

## Project : Centralized Multi-User Concurrent Bank Account Manager

### Overview:

The project is implemented to handle requests from multiple clients by a server to perform basic operations such as deposit and withdrawal. Along with basic operations server also adds periodic interest in each account. Communication between client and server is established using UNIX-based TCP sockets. Threads are used to perform parallel operations. Race conditions are dealt by using the '*pthread\_mutex\_t*' locks.

### Execution:

Run the *make* file.

Server will start first. Run *./server* to start server.

To start the client, use *./client*.

(Note: If you get 'Binding Failed' error please change the port number in both files.)

### Structure:

Project consists of two files, *server.cpp* and *client.cpp*.

#### *server.cpp*

It is made of three functions, *main()*, *calculate interest()*, *operations()*.

*calculate\_interest()*, *operations()* functions are handled with threads for achieving parallel processing. '*pthread\_mutex\_t*' is used to deal with the race condition which occurs in case of modifying the amount by both thread functions mentioned above.

First step carried about by server is reading the *account.txt* file and store the details into respective arrays. Then it *creates*, *binds*, and *listens* the listening socket and *accept* the connection from client. Once the connection is established thread function *operations()* is called with file descriptor of newly connected client. Buffer sent by client is read with *read()* function and string broken into pieces with *strtok()* function. Then account number is compared with the account numbers which are held in array and respective transaction is performed.

Assumption: Server will be always running.

**client.cpp**

It consists of the *main()* function in which transactions.txt file is read and then with help of a client socket the data from the file is sent to server with *write()* function. Data is sent line by line.

## Output

Screenshot 1:

### Successful execution with 1 client

```
server.cpp client.cpp accounts transactions
server.cpp > main()
189     }
190
191     int reuse_address = 1;
192     //Below code is referred from: https://pubs.opengroup.org/onlinepubs/000095399/functions/setsockopt.html
}

PROBLEMS OUTPUT TERMINAL DEBUG CONSOLE
anurag@anurag-VirtualBox:~/AOS/P1$ g++ server.cpp -o server -lpthread
[1]+  Killed                  ./server
anurag@anurag-VirtualBox:~/AOS/P1$ ./server
Socket created with FD: 3
4
127.0.0.1 connected on 49168
Client socket: 4
Client connected 4 Thread ID 140335958923008

Adding 10% Interest in every account after every 60 seconds
[]

10 104 w 500
Message from server: Insufficient balance

10 103 d 200
Message from server: Updated balance after deposit:
400.000000

10 108 d 64
Message from server: Updated balance after deposit:
463.000000

10 103 w 45
Message from server: Updated balance after withdrawal:
355.000000

10 105 w 400
Message from server: Insufficient balance

10 101 d 12
Message from server: Updated balance after deposit:
112.000000

10 109 d 15
Message from server: Updated balance after deposit:
116.000000

10 109 w 30
Message from server: Updated balance after withdrawal:
86.000000

10 110 d 355
Message from server: Updated balance after deposit:
804.000000

10 107 w 100
Message from server: Updated balance after withdrawal:
250.000000

Time in mili seconds: 1.444
anurag@anurag-VirtualBox:~/AOS/P1$
```

## Screenshot 2:

### Successful execution with 5 clients

```
PROBLEMS OUTPUT TERMINAL DEBUG CONSOLE
anurag@anurag-VirtualBox:~/A05/P1$ g++ server.cpp -o server -lpthread
[2]+  Killed                  ./server
anurag@anurag-VirtualBox:~/A05/P1$ ./server
Socket created with F
D: 3
Client connected 4 Thread
ID 140695591917312
Client connected 5 Thread
ID 140695583524608
Client connected 6 Thread
ID 140695575131904
Client connected 7 Thread
ID 140695567392000
Client connected 8 Thread
ID 140695558346496
Adding 10% Interest in eve
ry account after every 60
seconds
[]

10 108 d 64
Message from server: Update
d balance after deposit:
463.00

10 103 w 45
Message from server: Update
d balance after withdrawal:
355.00

10 105 w 400
Message from server: Insuff
icient balance

10 101 d 12
Message from server: Update
d balance after deposit:
112.00

10 109 d 15
Message from server: Update
d balance after deposit:
116.00

10 109 w 30
Message from server: Update
d balance after withdrawal:
86.00

10 110 d 355
Message from server: Update
d balance after deposit:
804.00

10 107 w 100
Message from server: Update
d balance after withdrawal:
250.00

Time in mili seconds: 1.074
anurag@anurag-VirtualBox:~/
A05/P1$ []

10 108 d 64
Message from server: Update
d balance after deposit:
527.00

10 103 w 45
Message from server: Update
d balance after withdrawal:
710.00

10 105 w 400
Message from server: Insuff
icient balance

10 101 d 12
Message from server: Update
d balance after deposit:
124.00

10 109 d 15
Message from server: Update
d balance after deposit:
101.00

10 109 w 30
Message from server: Update
d balance after withdrawal:
71.00

10 110 d 355
Message from server: Update
d balance after deposit:
1159.00

10 107 w 100
Message from server: Update
d balance after withdrawal:
150.00

Time in mili seconds: 0.904
anurag@anurag-VirtualBox:~/
A05/P1$ []

10 108 d 64
Message from server: Update
d balance after deposit:
591.00

10 103 w 45
Message from server: Update
d balance after withdrawal:
865.00

10 105 w 400
Message from server: Insuff
icient balance

10 101 d 12
Message from server: Update
d balance after deposit:
136.00

10 109 d 15
Message from server: Update
d balance after deposit:
86.00

10 109 w 30
Message from server: Update
d balance after withdrawal:
56.00

10 110 d 355
Message from server: Update
d balance after deposit:
1514.00

10 107 w 100
Message from server: Update
d balance after withdrawal:
50.00

Time in mili seconds: 1.313
anurag@anurag-VirtualBox:~/
A05/P1$ []

10 108 d 64
Message from server: Update
d balance after deposit:
655.00

10 103 w 45
Message from server: Update
d balance after withdrawal:
1020.00

10 105 w 400
Message from server: Insuff
icient balance

10 101 d 12
Message from server: Update
d balance after deposit:
148.00

10 109 d 15
Message from server: Update
d balance after deposit:
71.00

10 109 w 30
Message from server: Update
d balance after withdrawal:
41.00

10 110 d 355
Message from server: Update
d balance after deposit:
1869.00

10 107 w 100
Message from server: Insuff
icient balance

Time in mili seconds: 1.485
anurag@anurag-VirtualBox:~/
A05/P1$ []

10 108 d 64
Message from server: Update
d balance after deposit:
719.00

10 103 w 45
Message from server: Update
d balance after withdrawal:
975.00

10 105 w 400
Message from server: Insuff
icient balance

10 101 d 12
Message from server: Update
d balance after deposit:
160.00

10 109 d 15
Message from server: Update
d balance after deposit:
56.00

10 109 w 30
Message from server: Update
d balance after withdrawal:
26.00

10 110 d 355
Message from server: Update
d balance after deposit:
2224.00

10 107 w 100
Message from server: Insuff
icient balance

Time in mili seconds: 0.885
anurag@anurag-VirtualBox:~/
A05/P1$ []
```

## Performance analysis:

(Number of accounts: 10, Number of transactions: 10)

