

(Lex Part)

```
%{
#include <stdio.h>
#include "y.tab.h"
extern yylval;
%}

%%
[ \t];
[+|-|*|/|=|<|>] {printf("operator is %s\n",yytext);return OP;}
[0-9]+ {yylval = atoi(yytext); printf("numbers is %d\n",yylval); return DIGIT;}
int|char|bool|float|void|for|do|while|if|else|return|void {printf("keyword is %s\n",yytext);return
KEY;}
[a-zA-Z0-9]+ {printf("identifier is %s\n",yytext);return ID;}
. ;
%%
```

(Yacc Part)

```
%{
#include <stdio.h>
#include <stdlib.h>
int id=0, dig=0, key=0, op=0;
%}
%token DIGIT ID KEY OP

%%
input:
DIGIT input { dig++; }
| ID input { id++; }
| KEY input { key++; }
| OP input {op++;}
| DIGIT { dig++; }
| ID { id++; }
| KEY { key++; }
| OP { op++;}
;
%%

#include <stdio.h>
extern int yylex();
extern int yyparse();
extern FILE *yyin;
main()
{
	FILE *myfile = fopen("f2.c", "r");
	if (!myfile)
	{
		printf("I can't open f2.c!");
		return -1;
	}
	yyin = myfile;
	do{
		yyparse();
	}while (!feof(yyin));
	printf("numbers = %d\nKeywords = %d\nIdentifiers = %d\noperators = %d\n",dig,
key,id, op);
}

void yyerror() {
	printf("EEK, parse error! Message: ");
	exit(-1);
}
```

Create a file f2.c and write any c program like below.

```
#include<stido.h>

int main()
{
	printf("hello");
}
```

And save it.

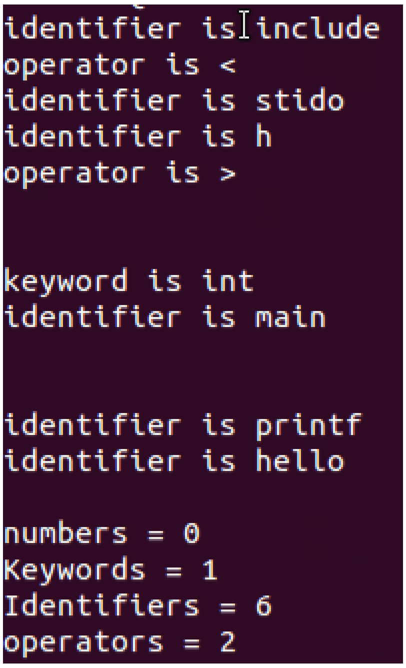
Sample Output

lex 6b.l

yacc –d 6b.y

cc lex.yy.c y.tab.c –ll

./a.out



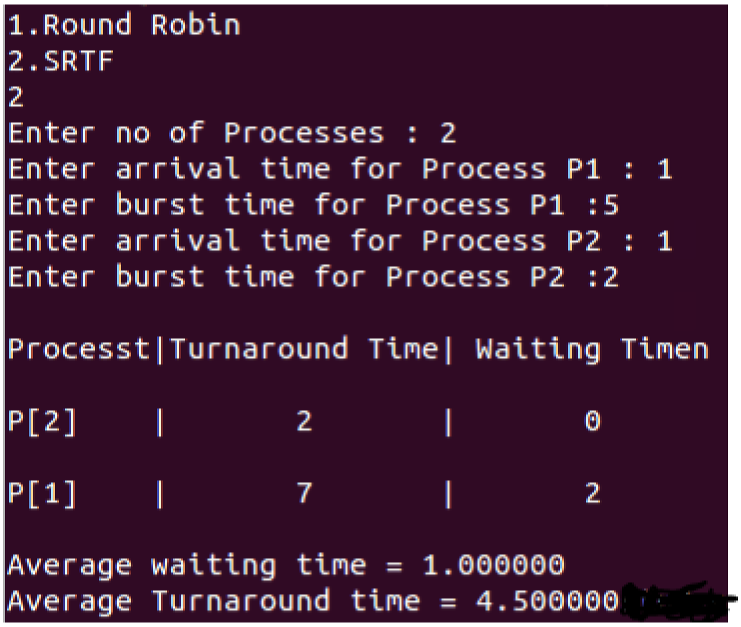
```
identifier is include
operator is <
identifier is stido
identifier is h
operator is >


keyword is int
identifier is main


identifier is printf
identifier is hello

numbers = 0
Keywords = 1
Identifiers = 6
operators = 2
```

7. Design, develop and implement a C/C++/Java program to simulate the working of Shortest remaining time and Round Robin (RR) scheduling algorithms. Experiment with different quantum sizes for RR algorithm.

```
#include<stdio.h>
int main()
{
    int count,j,n,time,flag=0,time_quantum,ch=0;
    int wait_time=0,turnaround_time=0,at[10],bt[10],rt[10];
    int endTime,i,smallest;
    int remain=0,sum_wait=0,sum_turnaround=0;
    printf("1.Round Robin \n2.SRTF \n");
    scanf("%d",&ch);
    printf("Enter no of Processes : ");
    scanf("%d",&n);
    for(i=0;i<n;i++)
    {
        printf("Enter arrival time for Process P%d : ",i+1);
        scanf("%d",&at[i]);
        printf("Enter burst time for Process P%d :",i+1);
        scanf("%d",&bt[i]);
        rt[i]=bt[i];
    }
    switch(ch)
    {
        case 1:
        printf("Enter Time Quantum:\t");
        scanf("%d",&time_quantum);
        remain=n;
        printf("\nProcess time|Turnaround Time|Waiting Time\n");
        for(time=0,count=0;remain!=0;)
        {
            if(rt[count]<=time_quantum && rt[count]>0)
            {
                time+=rt[count];
                rt[count]=0;
                flag=1;
            }
            else if(rt[count]>0)
            {
                rt[count]-=time_quantum;
                time+=time_quantum;
            }
            if(rt[count]==0 && flag==1)
            {
                remain--;
                printf("P[%d]\t|\t%d\t|\t%d\n",count+1,time-at[count],time-
at[count]-bt[count]);
                wait_time+=time-at[count]-bt[count];
                turnaround_time+=time-at[count];
                flag=0;
            }
            if(count==n-1)
                count=0;
            else if(at[count+1]<=time)
                count++;
            else
                count=0;
        }
        printf("\nAverage Waiting Time= %.2f\n",wait_time*1.0/n);
        printf("Avg Turnaround Time = %.2f\n",turnaround_time*1.0/n);
        break;
        case 2:
        remain=0;
        printf("\nProcesst|Turnaround Time| Waiting Timen\n");
        rt[9]=9999;
        for(time=0;remain!=n;time++)
        {
            smallest=9;
            for(i=0;i<n;i++)
                if(at[i]<=time && rt[i]<rt[smallest] && rt[i]>0)
                    smallest=i;
            rt[smallest]--;
            if(rt[smallest]==0)
            {
                remain++;
                endTime=time+1;
                printf("\nP[%d]\t|\t%d\t|\t%d",smallest+1,endTime-
at[smallest],endTime-bt[smallest]-at[smallest]);
                printf("\n");
                sum_wait+=endTime-bt[smallest]-at[smallest];
                sum_turnaround+=endTime-at[smallest];
            }
        }
        printf("\nAverage waiting time = %f\n",sum_wait*1.0/n);
        printf("Average Turnaround time = %f",sum_turnaround*1.0/n);
        break;
        default:
        printf("Invalid\n");
    }
    return 0;
}
--------------------------------------------------------------------------------------------------------------------
```

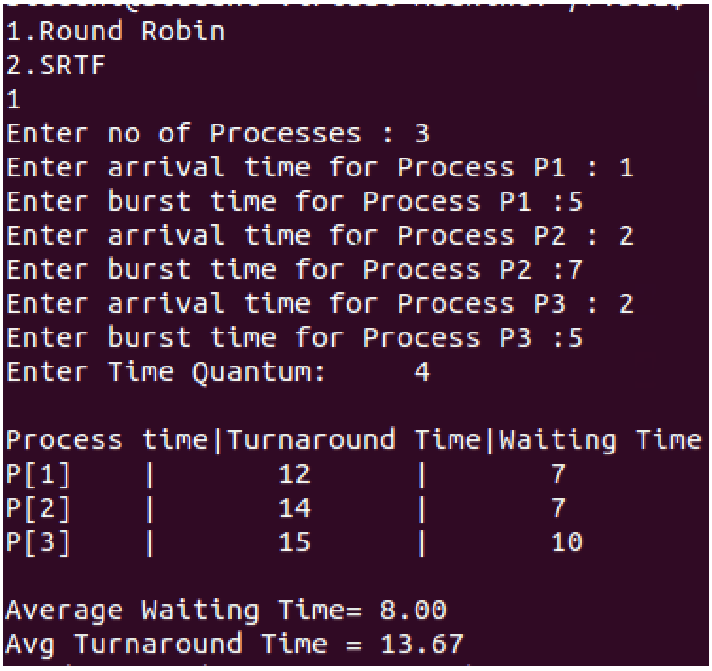
Sample output

cc 7.c
./a.out



```
1.Round Robin
2.SRTF
2
Enter no of Processes : 2
Enter arrival time for Process P1 : 1
Enter burst time for Process P1 :5
Enter arrival time for Process P2 : 1
Enter burst time for Process P2 :2

Processt|Turnaround Time| Waiting Timen

P[2]    |       2       |       0

P[1]    |       7       |       2

Average waiting time = 1.000000
Average Turnaround time = 4.500000[redacted]
```

./a.out



```
1.Round Robin
2.SRTF
1
Enter no of Processes : 3
Enter arrival time for Process P1 : 1
Enter burst time for Process P1 :5
Enter arrival time for Process P2 : 2
Enter burst time for Process P2 :7
Enter arrival time for Process P3 : 2
Enter burst time for Process P3 :5
Enter Time Quantum:     4

Process time|Turnaround Time|Waiting Time
P[1]    |       12      |       7
P[2]    |       14      |       7
P[3]    |       15      |       10

Average Waiting Time= 8.00
Avg Turnaround Time = 13.67
```

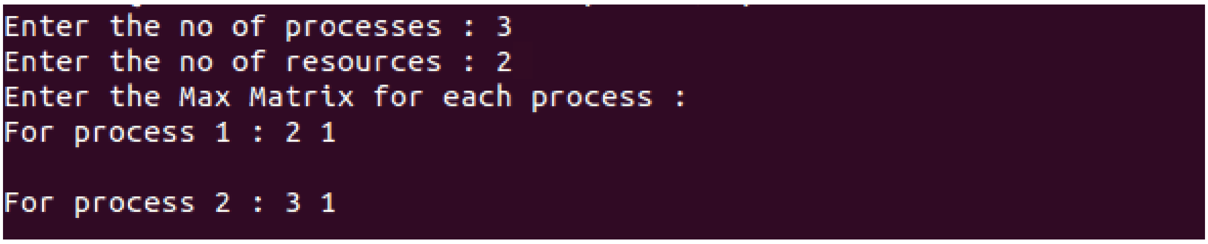
8. Design, develop and implement a C/C++/Java program to implement Banker’s algorithm. Assume suitable input required to demonstrate the results.

```
#include <stdio.h>
#include <stdlib.h>
int main()
{
        int Max[10][10], need[10][10], alloc[10][10], avail[10], completed[10],
safeSequence[10];
        int p, r, i, j, process, count;
        count = 0;
        printf("Enter the no of processes : ");
        scanf("%d", &p);
        for(i = 0; i< p; i++)
                completed[i] = 0;
        printf("Enter the no of resources : ");
        scanf("%d", &r);
        printf("Enter the Max Matrix for each process : ");
        for(i = 0; i < p; i++)
        {
                printf("\nFor process %d : ", i + 1);
                for(j = 0; j < r; j++)
                        scanf("%d", &Max[i][j]);
        }
        printf("Enter the allocation for each process : ");
        for(i = 0; i < p; i++)
        {
                printf("\nFor process %d : ",i + 1);
                for(j = 0; j < r; j++)
                        scanf("%d", &alloc[i][j]);
        }
        printf("Enter the Available Resources : ");
        for(i = 0; i < r; i++)
                scanf("%d", &avail[i]);
        for(i = 0; i < p; i++)
                for(j = 0; j < r; j++)
                        need[i][j] = Max[i][j] - alloc[i][j];
        do
        {
                printf("Max matrix:\t\nAllocation matrix:\n");
                for(i = 0; i < p; i++)
                {
                        for( j = 0; j < r; j++)
                                printf("%d ", Max[i][j]);
                        printf("\t\t");
                        for( j = 0; j < r; j++)
                        printf("%d ", alloc[i][j]);
                    printf("\n");
                }
                process = -1;
                for(i = 0; i < p; i++)
                {
                    if(completed[i] == 0)//if not completed
                    {
                        process = i ;
                        for(j = 0; j < r; j++)
                        {
                            if(avail[j] < need[i][j])
                            {
                                process = -1;
                                break;
                            }
                        }
                    }
                    if(process != -1)
                    break;
                }
                if(process != -1)
                {
                    printf("Process %d runs to completion!", process + 1);
                    safeSequence[count] = process + 1;
                    count++;
                    for(j = 0; j < r; j++)
                    {
                        avail[j] += alloc[process][j];
                        alloc[process][j] = 0;
                        Max[process][j] = 0;
                        completed[process] = 1;
                    }
                }
            }
            while(count != p && process != -1);
            if(count == p)
            {
                printf("The system is in a safe state!!\n");
                printf("Safe Sequence : < ");
                for( i = 0; i < p; i++)
                    printf("%d ", safeSequence[i]);
                printf(">\n");
            }
            else
                printf("The system is in an unsafe state!!");
}
```

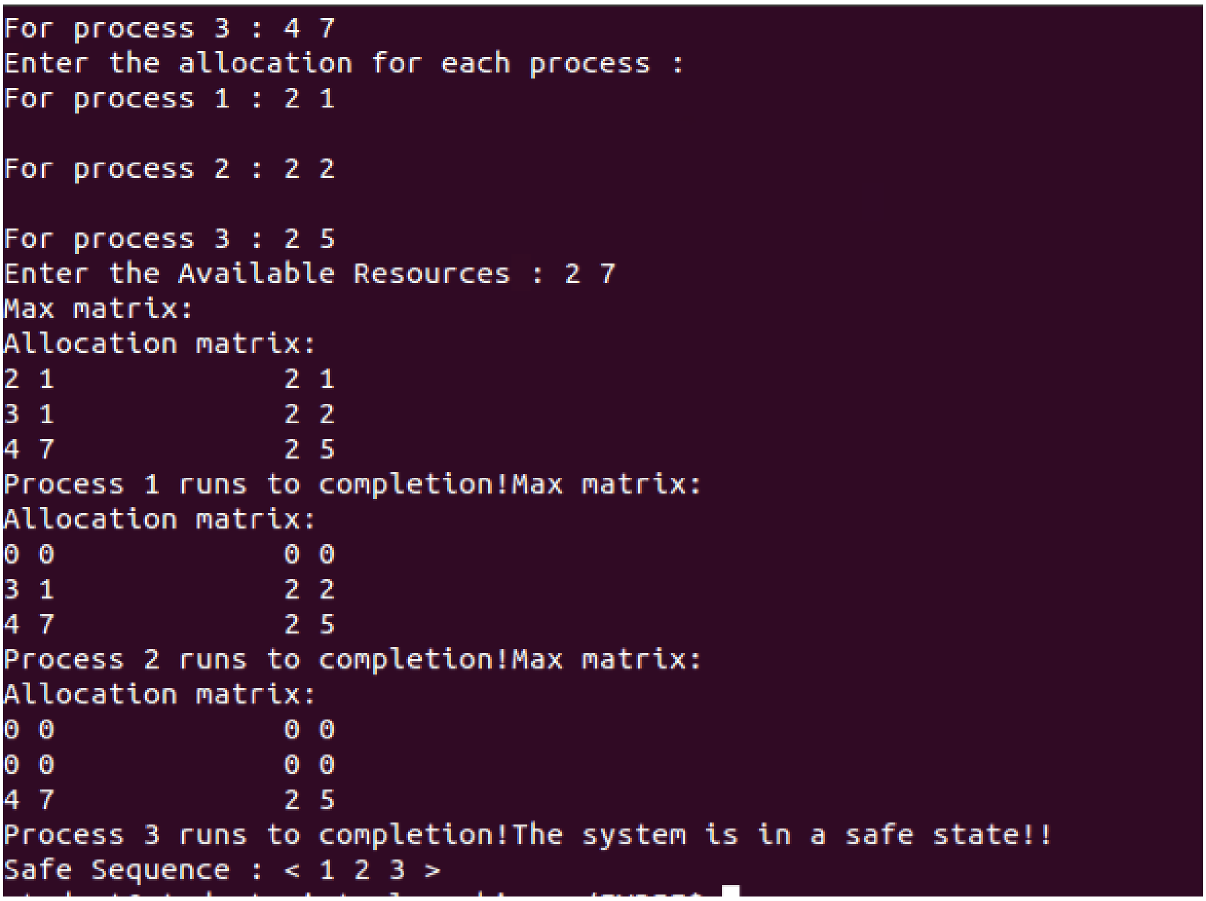
Sample output

cc 8.c

./a.out



```
Enter the no of processes : 3
Enter the no of resources : 2
Enter the Max Matrix for each process :
For process 1 : 2 1

For process 2 : 3 1
```



```
For process 3 : 4 7
Enter the allocation for each process :
For process 1 : 2 1

For process 2 : 2 2

For process 3 : 2 5
Enter the Available Resources : 2 7
Max matrix:
Allocation matrix:
2 1             2 1
3 1             2 2
4 7             2 5
Process 1 runs to completion!Max matrix:
Allocation matrix:
0 0             0 0
3 1             2 2
4 7             2 5
Process 2 runs to completion!Max matrix:
Allocation matrix:
0 0             0 0
0 0             0 0
4 7             2 5
Process 3 runs to completion!The system is in a safe state!!
Safe Sequence : < 1 2 3 >
```

9. Design, develop and implement a C/C++/Java program to implement page replacement algorithms LRU and FIFO. Assume suitable input required to demonstrate the results.

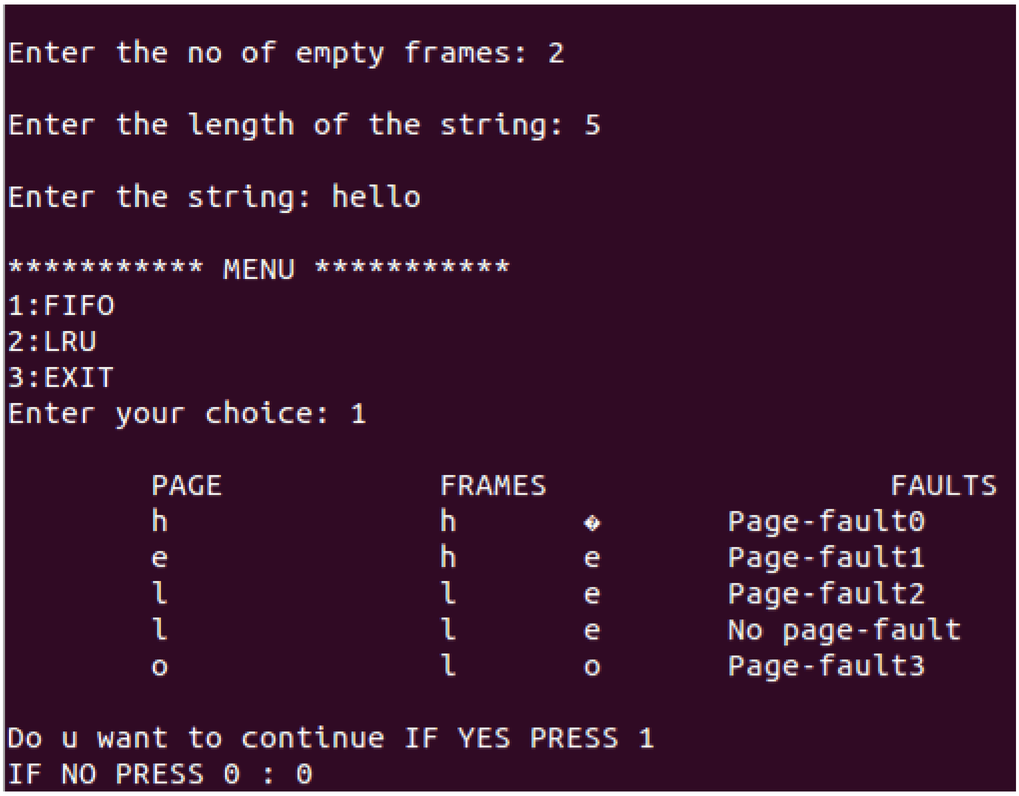
```
#include<stdio.h>
#include<stdlib.h>

void FIFO(char [ ],char [ ],int,int);
void lru(char [ ],char [ ],int,int);
void opt(char [ ],char [ ],int,int);

int main()
{
   int ch,YN=1,i,l,f;
   char F[10],s[25];
   printf("\nEnter the no of empty frames: ");
   scanf("%d",&f);
   printf("\nEnter the length of the string: ");
   scanf("%d",&l);
   printf("\nEnter the string: ");
   scanf("%s",s);
   for(i=0;i<f;i++)
      F[i]=-1;

   do
   {
      printf("\n*********** MENU ***********");
      printf("\n1:FIFO\n2:LRU \n3:EXIT");
      printf("\nEnter your choice: ");
      scanf("%d",&ch);

      switch(ch)
      {
         case 1: for(i=0;i<f;i++)
                  F[i]=-1;
               FIFO(s,F,l,f);
               break;

         case 2: for(i=0;i<f;i++)
                  F[i]=-1;
               lru(s,F,l,f);
               break;

         case 3: exit(0);
      }
      printf("\n\nDo u want to continue IF YES PRESS 1\nIF NO PRESS 0 : ");
      scanf("%d",&YN);
   } while(YN==1);
```

```
    return(0);
}

//FIFO
void FIFO(char s[],char F[],int l,int f)
{
    int i,j=0,k,flag=0,cnt=0;
    printf("\n\tPAGE\t   FRAMES\t\t\t FAULTS");
    for(i=0;i<l;i++)
    {
        for(k=0;k<f;k++)
        {
            if(F[k]==s[i])
                flag=1;
        }

        if(flag==0)
        {
            printf("\n\t%c\t",s[i]);
            F[j]=s[i];
            j++;
            for(k=0;k<f;k++)
                printf("         %c",F[k]);
            printf("\tPage-fault%d",cnt);
            cnt++;
        }

        else
        {
            flag=0;
            printf("\n\t%c\t",s[i]);
            for(k=0;k<f;k++)
                printf("         %c",F[k]);
            printf("\tNo page-fault");
        }
        if(j==f)
            j=0;
    }
}

//LRU
void lru(char s[],char F[],int l,int f)
{
    int i,j=0,k,m,flag=0,cnt=0,top=0;
    printf("\n\tPAGE\t   FRAMES\t\t\t FAULTS");
    for(i=0;i<l;i++)
    {
        for(k=0;k<f;k++)
        {
            if(F[k]==s[i])
            {
                flag=1;
                break;
            }
        }
        printf("\n\t%c\t",s[i]);
        if(j!=f && flag!=1)
        {
            F[top]=s[i];
            j++;
            if(j!=f)
                top++;
        }

        else
        {
            if(flag!=1)
            {
                for(k=0;k<top;k++)
                    F[k]=F[k+1];
                F[top]=s[i];
            }

            if(flag==1)
            {
                for(m=k;m<top;m++)
                    F[m]=F[m+1];
                F[top]=s[i];
            }
        }

        for(k=0;k<f;k++)
            printf(" %c",F[k]);

        if(flag==0)
        {
            printf("\tPage-fault%d",cnt);
            cnt++;
        }
        else
            printf("\tNo page fault");
        flag=0;
    }
}
```

Sample output

cc 9.c

./a.out



```
Enter the no of empty frames: 2

Enter the length of the string: 5

Enter the string: hello

*********** MENU ***********
1:FIFO
2:LRU
3:EXIT
Enter your choice: 1

        PAGE                    FRAMES                          FAULTS
        h                       h       �       Page-fault0
        e                       h       e       Page-fault1
        l                       l       e       Page-fault2
        l                       l       e       No page-fault
        o                       l       o       Page-fault3

Do u want to continue IF YES PRESS 1
IF NO PRESS 0 : 0
```