

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ



ΠΑΝΕΠΙΣΤΗΜΙΟ
ΔΥΤΙΚΗΣ ΑΤΤΙΚΗΣ
UNIVERSITY OF WEST ATTICA

ΤΜΗΜΑ ΜΗΧΑΝΙΚΩΝ ΠΛΗΡΟΦΟΡΙΚΗΣ ΚΑΙ
ΥΠΟΛΟΓΙΣΤΩΝ

ΕΡΓΑΣΙΑ 1
RPC

ΣΤΟΙΧΕΙΑ ΦΟΙΤΗΤΗ

ΟΝΟΜΑΤΕΠΩΝΥΜΟ : ΑΘΑΝΑΣΙΟΥ ΒΑΣΙΛΕΙΟΣ ΕΥΑΓΓΕΛΟΣ

ΑΡΙΘΜΟΣ ΜΗΤΡΩΟΥ : 19390005

ΕΞΑΜΗΝΟ ΦΟΙΤΗΤΗ : 8^ο

ΚΑΤΑΣΤΑΣΗ ΦΟΙΤΗΤΗ : ΠΡΟΠΤΥΧΙΑΚΟ

ΠΡΟΓΡΑΜΜΑ ΣΠΟΥΔΩΝ : ΠΑΔΑ

ΤΜΗΜΑ ΕΡΓΑΣΤΗΡΙΟΥ : ΣΤ5-Α ΠΕΜΠΤΗ 12:00 – 14:00

ΥΠΕΥΘΥΝΗ ΕΡΓΑΣΤΗΡΙΟΥ : ΔΟΚΑ ΑΙΚΑΤΕΡΙΝΗ

ΗΜΕΡΟΜΗΝΙΑ ΠΑΡΑΔΟΣΗΣ : 1/5/2023

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ

ΦΩΤΟΓΡΑΦΙΑ ΦΟΙΤΗΤΗ :



ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ

ΠΕΡΙΕΧΟΜΕΝΑ

<u>Σύντομη Αναφορά</u>	(ΣΕΛΙΔΑ 4)
<u>Δημιουργία των rpc αρχείων και εντολές μεταγλώττισης</u>	(ΣΕΛΙΔΕΣ 5 – 8)
<u>Εκτέλεση των προγραμμάτων</u>	(ΣΕΛΙΔΕΣ 9 – 20)
Socket clients : 1	(ΣΕΛΙΔΕΣ 9 – 12)
Socket clients : 2	(ΣΕΛΙΔΕΣ 13 – 16)
Socket clients : 4	(ΣΕΛΙΔΕΣ 16 – 20)
<u>Επαλήθευση των αποτελεσμάτων</u>	(ΣΕΛΙΔΕΣ 21 – 24)
[1] Εσωτερικό Γινόμενο $X * Y$	(ΣΕΛΙΔΑ 21)
[2] Μέση τιμή των δύο διανυσμάτων	(ΣΕΛΙΔΕΣ 22 – 23)
[3] Γινόμενο $r * (X + Y)$	(ΣΕΛΙΔΑ 24)

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ

Σύντομη Αναφορά

rpc_server.c

Ο concurrent rpc server λαμβάνει τα ακόλουθα δεδομένα

- Έναν πραγματικό αριθμό r
- Δύο διανύσματα ακεραίων X, Y μήκους n

και εκτελεί τους 3 ακόλουθους υπολογισμούς :

1. Το εσωτερικό γινόμενο των δύο διανυσμάτων X * Y (επιστρέφει έναν ακέραιο αριθμό)
2. Τη μέση τιμή κάθε διανύσματος: Ex, Ey (επιστρέφει έναν πίνακα 2 πραγματικών αριθμών)
3. Το γινόμενο r * (X + Y) (επιστρέφει ένα διάνυσμα πραγματικών αριθμών μήκους n)

Τα αποτελέσματα τα επιστρέφει στον rpc client (rpc_client.c) που κάλεσε την αντίστοιχη rpc ρουτίνα.

rpc_client.c

Ο rpc client συνδέεται μέσω TCP AF_INET socket μ' έναν socket client (socket_client.c) και λειτουργεί παράλληλα και ως socket server. Τα δεδομένα τα λαμβάνει από τον socket client, καλεί την αντίστοιχη rpc ρουτίνα σύμφωνα με την επιλογή που του έστειλε, λαμβάνει τα αποτελέσματα από τον rpc server και τέλος τα στέλνει στον socket client.

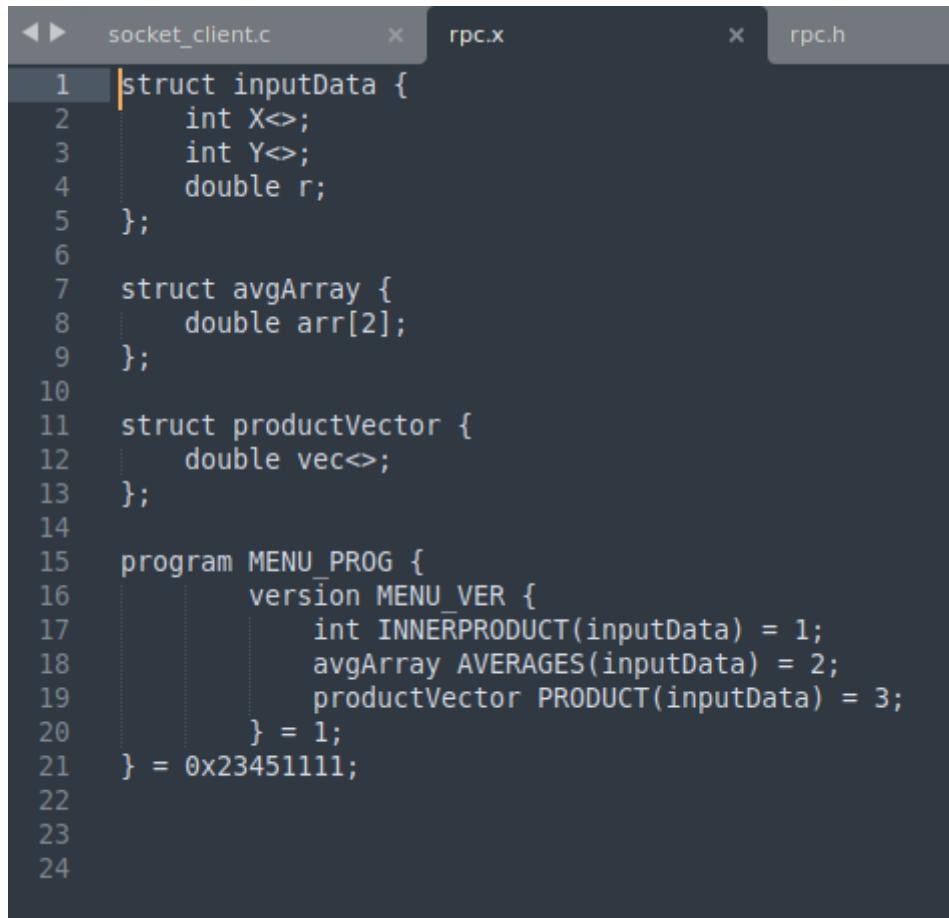
socket_client.c

Ο socket client κάνει αίτηση για σύνδεση μέσω TCP AF_INET socket με τον socket server που λειτουργεί παράλληλα και ως rpc client (rpc_client.c). Εισάγει τα δεδομένα, τα στέλνει στον socket server, ο οποίος καλεί την αντίστοιχη rpc ρουτίνα από έναν rpc server (rpc_server.c). Τέλος, ο socket client λαμβάνει τα αποτελέσματα από τον socket server και τα τυπώνει στο output.

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ

Δημιουργία των rpc αρχείων και εντολές μεταγλώττισης

Για την δημιουργία των rpc αρχείων ορίσαμε το απαιτούμενο interface file ('rpc.x').



```
1 struct inputData {
2     int X<>;
3     int Y<>;
4     double r;
5 };
6
7 struct avgArray {
8     double arr[2];
9 };
10
11 struct productVector {
12     double vec<>;
13 };
14
15 program MENU_PROG {
16     version MENU_VER {
17         int INNERPRODUCT(inputData) = 1;
18         avgArray AVERAGES(inputData) = 2;
19         productVector PRODUCT(inputData) = 3;
20     } = 1;
21 } = 0x23451111;
```

Εικόνα 1. To interface file “rpc.x” για την rpc επικοινωνία

struct inputData

Συγκεκριμένα, η δομή «inputData» περιέχει τις δομές δεδομένων εισόδου και των 3 rpc ρουτινών, δηλαδή, το διάνυσμα ακεραίων X με το μέγεθος του (το $X < >$ φτιάχνει μία δομή με 2 μέλη, το μέγεθος του X και το διάνυσμα X), το διάνυσμα ακεραίων Y με το μέγεθος του (παρόμοια ισχύει και στο $Y < >$) και την πραγματική τιμή r.

struct avgArray

Η δομή «avgArray» περιέχει την δομή δεδομένων που θα επιστρέψει η 2^η rpc ρουτίνα (μέση τιμή κάθε διανύσματος), δηλαδή, έναν στατικό πίνακα 2 πραγματικών αριθμών που η 1^η θέση θα περιέχει την μέση τιμή του διανύσματος X και η 2^η θέση θα περιέχει την μέση τιμή του διανύσματος Y.

struct productVector

Η δομή «productVector» περιέχει την δομή δεδομένων που θα επιστρέψει η 3^η rpc ρουτίνα (το γινόμενο $r * (X + Y)$), δηλαδή, έναν δυναμικό πίνακα N πραγματικών που κάθε θέση θα περιέχει το γινόμενο $r * (X[i] + Y[i])$, όπου i δείκτης θέσης ενός πίνακα.

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ

program MENU_PROG

Στο πρόγραμμα αυτό περιέχεται η version MENU_VER που περιέχει τις rpc ρουτίνες που ο rpc client μπορεί να καλέσει τον rpc server να εκτελέσει.

Η εντολή δημιουργίας των έτοιμων templates προγραμμάτων για τον rpc client και τον rpc server είναι η εξής

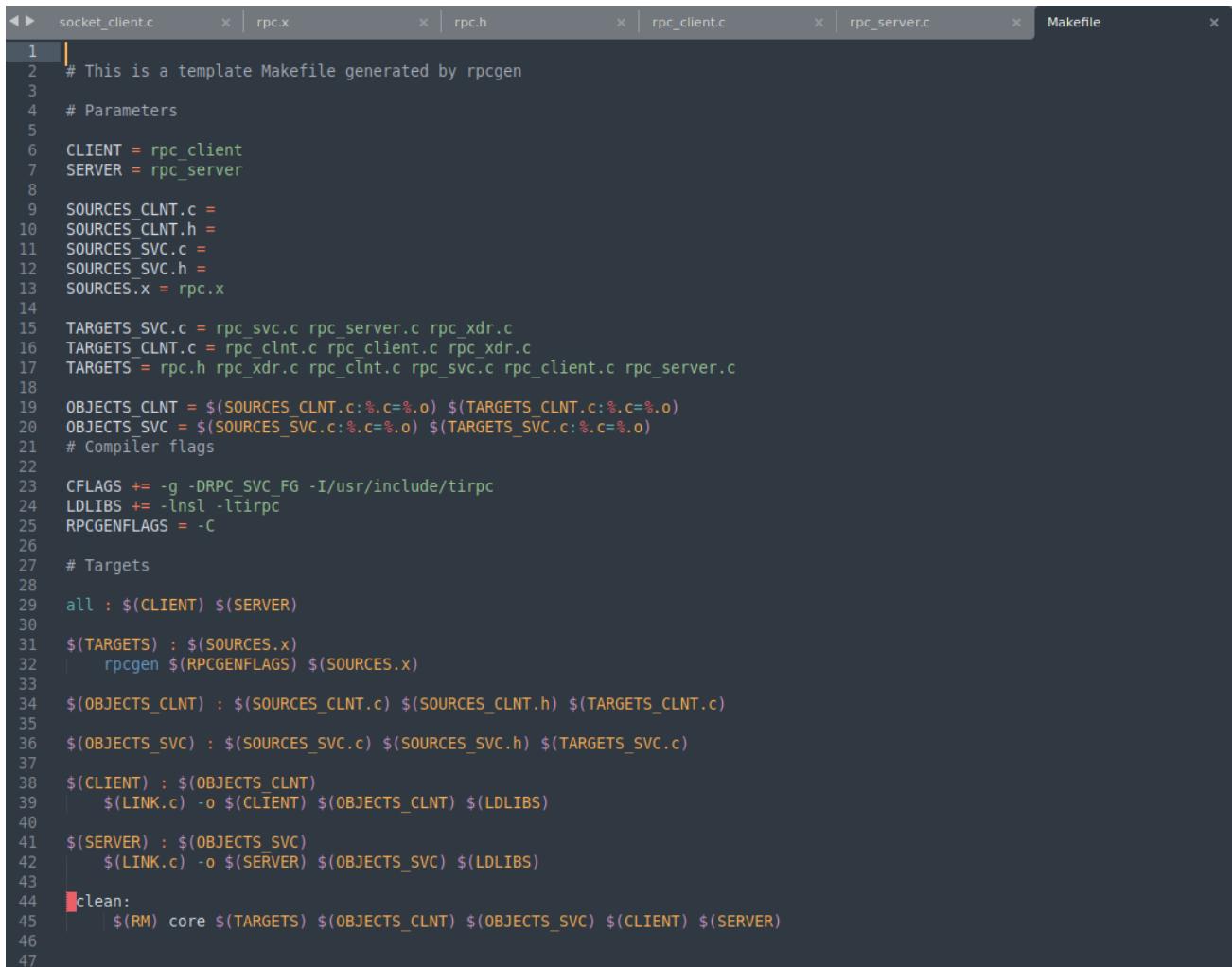
```
rpcgen -a -C rpc.x
```

Με την εκτέλεση της εντολής δημιουργήθηκαν τα αρχεία rpc.h (Εικόνα 2), Makefile (Εικόνα 3), rpc_client.c, rpc_server.c, rpc_clnt.c, rpc_svc.c και rpc_xdr.c

```
/* Please do not edit this file.  
 * It was generated using rpcgen.  
 */  
#ifndef _RPC_H_RPCGEN  
#define _RPC_H_RPCGEN  
  
#include <rpc/rpc.h>  
  
#ifdef __cplusplus  
extern "C" {  
#endif  
  
struct inputData {  
    struct {  
        u_int X_len;  
        int *X_val;  
    } X;  
    struct {  
        u_int Y_len;  
        int *Y_val;  
    } Y;  
    double r;  
};  
typedef struct inputData inputData;  
  
struct avgArray {  
    double arr[2];  
};  
typedef struct avgArray avgArray;  
  
struct productVector {  
    struct {  
        u_int vec_len;  
        double *vec_val;  
    } vec;  
};  
typedef struct productVector productVector;  
  
#define MENU_PROG 0x23451111  
#define MENU_VER 1  
  
#if defined(__STDC__) || defined(__cplusplus)  
#define INNERPRODUCT 1  
extern int * innerproduct_1(inputData *, CLIENT *);  
extern int * innerproduct_2(inputData *, SERVER *);
```

Εικόνα 2. Το rpc.h αρχείο

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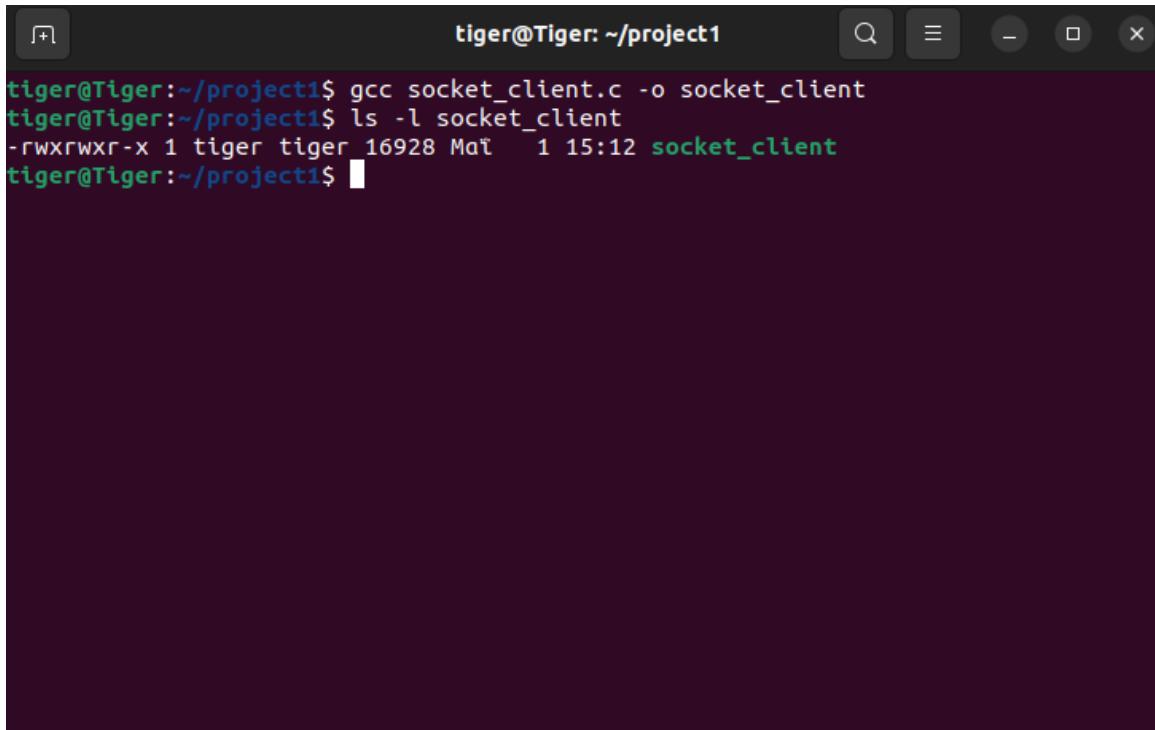
```
socket_client.c      x | rpc.x           x | rpc.h           x | rpc_client.c     x | rpc_server.c     x | Makefile
1 | # This is a template Makefile generated by rpcgen
2 |
3 | # Parameters
4 |
5 | CLIENT = rpc_client
6 | SERVER = rpc_server
7 |
8 | SOURCES_CLNT.c =
9 | SOURCES_CLNT.h =
10 | SOURCES_SVC.c =
11 | SOURCES_SVC.h =
12 | SOURCES.x = rpc.x
13 |
14 | TARGETS_SVC.c = rpc_svc.c rpc_server.c rpc_xdr.c
15 | TARGETS_CLNT.c = rpc_clnt.c rpc_client.c rpc_xdr.c
16 | TARGETS = rpc.h rpc_xdr.c rpc_clnt.c rpc_svc.c rpc_client.c rpc_server.c
17 |
18 | OBJECTS_CLNT = $(SOURCES_CLNT.c:.c=%.o) $(TARGETS_CLNT.c:.c=%.o)
19 | OBJECTS_SVC = $(SOURCES_SVC.c:.c=%.o) $(TARGETS_SVC.c:.c=%.o)
20 |
21 | # Compiler flags
22 |
23 | CFLAGS += -g -DRPC_SVC_FG -I/usr/include/tirpc
24 | LDLIBS += -lndl -ltirpc
25 | RPCGENFLAGS = -C
26 |
27 | # Targets
28 |
29 | all : $(CLIENT) $(SERVER)
30 |
31 | $(TARGETS) : $(SOURCES.x)
32 |   rpcgen $(RPCGENFLAGS) $(SOURCES.x)
33 |
34 | $(OBJECTS_CLNT) : $(SOURCES_CLNT.c) $(SOURCES_CLNT.h) $(TARGETS_CLNT.c)
35 |
36 | $(OBJECTS_SVC) : $(SOURCES_SVC.c) $(SOURCES_SVC.h) $(TARGETS_SVC.c)
37 |
38 | $(CLIENT) : $(OBJECTS_CLNT)
39 |   $(LINK.c) -o $(CLIENT) $(OBJECTS_CLNT) $(LDLIBS)
40 |
41 | $(SERVER) : $(OBJECTS_SVC)
42 |   $(LINK.c) -o $(SERVER) $(OBJECTS_SVC) $(LDLIBS)
43 |
44 | clean:
45 |   $(RM) core $(TARGETS) $(OBJECTS_CLNT) $(OBJECTS_SVC) $(CLIENT) $(SERVER)
46 |
47 |
```

Εικόνα 3. To Makefile αρχείο

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Η εντολή μεταγλώττισης για τον κάδικα του socket client είναι

```
gcc socket_client.c -o socket_client
```



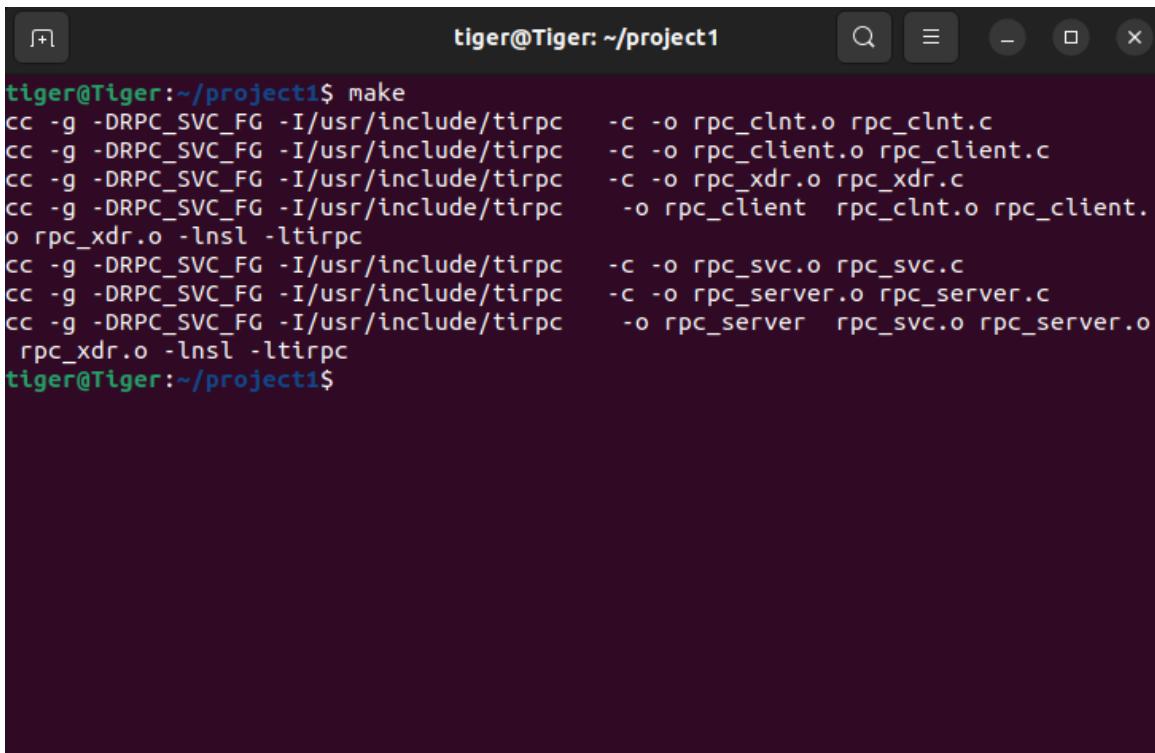
A terminal window titled "tiger@Tiger: ~/project1". The user has run the command "gcc socket_client.c -o socket_client". The output shows the file was compiled successfully into an executable named "socket_client". The permissions for the file are listed as "-rwxrwxr-x".

```
tiger@Tiger:~/project1$ gcc socket_client.c -o socket_client
tiger@Tiger:~/project1$ ls -l socket_client
-rwxrwxr-x 1 tiger tiger 16928 Mai 1 15:12 socket_client
tiger@Tiger:~/project1$
```

Εικόνα 4. Μεταγλώττιση socket_client.c

Η εντολή μεταγλώττισης για τα rpc_*.c αρχεία είναι

```
make
```



A terminal window titled "tiger@Tiger: ~/project1". The user has run the command "make". The output shows the compilation of multiple C files (rpc_clnt.c, rpc_client.c, rpc_xdr.c, rpc_svc.c, and rpc_server.c) into object files (rpc_clnt.o, rpc_client.o, rpc_xdr.o, rpc_svc.o, and rpc_server.o). It also links these object files into shared libraries (lnsl and ltirpc).

```
tiger@Tiger:~/project1$ make
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -c -o rpc_clnt.o rpc_clnt.c
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -c -o rpc_client.o rpc_client.c
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -c -o rpc_xdr.o rpc_xdr.c
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -o rpc_client  rpc_clnt.o rpc_client.
o rpc_xdr.o -lnsl -ltirpc
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -c -o rpc_svc.o rpc_svc.c
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -c -o rpc_server.o rpc_server.c
cc -g -DRPC_SVC_FG -I/usr/include/tirpc   -o rpc_server  rpc_svc.o rpc_server.o
tiger@Tiger:~/project1$
```

Εικόνα 5. Μεταγλώττιση των rpc_*.c αρχείων

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Εκτέλεση των προγραμμάτων

Socket clients : 1

Servers On

tiger@Tiger:~/project1\$./socket_client 7455 localhost
tiger@Tiger:~/project1\$./rpc_client 7455 localhost
tiger@Tiger:~/project1\$./rpc_server

Connection

tiger@Tiger:~/project1\$./socket_client 7455 localhost
[6040] : connected to socket server.
Input the size of vectors X and Y :
tiger@Tiger:~/project1\$./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
tiger@Tiger:~/project1\$./rpc_server

Input Data

tiger@Tiger:~/project1\$./socket_client 7455 localhost
[6040] : connected to socket server.
Input the size of vectors X and Y : 5
Input the 5 elements of vector X
X[0] : 12
X[1] : 3
X[2] : -5
X[3] : 1
X[4] : 67
Input the 5 elements of vector Y
Y[0] : 9
Y[1] : -87
Y[2] : 1
Y[3] : 3
Y[4] : 5
Input a value "r" of double range : 4.5
tiger@Tiger:~/project1\$./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
tiger@Tiger:~/project1\$./rpc_server

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1st Choice

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.

----- Data -----
Id : 6040
Size of vectors X and Y : 5
X[0] : 12      Y[0] : 9
X[1] : 3       Y[1] : -87
X[2] : -5      Y[2] : 1
X[3] : 1       Y[3] : 3
X[4] : 67      Y[4] : 5
Double value r : 4.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 1
```

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
```

```
tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
```

1st Choice Results

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.

----- Data -----
Id : 6040
Size of vectors X and Y : 5
X[0] : 12      Y[0] : 9
X[1] : 3       Y[1] : -87
X[2] : -5      Y[2] : 1
X[3] : 1       Y[3] : 3
X[4] : 67      Y[4] : 5
Double value r : 4.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 1
Sending data to socket server, waiting for results...

----- Results -----
Inner product X * Y : 180

Input the size of vectors X and Y :
```

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.

[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
```

```
tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
      Sending results to rpc client.
```

2nd Choice

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.

----- Data -----
Id : 6040
Size of vectors X and Y : 3
X[0] : 50      Y[0] : 80
X[1] : 60      Y[1] : 90
X[2] : 70      Y[2] : 100
Double value r : 2.300000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 2
```

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.

[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
```

```
tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
      Sending results to rpc client.
```

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2nd Choice Results

The screenshot shows three terminal windows side-by-side. The left window displays the client's menu and the vectors X and Y. The middle window shows the client sending data to the server. The right window shows the server processing the request and sending results back to the client.

```

tiger@Tiger: ~/project1$ ./rpc_client
----- Data -----
Id : 6040
Size of vectors X and Y : 3
X[0] : 50      Y[0] : 80
X[1] : 60      Y[1] : 90
X[2] : 70      Y[2] : 100
Double value r : 2.300000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 2
Sending data to socket server, waiting for results...
----- Results -----
Average value of vector X : 60.000000
Average value of vector Y : 90.000000

Input the size of vectors X and Y :

```

```

tiger@Tiger: ~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to socket client with Id 6040.
[6040] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to socket client with Id 6040.

```

```

tiger@Tiger: ~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 60.000000
Average value of Y : 90.000000
Sending results to rpc client.

```

3rd Choice

The screenshot shows three terminal windows side-by-side. The left window displays the client's menu and the vectors X and Y. The middle window shows the client sending data to the server. The right window shows the server processing the request and sending results back to the client.

```

tiger@Tiger: ~/project1$ ./rpc_client
----- Data -----
Id : 6040
Size of vectors X and Y : 6
X[0] : 1      Y[0] : 0
X[1] : -5     Y[1] : -10
X[2] : 4      Y[2] : 6
X[3] : 34     Y[3] : 2
X[4] : 10     Y[4] : 79
X[5] : 2      Y[5] : 810
Double value r : 5.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 3

```

```

tiger@Tiger: ~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to socket client with Id 6040.
[6040] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to socket client with Id 6040.

```

```

tiger@Tiger: ~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 60.000000
Average value of Y : 90.000000
Sending results to rpc client.

```

3rd Choice Results

The screenshot shows three terminal windows side-by-side. The left window displays the client's menu and the vectors X and Y. The middle window shows the client sending data to the server. The right window shows the server processing the request and sending results back to the client.

```

tiger@Tiger: ~/project1$ ./rpc_client
----- Data -----
Id : 6040
Size of vectors X and Y : 6
X[0] : 1      Y[0] : 0
X[1] : -5     Y[1] : -10
X[2] : 4      Y[2] : 6
X[3] : 34     Y[3] : 2
X[4] : 10     Y[4] : 79
X[5] : 2      Y[5] : 810
Double value r : 5.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 3
Sending data to socket server, waiting for results...
----- Results -----
r * (X + Y)[0] : 5.500000
r * (X + Y)[1] : -82.500000
r * (X + Y)[2] : 55.000000
r * (X + Y)[3] : 198.000000
r * (X + Y)[4] : 489.500000
r * (X + Y)[5] : 4466.000000

Input the size of vectors X and Y :

```

```

tiger@Tiger: ~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to socket client with Id 6040.
[6040] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to socket client with Id 6040.
[6040] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 5.500000
      r * (X + Y)[1] : -82.500000
      r * (X + Y)[2] : 55.000000
      r * (X + Y)[3] : 198.000000
      r * (X + Y)[4] : 489.500000
      r * (X + Y)[5] : 4466.000000
      Sending results to socket client with Id 6040.

```

```

tiger@Tiger: ~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 60.000000
Average value of Y : 90.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 5.500000
r * (X + Y)[1] : -82.500000
r * (X + Y)[2] : 55.000000
r * (X + Y)[3] : 198.000000
r * (X + Y)[4] : 489.500000
r * (X + Y)[5] : 4466.000000
Sending results to rpc client.

```

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4th Choice

```
tiger@Tiger: ~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to socket client with Id 6040.
[6040] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to socket client with Id 6040.
[6040] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 5.500000
      r * (X + Y)[1] : -82.500000
      r * (X + Y)[2] : 55.000000
      r * (X + Y)[3] : 198.000000
      r * (X + Y)[4] : 489.500000
      r * (X + Y)[5] : 4466.000000
      Sending results to socket client with Id 6040.

tiger@Tiger: ~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 60.000000
Average value of Y : 90.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 5.500000
r * (X + Y)[1] : -82.500000
r * (X + Y)[2] : 55.000000
r * (X + Y)[3] : 198.000000
r * (X + Y)[4] : 489.500000
r * (X + Y)[5] : 4466.000000
Sending results to rpc client.
```

4th Choice Results

```
tiger@Tiger: ~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to socket client with Id 6040.
[6040] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to socket client with Id 6040.
[6040] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 5.500000
      r * (X + Y)[1] : -82.500000
      r * (X + Y)[2] : 55.000000
      r * (X + Y)[3] : 198.000000
      r * (X + Y)[4] : 489.500000
      r * (X + Y)[5] : 4466.000000
      Sending results to socket client with Id 6040.
[6040] [4] Exit
[Disconnection] : socket client with Id 6040 has been disconnected.

tiger@Tiger: ~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 180
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 60.000000
Average value of Y : 90.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 5.500000
r * (X + Y)[1] : -82.500000
r * (X + Y)[2] : 55.000000
r * (X + Y)[3] : 198.000000
r * (X + Y)[4] : 489.500000
r * (X + Y)[5] : 4466.000000
Sending results to rpc client.
```

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Socket clients : 2

Servers On

The image shows four terminal windows side-by-side. The top-left window shows the command `tiger@Tiger:~/project1$./socket_client 7455 localhost`. The top-middle window shows the command `tiger@Tiger:~/project1$./rpc_client 7455 localhost`. The top-right window shows the command `tiger@Tiger:~/project1$./rpc_server`. The bottom-left window shows the command `tiger@Tiger:~/project1$./socket_client 7455 localhost`.

Connection

The image shows four terminal windows side-by-side. The top-left window shows the command `tiger@Tiger:~/project1$./socket_client 7455 localhost`, followed by output indicating a connection to a socket server with ID 6088 and a request for vector sizes. The top-middle window shows the command `tiger@Tiger:~/project1$./rpc_client 7455 localhost`, followed by output indicating connections from two socket clients with IDs 6088 and 6090. The top-right window shows the command `tiger@Tiger:~/project1$./rpc_server`. The bottom-left window shows the command `tiger@Tiger:~/project1$./socket_client 7455 localhost`, followed by output indicating a connection to a socket server with ID 6090 and a request for vector sizes.

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1st Choice Results

The image shows three terminal windows side-by-side. The left window displays a menu for vectors X and Y, including options for inner product, average value, product of r * (X + Y), and exit. The middle window shows a client connecting to a localhost port 7455 and sending data to a server. The right window shows a server receiving the data and sending the result back to the client. The client then prints the result.

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6088 has been connected.
[Connection] : socket client with Id 6090 has been connected.
[6088] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6088.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 130
Sending results to rpc client.

tiger@Tiger:~/project1$ ./socket_client 7455 localhost
[6090] : connected to socket server.
Input the size of vectors X and Y : 5
```

2nd Choice Results

The image shows three terminal windows side-by-side. The left window displays a menu for vectors X and Y, including options for inner product, average value, product of r * (X + Y), and exit. The middle window shows a client connecting to a localhost port 7455 and sending data to a server. The right window shows a server receiving the data and sending the result back to the client. The client then prints the result.

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6088 has been connected.
[Connection] : socket client with Id 6090 has been connected.
[6088] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6088.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 130
Sending results to rpc client.

tiger@Tiger:~/project1$ ./socket_client 7455 localhost
[6090] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to socket client with Id 6090.

tiger@Tiger:~/project1$
```

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3rd Choice Results

The image shows three terminal windows running on a Linux system (Ubuntu 14.04 LTS). The left window is the client, the middle is the client again, and the right is the server. They are performing operations on vectors X and Y.

Client Window 1:

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6088 has been connected.
[Connection] : socket client with Id 6090 has been connected.
[6088] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6088.
[6090] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to socket client with Id 6090.
[6088] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to socket client with Id 6088.
```

Client Window 2:

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6090 has been connected.
[Connection] : socket client with Id 6088 has been connected.
[6090] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6090.
[6088] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to socket client with Id 6088.
[6090] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to socket client with Id 6090.
```

Server Window:

```
tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
      ----- Results -----
      X * Y : 130
      Sending results to rpc client.
[2] Average value of each vector
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to rpc client.
[3] Product of r * (X + Y)
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to rpc client.
```

4th Choice Results

The image shows three terminal windows running on a Linux system (Ubuntu 14.04 LTS). The left window is the client, the middle is the client again, and the right is the server. They are performing operations on vectors X and Y.

Client Window 1:

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6088 has been connected.
[Connection] : socket client with Id 6090 has been connected.
[6088] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6088.
[6090] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to socket client with Id 6090.
[6088] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to socket client with Id 6088.
```

Client Window 2:

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6090 has been connected.
[Connection] : socket client with Id 6088 has been connected.
[6090] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6090.
[6088] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to socket client with Id 6088.
[6090] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to socket client with Id 6090.
```

Server Window:

```
tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
      ----- Results -----
      X * Y : 130
      Sending results to rpc client.
[2] Average value of each vector
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to rpc client.
[3] Product of r * (X + Y)
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to rpc client.
```

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New Connection

The image shows three terminal windows running on a Linux system. The left window displays a menu for a vector processing application. The middle window shows an RPC client connecting to a local host and performing calculations. The right window shows an RPC server executing the same calculations and sending results back to the client.

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6088 has been connected.
[Connection] : socket client with Id 6090 has been connected.
[6088] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 130
      Sending results to socket client with Id 6088.
[6090] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 14.000000
      Average value of Y : 20.000000
      Sending results to socket client with Id 6090.
[6088] [3] Product of r * (X + Y)
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      r * (X + Y)[0] : 4400.000000
      r * (X + Y)[1] : 6600.000000
      Sending results to socket client with Id 6088.
[6090] [4] Exit
[Disconnection] : socket client with Id 6090 has been disconnected.
[Connection] : socket client with Id 6108 has been connected.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 130
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 14.000000
Average value of Y : 20.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 4400.000000
r * (X + Y)[1] : 6600.000000
Sending results to rpc client.

tiger@Tiger:~/project1$ ./socket_client 7455 localhost
[6108] : connected to socket server.
Input the size of vectors X and Y : 2
----- Data -----
Id : 6088
Size of vectors X and Y : 2
X[0] : 200      Y[0] : 600
X[1] : 400      Y[1] : 800
Double value r : 5.500000

----- Data -----
Id : 6090
Size of vectors X and Y : 1
X[0] : 1        Y[0] : 1
Double value r : 3.200000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 4
```

Socket clients : 4

Servers On

The image shows four terminal windows. Three windows on the left show different clients connecting to a local host on port 7455. The fourth window on the right shows the server process running.

```
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
tiger@Tiger:~/project1$ ./rpc_server
```

Activate Windows
Go to Settings to activate Windows.

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Connection

The image shows four terminal windows side-by-side. The top-left window shows a socket client connection with ID 6166. The top-right window shows a socket client connection with ID 6168. The bottom-left window shows a socket client connection with ID 6170. The bottom-right window shows an RPC server running.

```
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
[6166] : connected to socket server.
Input the size of vectors X and Y : []
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
[6170] : connected to socket server.
Input the size of vectors X and Y : []
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
[6168] : connected to socket server.
Input the size of vectors X and Y : []
tiger@Tiger:~/project1$ ./rpc_server
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
```

Input Data

The image shows four terminal windows side-by-side. The top-left window shows vector data for ID 6166. The top-right window shows vector data for ID 6170. The bottom-left window shows vector data for ID 6168. The bottom-right window shows a menu selection for ID 6172.

```
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
----- Data -----
Id : 6166
Size of vectors X and Y : 5
X[0] : 1      Y[0] : 6
X[1] : 2      Y[1] : 7
X[2] : 3      Y[2] : 8
X[3] : 4      Y[3] : 9
X[4] : 5      Y[4] : 10
Double value r : 4.500000
----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 1
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
----- Data -----
Id : 6170
Size of vectors X and Y : 1
X[0] : 1      Y[0] : 2
Double value r : 3.200000
----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 4
tiger@Tiger:~/project1$ ./socket_client 7455 localhost
----- Data -----
Id : 6168
Size of vectors X and Y : 3
X[0] : 12     Y[0] : 12
X[1] : 80     Y[1] : 5
X[2] : -4     Y[2] : 67
Double value r : 7.800000
----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 2
tiger@Tiger:~/project1$ ./rpc_server
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
```

Activate Windows
Go to Settings to activate Windows.

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1st Choice Results

```

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
X * Y : 130
Sending results to socket client with Id 6166.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 130
Sending results to rpc client.

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
X * Y : 130
Sending results to socket client with Id 6166.

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
X * Y : 130
Sending results to socket client with Id 6166.

```

2nd Choice Results

```

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to socket client with Id 6166.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
----- Results -----
X * Y : 130
Sending results to rpc client.

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to socket client with Id 6166.

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to socket client with Id 6166.

tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6166 has been connected.
[Connection] : socket client with Id 6168 has been connected.
[Connection] : socket client with Id 6170 has been connected.
[Connection] : socket client with Id 6172 has been connected.
[6166] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to socket client with Id 6166.

```

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ

3rd Choice Results

```
tiger@Tiger:~/project1
```

----- Data -----
Id : 6166
Size of vectors X and Y : 5
X[0] : 1 Y[0] : 6
X[1] : 2 Y[1] : 7
X[2] : 3 Y[2] : 8
X[3] : 4 Y[3] : 9
X[4] : 5 Y[4] : 10
Double value r : 4.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit

```
tiger@Tiger:~/project1
```

----- Data -----
Id : 6170
Size of vectors X and Y : 1
X[0] : 1 Y[0] : 2
Double value r : 3.200000

----- Menu -----
tiger@Tiger:~/project1

```
tiger@Tiger:~/project1
```

----- Data -----
Id : 6172
Size of vectors X and Y : 4
X[0] : 1 Y[0] : 45
X[1] : 24 Y[1] : 9
X[2] : -6 Y[2] : 1
X[3] : 12 Y[3] : 3
Double value r : 6.900000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 3
Sending data to socket server, waiting for results.
..
----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000

----- Data -----
X * Y : 130
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000
Sending results to rpc client.

----- Data -----
tiger@Tiger:~/project1

----- Data -----
Id : 6168
[2] Average value of each vector
Sending socket client's data to rpc server, waiting for results...
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to socket client with Id 6168.
[3] Product of r * (X + Y)
Sending socket client's data to rpc server, waiting for results...
----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000
Sending results to socket client with Id 6172.

----- Data -----
X * Y : 130
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000
Sending results to rpc client.

4th Choice Results

```
tiger@Tiger: ~/project1
```

----- Data -----
Id : 6166
Size of vectors X and Y : 5
X[0] : 1 Y[0] : 6
X[1] : 2 Y[1] : 7
X[2] : 3 Y[2] : 8
X[3] : 4 Y[3] : 9
X[4] : 5 Y[4] : 10
Double value r : 4.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit

```
tiger@Tiger: ~/project1
```

----- Data -----
Id : 6170
Size of vectors X and Y : 1
X[0] : 1 Y[0] : 2
Double value r : 3.200000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 4
tiger@Tiger:~/project1\$

```
tiger@Tiger: ~/project1
```

----- Data -----
Id : 6168
Size of vectors X and Y : 3
X[0] : 12 Y[0] : 12
X[1] : 80 Y[1] : 5
X[2] : -4 Y[2] : 67
Double value r : 7.800000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 2
Sending data to socket server, waiting for results

```
tiger@Tiger: ~/project1
```

----- Data -----
Id : 6172
Size of vectors X and Y : 1
X[0] : 3 Y[0] : 2
Double value r : 3.000000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 3
Sending data to socket server, waiting for results.
..

----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000

----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to socket client with Id 6168.
6172] [3] Product of r * (X + Y)
Sending socket client's data to rpc server, waiting for results...

----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000
Sending results to socket client with Id 6172.
6170] [4] Exit
Disconnection] : socket client with Id 6170 has been connected.

```
tiger@Tiger: ~/project1
```

X * Y : 130
Sending results to rpc client.
[2] Average value of each vector
----- Results -----
Average value of X : 29.000000
Average value of Y : 28.000000
Sending results to rpc client.
[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 317.400000
r * (X + Y)[1] : 227.700000
r * (X + Y)[2] : -34.500000
r * (X + Y)[3] : 103.500000
Sending results to rpc client.

KATANEMHMENA ΣΥΣΤΗΜΑΤΑ

Disconnection

The image shows six terminal windows arranged in a grid, illustrating a client disconnecting from a server. The windows are labeled as follows:

- Top-left: tiger@Tiger: ~/project1
- Top-middle: tiger@Tiger: ~/project1
- Top-right: tiger@Tiger: ~/project1
- Middle-left: tiger@Tiger: ~/project1
- Middle-middle: tiger@Tiger: ~/project1
- Middle-right: tiger@Tiger: ~/project1

The terminal sessions show the following interactions:

- Top-left (Client 1):** Shows data and menu options for vector X and Y. It receives results for r * (X + Y) and sends them to socket client Id 6170.
- Top-middle (Client 2):** Shows data and menu options for vector X and Y. It receives results for r * (X + Y) and sends them to socket client Id 6170.
- Top-right (Client 3):** Shows data and menu options for vector X and Y. It receives results for r * (X + Y) and sends them to socket client Id 6170. It also handles disconnection messages for clients 6166, 6168, and 6172.
- Middle-left (Client 4):** Shows data and menu options for vector X and Y. It receives results for r * (X + Y) and sends them to rpc client.
- Middle-middle (Client 5):** Shows data and menu options for vector X and Y. It receives results for r * (X + Y) and sends them to rpc client.
- Middle-right (Client 6):** Shows data and menu options for vector X and Y. It receives results for r * (X + Y) and sends them to rpc client.

In the top-right window, the client disconnects from the server. Subsequent windows show the server handling disconnection requests from clients 6166, 6168, and 6172.

KATANEMHMENA ΣΥΣΤΗΜΑΤΑ

Επαλήθευση των αποτελεσμάτων

[1] Εσωτερικό Γινόμενο $X * Y$

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to socket client with Id 6040.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
      Results
      ----- Results -----
      X * Y : 180
      Sending results to rpc client.

----- Data -----
Id : 6040
Size of vectors X and Y : 5
X[0] : 12      Y[0] : 9
X[1] : 3       Y[1] : -87
X[2] : -5      Y[2] : 1
X[3] : 1       Y[3] : 3
X[4] : 67      Y[4] : 5
Double value r : 4.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 1
Sending data to socket server, waiting for results...

----- Results -----
Inner product X * Y : 180
Input the size of vectors X and Y :
```

vector	a	
a ₁	12	
a ₂	3	
a ₃	-5	
a ₄	1	
a ₅	67	
<input type="button" value="▼"/>	<input type="button" value="▲"/>	<input type="button" value="X"/>

vector	b	
b ₁	9	
b ₂	-87	
b ₃	1	
b ₄	3	
b ₅	5	
<input type="button" value="▼"/>	<input type="button" value="▲"/>	<input type="button" value="X"/>

vector product

	product
inner product c	180
outer product c	no answer

KATANEMHMENA ΣΥΣΤΗΜΑΤΑ

[2] Μέση τιμή των δύο διανυσμάτων

```
tiger@Tiger:~/project1$ ./rpc_client 7455 localhost
[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      X * Y : 180
      Sending results to rpc client.
[6040] [2] Average value of each vector
      Sending socket client's data to rpc server, waiting for results...
      ----- Results -----
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to rpc client.

tiger@Tiger:~/project1$ ./rpc_server
[1] Inner product of X * Y
      Results
      X * Y : 180
      Sending results to rpc client.
[2] Average value of each vector
      Results
      Average value of X : 60.000000
      Average value of Y : 90.000000
      Sending results to rpc client.

----- Data -----
Id : 6040
Size of vectors X and Y : 3
X[0] : 50      Y[0] : 80
X[1] : 60      Y[1] : 90
X[2] : 70      Y[2] : 100
Double value r : 2.300000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 2
Sending data to socket server, waiting for results...

----- Results -----
Average value of vector X : 60.000000
Average value of vector Y : 90.000000

Input the size of vectors X and Y :
```

Average Calculator

Please provide numbers separated by a comma to calculate the average of the numbers.

Result

Average: **60**

$$\begin{aligned}\text{Average} &= \frac{\text{Sum}}{\text{Count}} \\ &= \frac{180}{3} \\ &= 60\end{aligned}$$

Sum	180
Count	3
Median	60
Geometric Mean	59.439219527631
Largest	70
Smallest	50
Range	20

50, 60, 70

Calculate  **Clear**

KATANEMHMENA ΣΥΣΤΗΜΑΤΑ

Average Calculator

Please provide numbers separated by a comma to calculate the average of the numbers.

Result

Average: **90**

$$\begin{aligned}\text{Average} &= \frac{\text{Sum}}{\text{Count}} \\ &= \frac{270}{3} \\ &= 90\end{aligned}$$

Sum	270
Count	3
Median	90
Geometric Mean	89.628094931143
Largest	100
Smallest	80
Range	20

80, 90, 100

Calculate 

Clear

KATANEMHMENA ΣΥΣΤΗΜΑΤΑ

[3] Γινόμενο $r^*(X + Y)$

```
tiger@Tiger: ~/project1
```

----- Data -----
Id : 6040
Size of vectors X and Y : 6
X[0] : 1 Y[0] : 0
X[1] : -5 Y[1] : -10
X[2] : 4 Y[2] : 6
X[3] : 34 Y[3] : 2
X[4] : 10 Y[4] : 79
X[5] : 2 Y[5] : 810
Double value r : 5.500000

----- Menu -----
[1] Inner product of X * Y
[2] Average value of each vector
[3] Product of r * (X + Y)
[4] Exit
Input a choice from Menu : 3
Sending data to socket server, waiting for results...

----- Results -----
r * (X + Y)[0] : 5.500000
r * (X + Y)[1] : -82.500000
r * (X + Y)[2] : 55.000000
r * (X + Y)[3] : 198.000000
r * (X + Y)[4] : 489.500000
r * (X + Y)[5] : 4466.000000

Input the size of vectors X and Y : 6

```
tiger@Tiger: ~/project1$ ./rpc_client 7455 localhost
```

[Connection] : socket client with Id 6040 has been connected.
[6040] [1] Inner product of X * Y
Sending socket client's data to rpc server, waiting for results...
----- Results -----
X * Y : 180
Sending results to socket client with Id 6040.

```
tiger@Tiger: ~/project1$ ./rpc_server
```

[1] Inner product of X * Y
----- Results -----
X * Y : 180
Sending results to rpc client.

[2] Average value of each vector
----- Results -----
Average value of X : 60.000000
Average value of Y : 90.000000
Sending results to rpc client.

[3] Product of r * (X + Y)
----- Results -----
r * (X + Y)[0] : 5.500000
r * (X + Y)[1] : -82.500000
r * (X + Y)[2] : 55.000000
r * (X + Y)[3] : 198.000000
r * (X + Y)[4] : 489.500000
r * (X + Y)[5] : 4466.000000
Sending results to rpc client.

Matrix A Input

row	column
6	x 1
1	
-5	
4	
34	
10	
2	

Clear All 0 All 1 Random
Transpose Power of 2
Determinant Inverse × 3

A + B A - B AB A ↔ B

Matrix B Input

row	column
6	x 1
0	
-10	
6	
2	
79	
810	

Clear All 0 All 1 Random
Transpose Power of 2
Determinant Inverse × 3

Matrix A Input

row	column
6	x 1
1	
-15	
10	
36	
89	
812	

Clear All 0 All 1 Random
Transpose Power of 2
Determinant Inverse × 5.5

A + B A - B

Result

$$A + B = \begin{bmatrix} 1 \\ -15 \\ 10 \\ 36 \\ 89 \\ 812 \end{bmatrix}$$

[Copy To A](#) [Copy To B](#)

Result

$$A \times 5.5 = \begin{bmatrix} 5.5 \\ -82.5 \\ 55 \\ 198 \\ 489.5 \\ 4466 \end{bmatrix}$$

[Copy To A](#) [Copy To B](#)

ΚΑΤΑΝΕΜΗΜΕΝΑ ΣΥΣΤΗΜΑΤΑ



Σας ευχαριστώ για την προσοχή σας.

