

ASSIGNMENT NO. – 5

AIM: Implement token ring based mutual exclusion algorithm.

Objective:

To learn sequence number is used to distinguish old and current requests.

Outcome:

To the Site possesses the unique token, it is allowed to enter its critical section

Explanation:

Mutual exclusion is a concurrency control property which is introduced to prevent race conditions. It is the requirement that a process can not enter its critical section while another concurrent process is currently present or executing in its critical section i.e only one process is allowed to execute the critical section at any given instance of time.

Mutual exclusion in single computer system Vs. distributed system:

In single computer system, memory and other resources are shared between different processes. The status of shared resources and the status of users is easily available in the shared memory so with the help of shared variable (For example: Semaphores) mutual exclusion problem can be easily solved.

In Distributed systems, we neither have shared memory nor a common physical clock and there for we can not solve mutual exclusion problem using shared variables. To eliminate the mutual exclusion problem in distributed system approach based on message passing is used.

A site in distributed system do not have complete information of state of the system due to lack of shared memory and a common physical clock.

Requirements of Mutual exclusion Algorithm:

- **No Deadlock:**
Two or more site should not endlessly wait for any message that will never arrive.
- **No Starvation:**
Every site who wants to execute critical section should get an opportunity to execute it in finite time. Any site should not wait indefinitely to execute critical section while other site are repeatedly executing critical section
- **Fairness:**
Each site should get a fair chance to execute critical section. Any request to execute critical section must be executed in the order they are made i.e Critical section execution requests should be executed in the order of their arrival in the system.
- **Fault Tolerance:**
In case of failure, it should be able to recognize it by itself in order to continue functioning without any disruption.

Solution to distributed mutual exclusion:

As we know shared variables or a local kernel can not be used to implement mutual exclusion in distributed systems. Message passing is a way to implement mutual exclusion. Below are the three approaches based on message passing to implement mutual exclusion in distributed systems:

1. Token Based Algorithm:

- A unique **token** is shared among all the sites.
- If a site possesses the unique token, it is allowed to enter its critical section
- This approach uses sequence number to order requests for the critical section.
- Each requests for critical section contains a sequence number. This sequence number is used to distinguish old and current requests.
- This approach insures Mutual exclusion as the token is unique

- **Example:**

- Suzuki-Kasami's Broadcast Algorithm

2. Non-token based approach:

- A site communicates with other sites in order to determine which sites should execute critical section next. This requires exchange of two or more successive round of messages among sites.
- This approach use timestamps instead of sequence number to order requests for the critical section.
- When ever a site make request for critical section, it gets a timestamp. Timestamp is also used to resolve any conflict between critical section requests.
- All algorithm which follows non-token based approach maintains a logical clock. Logical clocks get updated according to Lamport's scheme

- **Example:**

- Lamport's algorithm, Ricart-Agrawala algorithm

3. Quorum based approach:

- Instead of requesting permission to execute the critical section from all other sites, Each site requests only a subset of sites which is called a **quorum**.
- Any two subsets of sites or Quorum contains a common site.
- This common site is responsible to ensure mutual exclusion

- **Example:**

- Maekawa's Algorithm
-

Program Input

1. MutualServer.java

```
import java.io.*;
```

```
import java.net.*;
```

```
public class MutualServer implements Runnable
```

```
{
```

```
Socket socket=null; static
```

```
ServerSocket ss;
```

```
MutualServer(Socket newSocket)
```

```
{
```

```
this.socket=newSocket;
```

```
}
```

```
public static void main(String args[]) throws IOException
```

```
{
```

```
ss=new ServerSocket(7000);
```

```
System.out.println("Server Started");
```

```
while(true)
```

```
{
```

```
Socket s = ss.accept();
```

```
MutualServer es = new MutualServer(s); Thread
```

```
t = new Thread(es);
```

```
t.start();
```

```
}
```

```
}
```

```
public void run()

{

try

{ BufferedReader

in

=

new

BufferedReader(new

InputStreamReader(socket.getInputStream()));

while(true)

{

System.out.println(in.readLine());

}

}

catch(Exception e){ }

}

}
```

2. ClientOne.java

```
import java.io.*;

import java.net.*;

public class ClientOne

{

public static void main(String args[])throws IOException

{

Socket s=new Socket("localhost",7000);

PrintStream out = new PrintStream(s.getOutputStream());

Server Socket s1 = ss.accept();

BufferedReader in1 = new BufferedReader(new

InputStreamReader(s1.getInputStream()));

PrintStream out1 = new PrintStream(s1.getOutputStream()); BufferedReader br = new

BufferedReader(new InputStreamReader(System.in));

String str="Token";

while(true)

{

if(str.equalsIgnoreCase("Token"))

{
```

```
System.out.println("Do you want to send some data");
```

```
System.out.println("Enter Yes or No"); str=br.readLine();
```

```
if(str.equalsIgnoreCase("Yes"))
```

```
{ System.out.println("Enter the data");
```

```
str=br.readLine();
```

```
out.println(str);
```

```
}
```

```
out1.println("Token");
```

```
}
```

```
System.out.println("Waiting for Token");
```

```
str=in1.readLine();
```

```
}
```

```
}
```

```
}
```

3. ClientTwo.java

```
import java.io.*;
```

```
import java.net.*;
```

```
public class ClientTwo
```

```
{

public static void main(String args[])throws IOException

{

Socket s=new Socket("localhost",7000);

PrintStream out = new PrintStream(s.getOutputStream()); Socket

s2=new Socket("localhost",7001); BufferedReader in2 = new

BufferedReader(new InputStreamReader(s2.getInputStream()));

PrintStream out2 = new PrintStream(s2.getOutputStream()); BufferedReader br = new

BufferedReader(new InputStreamReader(System.in));

String str;

while(true)

{

System.out.println("Waiting for Token");

str=in2.readLine();

if(str.equalsIgnoreCase("Token"))

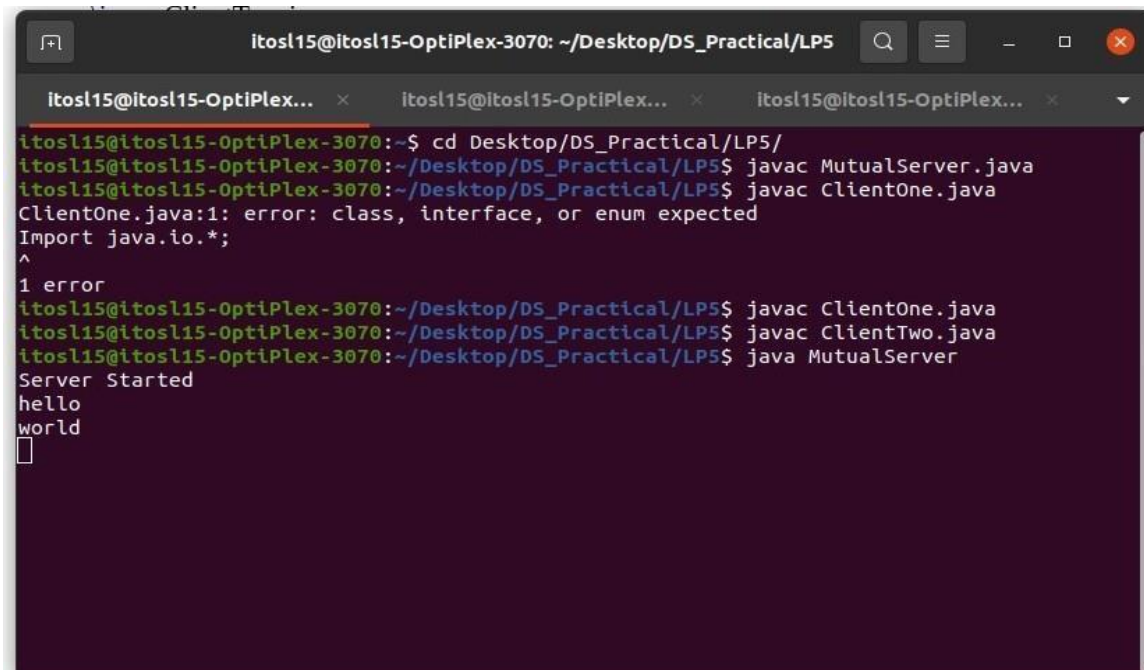
{

System.out.println("Do you want to send some data");

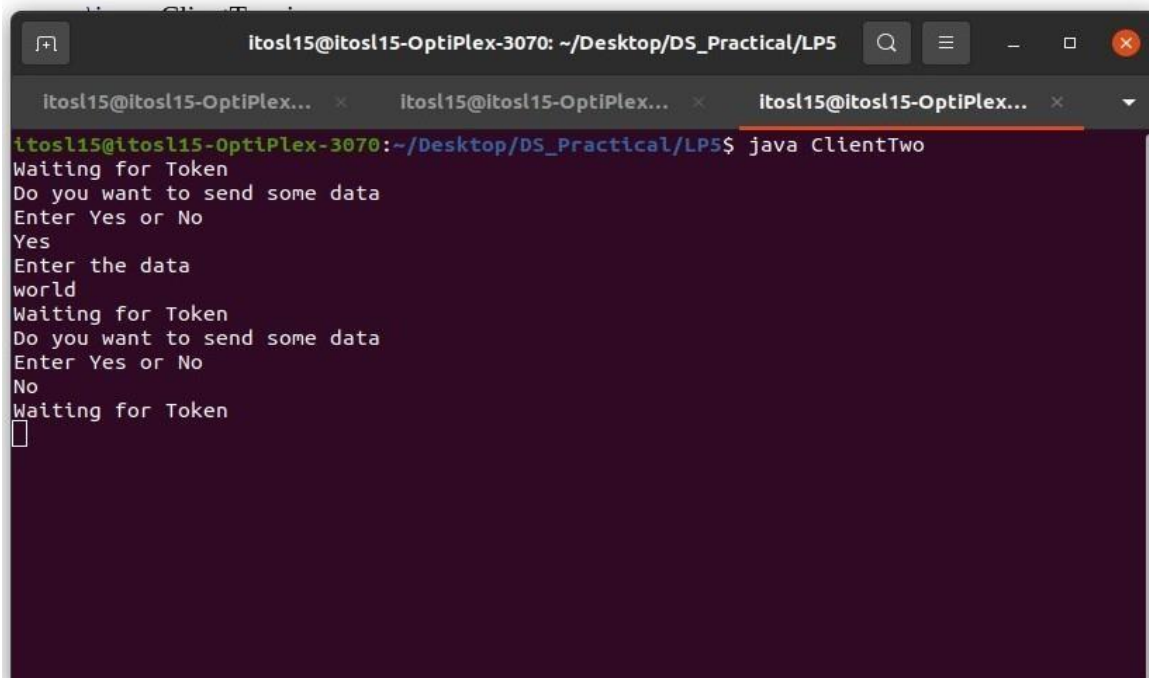
System.out.println("Enter Yes or No"); str=br.readLine();
```

```
if(str.equalsIgnoreCase("Yes")){  
  
    System.out.println("Enter the data"); str=br.readLine();  
  
    out.println(str);  
  
}  
  
out2.println("Token");  
  
}  
  
}  
  
}
```

OUTPUT

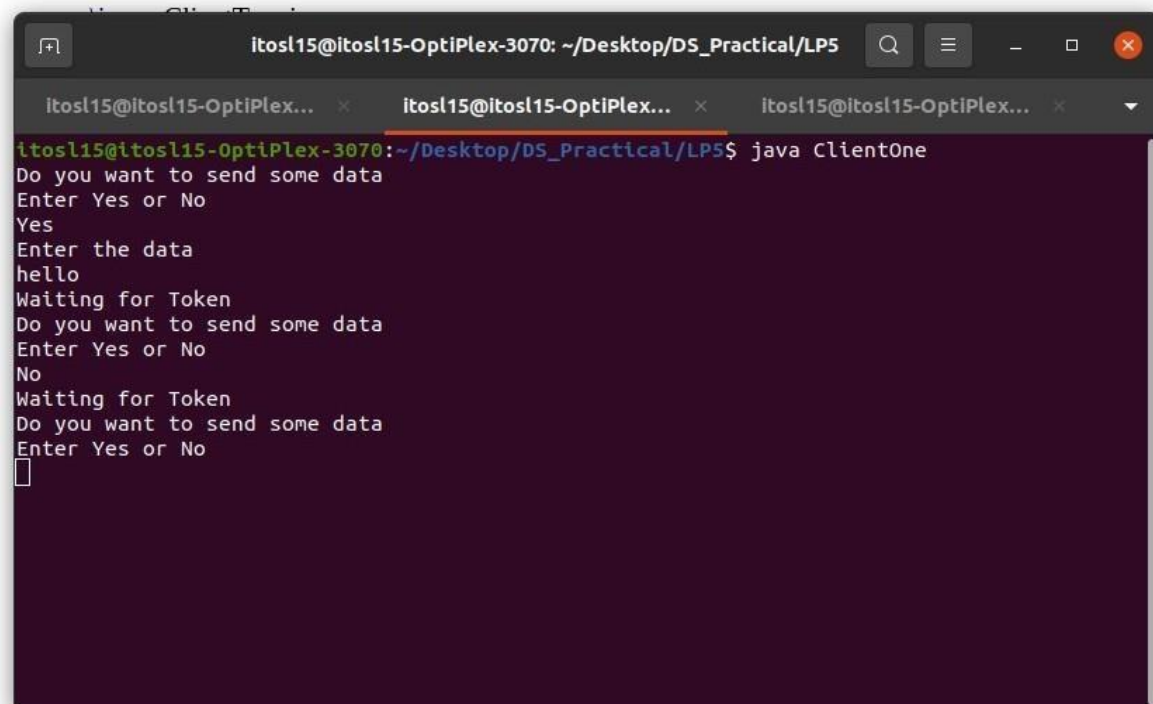


```
itosl15@itosl15-OptiPlex-3070: ~/Desktop/DS_Practical/LP5  
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ cd Desktop/DS_Practical/LP5/  
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ javac MutualServer.java  
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ javac ClientOne.java  
ClientOne.java:1: error: class, interface, or enum expected  
Import java.io.*;  
^  
1 error  
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ javac ClientOne.java  
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ javac ClientTwo.java  
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ java MutualServer  
Server Started  
hello  
world  
□
```

```
itosl15@itosl15-OptiPlex-3070: ~/Desktop/DS_Practical/LP5
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ java ClientTwo
Waiting for Token
Do you want to send some data
Enter Yes or No
Yes
Enter the data
world
Waiting for Token
Do you want to send some data
Enter Yes or No
No
Waiting for Token

```



```
itosl15@itosl15-OptiPlex-3070: ~/Desktop/DS_Practical/LP5
itosl15@itosl15-OptiPlex-3070:~/Desktop/DS_Practical/LP5$ java ClientOne
Do you want to send some data
Enter Yes or No
Yes
Enter the data
hello
Waiting for Token
Do you want to send some data
Enter Yes or No
No
Waiting for Token
Do you want to send some data
Enter Yes or No

```

Result:

Successfully communicate with multiple client machine from server.

| | |
|-------------------------------------|--|
| Date: | |
| Marks obtained: | |
| Sign of course coordinator: | |
| Name of course Coordinator : | |