

How to Compile:

Server: `gcc -pthread -o server server.c`

Client: `gcc -o client client.c`

How to Run:

Server:

General Format: `./server [-function] [func1] [func2].. [-s] [serv1] [serv2]...`

`[-function]` is optional, if it's not used, then all functions in the code will be loaded.

`[-s]` is followed by a list of servers to connect to.

A port number will be randomly given.

A prompt will appear for the busy percentage, which determines how often the server will be busy.

Here is a screen shot example:

The screenshot displays four terminal windows illustrating the server and client workflow. The top-left window shows the server starting with functions 'a b c' and listening on port 4013. The top-right window shows the server starting with functions 'd e f' and listening on port 4014. The bottom-left window shows the server starting with functions 'd e' and listening on port 4015. The bottom-right window shows the server starting with function 'e' and listening on port 4016. Annotations with red boxes and arrows highlight the 'Server name' field and the 'Server name must match' message. The bottom of the image shows a taskbar with multiple terminal windows and a file browser.

```
Terminal
File Edit View Terminal Help
kenns@kenns-laptop:~/cs470/proj02$ ./server -function a b c
To simulate the Busy Case, please enter the percentage that the server will be busy. Ex: 50 for 50 percent, 100 for 100 percent:
50
=====
Server Starts.
Server name: kenns-laptop:4013
Here is a list of services this server provides:
a int int
b int int
c int int
This server has 50 percent chance to be busy.
=====
Listening on port: 4013

Terminal
File Edit View Terminal Help
kenns@kenns-laptop:~/cs470/proj02$ ./server -function d e f -s kenns-laptop:4013
To simulate the Busy Case, please enter the percentage that the server will be busy. Ex: 50 for 50 percent, 100 for 100 percent:
50
=====
Server Starts.
Server name: kenns-laptop:4014
Here is a list of services this server provides:
d int int
e int int
f int int
This server has 50 percent chance to be busy.
=====
Listening on port: 4014

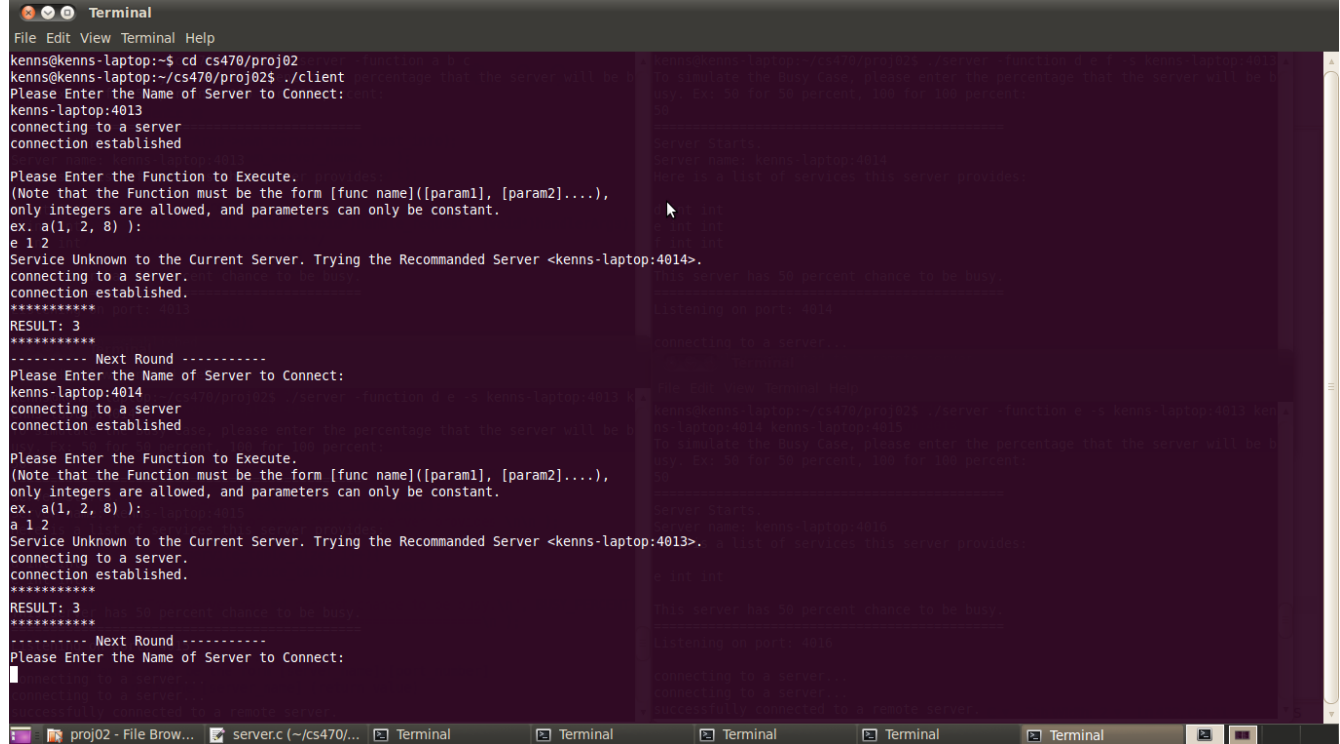
Terminal
File Edit View Terminal Help
kenns@kenns-laptop:~/cs470/proj02$ ./server -function d e -s kenns-laptop:4013 kenns-laptop:4014
To simulate the Busy Case, please enter the percentage that the server will be busy. Ex: 50 for 50 percent, 100 for 100 percent:
50
=====
Server Starts.
Server name: kenns-laptop:4015
Here is a list of services this server provides:
d int int
e int int
This server has 50 percent chance to be busy.
=====
Listening on port: 4015

Terminal
File Edit View Terminal Help
kenns@kenns-laptop:~/cs470/proj02$ ./server -function e -s kenns-laptop:4013 kenns-laptop:4014 kenns-laptop:4015
To simulate the Busy Case, please enter the percentage that the server will be busy. Ex: 50 for 50 percent, 100 for 100 percent:
50
=====
Server Starts.
Server name: kenns-laptop:4016
Here is a list of services this server provides:
e int int
This server has 50 percent chance to be busy.
=====
Listening on port: 4016

connecting to a server...
connecting to a server...
successfully connected to a remote server.
```

Client:

Picture says all. All parameters of the functions must be INTEGER.



```
Terminal
File Edit View Terminal Help
kenns@kenns-laptop:~$ cd cs470/proj02
kenns@kenns-laptop:~/cs470/proj02$ ./client
Please Enter the Name of Server to Connect:
kenns-laptop:4013
connecting to a server
connection established

Please Enter the Function to Execute.
(Note that the Function must be the form [func name]([param1], [param2]....),
only integers are allowed, and parameters can only be constant.
ex. a(1, 2, 8) ):
e 1 2
Service Unknown to the Current Server. Trying the Recommended Server <kenns-laptop:4014>.
connecting to a server.
connection established.
*****
RESULT: 3
*****
----- Next Round -----
Please Enter the Name of Server to Connect:
kenns-laptop:4014
connecting to a server
connection established

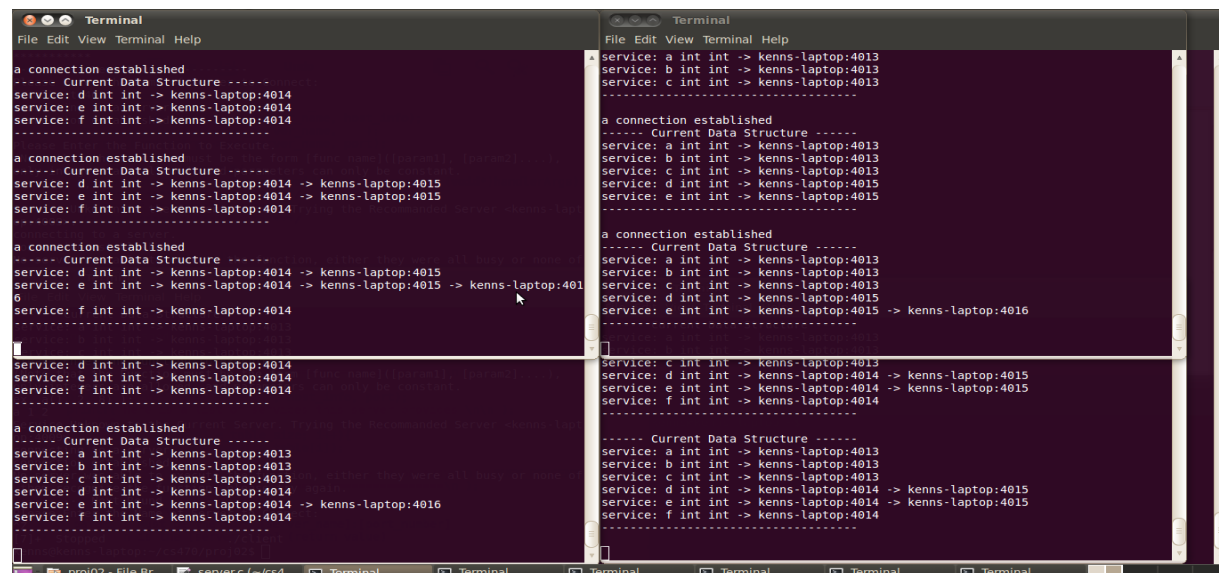
Please Enter the Function to Execute.
(Note that the Function must be the form [func name]([param1], [param2]....),
only integers are allowed, and parameters can only be constant.
ex. a(1, 2, 8) ):
a 1 2
Service Unknown to the Current Server. Trying the Recommended Server <kenns-laptop:4013>.
connecting to a server.
connection established.
*****
RESULT: 3
*****
----- Next Round -----
Please Enter the Name of Server to Connect:

```

When the current server doesn't have the function the client requested, it will send a recommended server to the client.

Data Structure:

The server will maintain a 2D linked list, which stores the information of all the OTHER servers. Every time a new server enters the system, it will communicate with all other servers to update the data structure.



```
Terminal
File Edit View Terminal Help
a connection established
----- Current Data Structure -----
service: d int int -> kenns-laptop:4014
service: e int int -> kenns-laptop:4014
service: f int int -> kenns-laptop:4014
-----

a connection established
----- Current Data Structure -----
service: d int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: e int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: f int int -> kenns-laptop:4014
-----

a connection established
----- Current Data Structure -----
service: d int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: e int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: f int int -> kenns-laptop:4014 -> kenns-laptop:4016
-----

a connection established
----- Current Data Structure -----
service: a int int -> kenns-laptop:4013
service: b int int -> kenns-laptop:4013
service: c int int -> kenns-laptop:4013
service: d int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: e int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: f int int -> kenns-laptop:4014
-----

a connection established
----- Current Data Structure -----
service: a int int -> kenns-laptop:4013
service: b int int -> kenns-laptop:4013
service: c int int -> kenns-laptop:4013
service: d int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: e int int -> kenns-laptop:4014 -> kenns-laptop:4015
service: f int int -> kenns-laptop:4014
-----
```

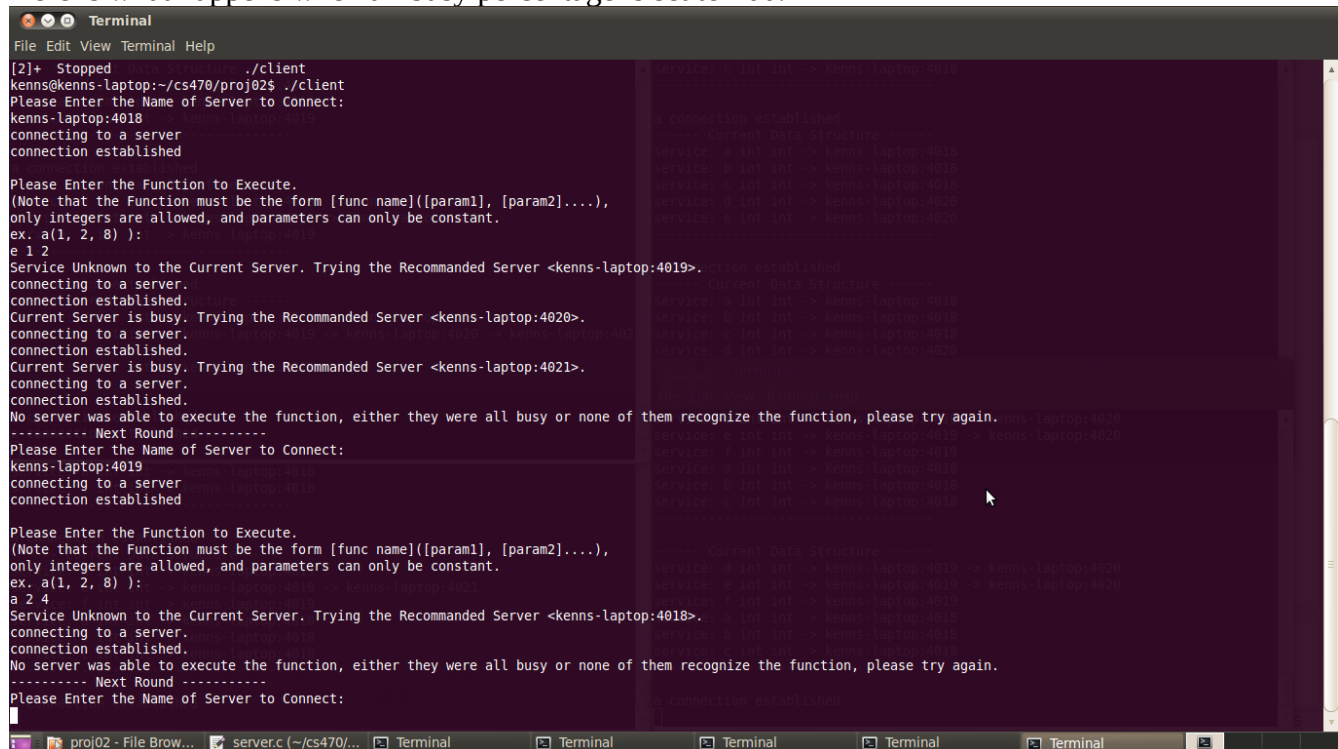
The last one of each server is the most updated data structure.

The server will also maintain a service table for itself, which contains the functions it has in itself.

The client maintains a list of all the servers it has connected, and it will send the list when connected to a server. The server then will compare the linked list to the client server list, to determine whether the client has visited all other servers which contains the servers. (Thus the ordering of the linked list doesn't matter)

If the client did visited all the servers, and no result is given, the server will send a message indicate either all servers were busy or no server recognize the function.

Here is what happens when all busy percentage is set to 100.



```
Terminal
File Edit View Terminal Help
[2]+ Stopped ./client
kenns@kenns-laptop:~/cs470/proj02$ ./client
Please Enter the Name of Server to Connect:
kenns-laptop:4018
connecting to a server
connection established
Please Enter the Function to Execute.
(Note that the Function must be the form [func name]([param1], [param2]....),
only integers are allowed, and parameters can only be constant.
ex. a(1, 2, 8) ):
e 1 2
Service Unknown to the Current Server. Trying the Recommended Server <kenns-laptop:4019>.
connecting to a server.
connection established.
Current Server is busy. Trying the Recommended Server <kenns-laptop:4020>.
connecting to a server.
connection established.
Current Server is busy. Trying the Recommended Server <kenns-laptop:4021>.
connecting to a server.
connection established.
No server was able to execute the function, either they were all busy or none of them recognize the function, please try again.
----- Next Round -----
Please Enter the Name of Server to Connect:
kenns-laptop:4019
connecting to a server
connection established
Please Enter the Function to Execute.
(Note that the Function must be the form [func name]([param1], [param2]....),
only integers are allowed, and parameters can only be constant.
ex. a(1, 2, 8) ):
a 2 4
Service Unknown to the Current Server. Trying the Recommended Server <kenns-laptop:4018>.
connecting to a server.
connection established.
No server was able to execute the function, either they were all busy or none of them recognize the function, please try again.
----- Next Round -----
Please Enter the Name of Server to Connect:
```

Protocols:

Examples:

/* sends hello msg to other servers, to update the data structure */

SERVER/HELLO

www.empty.com:4000

a int int

b int

...

/* send request to server, with a list of all the servers visited */

CLIENT/REQUEST

a 1 2

www.empty.com:4000

www.empty.com:4001

...

/* the server doesn't know the function, so a recommended server is sent to the client */

SERVER/UNKNOWN

e int int

www.empty.com:4001

/* the server is busy, so a recommended server is sent to the client */

SERVER/BUSY

e int int

www.empty.com:4001

/* the client has visited all the others servers and no result given */

/* so server sends the message back to the client */

SERVER/OUT

/* the server has the function, but the number of parameters doesn't match */

/* so a correct format is sent back to the client */

SERVER/MISMATCH

a int int

/* The function successfully executes, so the server sends result back to client */

SERVER/RESULT

a int int

7