TASK 1.

Find a host near you that responds to a ping command. Start by sending an ICMP echo request with 1500 bytes of data that has the Don't Fragment bit set. Then send another similar ICMP echo request with 500 bytes of data. Continue using a Binary Search until you find the largest amount of data that can be transmitted without fragmentation. Indicate what you think this MTU size is and why.

ANSWER 1.

1. Method: To find a host near me I typed a command `arp -a` and received a list of hosts:

```
Last login: Wed Dec 30 00:26:09 on ttys000
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$    arp –a

vodafonemobile.cpe (192.168.1.1) at 0:34:fe:e9:8d:87 on en1 ifscope
[ethernet]
? (192.168.1.255) at ff:ff:ff:ff:ff:ff on en1 ifscope [ethernet]
```

I had chosen this host: `vodafonemobile.cpe (192.168.1.1)` and sent it a ping command by typing: `ping -c 5 192.168.1.1`

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -c 5 192.168.1.1

PING 192.168.1.1 (192.168.1.1): 56 data bytes
64 bytes from 192.168.1.1: icmp_seq=0 ttl=64 time=2.442 ms
64 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=5.592 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=2.620 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=1.392 ms
64 bytes from 192.168.1.1: icmp_seq=4 ttl=64 time=1.447 ms

--- 192.168.1.1 ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 1.392/2.699/5.592/1.531 ms
```

Result: I received a successful response to a ping command.

2. Method: I started by sending an ICMP echo request with 1500 bytes of data that has the Don't Fragment bit set.

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$  ping -g 64 —G 1500  -h 10
-D 192.168.1.1
```

Note: `-g` define the minimum packet size; `-G` flags define the maximum packet size (the default is 56, which translates into 64 ICMP data bytes when combined with the 8 bytes of ICMP header data). While the `-h` [number] is the amount by which to increment the packet size each time. The `-D` is 'Do Not Fragment'. (Apple)

```
PING 192.168.1.1 (192.168.1.1): (64 ... 1500) data bytes
72 bytes from 192.168.1.1: icmp_seq=0 ttl=64 time=3.767 ms
82 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=3.224 ms
92 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=3.408 ms
102 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=25.793 ms
112 bytes from 192.168.1.1: icmp_seq=4 ttl=64 time=3.660 ms

..[output omitted]..

1432 bytes from 192.168.1.1: icmp_seq=136 ttl=64 time=3.446 ms
1442 bytes from 192.168.1.1: icmp_seq=137 ttl=64 time=1.622 ms
1452 bytes from 192.168.1.1: icmp_seq=138 ttl=64 time=3.824 ms
1462 bytes from 192.168.1.1: icmp_seq=139 ttl=64 time=4.319 ms
1472 bytes from 192.168.1.1: icmp_seq=140 ttl=64 time=1.642 ms
ping: sendto: Message too long
ping: sendto: Message too long
Request timeout for icmp_seq 141
ping: sendto: Message too long
Request timeout for icmp_seq 142

--- 192.168.1.1 ping statistics ---
144 packets transmitted, 141 packets received, 2.1% packet loss
round-trip min/avg/max/stddev = 1.300/9.042/265.432/30.688 ms
```

Result: I received a fail response to a ping command. From 144 packets being transmitted only 141 packets were received and 2.1% packet loss.

3. Method: After I sent another similar ICMP echo request with 500 bytes of data.

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -g 64 -G 500 -h 10 -D
192.168.1.1

PING 192.168.1.1 (192.168.1.1): (64 ... 500) data bytes
72 bytes from 192.168.1.1: icmp_seq=0 ttl=64 time=3.213 ms
82 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=3.388 ms
92 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=4.827 ms
102 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=3.251 ms
112 bytes from 192.168.1.1: icmp_seq=4 ttl=64 time=3.940 ms

..[output omitted]..

462 bytes from 192.168.1.1: icmp_seq=39 ttl=64 time=3.893 ms
472 bytes from 192.168.1.1: icmp_seq=40 ttl=64 time=4.355 ms
482 bytes from 192.168.1.1: icmp_seq=41 ttl=64 time=3.809 ms
492 bytes from 192.168.1.1: icmp_seq=42 ttl=64 time=3.284 ms
502 bytes from 192.168.1.1: icmp_seq=43 ttl=64 time=3.653 ms

--- 192.168.1.1 ping statistics ---
44 packets transmitted, 44 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 1.344/4.206/10.407/2.114 ms
```

I received a successful response to a ping command. All packets were transmitted and received successfully and no packet loss.

4. Method: I continued to do Binary Search until I found the largest amount of data that can be transmitted without fragmentation.
5
I understood that the maximum data size lies somewhere between 500 and 1500 bytes.

I decided to send another similar ICMP echo request with 1000 bytes of data.

between 500 - 1500: 1000 bytes could be sent;
1000 - 1500: 1250 bytes could be sent;
1250 - 1500: 1375 bytes could be sent;
1375 - 1500: 1438 bytes could be sent;
1438 - 1500: 1469 bytes could be sent;
1469 - 1500: 1485 bytes couldn't be sent;
1469 - 1485: 1477 bytes couldn't be sent;
1469 - 1477: 1473 bytes couldn't be sent;
1469 - 1473: 1471 bytes could be sent;
1471 - 1473: 1472 bytes could be sent.

Result: I discovered that the largest amount of data that can be transmitted without fragmentation is 1472 bytes.

After I sent another similar ICMP echo request with 1472 bytes of data that proves my Binary Search result.

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -g 64 -G 1472 -h 10 -
D 192.168.1.1

PING 192.168.1.1 (192.168.1.1): (64 ... 1472) data bytes
72 bytes from 192.168.1.1: icmp_seq=0 ttl=64 time=1.845 ms
82 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=3.293 ms
92 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=2.529 ms
102 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=1.427 ms

..[output omitted]..

1432 bytes from 192.168.1.1: icmp_seq=136 ttl=64 time=3.938 ms
1442 bytes from 192.168.1.1: icmp_seq=137 ttl=64 time=4.274 ms
1452 bytes from 192.168.1.1: icmp_seq=138 ttl=64 time=3.547 ms
1462 bytes from 192.168.1.1: icmp_seq=139 ttl=64 time=8.327 ms
1472 bytes from 192.168.1.1: icmp_seq=140 ttl=64 time=1.499 ms

--- 192.168.1.1 ping statistics ---
141 packets transmitted, 141 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 1.331/4.555/21.803/3.184 ms
112 bytes from 192.168.1.1: icmp_seq=4 ttl=64 time=1.700 ms
```

This is a result that proves my Binary Search. I received a successful response to a ping command. All packets were transmitted and received successfully and no packet loss.

Now I need to indicate what the Maximum Transfer Unit (MTU) size is and why, and explain why the MTU size has been set to this value.
I just verified that the largest amount of data that can be transmitted without fragmentation is 1472 bytes.

5. Method: I added 28 bytes because 20 bytes were reserved for the IP header and 8 bytes must be allocated for the ICMP Echo Request header.

Result: 1472 + 28 = 1500 bytes this is MTU size.

TASK 2.

Find a correlation between Round Trip Time (RTT) and distance.

Identify five host sites, one of each continent, that respond to ICMP echo requests generated by ping commands. Ping each 5 of the five sites you found above and record the average RTT from the ping replies. Calculate distance between your own location and the host sites. Create a Scatter Graph.

ANSWER 2.

1. Method: I did research in Internet and identified 5 host sites, one on each continent, that respond to ICMP echo request generated by a ping command, and sent a ping command to each of the 5 host sites and recorded the average RTT from the ping replies.

1 - Oceania (Brisbane, Australia), The University of Queensland
host: www.future-students.uq.edu.au IP: 130.102.131.115

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -c 5
www.future-students.uq.edu.au

PING cms-vip-1.soe.uq.edu.au (130.102.131.115): 56 data bytes
64 bytes from 130.102.131.115: icmp_seq=0 ttl=107 time=612.013 ms
64 bytes from 130.102.131.115: icmp_seq=1 ttl=107 time=432.206 ms
64 bytes from 130.102.131.115: icmp_seq=2 ttl=107 time=453.878 ms
64 bytes from 130.102.131.115: icmp_seq=3 ttl=107 time=361.456 ms
64 bytes from 130.102.131.115: icmp_seq=4 ttl=107 time=360.345 ms

--- cms-vip-1.soe.uq.edu.au ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 360.345/443.980/612.013/91.953 ms
```

Result: The Average RTT is: 443.980 ms

2 – Europe (Heidelberg, Germany), Heidelberg University
host: www.uni-heidelberg.de IP: 129.206.13.27

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -c 5
www.uni-heidelberg.de

PING www.uni-heidelberg.de (129.206.13.27): 56 data bytes
64 bytes from 129.206.13.27: icmp_seq=0 ttl=50 time=101.552 ms
64 bytes from 129.206.13.27: icmp_seq=1 ttl=50 time=96.635 ms
64 bytes from 129.206.13.27: icmp_seq=2 ttl=50 time=97.463 ms
64 bytes from 129.206.13.27: icmp_seq=3 ttl=50 time=95.863 ms
64 bytes from 129.206.13.27: icmp_seq=4 ttl=50 time=116.592 ms

--- www.uni-heidelberg.de ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 95.863/101.621/116.592/7.739 ms
```

Result: The Average RTT is: 101.621 ms

3 – Asia (Kaohsiung, Taiwan), Kaohsiung Medical University
host: www2.kmu.edu.tw IP: 163.15.154.11

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -c 5
www2.kmu.edu.tw

PING www2.kmu.edu.tw (163.15.154.11): 56 data bytes
64 bytes from 163.15.154.11: icmp_seq=0 ttl=43 time=408.116 ms
64 bytes from 163.15.154.11: icmp_seq=1 ttl=43 time=429.850 ms
64 bytes from 163.15.154.11: icmp_seq=2 ttl=43 time=451.636 ms
64 bytes from 163.15.154.11: icmp_seq=3 ttl=43 time=471.168 ms
64 bytes from 163.15.154.11: icmp_seq=4 ttl=43 time=489.678 ms

--- www2.kmu.edu.tw ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 408.116/450.090/489.678/28.932 ms
```

Result: The Average RTT is: 450.090 ms

4 - South America (Santiago, Chile), The Pontificia Universidad Católica de Chile host: www.uc.cl IP: 146.155.99.60

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -c 5
www.uc.cl

PING www.uc.cl (146.155.99.60): 56 data bytes
64 bytes from 146.155.99.60: icmp_seq=0 ttl=111 time=420.205 ms
64 bytes from 146.155.99.60: icmp_seq=1 ttl=111 time=316.278 ms
64 bytes from 146.155.99.60: icmp_seq=2 ttl=111 time=334.319 ms
64 bytes from 146.155.99.60: icmp_seq=3 ttl=111 time=358.513 ms
64 bytes from 146.155.99.60: icmp_seq=4 ttl=111 time=373.580 ms

--- www.uc.cl ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 316.278/360.579/420.205/35.723 ms
```

Result: The Average RTT is: 360.579 ms

5 - North America (Vancouver, Canada), Emily Carr University of Art + Design
host: www.ecuad.ca IP:137.82.55.112

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -c 5
www.ecuad.ca

PING artemis.ecuad.ca (137.82.55.112): 56 data bytes
64 bytes from 137.82.55.112: icmp_seq=0 ttl=42 time=235.792 ms
64 bytes from 137.82.55.112: icmp_seq=1 ttl=42 time=210.371 ms
64 bytes from 137.82.55.112: icmp_seq=2 ttl=42 time=214.188 ms
64 bytes from 137.82.55.112: icmp_seq=3 ttl=42 time=219.839 ms
64 bytes from 137.82.55.112: icmp_seq=4 ttl=42 time=209.756 ms

--- artemis.ecuad.ca ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
```

```
round-trip min/avg/max/stddev = 209.756/217.989/235.792/9.598 ms
```

Result: The Average RTT is: 217.989 ms

2. Method: By using on-line distance calculator (I used www.daftlogic.com) I calculated the distance between my own location (Ta'Xbiex, Malta) and the host sites. I stored the results in a spreadsheet table.

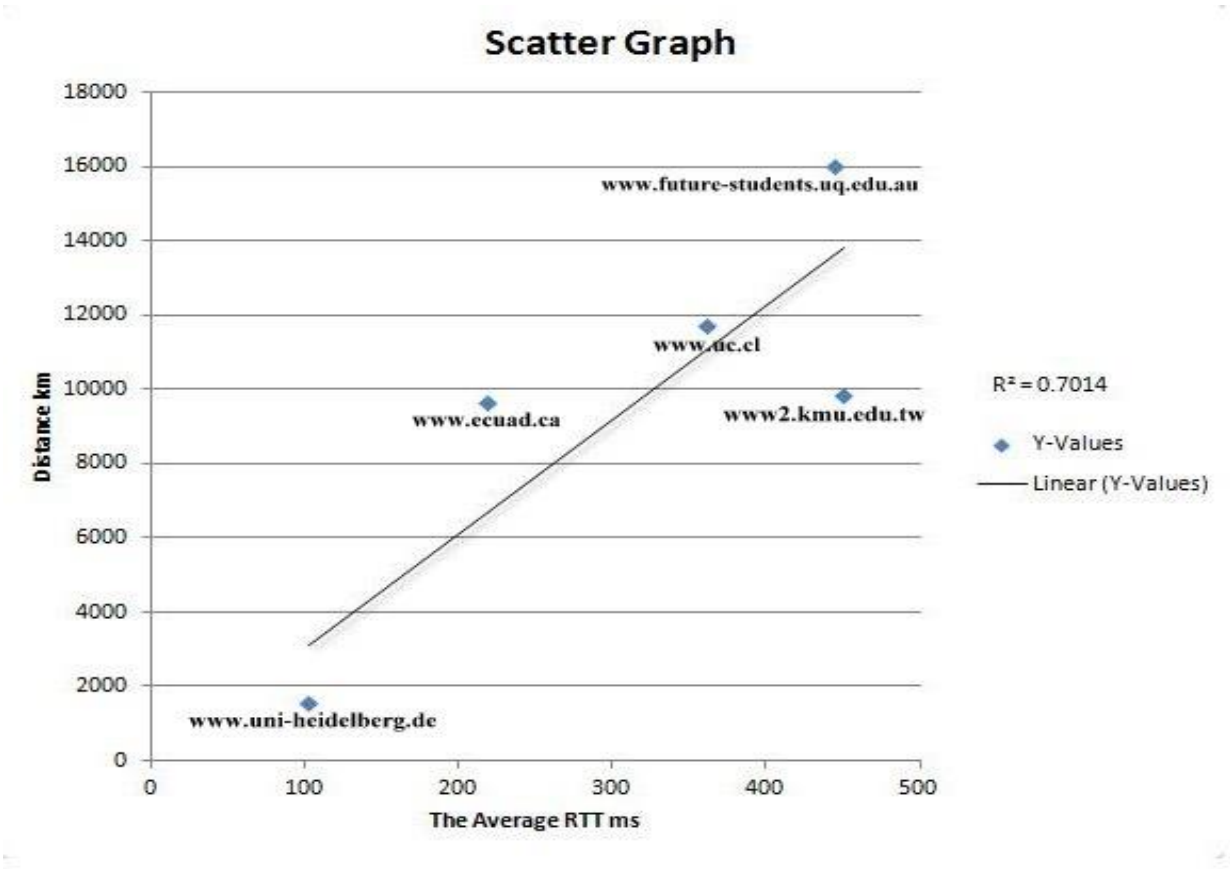
Result:

Continent	City, Country	Hostname	The Average RTT (ms)	Distance (km)
Oceania	Brisbane, Australia	www.future-students.uq.edu.au	443.980	16041.491
Europe	Heidelberg, Germany	www.uni-heidelberg.de	101.621	1587.612
Asia	Kaohsiung, Taiwan	www2.kmu.edu.tw	450.090	9886.489
South America	Santiago, Chile	www.uc.cl	360.579	11730.337
North America	Vancouver, Canada	www.ecuad.ca	217.989	9664.855

Pic.1 Spreadsheet table "Continents"

3. Method: By using Microsoft Word I created the Scatter Graph to show the relationship between RTT and Distance. I also drew the trend line and calculated the correlation between RTT and Distance.

Result :



Pic.2 Scatter Graph "Continents"

Result : The correlation between RTT and Distance is equal: $R^2 = 0.7014$

TASK 3.

Identify five host sites within your own country that respond to a ping command.

ANSWER 3.

1.Method: I did research in Internet and I identified 5 host sites within my own country (Malta) that respond to a ping command, and sent ping command to each of 5 host sites and recorded the average RTT from the ping replies.

1 - Europe, Malta, Msida, University of Malta
host: www.um.edu.mt IP: 193.188.46.72

```
PING www.um.edu.mt (193.188.46.72): 56 data bytes
64 bytes from 193.188.46.72: icmp_seq=0 ttl=57 time=38.758 ms
64 bytes from 193.188.46.72: icmp_seq=1 ttl=57 time=27.238 ms
64 bytes from 193.188.46.72: icmp_seq=2 ttl=57 time=25.547 ms
64 bytes from 193.188.46.72: icmp_seq=3 ttl=57 time=21.930 ms
64 bytes from 193.188.46.72: icmp_seq=4 ttl=57 time=40.743 ms

--- www.um.edu.mt ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 21.930/30.843/40.743/7.499 ms
```

The Average RTT is: 30.843 ms

2 - Europe, Malta, Marsa, Local Discovery Search Tool "Yellow"
host: www.yellow.com.mt IP: 78.133.127.59

```
PING www.yellow.com.mt (78.133.127.59): 56 data bytes
64 bytes from 78.133.127.59: icmp_seq=0 ttl=53 time=196.728 ms
64 bytes from 78.133.127.59: icmp_seq=1 ttl=53 time=56.492 ms
64 bytes from 78.133.127.59: icmp_seq=2 ttl=53 time=79.861 ms
64 bytes from 78.133.127.59: icmp_seq=3 ttl=53 time=71.608 ms
64 bytes from 78.133.127.59: icmp_seq=4 ttl=53 time=68.687 ms

--- www.yellow.com.mt ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 56.492/94.675/196.728/51.575 ms
```

The Average RTT is: 94.675 ms

3 - Europe, Malta, San Gwann, Media House "Malta Today"
host: www.maltatoday.com.mt IP: 95.131.238.111

```
PING maltatoday.com.mt (95.131.238.111): 56 data bytes
64 bytes from 95.131.238.111: icmp_seq=0 ttl=51 time=82.711 ms
64 bytes from 95.131.238.111: icmp_seq=1 ttl=51 time=70.568 ms
64 bytes from 95.131.238.111: icmp_seq=2 ttl=51 time=68.580 ms
64 bytes from 95.131.238.111: icmp_seq=3 ttl=51 time=66.716 ms
64 bytes from 95.131.238.111: icmp_seq=4 ttl=51 time=83.031 ms

--- maltatoday.com.mt ping statistics ---
```

```
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 66.716/74.321/83.031/7.087 ms
```

The Average RTT is: 74.321 ms

4 - Europe, Malta, Valletta, The Malta Stock Exchange
host: www.borzamalta.com.mt IP: 194.158.42.14

```
PING borzamalta.com.mt (194.158.42.14): 56 data bytes
64 bytes from 194.158.42.14: icmp_seq=0 ttl=244 time=76.991 ms
64 bytes from 194.158.42.14: icmp_seq=1 ttl=244 time=77.803 ms
64 bytes from 194.158.42.14: icmp_seq=2 ttl=244 time=74.443 ms
64 bytes from 194.158.42.14: icmp_seq=3 ttl=244 time=112.057 ms
64 bytes from 194.158.42.14: icmp_seq=4 ttl=244 time=62.931 ms

--- borzamalta.com.mt ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 62.931/80.845/112.057/16.494 ms
```

The Average RTT is: 80.845 ms

5 - Europe, Malta, Qormi, Web Development Company “Alert”
host: www.alert.com.mt IP: 85.119.122.2

```
PING www.alert.com.mt (85.119.122.2): 56 data bytes
64 bytes from 85.119.122.2: icmp_seq=0 ttl=122 time=28.173 ms
64 bytes from 85.119.122.2: icmp_seq=1 ttl=122 time=28.069 ms
64 bytes from 85.119.122.2: icmp_seq=2 ttl=122 time=29.858 ms
64 bytes from 85.119.122.2: icmp_seq=3 ttl=122 time=26.458 ms
64 bytes from 85.119.122.2: icmp_seq=4 ttl=114 time=86.219 ms

--- www.alert.com.mt ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 26.458/39.755/86.219/23.257 ms
```

The Average RTT is: 39.755 ms

2. Method: By using on-line distance calculator (I used www.daftlogic.com) I calculated the distance between my own location (Ta'Xbiex, Malta) and the host sites. I stored the results in a spreadsheet table.

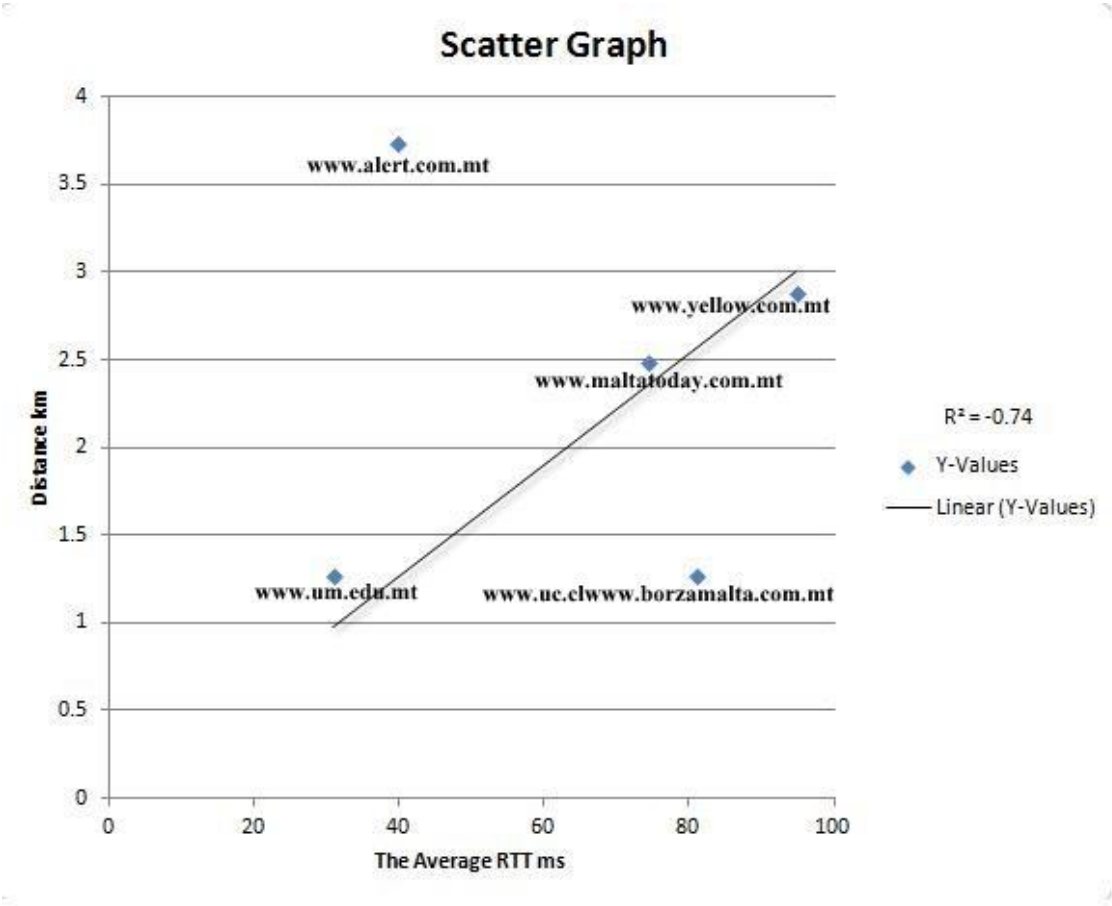
Result :

Continent	City, Country	Hostname	The Average RTT (ms)	Distance (km)
Europe	Malta, Msida	www.um.edu.mt	30.843	1.273
Europe	Malta, Marsa	www.yellow.com.mt	94.675	2.885
Europe	Malta, San Gwann	www.maltatoday.com.mt	74.321	2.487
Europe	Malta, Valletta	www.uc.clwww.borzamalta.com.mt	80.845	1.269
Europe	Malta, Qormi	www.alert.com.mt	39.755	3.742

Pic.3 Spreadsheet table "Malta"

3. Method: By using Microsoft Word I created the Scatter Graph to show the relationship between RTT and Distance. I also draw the trend line and calculated the correlation between RTT and Distance.

Result :



Pic.4 Scatter Graph "Malta"

Result : The correlation between RTT and Distance is equal: $R^2 = -0.74$

TASK 4

Investigate the effect of changing the initial value in the Time To Live (TTL) field in an ICMP echo request packet.

Choose one of the five hosts from Task 3 above and ping it with an initial TTL of 1 and note the IP address from which the TTL expired message was received. Increment the initial TTL by 1 each time until a reply is received from the host being pinged.

ANSWER 4.

1.Method:

1. I had chosen 1 host www.ecuad.ca from Task 2 and pinged it with an initial TTL of 1.

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -t 1 www.ecuad.ca

PING artemis.ecuad.ca (137.82.55.112): 56 data bytes
64 bytes from 137.82.55.112: icmp_seq=0 ttl=42 time=213.500 ms

--- artemis.ecuad.ca ping statistics ---
2 packets transmitted, 1 packets received, 50.0% packet loss
round-trip min/avg/max/stddev = 213.500/213.500/213.500/0.000 ms
```

Result 1: This is IP address from which TTL expired message was received: 137.82.55.112.

2. I pinged it with an initial TTL of 2 (1 incremented by 1).

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ ping -t 2 www.ecuad.ca

PING artemis.ecuad.ca (137.82.55.112): 56 data bytes
64 bytes from 137.82.55.112: icmp_seq=0 ttl=42 time=275.167 ms
64 bytes from 137.82.55.112: icmp_seq=1 ttl=42 time=286.502 ms

--- artemis.ecuad.ca ping statistics ---
2 packets transmitted, 2 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 275.167/280.834/286.502/5.667 ms
```

Result 2: I received a successful reply from host being pinged.

Analysis:

The number of router hops the packet has been through can be established by using TTL. If the value in the TTL field changes within succeeding pings, this may be an indication that the corresponding reply packets are passing from diverse routes.

TASK 5.

Carry out traceroutes to each of the five hosts you pinged in Task 3 above. Study the routs followed by the packets to these hosts and record the location of the routers.

ANSWER 5.

Method: I carried out traceroutes to each 5 hosts from Task 2 to figure out the routes followed by the packets to these hosts and record the location of the routers.

1 - Oceania (Brisbane, Australia), The University of Queensland
host: www.future-students.uq.edu.au IP: 130.102.131.115

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ traceroute www.future-
students.uq.edu.au
```

Result:

```
traceroute to cms-vip-1.soe.uq.edu.au (130.102.131.115), 64 hops
max, 72 byte packets

1  vodafonemobile.cpe (192.168.1.1)  10.010 ms  2.939 ms  1.294 ms

2  159.20.30.215 (159.20.30.215)  15.413 ms  16.849 ms  52.063 ms

3  159.20.30.214 (159.20.30.214)  15.507 ms  23.415 ms  24.972 ms

4  159.20.30.96 (159.20.30.96)  16.570 ms  15.688 ms  18.355 ms

5  ge-2-2-6-100-xcr1.mlu.cw.net (208.175.148.197)  50.712 ms  53.394
ms  58.227 ms

6  ae6-xcr1.fix.cw.net (195.2.10.245)  203.854 ms  209.854 ms
203.788 ms

7  ae6-xcr2.amd.cw.net (195.2.28.185)  208.529 ms  208.516 ms
200.812 ms

8  ae0-xcr1.ltw.cw.net (195.2.24.121)  206.508 ms  202.004 ms
287.133 ms

9  et-9-1-0-xcr2.ash.cw.net (195.2.24.245)  174.214 ms  167.053 ms
158.894 ms

10  xe-8-2-0-xcr1.lax.cw.net (195.2.30.246)  197.429 ms  208.982 ms
224.869 ms

11  ge-2-3-0.bb1.a.lax.aarnet.net.au (198.32.146.43)  199.506 ms
202.616 ms  282.673 ms

12  xe-0-0-3.pe1.tkpa.akl.aarnet.net.au (202.158.194.172)  335.883
ms  328.513 ms  329.810 ms
```

13 et-0-1-0.200.pe1.wnpa.akl.aarnet.net.au (113.197.15.68) 336.110 ms 409.383 ms 334.761 ms

14 xe-1-2-1.pe1.msct.nsw.aarnet.net.au (113.197.15.66) 394.657 ms 357.932 ms 443.056 ms

15 ae9.bb1.b.syd.aarnet.net.au (113.197.15.65) 362.925 ms 353.987 ms 401.752 ms

16 so-0-1-0.bb1.a.bne.aarnet.net.au (202.158.194.50) 377.994 ms 440.858 ms 513.830 ms

17 tengigabitethernet2-1.er2.uq.cpe.aarnet.net.au (202.158.209.3) 408.058 ms 408.801 ms 425.440 ms

18 gw2.er2.uq.cpe.aarnet.net.au (113.197.8.34) 394.985 ms 408.074 ms 410.728 ms

19 uq-se1-uq-gw1.router.uq.edu.au (130.102.159.1) 421.407 ms 395.842 ms 359.235 ms

20 zeus-uqse1.router.uq.edu.au (130.102.0.242) 460.046 ms 410.332 ms 376.822 ms

21 a82-27.nat.uq.edu.au (130.102.82.27) 448.047 ms 402.368 ms 361.601 ms

22 cms-vip-1.soe.uq.edu.au (130.102.131.115) 457.573 ms 408.524 ms 606.238 ms

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Analysis: This host had been reached successfully because the host address and IP address when traceroute had been started and finished are the same:

```
traceroute to cms-vip-1.soe.uq.edu.au (130.102.131.115), 64 hops
max, 72 byte packets
```

and

```
22  cms-vip-1.soe.uq.edu.au (130.102.131.115)  457.573 ms  408.524
ms  606.238 ms
```

2 – Europe (Heidelberg, Germany), Heidelberg University
host: www.uni-heidelberg.de IP: 129.206.13.27

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ traceroute
www.uni-heidelberg.de
```

Result:

```
traceroute to www.uni-heidelberg.de (129.206.13.27), 64 hops max, 52
byte packets
 1  vodafonemobile.cpe (192.168.1.1)  30.423 ms  2.797 ms  4.541 ms
 2  159.20.30.215 (159.20.30.215)  12.841 ms  34.925 ms  43.032 ms
 3  159.20.30.214 (159.20.30.214)  14.430 ms  14.888 ms  18.528 ms
 4  159.20.30.98 (159.20.30.98)  44.100 ms
    159.20.30.96 (159.20.30.96)  17.179 ms  18.735 ms
 5  ge-2-2-6-100-xcr1.mlu.cw.net (208.175.148.197)  50.849 ms
97.972 ms  56.788 ms
 6  mno-b2-link.telia.net (213.248.92.125)  48.608 ms  66.966 ms
50.344 ms
```

```
 7  ffm-bb2-link.telia.net (62.115.142.150)  67.718 ms  63.257 ms
61.556 ms
 8  sgrt-b1-link.telia.net (62.115.140.125)  108.235 ms  99.794 ms
67.031 ms
 9  universstutt-ic-311007-sgrt-b1.c.telia.net (62.115.55.98)
67.186 ms  64.391 ms  68.971 ms
10  stuttgart-al30-1-10ge-0-0-0-0.belwue.net (129.143.59.33)  83.232
ms
    karlsruhe-rz-1-10ge-0-0-0-1.belwue.net (129.143.59.210)  66.931
ms
    stuttgart-al30-1-10ge-0-2-0-0.belwue.net (129.143.57.1)  98.072
ms
11  karlsruhe-bib-1-10ge-0-0-0-0.belwue.net (129.143.59.141)  97.899
ms
    karlsruhe-bib-1-10ge-0-0-0-1.belwue.net (129.143.57.42)  80.439
ms
    karlsruhe-bib-1-10ge-0-0-0-0.belwue.net (129.143.59.141)  81.780
ms
12  mannheim-rz-1-10ge-0-0-0-1.belwue.net (129.143.59.54)  89.198 ms
    mannheim-rz-1-10ge-0-2-0-1.belwue.net (129.143.59.222)  90.101
ms
    mannheim-rz-1-10ge-0-0-0-1.belwue.net (129.143.59.54)  92.827 ms
13  rz-uniheidelberg.belwue.de (129.143.55.126)  84.009 ms  82.826
ms  80.809 ms
14  br-urz-arurz.urz.uni-heidelberg.de (129.206.215.222)  81.999 ms
94.550 ms  93.992 ms
15  www.uni-heidelberg.de (129.206.13.27)  82.762 ms  90.683 ms
93.419 ms
```

Analysis: This host had been reached successfully because the host address and IP address when traceroute had been started and finished are the same:

```
traceroute to www.uni-heidelberg.de (129.206.13.27), 64 hops max, 52
byte packets
```

and

```
15  www.uni-heidelberg.de (129.206.13.27)  82.762 ms  90.683 ms
93.419 ms
```

3 – Asia (Kaohsiung, Taiwan), Kaohsiung Medical University
host: www2.kmu.edu.tw IP: 163.15.154.11

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ traceroute
 www2.kmu.edu.tw
```

Result:

```
traceroute to www2.kmu.edu.tw (163.15.154.11), 64 hops max, 72 byte
packets
 1  vodafonemobile.cpe (192.168.1.1)  49.344 ms  0.978 ms  0.960 ms
 2  159.20.30.215 (159.20.30.215)  13.906 ms  12.694 ms  15.437 ms
 3  159.20.30.214 (159.20.30.214)  13.362 ms  20.473 ms  12.938 ms
```

```
 4  159.20.30.98 (159.20.30.98)  40.265 ms  15.228 ms  17.494 ms
 5  ge-2-2-6-100-xcr1.mlu.cw.net (208.175.148.197)  49.090 ms
57.717 ms  58.636 ms
 6  mno-b2-link.telia.net (213.248.92.125)  52.509 ms  48.445 ms
48.812 ms
 7  prs-bb2-link.telia.net (62.115.135.78)  66.597 ms  65.827 ms
67.704 ms
 8  nyk-bb2-link.telia.net (80.91.251.100)  159.381 ms
    nyk-bb2-link.telia.net (62.115.135.102)  138.979 ms
    ash-bb4-link.telia.net (80.91.251.247)  143.390 ms
 9  palo-b1-link.telia.net (62.115.114.7)  243.078 ms
    ash-bb4-link.telia.net (213.155.134.144)  144.741 ms  143.106 ms
10  chunghwa-ic-313586-palo-b1.c.telia.net (62.115.60.6)  316.126 ms
    las-b21-link.telia.net (213.155.137.113)  240.940 ms
    chunghwa-ic-313586-palo-b1.c.telia.net (62.115.60.6)  270.350 ms
11  170-58-41-175.twgate-ip.twgate.net (175.41.58.170)  306.571 ms
306.751 ms  307.279 ms
12  * * *
13  internet-moe-n-tanet.edu.tw (203.72.43.9)  366.775 ms  408.469
ms  409.657 ms
14  bb-nsysu-twaren.tanet.edu.tw (192.83.196.117)  409.772 ms
397.264 ms
    internet-stm16-twasr-tanet.edu.tw (203.72.43.17)  411.218 ms
15  140.127.160.66 (140.127.160.66)  409.034 ms
    internet-moe-n-tanet.edu.tw (203.72.43.9)  408.969 ms  409.249
ms
16  211-21-255-120.hinet-ip.hinet.net (211.21.255.120)  409.886 ms *
    118-163-160-58.hinet-ip.hinet.net (118.163.160.58)  454.809 ms
17  140.127.160.66 (140.127.160.66)  391.627 ms *  360.187 ms
18  * www2.kmu.edu.tw (163.15.154.11)  482.532 ms  409.357 ms
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```

Analysis: This host had been reached successfully because the host address and IP address when traceroute had been started and finished are the same:

```
traceroute to www2.kmu.edu.tw (163.15.154.11), 64 hops max, 72 byte
packets
```

and

```
18  * www2.kmu.edu.tw (163.15.154.11)  482.532 ms  409.357 ms
```

4 - South America (Santiago,Chilie), The Pontificia Universidad Católica de Chile host: www.uc.cl IP: 146.155.99.60

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ traceroute
www.uc.cl
```

Result:

```
traceroute to www.uc.cl (146.155.99.60), 64 hops max, 72 byte
packets
 1  vodafonemobile.cpe (192.168.1.1)  30.610 ms  1.009 ms  0.933 ms
 2  159.20.30.215 (159.20.30.215)  12.070 ms  13.444 ms  12.573 ms
 3  159.20.30.214 (159.20.30.214)  27.042 ms  14.692 ms  15.887 ms
 4  159.20.30.98 (159.20.30.98)  14.125 ms  15.486 ms  15.609 ms
 5  ge-2-3-6-100-xcr1.mlu.cw.net (208.175.148.253)  48.050 ms
48.596 ms  49.204 ms
 6  195.2.19.98 (195.2.19.98)  49.135 ms  49.256 ms  49.925 ms
 7  be2314.ccr21.mrs01.atlas.cogentco.com (130.117.50.93)  58.131 ms
57.506 ms  58.647 ms
```

```
 8  be2236.ccr41.par01.atlas.cogentco.com (130.117.1.157)  74.034 ms
68.015 ms  67.760 ms
 9  be2746.ccr41.jfk02.atlas.cogentco.com (154.54.29.117)  138.369
ms  138.688 ms  138.044 ms
10  be2324.ccr21.jfk04.atlas.cogentco.com (154.54.47.18)  138.379 ms
138.287 ms  149.515 ms
11  38.104.72.218 (38.104.72.218)  383.100 ms  301.825 ms  264.150
ms
12  190.208.9.14 (190.208.9.14)  348.952 ms  306.719 ms  307.197 ms
13  190.208.4.142 (190.208.4.142)  262.926 ms  350.846 ms  307.206
ms
14  * * *
15  www.puc.cl (146.155.99.60)  353.023 ms  307.097 ms  307.011 ms
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```

Analysis: This host had been reached successfully because the host address and IP address when traceroute had been started and finished are the same:

```
traceroute to www.uc.cl (146.155.99.60), 64 hops max, 72 byte
packets
```

and

```
15  www.puc.cl (146.155.99.60)  353.023 ms  307.097 ms  307.011 ms
```

5 - North America (Vancouver, Canada), Emily Carr University of Art + Design
host: www.ecuad.ca IP:137.82.55.112

```
MacBook-ANASTASIA-RIZZO:~ anastasiarizzo$ traceroute
www.ecuad.ca
```

Result:

```
traceroute to artemis.ecuad.ca (137.82.55.112), 64 hops max, 72 byte
packets
 1  vodafonemobile.cpe (192.168.1.1)  24.186 ms  8.474 ms  1.278 ms
 2  159.20.30.215 (159.20.30.215)  38.052 ms  14.681 ms  12.259 ms
 3  159.20.30.214 (159.20.30.214)  15.517 ms  14.869 ms  13.571 ms
 4  159.20.30.96 (159.20.30.96)  23.944 ms  16.656 ms  15.933 ms
 5  ge-2-2-6-100-xcr1.mlu.cw.net (208.175.148.197)  56.905 ms
53.949 ms  48.615 ms
 6  ae6-xcr1.fix.cw.net (195.2.10.245)  60.875 ms  56.648 ms  60.472
ms
 7  195.2.19.30 (195.2.19.30)  79.429 ms  90.368 ms  99.613 ms
 8  100ge5-2.core1.par2.he.net (72.52.92.13)  78.023 ms  74.392 ms
84.115 ms
 9  100ge7-1.core1.nyc4.he.net (184.105.81.77)  144.952 ms  136.711
ms  143.964 ms
10  100ge7-2.core1.chi1.he.net (184.105.223.161)  159.978 ms
153.430 ms  182.431 ms
11  100ge10-1.core1.msp1.he.net (184.105.223.178)  168.577 ms
168.595 ms  208.031 ms
12  10ge1-3.core1.ywg1.he.net (184.105.80.14)  169.865 ms  172.878
ms  175.062 ms
13  10ge1-1.core1.yyc1.he.net (184.105.223.214)  213.905 ms  212.022
ms  212.764 ms
14  10ge2-2.core1.yvr1.he.net (184.105.223.218)  216.738 ms  207.904
ms  219.400 ms
15  184.105.148.150 (184.105.148.150)  207.358 ms  207.548 ms
207.701 ms
```

```
16  347-tx-ubcab-cr1.vncv1.bc.net (207.23.240.85)  208.839 ms
208.676 ms  207.710 ms
17  a0-anguborder.net.ubc.ca (137.82.123.138)  221.095 ms  304.547
ms  308.307 ms
18  a21-a0.net.ubc.ca (137.82.123.65)  308.136 ms  306.285 ms
307.188 ms
19  * * *
20  * * *
21  137.82.55.125 (137.82.55.125)  214.925 ms  213.755 ms  209.977
ms
22  137.82.55.112 (137.82.55.112)  209.001 ms  210.606 ms  211.033
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```

Analysis: This host had been reached successfully because the host address and IP address when traceroute had been started and finished are the same:

```
traceroute to artemis.ecuad.ca (137.82.55.112), 64 hops max, 72 byte packets
```

and

```
22  137.82.55.112 (137.82.55.112)  209.001 ms  210.606 ms  211.033 ms
```