DEPARTMENT OF COMPUTER SCIENCE AND ENGINNERING
BUNDELKHAND INSTITUTE OF ENGINEERING AND TECHNOLOGY, JHANSI

LAB FILE

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SYSTEMS

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EXPERIMENT: 1

Object: Simulate the functioning of Lamport's Logical Clock in C.

Aim: Simulate the functioning of Lamport's Logical Clock in 'C'.

Theory: Logical Clocks refer to implementing a protocol on all machines within your distributed system, so that the machines are able to maintain consistent ordering of events within some virtual time span. A logical clock is a mechanism for capturing chronological and causal relationships in a distributed system. Distributed systems may have no physically synchronous global clock, so a logical clock allows global ordering on events from different processes in such systems.

Program:

```
#include<stdio.h>
#include<conio.h>
int max(int a,int b);
int main()
{
   int i,j,k,p1[20],p2[20],e1,e2,dep[20][20];
   printf("*** Lamport's Logical Clock ***\
   n"); printf("Enter the events : ");
   scanf("%d
   %d",&e1,&e2);
   for(i=0;i<e1;i++)
      p1[i]=i+1;
   for(i=0;i<e2;i+
   +)
      p2[i]=i+1;
   printf("Enter the Dependency matrix:\n");
   printf("\nEnter 1 if E1->E2 \nEnter -1, if E2->E1 \nElse Enter 0 \n\
   n"); printf(" ");
   for(i=0;i<e2;i++)
      printf("
      e2%d",i+1);
   for(i=0;i<e1;i++)
      { printf("\ne1%d
      ",i+1);
      for(j=0;j<e2;j++){
         scanf("%d",&dep[i][j]);
      }
   }
```

```
    for(i=0;i<e1;i++)
       { for(j=0;j<e2;j+
       +){
          //change the Time stamp if dependency exist
          if(dep[i][j]==1){
             p2[j]=max(p2[j],p1[i]
             +1); for(k=j;k<e2;k++)
                p2[k+1]=p2[k]+1;}
          //change the Time stamp if dependency exist
          if(dep[i][j]==-1){
             p1[i]=max(p1[i],p2[j]
             +1); for(k=i;k<e1;k++)
                p2[k+1]=p1[k]+1;
          }
       }
    }
    //to print the outcome of Lamport Logical Clock
    printf("\nP1 : ");
    for(i=0;i<e1;i++)
       { printf("%d",p1[i
       ]);
    }
    printf("\nP2 : ");
    for(j=0;j<e2;j++)
    printf("%d",p2[j])
    ; getch();
    return 0 ;
}
 //to find the maximum timestamp between two events
 int max(int a, int b)
{
          if
       (a>b)
       return a;
    else
    return b;

}
```

OUTPUT:

```
*** Lamport's Logical Clock ***
Enter the events : 2 4
Enter the Dependency matrix:

Enter 1 if E1->E2
Enter -1, if E2->E1
Else Enter 0

   e21 e22 e23 e24
e11 0    0   1  -1

e12 1    1   0   1

P1 : 52
P2 : 3456
```

EXPERIMENT: 2

Object: Simulate the Distributed Mutual Exclusion in C.

Theory: Distributed Mutual Exclusion Algorithm is a permission based algorithm proposed by Lamport as an illustration of his synchronization scheme for distributed systems. In permission based timestamp is used to order critical section requests and to resolve any conflict between requests.

In this algorithm:

- Three types of messages (REQUEST, **REPLY** and **RELEASE**) are used and communication channels are assumed to follow FIFO order.
- A site sends a **REQUEST** message to all other site to get their permission to enter critical section.
- A site sends a **REPLY** message to requesting site to give its permission to enter the critical section.
- A site sends a **RELEASE** message to all other site upon exiting the critical section.
- Every site S_i, keeps a queue to store critical section requests ordered by their timestamps.
  request_queue$_i$ denotes the queue of site S_i
- A timestamp is given to each critical section request using Lamport's logical clock.
- Timestamp is used to determine priority of critical section requests. Smaller timestamp gets high priority over larger timestamp. The execution of critical section request is always in the order of their timestamp.

Algorithm:

- **To enter Critical section:**
  - When a site S_i wants to enter the critical section, it sends a request message **Request (ts_i, i)** to all other sites and places the request on **request_queue$_i$**. Here, Ts_i denotes the timestamp of Site S_i.
  - When a site S_j receives the request message **REQUEST (ts_i, i)** from site S_i, it returns a times tamped REPLY message to site S_i and places the request of site S_i on **request_queue$_j$**.

  .
- **To execute the critical section:**

- A site S_i can enter the critical section if it has received the message with timestamp larger than **(ts_i, i)** from all other sites and its own request is at the top of **$request\_queue_i$**.

- **To release the critical section:**
  - When a site S_i exits the critical section, it removes its own request from the top of its request queue and sends a times tamped **RELEASE** message to all other sites.
  - When a site S_j receives the times tamped **RELEASE** message from site S_i, it removes the request of S_i from its request queue.

Program:

```
#include<stdio.h>
#include<conio.h
> #include<dos.h>
#include<time.h>
void main()
{
int
cs=0,pro=0;
double run=5;
char key='a';
time_t t1,t2;
clrscr();
printf("Press a key(except q) to enter a proc
ess into critical section.");
printf("
\
nPress q at any time to exit.");
t1 = time(NULL)
-
5;
while(key!='q')
{
while(!
kbhit()) if(cs!
=0)
{
t2 =
time(NULL);
if(t2
-
t1 > run)
{
printf("Process%d ",pro
```

```
  -
  1);
  printf(" exits crit
  ical section.

\n");

cs=0;

}
}

  key =
  getch();
  if(key!='q')
{

if(cs!=0)
  printf("Error: Another process is currently executing
  critical section Please wait till its execution is over.

  \
  n");

else
{

  printf("Proce
  ss %d ",pro);
printf(" entered critical section

  \
  n");
  cs=1;
  pro+
  +;
t1 = time(NULL);
}
}

}
}
```

Output:

Press a key(except q) to enter a process into critical section.
Press q at any time to exit.
Process 0 entered critical section.

Error: Another process is currently executing critical section.
Please wait till its execution is over.

Process 0 exits critical section.
Process 1 entered critical section.
Process 1 exits critical section.

Process 2 entered critical section.

Error: Another process is currently executing critical section.
Please wait till its execution is over.

Process 2 exits critical section

EXPERIMENT: 3

Object: Implement a Distributed Chat Server using TCP Sockets in C.

Theory: TCP is a connection-oriented protocol that provides a reliable. Flow of data between two computers.

Example applications that. Use such services are HTTP, FTP, and Telnet.

Program:

event.c/

```
#include <sys/time.h>
#include <string.h>
#include <stdio.h>
#include "event.h"
void init_fdvec(fdvec *e)

{
FD_ZERO(&e->fds);

memset(&e->f, '\0', sizeof(e-
>f)); e->size = 0;
}

void init_eventset(eventset *e)
{

init_fdvec(&e->read
);
init_fdvec(&e->write);

}
void on_event(fdvec *e, int fd, void (*f)(int fd))

{
FD_SET(fd,&e-
>fds); e->f[fd] = f;
if (fd >= e->size) e->size = fd + 1;
}

void on_event_nop(fdvec *e, int fd)
{

int i;
FD_CLR(fd,&e-
>fds); e->f[fd] =
NULL;
if (fd == e->size-1)
{ e->size = 0;
for (i = 0; i != fd; i++) {
if (FD_ISSET(i, &e->fds)) e->size = i + 1;
}

}
```

```
}

void handle_events(eventset *e)
{
fd_set readfds, writefds;int maxfd; int i;

 int n
 othing_to_write = 1;
 readfds = e->read.fds;
 writefds = e->write.fds;
 maxfd = (e->read.size > e->write.size) ? e->read.size : e-
 >write.size; select(maxfd, &readfds, &writefds, 0, 0);

 for (i = 0; i != maxfd; i+
 +) { if (FD_ISSET(i, &

writefds) && FD_ISSET(i, &e->write.fds)) {

 /* fprintf(stderr, "%d writable\n", i); */
 e->write.f[i](i);

nothing_to_write = 0;

}

}

if (nothing_to_write) {

for (i = 0; i != maxfd; i++) {

 if (FD_ISSET(i, &readfds) &&
 FD_ISS ET(i, &e->read.fds)) {

 /* fprintf(stderr, "%d readable\n", i); */
 e->read.f[i](i);

}

}

}

}

 event.h/
 typedef struct

{

fd_set fds;

 void (*f[FD_SETSIZE])(int
 fd); int size;

 } fdvec;
 typedef struct

{
```

```
 fdvec
 read;

fdvec write;

} eventset;

void init_eventset(eventset *e);

 void on_event(fdvec *e, int fd, void (*f)(int
 fd)); void on_event_nop(fdvec *e, int fd);

 void handle_events(eventset *e);
 die.c/

#include <stdio

.h>

#include <string.h>#include <errno.h>
void die_if_func(int whether, char *cond, char *file, int line, char *msg)

{
 if (whether)
 { char *s;

 for (s = msg; *s; ++s)
 { if (*s != '%') {

putc(*s, stderr);
} else {

++s;
switch(*s)
{

case '\0':
 fprintf(stderr, "(Unterminated %% sequence in error string)\n");
 goto done_with_msg;

case '%':

 putc('%', stderr);
 break;

case 'f':

 fprintf(stderr, "%s",
 file); break;
case 'l':
 fprintf(stderr, "%d", line);
 break;
case 'c':
 fprintf(stderr, "%s", cond);
 break;

case 'e':

 fprintf(stderr, "%s", strerror(errno));
 break;
```

```
default:
 fprintf(stderr, "(invalid %% sequence %%%c in error string)\n",
 *s); break;
}
}
}
done_with_msg:
 putc('\n', stderr);
 fflush(stderr);
 exit(1);
}
}
 char *out_of_memory = "Out of memory at %f:%l (says %c) (error
 %e)"; die_test.c/
 #include "die.h"
 int main()
{die_if(1, out_of_memory); return 0;
}
die.h/          `
 #define die_if(cond,msg)
 (die_if_func(cond,#cond,__FILE__,__LINE
 ,msg))
 void die_if_func(int whether, char *cond, char *file, int line, char *msg);
 char *out_of_memory;
kstr.c/
 #include <string.h>
 #include <stdio.h>
 #include <stdlib.h>
 #include <unistd.h>
 #include "die.h"
 #include "kstr.h"
 #include "talloc.h"
 void kstr_new(kstr
 *k)
{
 *k = talloc(sizeof(**k));
 die_if(!*k, out_of_memory);
 (*k)->start = 0;
(*k)->length = 0;
(*k)->allocated_length = 0;
}
void kstr_del(kstr k)
{
```

```
 tfree(k->start);
 tfree(k);
}
void kstr_growto(kstr k, int len)

{
 if (len > k->allocated_length)
 { int nal = ((len | 7) + 1) * 2;
 char *nstart = talloc(nal);
 die_if(!nstart, out_of_memory);
 memset(nstart, 'Y', nal);
 memcpy(nstart, k->start, k->length);
 tfree(k->start);

k->start = nstart;

k->allocated_length = nal;

}
}
void kstr_growby(kstr k, int len)

{
kstr_growto(k, len + k->length);

}void kstr_getline(kstr k, FILE *f)
{

int l = 80;
 k->length =
 0; for (;;) {

 char *rv;
 kstr_growby(k,
 l); clearerr(f);

 rv = fgets(k->start + k->length, l,
 f); if (!rv) {

return;

}

 k->length += strlen(k->start + k-
 >length); if (k->start[k->length-1] == '\')
 {

/* end of line */

 k->start[k->length] =
 'X'; return;
}
l *= 2;

}
}

int kstr_read(kstr k, int fd, int maxlen)
```

```
{
int rv;

kstr_growto(k, maxlen);
 rv = read(fd, k->start,
 maxlen); if (rv <= 0) {

 k->length =
 0; return rv;

} else {
 k->length =
 rv; return rv;

}

}

void kstr_append(kstr k, char *s, int len)

{

kstr_growby(k, len);
 memcpy(k->start + k->length, s,
 len); k->length += len;
}
 kstr.h/ typedef
 struct

{

 char *start;
 int length;

int allocated_length;

} *kstr;void kstr_new(kstr * k);

void kstr_del(kstr k);
 void kstr_growto(kstr k, int len);
 void kstr_growby(kstr k, int
 len); void kstr_getline(kstr k,
 FILE *f);

 int kstr_read(kstr k, int fd, int maxlen);
 void kstr_append(kstr k, char *s, int len);
 kstr_test.c/

 #include <stdio.h>
 #include "kstr.h"
 #include "die.h"

 char *input_error = "input error at %f:%l:
 %e"; int main()

{

 kstr s;
 kstr_new(&s);
```

```
  while (!feof(stdin))
  { kstr_getline(s, stdin);
  die_if(ferror(stdin), input_error);
fwrite(s->start, s->length, 1, stdout);
}
  kstr_del(s);
  return 0;
}
```

talloc.c/

```
  #include
  <stdlib.h>
  #include  <stdio.h>
  #include "talloc.h"
/* to turn on tracing:
  #define tracing /* */
  void *talloc(int n)
{
  void *rv =
  malloc(n); #ifdef
  tracing
  fprintf(stderr, "0x%08x: %d bytes\n", (unsigned)rv, n);
  #endif
return rv;
}
void tfree(void *p)
{
#ifdef tracing
  fprintf(stderr, "0x%08x: freed\n", (unsigned)p);
  #endif
free(p);
}
```

talloc.h/void *talloc(int n); void tfree(void *p);

```
  mem-used/#!/var/u/sittler/bin/perl-w
  use strict;
  # analyze memory usage trace from talloc.
  my %blocks;
  my $total = 0;
  while (<>) {
  printf "%9d %s", $total, $_;
  if (/^(0x[0-9a-f]+):
   (\d+) bytes$/) {
if (exists $blocks{$1}) {
```

```
warn "Uh-oh: $1 allocated twice without intervening free\n";

} else {

$blocks{$1} = $2;

$total += $2;

}

  } elsif (/^(0x[0-9a-f]
   +): freed$/) {

next if $1 eq '0x00000000';

  $total -=
  $blocks{$1}; delete
  $blocks{$1};

}

}

  Print "Final: $total\n";
  chat-serve
r.c/
  #include <sys/types.h>
  #include <sys/socket.h>
  #include <errno.h>
  #include <stdio.h>
  #include <netinet/in.h>
  #include <arpa/inet.h>
  #include <unistd.h>
  #include <fcntl.h>
  #include <signal.h>
  #include "event.h"
  #include "kstr.h"
  #include "die.h"
  eve
  ntset e;
kstr client_list;
typedef struct client_info
{

int connected;
  struct sockaddr_in sin;
  kstr outbuf;
```

```
int outbufp;
} client_info;

client_info *get_cip(int fd)
{

return ((client_info*)client_list->start) + fd;
}
 void handle_disconnectio
 n(int fd)

{

 client_info *cip =
 get_cip(fd); cip->connected
 = 0; kstr_del(cip->outbuf);
 on_event_nop(&e.read, fd);
 on_event_nop(&e.write, fd);
 close(fd);
}
void write_queued_data(int fd)

{
 client_info *cip =
 get_cip(fd); int rv;

 die_if(!cip->connected, "Damn event handler called on disconnected client");
 die_if(cip->outbufp > cip->outbuf->length, "outbufp out of range (%c)");

 rv = write(fd, cip->outbuf->start + cip->outbufp, cip->outbuf->length -cip-
 >outbufp); if (rv < 0) {

 fprintf(stderr, "error writing to client %d (%s): ", fd, net_ntoa(cip->sin.sin_addr));
 perror("closing connection");

handle_disconnection(fd);

} else {
cip->outbufp += rv;

if (cip->outbufp == cip->outbuf->length)
{

cip->outbufp = 0;
 cip->outbuf->length = 0;
 on_event_nop(&e.write, fd);
} else {
if (cip->outbufp > 15*cip->outbuf->length/16) {

/* time to move it back to the beginning of the buffer */
memcpy(cip->outbuf->start, cip->outbuf->start+cip->outbufp, cip->outbuf->length -cip-
>outbufp);

 cip->outbuf->length -= cip-
 >outbufp; cip->outbufp = 0;
}
}
```

```
}

}
 char lostmsg[] = "(Lost messages)\r\n";
 int queuelimit = 50 * 1024;void
 queue_data(int fd, char *s, int len)

{

client_info *cip = get_cip(fd);
 die_if(!cip->connected, "Attempt to send to disconnected client");
 if (cip->outbuf->length + len > queuelimit) {

 if (cip->outbuf->length < queuelimit)
 { kstr_append(cip->outbuf, lostmsg, sizeof(lostmsg)-
 1);

} else {
}

} else {
kstr_append(cip->outbuf, s, len);
}

on_event(&e.write, fd, write_queued_data);
}

void queue_string(int fd, char *s)
{
queue_data(fd, s, strlen(s));

}
kstr rbuf;

void handle_client_data(int fd)
{

int rv;
 rv = kstr_read(rbuf, fd, 8192);
 if (rv < 0) {
 fprintf(stderr, "client fd %d:", fd);
 perror("read error");
 } else if (rv == 0)
 { handle_disconnection(fd
 );
 } else
 { int i;

 client_info *cip =
 get_cip(0); for (i = 0; i != e.

read.size; i++) {

 if (cip[i].connected)
 { queue_string(i, "From
 ");
```

```
  queue_string(i, inet_ntoa(cip[fd].sin.sin_addr));
  queue_string(i, ": ");

queue_data(i, rbuf->start, rbuf->length);

}

}

}

}

void new_client_conn(int listenfd)

{

  struct sockaddr_in addr;
  socklen_t socklen =
  sizeof(addr); client_info *cip;int
  space_to_allocate;

  int nc = accept(listenfd, (struct sockaddr*)&addr, &socklen);
  fcntl(nc, F_SETFL, fcntl(nc, F_GETFL, 0) | O_NDELAY);
  kstr_growto(client_list, (nc+1) * sizeof(struct client_info));

  space_to_allocate = (nc+1) * sizeof(struct client_info) -client_list->length;
  memset(client_list->start + client_list->length, '\0', space_to_allocate);
  client_list->length += space_to_allocate;

  cip = ((client_info*)client_list->start) +
  nc; cip->connected = 1;
  cip->sin = addr;
  kstr_new(&cip-
  >outbuf); cip->outbufp
  = 0;
  on_event(&e.read, nc, handle_client_data);
  queue_string(nc, "Hello there ");
  queue_string(nc, inet_ntoa(addr.sin_addr));
  queue_string(nc, "\n");
}

int open_server_socket()
{

  int fd = socket(PF_INET,
  SOCK_STREAM, 0); int rv;
int one = 1;
struct sockaddr_in addr;
  setsockopt(fd, SOL_SOCKET, SO_REUSEADDR, &one, sizeof
  one); memset((char*)&addr, '\0', sizeof(addr));

  addr.sin_family = AF_INET;
  addr.sin_port = htons(17224);
  addr.sin_addr.s_addr =
  INADDR_ANY;
```

```
  rv = bind(fd, (struct sockaddr*)&addr,
  sizeof(addr)); die_if(rv<0, "bind failed: %e");
rv = listen(fd, 5);
  die_if(rv<0, "listen failed:
  %e"); return fd;
}
void end_server(int fd)
{
  kstr_del(client_list);
  kstr_del(rbuf);
  exit(0);
}
int main()
{
  int s = open_server_socket();
  kstr_new(&client_list);
  kstr_new(&rbuf);
  sigignore(SIGPIPE);
  init_eventset(&e);on_even
  t(&e.read, s, new_client_conn);
  on_event(&e.read, 0, end_server);
  for (;;) {
handle_events(&e);
}
  die_if(1 + 1 == 2, "Can't happen at %f:
  %l"); return 0;
}
```

EXPERIMENT: 4

Object: Implement RPC mechanism for a file transfer across a network in C.

Theory: **RPC** is a request–response protocol. An **RPC** is initiated by the client, which sends a request message to a known remote server to execute a specified procedure with supplied parameters. The remote server sends a response to the client, and the application continues its process.

Theory: **RPC** is a request–response protocol. An **RPC** is initiated by the client, which sends a request message to a known remote server to execute a specified procedure with supplied parameters. The remote server sends a response to the client, and the application continues its process.

Program:

```
client.java
import java.io.*;
import java.net.*;
class client{
public static void main(String args[])
{ try{
Socket sock=new Socket (args[0],8081);
FileInputStream is=new
FileInputStream("client.class"); OutputStream
os=sock.getOutput
Stream();
int ch=0;
ch=is.read()
; do{
os.write(ch);
ch=is.read();
}while(ch!=-
1); os.flush();
os.close();
sock.close();
}
catch(Exception e){System.out.println(e);}
}
}
server.java import
java.io.*; import
java.net.*; class
```

```
 server { public
 static voi
 d main(String args[])
 { new server().go();
}
public void go(){while(true){ try{
 ServerSocket server=new ServerSocket(8081);
 Socket socket=server.accept();
new Thread(new thread(socket)).start();
}
catch(Exception e){
}
}
}
 class thread implements
 Runnable{
 Socket s;
 thread(Socket s){
 this.s=s;
}
 public void run()
 { try{
InputStream is=s.getInputStream();
 FileOutputStream out =new FileOutputStream(new File("clientcopy.class"));
 int ch=0;
 ch=is.read();
 do{ out.write(
 ch);
 ch=is.read();
 }while(ch!=-
 1); out.flush();
 System.out.println("File (client.class) Copied to server as
 (clientcopy.class)");
out.close();
s.close();
}
 catch(Exception e)
 { System.out.println(e
 );
}
}
}
}
```

EXPERIMENT 5

Object: Implement Java RMI mechanism for accessing methods of remote systems.

Theory:

Remote Method Invocation (RMI) is an API which allows an object to invoke a method on an object that exists in another address space, which could be on the same machine or on a remote machine. Through RMI, object running in a JVM present on a computer (Client side) can invoke methods on an object present in another JVM (Server side).

Working of RMI:

The communication between client and server is handled by using two intermediate objects: S tub object (on client side) and Skeleton object (on server side).

Program:

AddClient.java

```
import java.rmi.*;
public class
AddClient
{
public static void main(String args[])

{
try
{

String addServerURL="rmi://"+ args[0] +
"/AddServer"; AddServerIntf addServerIntf =
(AddServerIntf)Naming.lookup(addServerURL);
System.out.println("the first no is:" + args[1]);
double d1=Double.valueOf(args[1]).doubleValue();
System.out.println("the second no is:" + args[2]);
double d2=Double.valueOf(args[2]).doubleValue();

System.out.println("Sum = " + addServerIntf.add(d1,d2));

}

catch(Exception e)
{
System.out.println("Exception:" +e);

}
}

}
```

AddServer.java

```
import java.net.*;
import java.rmi.*;
public class
AddServer
{
```

```
public static void main(String args[]){try
{
  AddServerImpl addServerImpl = new AddServerImpl();
  Naming.rebind("AddServer", addServerImpl);
}
catch(Exception e)
{
System.out.println("Exception:" +e);
}
}
}
```

AddServerImpl.jav
a import java.rmi.*;
import java.rmi.
server.*;

```
public class AddServerImpl extends UnicastRemoteObject implements
AddServerIntf
{
public AddServerImpl() throws RemoteException
{
}
public double add(double d1,double d2) throws RemoteException
{
return d1+d2;
}
}
```

AddServerIntf.jav
a import
java.rmi.*;

```
public interface AddServerIntf extends Remote
{
double add(double d1, double d2) throws RemoteException;
}
```

Output:

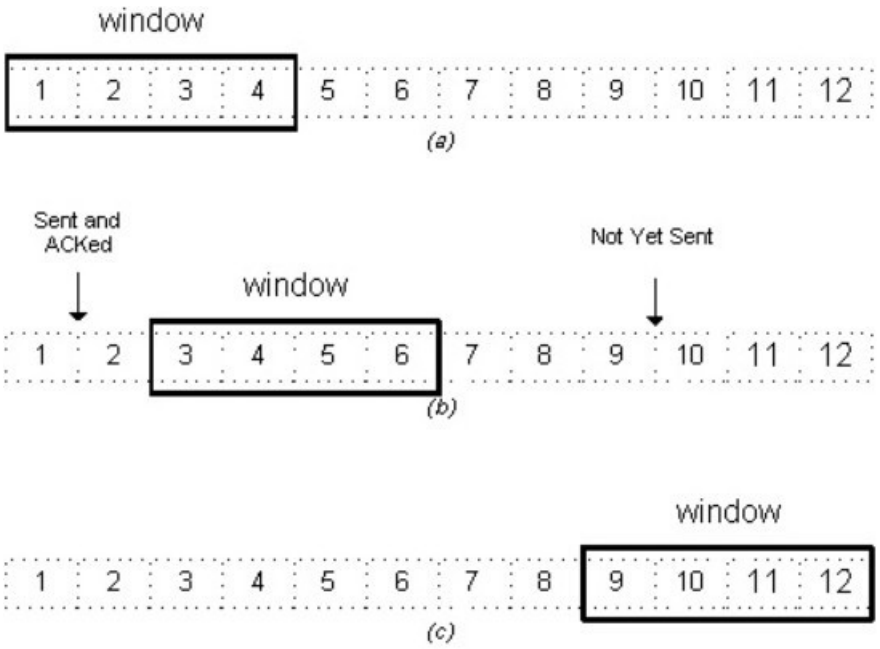
/ when arguments are passed as 35 and 16
Sum = 51

EXPERIMENT: 6

Object: Simulate Balanced Sliding Window Protocol in C

Theory: In computer networks sliding window protocol is a method to transmit data on a network. Sliding window protocol is applied on the Data Link Layer of OSI model. At data link layer data is in the form of frames. In Networking, Window simply means a buffer which has data frames that needs to be transmitted.

As soon as sender receives the acknowledgement of a frame it is replaced by the next frames to be transmitted by the sender. If receiver sends a collective or cumulative acknowledgement to sender then it understands that more than one frames are properly received, for eg:- if ack of frame 3 is received it understands that frame 1 and frame 2 are received properly.



Efficiency of Sliding Window Protocol

$\eta = (W*t_x)/(t_x+2t_p)$

W = Window Size

t_x = Transmission time
t_p = Propagation delay

Sliding window works in full duplex mode

Program:

```
#include<stdio.h>

int main()

{

    int w,i,f,frames[50];

    printf("Enter window size:
    "); scanf("%d",&w);


    printf("\nEnter number of frames to transmit: ");
    scanf("%d",&f);


    printf("\nEnter %d frames: ",f);

    for(i=1;i<=f;i++)
       scanf("%d",&frames[i]);


    printf("\nWith sliding window protocol the frames will be sent in the following manner
 (assuming no corruption of frames)\n\n");
    printf("After sending %d frames at each stage sender waits for acknowledgement sent by
 the receiver\n\n",w);

    for(i=1;i<=f;i++)
    {

       if(i%w==0)
       {

          printf("%d\n",frames[i]);
          printf("Acknowledgement of above frames sent is received by sender\n\n");
       }

       else
          printf("%d ",frames[i]);

    }

    if(f%w!=0)
       printf("\nAcknowledgement of above frames sent is received by sender\n");

    return 0;
}
```

Output:

Enter window size: 3
Enter number of frames to transmit: 5
Enter 5 frames: 12 5 89 4 6

With sliding window protocol the
frames will be sent in the following
manner (assuming no corruption of
frames)
After sending 3 frames at each stage sender waits for acknowledgement sent by the
receiver
12 5 89
Acknowledgement of above frames sent is received by sender
4 6
Acknowledgement of above frames sent is received by sender

EXPERIMENT: 7

Object: Implement CORBA mechanism by using C++ program at one end and Java program on the other

Program:

Server programs:

```
#ifndef __hello_skel_h_
_____________________
 #define
__hello_skel_h
_______________
 #include
<hello.h>
class Hello_skel : virtual public
Hello, virtual public
CORBA_Object_skel
{
static CORBA_ULong _ob_num_;
Hello_skel(const Hello_skel&);
void operator=(const
Hello_skel&); protected:
Hello_skel() { }
Hello_skel(const
char*); public:
Hello_ptr _this() { return
Hello::_duplicate(this); } virtual CORBA_ULong
_OB_incNumber() const;
virtual OBDispatchStatus _OB_dispatch(const char*, OBFixSeq< CORBA_Octet
>&, bool, CORBA
_ULong, CORBA_ULong);
};
#endif
#include
<OB/CORBA.h>
#include <hello_skel.h>
CORBA_ULong Hello_skel::_ob_num_ =
0; Hello_skel::Hello_skel(const char*
name)
{
assert_nca(name,
OBNCANullString); try
{
```

```
 _OB_cre
 ateObjectKeyWithName(name);
}
catch(...)

{
 _OB_setRef(0)
 ; throw;}
}

 CORBA_ULong
 Hello_skel::_OB_incNumber()
 const
{
return Hello_skel::_ob_num_++;
}

 OBDispatchStatus
 Hello_skel::_OB_dispatch(const char*
 _ob_op, OBFixSeq< CORBA_Octet >&
 _ob_seq,
 bool _ob_sw,
 CORBA_ULong
 _ob_offIn,
 CORBA_ULong
 _ob_offOut)
{

if(strcmp(_ob_op, "hello") == 0)
{
hello();

CORBA_ULong _ob_cnt = _ob_offOut;
_ob_seq.length(0);

 _ob_seq.length(_ob_cnt);
 #ifdef
 OB_CLEAR_MEM
 memset(_ob_seq.data(), 0, _ob_seq.length());
 #endif
return OBDispatchStatusOK;

}
else

 return CORBA_Objec
 t_skel::_OB_dispatch(_ob_op, _ob_seq, _ob_sw,
_ob_offIn, _ob_offOut);

}
 #ifndef __hello_h_
 _____________
  #define __hello_h_
```

```
class Hello;

 typedef Hello* Hello_ptr;
 typedef Hello* HelloRef;
typedef OBObjVar< Hello > Hello_var;

class Hello : virtual public CORBA_Object

{
Hello(const Hello&);

void operator=(const Hello&);protected:
 Hello() {
 } public:

static inline Hello_ptr

_duplicate(Hello_ptr p)

{
 CORBA_Object::_duplicate(p
 ); return p;

}

static inline Hello_ptr
_nil()
{

return 0;
}

 static Hello_ptr _narrow(CORBA_Object_ptr);
 virtual void* _OB_narrowHelp(const char*)
 const; virtual const char* _OB_typeId() const;
friend void OBUnmar
shal(Hello_ptr&, const CORBA_Octet*&, bool);

friend CORBA_Boolean operator>>=(const CORBA_Any&, Hello_ptr&);
virtual void hello();

};
extern const OBTypeCodeConst _tc_Hello;

 inline
 void

CORBA_release(Hello_ptr p)

{
CORBA_release((CORBA_Object_ptr)p);

}
```

```
 inline CORBA_Boolean
 CORBA_is_nil(Hello_ptr
 p)
{
return p == 0;
}
inline void
OBMarshal(Hello_ptr p, CORBA_Octet*& oct)
{
OBMarshal((CORBA_Object_ptr)p, oct);
}
 inline
 v
 oidOB
 Marsh
 alCoun
 t(Hello
 _ptr p,
 CORB
 A_UL
 ong&
 count)
{
OBMarshalCount((CORBA_Object_ptr)p, count);
}
 void OBUnmarshal(Hello_ptr&, const CORBA_Octet*&,
 bool); void operator<<=(CORBA_Any&, Hello_ptr);
void operator<<=(CORBA_Any&, Hello_ptr*);
CORBA_Bool
 ean operator>>=(const CORBA_Any&,
 Hello_ptr&); inline void
operator<<=(CORBA_Any_var& any, Hello_ptr val)
{
any.inout() <<= val;
}
inline void
operator<<=(CORBA_Any_var& any, Hello_ptr* val)
{
any.inout() <<= val;
}
inline CORBA_Boolean
operator>>=(const CORBA_Any_var& any, Hello_ptr& val)
```

```
{
return any.in() >>= val;
}

#endif
 #include <OB/CORBA.h>
 #include
 <OB/TemplateI.h>
 #include <hello.h>

#ifndef HAVE_NO_EXPLICIT_TEMPLATES
 template class OBObjVar< Hello
 >; templa
 te class OBObjForSeq< Hello
 >; #endif
 Hello_ptr
 Hello::_narrow(CORBA_Object_ptr
 p)
{
if(!CORBA_is_nil(p))
{
 void* v = p ->
 _OB_narrowHelp("IDL:Hello:1.0"); if(v)
return _duplicate((Hello_ptr)v);
if(p -> _OB_remoteIsA("IDL:Hello:1.0"))
{
Hello_ptr val = new Hello;val -> _OB_copyFrom(p); return val;
}
}
return _nil();
}
void*
Hello::_OB_narrowHelp(const char* _ob_id) const
{
if(strcmp("IDL:Hello:1
 .0", _ob_id) == 0)
 return (void*)this;
 else
return CORBA_Object::_OB_narrowHelp(_ob_id);
}
 const char*
 Hello::_OB_typeId()
 const
{
return "IDL:Hello:1.0";
}
```

```
void

OBUnmarshal(Hello_ptr& val, const CORBA_Octet*& coct, bool swap)
{
 Hello_var old = val;
 CORBA_Object_var p;
 OBUnmarshal(p.inout(), coct,
 swap); if(!CORBA_is_nil(p))

{
 void* v = p->
 _OB_narrowHelp("IDL:Hello:1.0"); if(v)

 val =
 Hello::_duplicate((Hello_ptr)v); else

{

 assert_nca(!(p -> _is_local() && p ->
 _is_dynamic()), OBNCADynamicAsStatic);

 assert(!p ->
 _is_local()); val = new
 Hello;

val -> _OB_copyFrom(p);

}

}

else

val = Hello::_nil();

}

const OBTypeCodeConst
_tc_Hello( "010000000E0000002200000010000000E00000049444C3A48656C6C6F3A312E
300000000 6000""00048656C6C6F00");

void
```

```
operator<<=(CORBA_Any& any, Hello_ptr val)
{

OBObjAny* o = new OBObjAny;
 o -> b = CORBA_Object::_duplicate(val);
 o  -> d =
 CORBA_Object::_duplicate(val);
 any.replace(_tc_Hello, o, true);
}

void
operator<<=(CORBA_Any& any, Hello_ptr* val)

{
OBObjAny* o = new OBObjAny;
 o -> b = *val;
 o  -> d =
 CORBA_Object::_duplicate(*val);
 any.replace(_tc_Hello, o, true);
}
CORBA_Boolean
operator>>=(const CORBA_Any& any, Hello_ptr& val)

{
if(any.check_type(_tc_Hello))

{
 OBObjAny* o =
 (OBObjAny*)any.value(); assert(o);

if(!CORBA_is_nil(o -> d)){

 void*v = o -> d ->
 _OB_narrowHelp("IDL:Hello:1.0"); if(v)

 val =
 (Hello_ptr)v; else

{

 assert_nca(!(o -> d -> _is_local() && o -> d -> _is_dynamic()),
 OBNCADynamicAsStatic); assert(!o -> d -> _is_local());

val = new Hello;

 val -> _OB_copyFrom(o -> d);
 OBObjAny* no = new
 OBObjAny;

 no -> b = CORBA_Object::_duplicate(o ->
 b); no -> d = val;

((CORBA_Any&)any).replace(_tc_Hello, no, true);

}

}
```

```
else
  val =
  Hello::_nil();
  return true;
}
else
return false;
}
  void
  Hello::hello(
  )
  {
  if(CORBA_is_nil(_ob_con
  _)) throw CORBA_N
  O_IMPLEMENT();
  CORBA_ULong _ob_off = _ob_con_ -> offset(this,
  "hello"); CORBA_ULong _ob_cnt = _ob_off;
OBFixSeq< CORBA_Octet > _ob_seq(_ob_cnt);
  _ob_seq.length(_ob_cnt);
  #ifdef
  OB_CLEAR_MEM
  memset(_ob_seq.data(), 0, _ob_seq.length());
  #endif
bool _ob_sw, _ob_ex, _ob_fo;
  _ob_off = _ob_con_ -> request(this, "hello", _ob_seq, _ob_sw, _ob_ex, _ob_fo, _ob_tout_);
  if(_ob_fo)
{
const CORBA_Octet* _ob_co = _ob_seq.data() + _ob_off;
  _OB_forward(_ob_co,
  _ob_sw); hello();
return;
}
if(_ob_ex)
throw CORBA_UNKNOWN();
}
#include <hello_skel.h>
class Hello_impl : public Hello_skel
{
public:
```

```
 Hello_impl();
 virtual void
 hello();
};
 #include <CORBA.h>
 #include <hello_impl.h>
 Hello_impl::Hello_impl
 ()
{
}
 void
 Hello_impl::hello(
 )
{
cout << "Hello World!" << endl;
}
 #include <CORBA.h>
 #include
 <hello_impl.h>
 #include <fstream.h>
 int
main(int argc, char* argv[], char*[])
{
CORBA_ORB_var orb = CORBA_ORB_init(argc, argv);CORBA_BOA_var boa = orb ->
BOA_init(argc, argv); Hello_var p = new Hello_impl;
 CORBA_String_var s = orb ->
 object_to_string(p); const char* refFile =
 "Hello.ref";
 ofstream out(refFile);
 out << s << endl;
 out.close();
boa -> impl_is_ready(CORBA_ImplementationDef::_nil());
}
```

Client programs:

```
public interface Hello extends org.omg.CORBA.Object
{
void hello();
public void hello(); }
 abstract public class _sk_Hello extends org.omg.CORBA.portable.Skeleton
 implements Hello
{ protected _sk_Hello(java.lang.String name)
{
super(name); }
protected _sk_Hello() { super(); }
```

```
public java.lang.String[] _ids() { return_ids; }

 private static java.lang.String[]_ids = { "IDL:Hello:1.0" };
 public org.omg.CORBA.portable.
MethodPointer[] _methods()

 { org.omg.CORBA.portable.MethodPointer[] methods =
 { new org.omg.CORBA.portable.MethodPointer("hello", 0,
 0), }; return methods; }
 public boolean _execute(org.omg.CORBA.portable.MethodPointer method,
 org.omg.CORBA.portable.InputStream input,
 org.omg.CORBA.portable.OutputStream output) { switch(method.interface_id)
{

case 0:
{
return _sk_Hello._execute(this, method.method_id, input, output);

}
}

 throw new
 org.omg.CORBA.MARSHAL(); } public
 static boolean _execute(Hello _s elf, int
 _method_id,
org.omg.CORBA.portable.InputStream _input, org.omg.CORBA.portable.OutputStream
_output)

{
 switch(_method_id) { case 0: { _self.hello(); return false; } } throw
 new org.omg.CORBA.MARSHAL(); } }
 class hello_client
 { public static vo
id main( String args[] ) {try{
 System.out.println( "Initializing the orb.");
 org.omg.CORBA.ORB orb =
 org.omg.CORBA.ORB.init(); IORHolder ior_holder =
 new IORHolder();

String iorString = ior_holder.readIORFile( "Hello.ref"

);
 org.omg.CORBA.Object object =
 orb.string_to_object( iorString ); Hello hello =
 HelloHelper.narrow( object );

hello.hello();

} catch ( org.omg.CORBA.SystemException e ) {
 System.err.println( "System Exception
 ");
System.err.println( e );
}

}}
```