Lab 1

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Exercise 1

1. www.koala.com.au has three different IP addresses, 104.18.61.21, 172.67.219.46, and 104.18.60.21. The website may want to balance the work of several servers by having different IP addresses.

```
Last login: Tue Jun  9 11:00:33 on ttys000
(base) Luoyou% nslookup www.koala.com.au
Server:         114.114.114.114
Address:        114.114.114.114#53

Non-authoritative answer:
Name:   www.koala.com.au
Address: 104.18.61.21
Name:   www.koala.com.au
Address: 172.67.219.46
Name:   www.koala.com.au
Address: 104.18.60.21

(base) Luoyou%
```

2. The name of IP address 127.0.0.1 is localhost. This is the IP address of this computer.

Exercise 2

www.unsw.edu.au](http://www.unsw.edu.au/), www.mit.edu, www.intel.com.au, www.tpg.com.au, www.amazon.com, and www.tsinghua.edu.cn is reachable.

www.kremlin.ru is not reachable by ping command but can be reached by Web browser. This could because of this russian website has some security measure to protect its website form ping command.

www.hola.hp and www.getfittest.com.au are not exist, so they cannot be reachable.

Exercise 3

1. The following picture shows there are 22 routers between my work station and www.columbia.edu . And the first 5 routes are part of UNSW network. Thr delay from route 7 to 8 nearly double, so these two route cross the Pacific Ocean.

```
(base) Luoyou% traceroute www.columbia.edu
traceroute to www.wwwr53.cc.columbia.edu (128.59.105.24), 64 hops max, 52 byte
packets
 1  * unswer1-vl-3023.gw.unsw.edu.au (129.94.254.34)  202.945 ms  206.644 ms
 2  efw1-ae-1-3068.gw.unsw.edu.au (129.94.254.220)  203.614 ms  203.233 ms  203
.656 ms
 3  * unswer1-vl-3067.gw.unsw.edu.au (129.94.254.210)  204.173 ms *
 4  libcr1-te-1-7.gw.unsw.edu.au (149.171.255.149)  209.901 ms *  210.308 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  214.104 ms * *
 6  138.44.5.0 (138.44.5.0)  238.142 ms * *
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  212.531 ms  206.4
46 ms  205.209 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  401.048 ms *  318.394 ms
 9  * et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  422.270 ms  409.541 m
s
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  410.141 ms  39
8.421 ms  417.905 ms
11  ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  395.936 ms  412.319
 ms *
12  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  594.271 ms  613.051
 ms  513.562 ms
13  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  511.973 ms  632.91
8 ms  530.721 ms
14  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  493.440 ms  512.242
 ms  408.228 ms
15  * buf-9208-i2-clev.nysernet.net (199.109.11.33)  525.754 ms  515.360 ms
16  syr-9208-buf-9208.nysernet.net (199.109.7.193)  508.646 ms  505.861 ms  426
.376 ms
17  nyc111-9204-syr-9208.nysernet.net (199.109.7.94)  426.808 ms * *
18  nyc-9208-nyc111-9204.nysernet.net (199.109.7.165)  503.502 ms  499.043 ms
427.189 ms
19  * * columbia.nyc-9208.nysernet.net (199.109.4.14)  523.900 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  511.783 ms * *
21  * cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  460.111 ms  427.4
90 ms
22  columbiauniversity.us (128.59.105.24)  493.628 ms  425.435 ms  489.478 ms
(base) Luoyou%
```

2. ◦ UCLA

```
(base) Luoyou% traceroute www.ucla.edu
traceroute to gateway.lb.it.ucla.edu (164.67.228.152), 64 hops max, 52 byte pack
ets
 1  unswer1-vl-3023.gw.unsw.edu.au (129.94.254.34)  203.367 ms  201.797 ms *
 2  * efw1-ae-1-3068.gw.unsw.edu.au (129.94.254.220)  210.178 ms  201.801 ms
 3  unswer1-vl-3067.gw.unsw.edu.au (129.94.254.210)  204.719 ms  204.109 ms  337
.595 ms
 4  ombcr1-te-1-7.gw.unsw.edu.au (149.171.255.153)  201.676 ms *  207.612 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  212.168 ms  201.468 ms  20
4.918 ms
 6  138.44.5.0 (138.44.5.0)  208.534 ms  201.664 ms  202.097 ms
 7  * et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  208.713 ms  202.
237 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  343.542 ms *  298.133 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  358.554 ms  459.623 ms
409.458 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  369.268 ms
364.170 ms  363.804 ms
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  361.122 ms  361.949
ms  360.186 ms
12  * * *
13  * bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  426.334 ms  398.10
5 ms
14  cr00f1.anderson--rtr11f4.mathsci.ucla.net (169.232.8.185)  414.985 ms
    cr00f2.csb1--rtr11f4.mathsci.ucla.net (169.232.8.181)  510.719 ms  363.453 m
s
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
```

- u-Tokyo

```
(base) Luoyou% traceroute www.u-tokyo.ac.jp
traceroute to www.u-tokyo.ac.jp (210.152.243.234), 64 hops max, 52 byte packets
 1  unswer1-vl-3023.gw.unsw.edu.au (129.94.254.34)  203.587 ms  203.256 ms  206.
656 ms
 2  efw1-ae-1-3068.gw.unsw.edu.au (129.94.254.220)  204.892 ms  203.225 ms  202.
891 ms
 3  * unswer1-vl-3067.gw.unsw.edu.au (129.94.254.210)  246.458 ms *
 4  ombcr1-te-1-7.gw.unsw.edu.au (149.171.255.153)  206.750 ms  223.211 ms  204.
678 ms
 5  * * unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  211.243 ms
 6  * * 138.44.5.0 (138.44.5.0)  209.834 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  205.226 ms  204.834 ms
  204.352 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  415.741 ms  404.292 ms
415.426 ms
 9  paloalto0.iij.net (198.32.176.24)  403.217 ms  408.397 ms  409.371 ms
10  osk004bb00.iij.net (58.138.88.185)  518.161 ms  490.621 ms
    osk004bb01.iij.net (58.138.88.189)  469.777 ms
11  osk004ip57.iij.net (58.138.106.162)  523.381 ms  523.869 ms
    osk004ip57.iij.net (58.138.106.166)  483.778 ms
12  210.130.135.130 (210.130.135.130)  516.673 ms  515.846 ms  508.588 ms
13  124.83.228.58 (124.83.228.58)  511.881 ms  477.389 ms  478.598 ms
14  124.83.252.178 (124.83.252.178)  882.045 ms  492.768 ms  560.450 ms
15  158.205.134.26 (158.205.134.26)  528.291 ms  514.064 ms  512.100 ms
16  * 158.205.121.46 (158.205.121.46)  535.746 ms  542.507 ms
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
```

- Lancaster

```
(base) Luoyou% traceroute www.lancaster.ac.uk
traceroute to www.lancs.ac.uk (148.88.65.80), 64 hops max, 52 byte packets
 1  * unswer1-vl-3023.gw.unsw.edu.au (129.94.254.34)  407.473 ms  409.614 ms
 2  efw1-ae-1-3068.gw.unsw.edu.au (129.94.254.220)  330.135 ms  388.641 ms  203.08
2 ms
 3  unswer1-vl-3067.gw.unsw.edu.au (129.94.254.210)  211.222 ms  205.504 ms *
 4  ombcr1-te-1-7.gw.unsw.edu.au (149.171.255.153)  209.458 ms  202.036 ms *
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  427.383 ms  207.892 ms  201.
969 ms
 6  138.44.5.0 (138.44.5.0)  202.224 ms  201.723 ms  201.327 ms
 7  * et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  207.761 ms *
 8  xe-1-1-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.199)  208.286 ms  202.992 ms
210.226 ms
 9  et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  332.113 ms  222.397 ms  21
9.670 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  275.391 ms  247.097 ms  26
1.359 ms
11  et-2-1-2.bdr2.sing.sin.aarnet.net.au (113.197.15.247)  314.662 ms  293.834 ms
 313.592 ms
12  ae1.bdr1.sing.sin.aarnet.net.au (113.197.15.234)  291.706 ms  318.949 ms  307.
200 ms
13  138.44.226.7 (138.44.226.7)  511.834 ms *  459.443 ms
14  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  468.906 ms  508.695 ms  527.681
 ms
15  ae29.londpg-sbr2.ja.net (146.97.33.2)  496.125 ms  510.934 ms  512.393 ms
16  ae31.erdiss-sbr2.ja.net (146.97.33.22)  511.575 ms  511.869 ms  511.998 ms
17  ae29.manckh-sbr2.ja.net (146.97.33.42)  511.575 ms  509.547 ms  518.095 ms
18  ae24.lanclu-rbr1.ja.net (146.97.38.58)  505.750 ms  468.199 ms  555.138 ms
19  lancaster-university.ja.net (194.81.46.2)  607.636 ms  511.027 ms  492.179 ms
20  is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202)  532.515 ms  516.288 ms  50
5.871 ms
21  bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98)  519.146 ms  505.1
10 ms  525.377 ms
22  * * *
23  www.lancs.ac.uk (148.88.65.80)  492.668 ms !Z  518.512 ms !Z  495.200 ms !Z
(base) Luoyou%
```

As the three pictures shows, the paths diverge from route 6, in route 7, these paths go to three different toutes. By Whois command, I find this route is an Asia Pacidic Network Information centre.

```
(base) Luoyou% Whois 138.44.5.0
% IANA WHOIS server
% for more information on IANA, visit http://www.iana.org
% This query returned 1 object

refer:        whois.arin.net

inetnum:      138.0.0.0 - 138.255.255.255
organisation: Administered by ARIN
status:       LEGACY

whois:        whois.arin.net

changed:      1993-05
source:       IANA

# whois.arin.net

NetRange:       138.44.0.0 - 138.44.255.255
CIDR:           138.44.0.0/16
NetName:        APNIC-ERX-138-44-0-0
NetHandle:      NET-138-44-0-0-1
Parent:         NET138 (NET-138-0-0-0-0)
NetType:        Early Registrations, Transferred to APNIC
OriginAS:
Organization:   Asia Pacific Network Information Centre (APNIC)
RegDate:        2003-12-11
Updated:        2009-10-08
Comment:        This IP address range is not registered in the ARIN database.
Comment:        This range was transferred to the APNIC Whois Database as
Comment:        part of the ERX (Early Registration Transfer) project.
Comment:        For details, refer to the APNIC Whois Database via
Comment:        WHOIS.APNIC.NET or http://wq.apnic.net/apnic-bin/whois.pl
Comment:
Comment:        ** IMPORTANT NOTE: APNIC is the Regional Internet Registry
Comment:        for the Asia Pacific region.  APNIC does not operate networks
Comment:        using this IP address range and is not able to investigate
```

And there is no relation between the number of hops and the physical distance.

Distance between UNSW and Lancaster: 16,984 km

Routes Number: 23

Distance between UNSW and UCLA: 12,051 km

Routes Number: 50+

3.
   - My IP address is 192.168.101.255, www.lancaster.ac.uk IP address is 148.88.65.80. And I am using https://www.telstra.net/cgi-bin/trace to run trace route.
   - the reverse path go through different routers and different IP addresses as forward path.

Exercise 4

1. Distance between UNSW and UQ : 921.3 km, the delay should be 3.07100 milliseconds

   Distance between UNSW and DLSU : 6,266 km, the delay should be 20.8866667 milliseconds

Distance between UNSW and Berlin Institute of Technology : 16,095 km, the delay should be 53.65 milliseconds

Clearly, the actual delay is far more than the thoretical delay. First, the distance above is distance as the crow flies, but the distance of cable should be larger. Second, light is reflexing in the cable, so the velocity of light in cable is slower than the therotical velocity.

2. As we can see, the delay to the destination is random. Because it could be affected by many factors such as network congestion, the size of packet, or the physical distance.
3. By using trace route command, I find the first 11 routes are still in Australia, and suddenly jump to a new IP address. By google this IP address, 104.20.229.42, I find it i belongs to CloudFlare Inc. in California, USA.

```
(base) Luoyou% traceroute www.epfl.ch
traceroute: Warning: www.epfl.ch has multiple addresses; using 104.20.229.42
traceroute to www.epfl.ch.cdn.cloudflare.net (104.20.229.42), 64 hops max, 52 byte
 packets
 1  unswer1-vl-3023.gw.unsw.edu.au (129.94.254.34)  205.171 ms  194.366 ms  208.23
5 ms
 2  efw1-ae-1-3068.gw.unsw.edu.au (129.94.254.220)  199.747 ms  195.118 ms  200.58
6 ms
 3  unswer1-vl-3067.gw.unsw.edu.au (129.94.254.210)  200.571 ms  200.605 ms  200.1
02 ms
 4  ombcr1-te-1-7.gw.unsw.edu.au (149.171.255.153)  193.571 ms  200.869 ms  196.12
4 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  192.836 ms  200.784 ms  195.
006 ms
 6  138.44.5.0 (138.44.5.0)  193.859 ms  204.177 ms  195.507 ms
 7  ae2.bdr1.msc4.nsw.aarnet.net.au (113.197.15.77)  203.315 ms  193.287 ms  193.0
90 ms
 8  as4826.bdr1.msc4.nsw.aarnet.net.au (138.44.10.45)  203.239 ms  193.889 ms  202
.372 ms
 9  * be107.cor01.syd11.nsw.vocus.network (114.31.192.80)  202.292 ms
    be107.cor02.syd04.nsw.vocus.network (114.31.192.82)  194.702 ms
10  be101.bdr02.syd03.nsw.vocus.network (114.31.192.37)  203.128 ms  200.018 ms  2
05.082 ms
11  as13335.bdr02.syd03.nsw.vocus.net.au (175.45.124.197)  197.842 ms  205.353 ms
 201.370 ms
12  104.20.229.42 (104.20.229.42)  193.960 ms  195.835 ms  205.510 ms
(base) Luoyou%
```

4. The propagation delay has nothing to do with packet size. Queuing delay depends on network congestion instead of how big the file is. Processing and transmission delay are affected by packet size, and transmission delay is more efluenced than Processing delay.