hw4
Ruicong Xie
rx2119

1.
a)
The Whois database is an online repository of information associated with registered domain names. It stores and publicly displays domain name information, such creation and expiration dates, the registrar of record, and its various contacts. When you register a domain name, they collect this information, per the Internet Corporation for Assigned Names and Numbers (ICANN) regulations for domain name registrars. The information in the Whois database is available to anyone who does a Whois search for a particular domain name.

b)
whois columbia.edu

Administrative Contact:

Columbia University Computer Operations
Columbia University
615 West 131st Street
CUIT - 5th Floor
New York, NY 10027
UNITED STATES
(212) 854-2652
noc@columbia.edu

Name Servers:
EXT-NS1.COLUMBIA.EDU 128.59.1.1
DNS2.ITD.UMICH.EDU
NS1.LSE.AC.UK
SNS-PB.ISC.ORG
ADNS1.BERKELEY.EDU
ADNS2.BERKELEY.EDU

c)
ruicongxie@dyn-160-39-141-233 ~ $ nslookup EXT-NS1.COLUMBIA.EDU
Server: 128.59.1.3
Address: 128.59.1.3#53

Non-authoritative answer:
Name: EXT-NS1.COLUMBIA.EDU
Address: 128.59.1.1

ruicongxie@dyn-160-39-141-233 ~ $ nslookup authdns0.csx.cam.ac.uk

Server: 128.59.1.4
Address: 128.59.1.4#53

Non-authoritative answer:
Name: authdns0.csx.cam.ac.uk
Address: 131.111.8.37

ruicongxie@dyn-160-39-141-233 ~ $ nslookup ns0.wikimedia.org
Server: 128.59.1.4
Address: 128.59.1.4#53

Non-authoritative answer:
Name: ns0.wikimedia.org
Address: 208.80.154.238

ruicongxie@dyn-160-39-141-233 ~ $ nslookup -querytype=a yahoo.com
Server: 128.59.1.4
Address: 128.59.1.4#53

Non-authoritative answer:
Name: yahoo.com
Address: 206.190.36.45
Name: yahoo.com
Address: 98.139.183.24
Name: yahoo.com
Address: 98.138.253.109

ruicongxie@dyn-160-39-141-233 ~ $ nslookup -querytype=ns yahoo.com
Server: 128.59.1.4
Address: 128.59.1.4#53

Non-authoritative answer:
yahoo.com nameserver = ns5.yahoo.com.
yahoo.com nameserver = ns4.yahoo.com.
yahoo.com nameserver = ns1.yahoo.com.
yahoo.com nameserver = ns6.yahoo.com.
yahoo.com nameserver = ns3.yahoo.com.
yahoo.com nameserver = ns2.yahoo.com.

Authoritative answers can be found from:

ruicongxie@dyn-160-39-141-233 ~ $ nslookup -querytype=mx yahoo.com
Server: 128.59.1.4
Address: 128.59.1.4#53

Non-authoritative answer:
yahoo.com  mail exchanger = 1 mta7.am0.yahoodns.net.
yahoo.com  mail exchanger = 1 mta5.am0.yahoodns.net.
yahoo.com  mail exchanger = 1 mta6.am0.yahoodns.net.

ruicongxie@dyn-160-39-141-233 ~ $ nslookup -querytype=mx bitbucket.org
Server:  128.59.1.4
Address:  128.59.1.4#53

Non-authoritative answer:
bitbucket.org  mail exchanger = 10 aspmx2.googlemail.com.
bitbucket.org  mail exchanger = 10 aspmx3.googlemail.com.
bitbucket.org  mail exchanger = 5 alt1.aspmx.l.google.com.
bitbucket.org  mail exchanger = 5 alt2.aspmx.l.google.com.
bitbucket.org  mail exchanger = 1 aspmx.l.google.com.

Authoritative answers can be found from:

ruicongxie@dyn-160-39-141-233 ~ $ nslookup -querytype=ns bitbucket.org
Server:  128.59.1.4
Address:  128.59.1.4#53

Non-authoritative answer:
bitbucket.org  nameserver = ns-1305.awsdns-35.org.
bitbucket.org  nameserver = ns-584.awsdns-09.net.
bitbucket.org  nameserver = ns-1746.awsdns-26.co.uk.
bitbucket.org  nameserver = ns-445.awsdns-55.com.

Authoritative answers can be found from:

ruicongxie@dyn-160-39-141-233 ~ $ nslookup -querytype=a bitbucket.org
Server:  128.59.1.4
Address:  128.59.1.4#53

Non-authoritative answer:
Name:  bitbucket.org
Address: 104.192.143.3
Name:  bitbucket.org
Address: 104.192.143.2
Name:  bitbucket.org
Address: 104.192.143.1

d)
nslookup -query=a ebay.com

Server: 192.168.0.12
Address: 192.168.0.12#53

Non-authoritative answer:
Name: ebay.com
Address: 66.135.216.190
Name: ebay.com
Address: 66.211.162.12
Name: ebay.com
Address: 66.211.185.25
Name: ebay.com
Address: 66.211.160.86
Name: ebay.com
Address: 66.135.209.52
Name: ebay.com
Address: 66.211.181.123

The order of records returned doesn't change, but it rotates every time someone queries it.

e)
dig +nocmd +noall +answer www.ebay.com

| | | | | |
|---|---|---|---|---|
| www.ebay.com. | 254 | IN | CNAME | www-us.g.ebay.com. |
| www-us.g.ebay.com. | 14 | IN | CNAME | slot9428.ebay.com.edgekey.net. |
| slot9428.ebay.com.edgekey.net. | 13436 | IN | CNAME | e9428.b.akamaiedge.net. |
| e9428.b.akamaiedge.net. | 19 | IN | A | 23.203.105.150 |

The second column is the TTL. It's used in IP layer that determine the life of a packet in the network layer.

f)
https://whois.arin.net/rest/net/NET-128-59-0-0-1/pft?s=128.59.0.0
Net Range 128.59.0.0 – 128.59.255.255

g)
When people register a domain name, they will be asked to provide up-to-date contact information. This is part of a policy established by the Internet Corporation for Assigned Names and Numbers (ICANN), the organization that coordinates the world's domain system. Their information is then stored in a WHOIS database. On one hand, the information in the WHOIS database is important to law enforcement, intellectual property and other attorneys, who use this data to locate domain name owners for the purpose of enforcing laws or addressing grievances. On the other, these information can also be easily accessed by anyone including spammers, marketers, identity thieves, and etc.

There is definitely efforts to obscuring this information. Service like domain privacy offered by a number of domain name registrars. A user buys privacy from the company, who in turn replaces the user's info in the WHOIS with the info of a forwarding service.

2.
actual output of each command is on the last page
a)
www.cs.columbia.edu
i.root-servers.net.
192.36.148.17
g.edu-servers.net
192.42.93.30
adns2.berkeley.edu.
128.32.136.14
sundog.ee.columbia.edu.
128.59.64.59

b)
www.google.com
192.5.5.241
f.root-servers.net.
192.42.93.30
g.gtld-servers.net.
216.239.32.10
ns1.google.com.

www.google.co.in
193.0.14.129
k.root-servers.net.
199.249.125.1
b2.in.afilias-nst.org.
216.239.36.10
ns3.google.com.

wikipedia.org
192.5.5.241
f.root-servers.net.
199.19.54.1
b0.org.afilias-nst.org.
208.80.153.231
ns1.wikimedia.org.

3.
Peer 4 replace its first successor(peer 7) with its second successor(peer 14). Peer 4 then asks its new first successor(peer 14) for the identifier and IP address of its immediate successor(peer 20). Peer 4 then makes peer 20 its second successor.

4.
a)

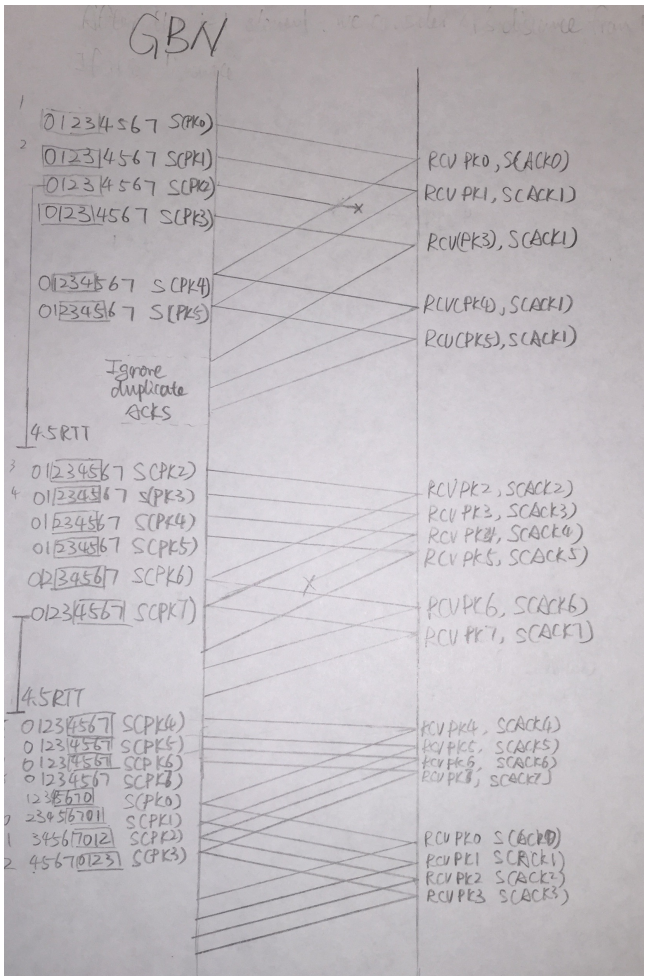
No, with a NAK-only protocol a lost packets will only be detected when a subsequent packet is correctly received by the receiver which will then notice a gap in the received sequence numbers. This means that with infrequent data transmissions like a NAK based protocol can have a long error recovery time. Hence, a NAK-only protocol would not be desirable in this case.

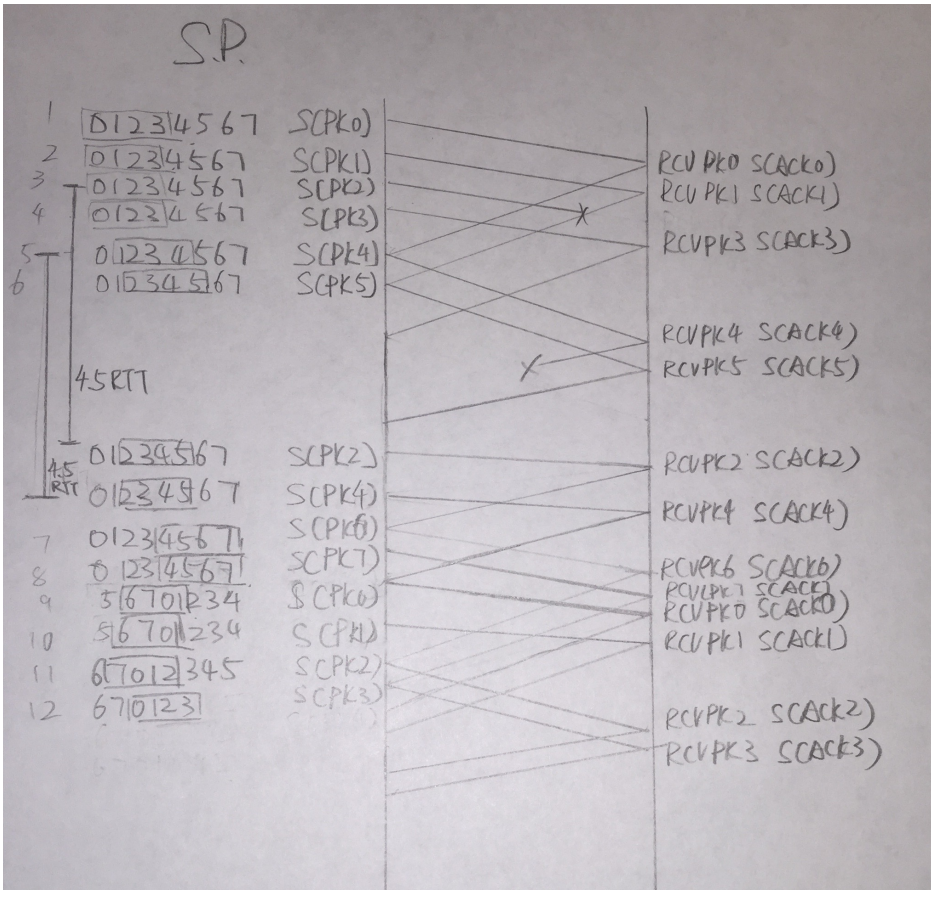
b)
Yes, on the other hand, if data is being sent often, then the error recovery under a NAK-only protocol could happen much faster. Moreover, if errors are infrequent, then NAKs are only sent when needed, which is a significant network traffic reduction in feedback under the NAK-only case comparing with the ACK-only case.

c)
When NAK is lost in the transition then we have a problem. The solution to that is to key a timer on receiver side for each NAK sent. If a package is not retransmitted with in a certain amount of time, then resend NAK with that package number. This way will guarantee the delivery of all packages in case of NAK lose.

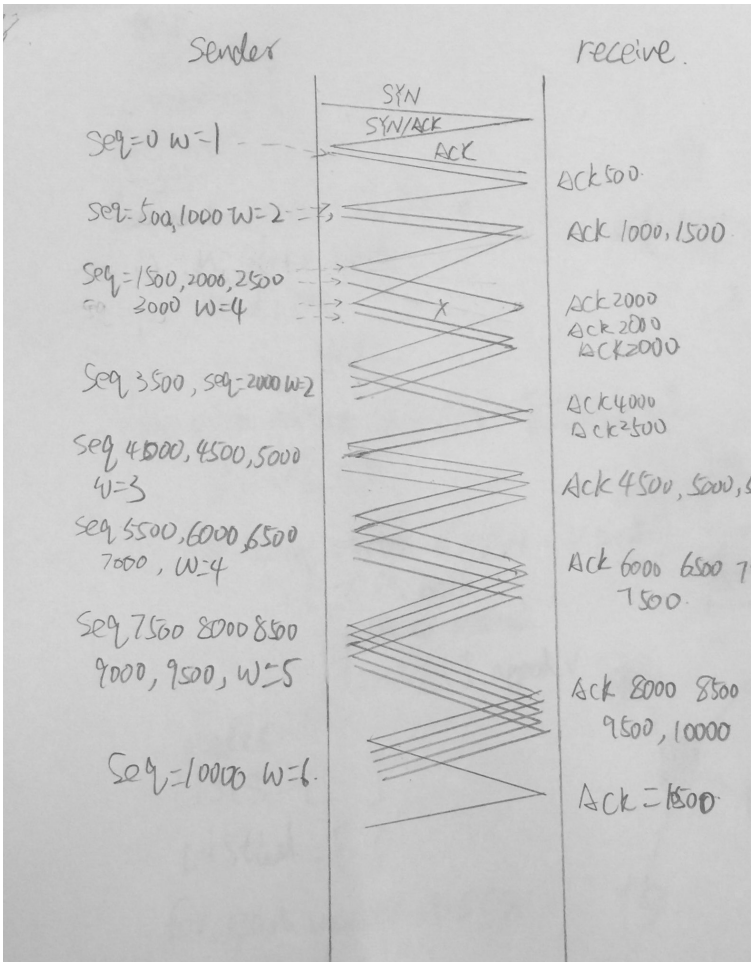
5)
If the channel can arbitrarily duplicate package and the package can appear in the channel at anytime. Then the alternating bit protocol will not be able to achieve reliable data transfer. After sender send package 0, it will wait for package ACK0. Unfortunately, the ACK0 from last round may appear in the channel, and the sender will not be able to distinguish them one from another and let the wrong package get received, which will cause a problem for the receiver when reassemble all the packages.

6)
SEE NEXT PAGE


GBN
Ignore duplicate ACKs
4.5RTT
4.5RTT


S.P
4.5RTT
4.5 RTT

7)
10000/500 = 20 segments with RRT = 100ms
There are 9 RTT. Including the three way hand shake there are 22 packages.
Throughput = 500 * 22*8 / (9 * 0.1) = 97777.78 bits / sec




8)

```
ruicongxie@dyn-160-39-140-218 ~ :( $ iperf3 -c ping.online.net --set-mss 500 -n 10000
Connecting to host ping.online.net, port 5201
[  5] local 160.39.140.218 port 62917 connected to 62.210.18.40 port 5201
[ ID] Interval           Transfer     Bandwidth
[  5]   0.00-0.08   sec   128 KBytes  13.8 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth
[  5]   0.00-0.08   sec   128 KBytes  13.8 Mbits/sec                  sender
[  5]   0.00-0.08   sec  1.43 KBytes   154 Kbits/sec                  receiver

iperf Done.

PING ping.online.net (62.210.18.40): 500 data bytes
508 bytes from 62.210.18.40: icmp_seq=0 ttl=52 time=353.816 ms
508 bytes from 62.210.18.40: icmp_seq=1 ttl=52 time=90.806 ms
508 bytes from 62.210.18.40: icmp_seq=2 ttl=52 time=81.816 ms
508 bytes from 62.210.18.40: icmp_seq=3 ttl=52 time=79.599 ms
```

```
508 bytes from 62.210.18.40: icmp_seq=4 ttl=52 time=86.231 ms
508 bytes from 62.210.18.40: icmp_seq=5 ttl=52 time=87.080 ms
508 bytes from 62.210.18.40: icmp_seq=6 ttl=52 time=87.598 ms
508 bytes from 62.210.18.40: icmp_seq=7 ttl=52 time=88.114 ms
508 bytes from 62.210.18.40: icmp_seq=8 ttl=52 time=83.788 ms
508 bytes from 62.210.18.40: icmp_seq=9 ttl=52 time=87.082 ms
508 bytes from 62.210.18.40: icmp_seq=10 ttl=52 time=84.380 ms
508 bytes from 62.210.18.40: icmp_seq=11 ttl=52 time=86.089 ms
508 bytes from 62.210.18.40: icmp_seq=12 ttl=52 time=86.323 ms
508 bytes from 62.210.18.40: icmp_seq=13 ttl=52 time=90.859 ms
508 bytes from 62.210.18.40: icmp_seq=14 ttl=52 time=89.332 ms
508 bytes from 62.210.18.40: icmp_seq=15 ttl=52 time=86.789 ms
508 bytes from 62.210.18.40: icmp_seq=16 ttl=52 time=79.405 ms
508 bytes from 62.210.18.40: icmp_seq=17 ttl=52 time=79.747 ms
508 bytes from 62.210.18.40: icmp_seq=18 ttl=52 time=79.078 ms
508 bytes from 62.210.18.40: icmp_seq=19 ttl=52 time=78.551 ms
508 bytes from 62.210.18.40: icmp_seq=20 ttl=52 time=79.383 ms
508 bytes from 62.210.18.40: icmp_seq=21 ttl=52 time=78.580 ms
508 bytes from 62.210.18.40: icmp_seq=22 ttl=52 time=79.636 ms
508 bytes from 62.210.18.40: icmp_seq=23 ttl=52 time=79.035 ms
^C
--- ping.online.net ping statistics ---
24 packets transmitted, 24 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 78.551/95.130/353.816/54.096 ms
```

Throughput (acutal) = 1.43 Kbytes / 0.08 sec = 146432 bit /sec
Throughput(theory) = 500 bytes * 25 (MSS) *8/ (0.095130 ms * 9) =116799.23 bits /sec
Actual theoretical throughput is faster than the theoretical throughput.

OUTPUT FOR QUESTION 2

; <<>> DiG 9.8.3-P1 <<>> +trace www.cs.columbia.edu
;; global options: +cmd
. 437916 IN NS k.root-servers.net.
. 437916 IN NS l.root-servers.net.
. 437916 IN NS d.root-servers.net.
. 437916 IN NS a.root-servers.net.
. 437916 IN NS j.root-servers.net.
. 437916 IN NS m.root-servers.net.
. 437916 IN NS c.root-servers.net.
. 437916 IN NS f.root-servers.net.
. 437916 IN NS g.root-servers.net.
. 437916 IN NS e.root-servers.net.
. 437916 IN NS h.root-servers.net.
. 437916 IN NS b.root-servers.net.
. 437916 IN NS i.root-servers.net.
;; Received 228 bytes from 128.59.1.3#53(128.59.1.3) in 69 ms

edu. 172800 IN NS g.edu-servers.net.
edu. 172800 IN NS f.edu-servers.net.
edu. 172800 IN NS l.edu-servers.net.

```
edu.            172800  IN   NS  c.edu-servers.net.
edu.            172800  IN   NS  d.edu-servers.net.
edu.            172800  IN   NS  a.edu-servers.net.
;; Received 272 bytes from 192.36.148.17#53(192.36.148.17) in 31 ms

columbia.edu.           172800  IN   NS  dns2.itd.umich.edu.
columbia.edu.           172800  IN   NS  adns1.berkeley.edu.
columbia.edu.           172800  IN   NS  adns2.berkeley.edu.
columbia.edu.           172800  IN   NS  ns1.lse.ac.uk.
columbia.edu.           172800  IN   NS  sns-pb.isc.org.
columbia.edu.           172800  IN   NS  ext-ns1.columbia.edu.
;; Received 256 bytes from 192.42.93.30#53(192.42.93.30) in 81 ms

cs.columbia.edu. 3600     IN   NS  sundog.ee.columbia.edu.
cs.columbia.edu. 3600     IN   NS  diana.cs.columbia.edu.
cs.columbia.edu. 3600     IN   NS  apollo.cs.columbia.edu.
cs.columbia.edu. 3600     IN   NS  dns2.itd.umich.edu.
cs.columbia.edu. 3600     IN   NS  ext-ns1.columbia.edu.
;; Received 217 bytes from 128.32.136.14#53(128.32.136.14) in 102 ms

www.cs.columbia.edu.    60   IN   CNAME     webcluster.cs.columbia.edu.
webcluster.cs.columbia.edu. 60     IN   A    128.59.11.206
cs.columbia.edu. 60   IN   NS  diana.cs.columbia.edu.
cs.columbia.edu. 60   IN   NS  apollo.cs.columbia.edu.
cs.columbia.edu. 60   IN   NS  dns2.itd.umich.edu.
cs.columbia.edu. 60   IN   NS  ext-ns1.columbia.edu.
cs.columbia.edu. 60   IN   NS  sundog.ee.columbia.edu.
;; Received 242 bytes from 128.59.64.59#53(128.59.64.59) in 2 ms




; <<>> DiG 9.8.3-P1 <<>> +trace www.google.com
;; global options: +cmd
.               436991  IN   NS  e.root-servers.net.
.               436991  IN   NS  f.root-servers.net.
.               436991  IN   NS  m.root-servers.net.
.               436991  IN   NS  h.root-servers.net.
.               436991  IN   NS  a.root-servers.net.
.               436991  IN   NS  d.root-servers.net.
.               436991  IN   NS  l.root-servers.net.
.               436991  IN   NS  j.root-servers.net.
.               436991  IN   NS  k.root-servers.net.
.               436991  IN   NS  b.root-servers.net.
.               436991  IN   NS  i.root-servers.net.
```

```
.                436991  IN   NS  c.root-servers.net.
.                436991  IN   NS  g.root-servers.net.
;; Received 228 bytes from 128.59.1.3#53(128.59.1.3) in 52 ms

com.             172800  IN   NS  h.gtld-servers.net.
com.             172800  IN   NS  c.gtld-servers.net.
com.             172800  IN   NS  l.gtld-servers.net.
com.             172800  IN   NS  k.gtld-servers.net.
com.             172800  IN   NS  i.gtld-servers.net.
com.             172800  IN   NS  a.gtld-servers.net.
com.             172800  IN   NS  g.gtld-servers.net.
com.             172800  IN   NS  j.gtld-servers.net.
com.             172800  IN   NS  f.gtld-servers.net.
com.             172800  IN   NS  m.gtld-servers.net.
com.             172800  IN   NS  b.gtld-servers.net.
com.             172800  IN   NS  d.gtld-servers.net.
com.             172800  IN   NS  e.gtld-servers.net.
;; Received 504 bytes from 192.5.5.241#53(192.5.5.241) in 31 ms

google.com.      172800  IN   NS  ns2.google.com.
google.com.      172800  IN   NS  ns1.google.com.
google.com.      172800  IN   NS  ns3.google.com.
google.com.      172800  IN   NS  ns4.google.com.
;; Received 168 bytes from 192.42.93.30#53(192.42.93.30) in 78 ms

www.google.com.          300 IN   A    172.217.2.4
;; Received 48 bytes from 216.239.32.10#53(216.239.32.10) in 17 ms




; <<>> DiG 9.8.3-P1 <<>> +trace www.google.co.in
;; global options: +cmd
.                436831  IN   NS  a.root-servers.net.
.                436831  IN   NS  i.root-servers.net.
.                436831  IN   NS  j.root-servers.net.
.                436831  IN   NS  f.root-servers.net.
.                436831  IN   NS  k.root-servers.net.
.                436831  IN   NS  m.root-servers.net.
.                436831  IN   NS  c.root-servers.net.
.                436831  IN   NS  e.root-servers.net.
.                436831  IN   NS  b.root-servers.net.
.                436831  IN   NS  d.root-servers.net.
.                436831  IN   NS  h.root-servers.net.
.                436831  IN   NS  l.root-servers.net.
```

```
.               436831  IN   NS  g.root-servers.net.
;; Received 228 bytes from 128.59.1.3#53(128.59.1.3) in 43 ms

in.             172800  IN   NS  a0.in.afilias-nst.info.
in.             172800  IN   NS  a1.in.afilias-nst.in.
in.             172800  IN   NS  a2.in.afilias-nst.info.
in.             172800  IN   NS  b0.in.afilias-nst.org.
in.             172800  IN   NS  b1.in.afilias-nst.in.
in.             172800  IN   NS  b2.in.afilias-nst.org.
in.             172800  IN   NS  c0.in.afilias-nst.info.
;; Received 500 bytes from 193.0.14.129#53(193.0.14.129) in 110 ms

google.co.in.       86400   IN   NS  ns1.google.com.
google.co.in.       86400   IN   NS  ns2.google.com.
google.co.in.       86400   IN   NS  ns3.google.com.
;; Received 98 bytes from 199.249.125.1#53(199.249.125.1) in 11 ms

www.google.co.in.   300 IN   A    172.217.2.3
;; Received 50 bytes from 216.239.36.10#53(216.239.36.10) in 18 ms




; <<>> DiG 9.8.3-P1 <<>> +trace wikipedia.org
;; global options: +cmd
.               436671  IN   NS  c.root-servers.net.
.               436671  IN   NS  l.root-servers.net.
.               436671  IN   NS  e.root-servers.net.
.               436671  IN   NS  i.root-servers.net.
.               436671  IN   NS  j.root-servers.net.
.               436671  IN   NS  h.root-servers.net.
.               436671  IN   NS  m.root-servers.net.
.               436671  IN   NS  d.root-servers.net.
.               436671  IN   NS  f.root-servers.net.
.               436671  IN   NS  b.root-servers.net.
.               436671  IN   NS  k.root-servers.net.
.               436671  IN   NS  g.root-servers.net.
.               436671  IN   NS  a.root-servers.net.
;; Received 228 bytes from 128.59.1.3#53(128.59.1.3) in 40 ms

org.            172800  IN   NS  a2.org.afilias-nst.info.
org.            172800  IN   NS  a0.org.afilias-nst.info.
org.            172800  IN   NS  c0.org.afilias-nst.info.
org.            172800  IN   NS  b2.org.afilias-nst.org.
```

```
org.            172800  IN   NS  d0.org.afilias-nst.org.
org.            172800  IN   NS  b0.org.afilias-nst.org.
;; Received 433 bytes from 192.5.5.241#53(192.5.5.241) in 29 ms

wikipedia.org.          86400   IN   NS  ns1.wikimedia.org.
wikipedia.org.          86400   IN   NS  ns0.wikimedia.org.
wikipedia.org.          86400   IN   NS  ns2.wikimedia.org.
;; Received 143 bytes from 199.19.54.1#53(199.19.54.1) in 37 ms

wikipedia.org.          600 IN   A    208.80.154.224
;; Received 75 bytes from 208.80.153.231#53(208.80.153.231) in 46 ms
```