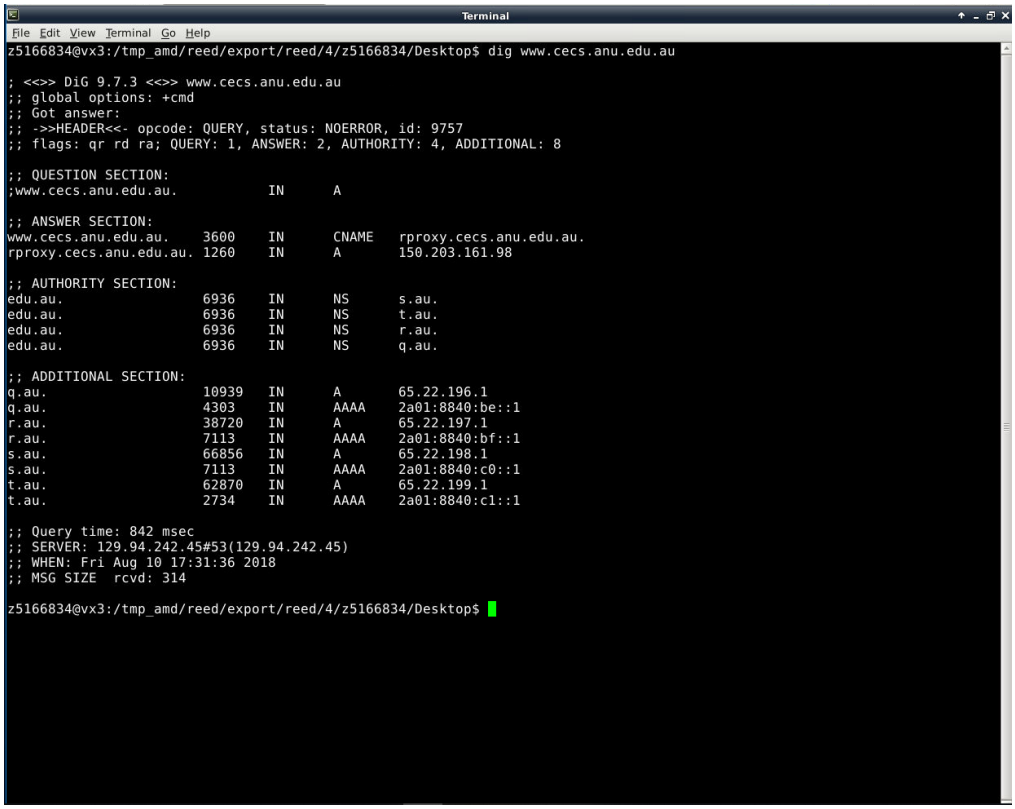
Exercise 3:

Q1:



According to the information in ANSWER SECTION, the IP address of www.cecs.anu.edu.au is 150.203.161.98. As we can see from QUESTION SECTION, type A DNS query is sent to get the answer.

Q2:

As it is shown in the CNAME record, the canonical name for CECS ANU web server is rproxy.cecs.anu.edu.au. The IP address is 150.203.161.98.

Reason: The hosts on the Internet can be identified using different methods, one is hostname and another is IP address. Hostname(alias) is easy for humans to remember but does not contains much detailed information about the host, and

it is difficult for routers to handle these hostnames. So, IP addresses are also used to identify hosts, but they are difficult for humans to remember. Aliasing is also useful when running multiple services.

Q3:

The authority section contains NS resource records for cecs.anu.edu.au domain name, there are three authoritative name servers for this domain name, which are ns2.cecs.anu.edu.au, ns4.cecs.anu.edu.au and ns3.cecs.anu.edu.au.

The additional section contains the IP addresses for these three authoritative name servers. The records with AAAA are for IPv6 addresses.

Q4:

From the information included at the bottom of the output in the above picture, the IP address of the local nameserver for my machine is 129.94.242.45. This query is made by connecting to CSE server within the campus.

Q5:

```
z5166834@vx2:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig cecs.anu.edu.au NS

; <<>> DiG 9.7.3 <<>> cecs.anu.edu.au NS
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 15800
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 0, ADDITIONAL: 6

;; QUESTION SECTION:
;cecs.anu.edu.au.               IN      NS

;; ANSWER SECTION:
cecs.anu.edu.au.        20      IN      NS      ns4.cecs.anu.edu.au.
cecs.anu.edu.au.        20      IN      NS      ns3.cecs.anu.edu.au.
cecs.anu.edu.au.        20      IN      NS      ns2.cecs.anu.edu.au.

;; ADDITIONAL SECTION:
ns2.cecs.anu.edu.au.    1090    IN      A       150.203.161.36
ns2.cecs.anu.edu.au.    20      IN      AAAA    2001:388:1034:2905::24
ns3.cecs.anu.edu.au.    1090    IN      A       150.203.161.50
ns3.cecs.anu.edu.au.    20      IN      AAAA    2001:388:1034:2905::32
ns4.cecs.anu.edu.au.    496     IN      A       150.203.161.38
ns4.cecs.anu.edu.au.    20      IN      AAAA    2001:388:1034:2905::26

;; Query time: 10 msec
;; SERVER: 129.94.242.2#53(129.94.242.2)
;; WHEN: Sat Aug 11 14:28:24 2018
;; MSG SIZE  rcvd: 219
```

For this question, I made a NS query as is shown in the above picture. This query is made by connecting to CSE server using cisco AnyConnect VPN from outside the campus, which is slightly different from the previous query above. The DNS nameservers for the “cecs.anu.edu.au” domain are:

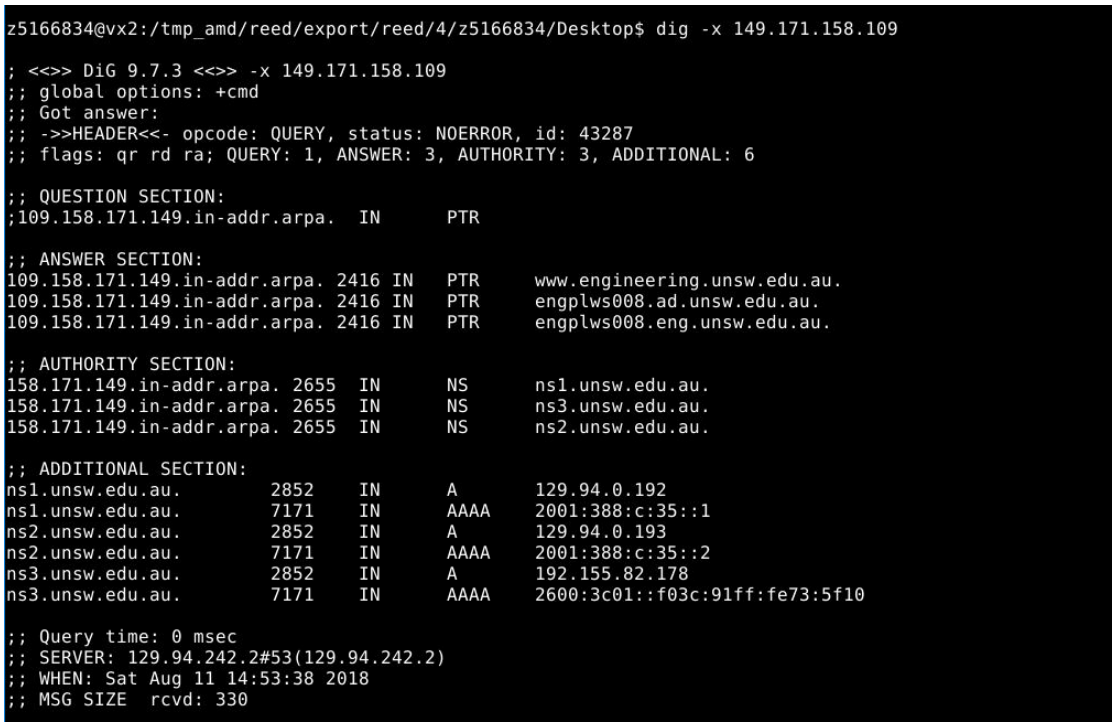
1:ns4.cecs.anu.edu.au(150.203.161.38), 2:ns3.cecs.anu.edu.au(150.203.161.50)

3:ns2.cecs.anu.edu.au(150.203.161.36).

Q6:

For this question, I made a reverse query, which is a type PTR query for 109.158.171.149.in-addr.arpa. As is shown in the picture below, the DNS name associated with 149.171.158.109 is

engineering.unsw.edu.au.



```
z5166834@vx2:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig -x 149.171.158.109

; <<>> DiG 9.7.3 <<>> -x 149.171.158.109
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 43287
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 3, ADDITIONAL: 6

;; QUESTION SECTION:
;109.158.171.149.in-addr.arpa.  IN      PTR

;; ANSWER SECTION:
109.158.171.149.in-addr.arpa. 2416 IN   PTR     www.engineering.unsw.edu.au.
109.158.171.149.in-addr.arpa. 2416 IN   PTR     engplws008.ad.unsw.edu.au.
109.158.171.149.in-addr.arpa. 2416 IN   PTR     engplws008.eng.unsw.edu.au.

;; AUTHORITY SECTION:
158.171.149.in-addr.arpa. 2655  IN      NS      ns1.unsw.edu.au.
158.171.149.in-addr.arpa. 2655  IN      NS      ns3.unsw.edu.au.
158.171.149.in-addr.arpa. 2655  IN      NS      ns2.unsw.edu.au.

;; ADDITIONAL SECTION:
ns1.unsw.edu.au.        2852    IN      A       129.94.0.192
ns1.unsw.edu.au.        7171    IN      AAAA    2001:388:c:35::1
ns2.unsw.edu.au.        2852    IN      A       129.94.0.193
ns2.unsw.edu.au.        7171    IN      AAAA    2001:388:c:35::2
ns3.unsw.edu.au.        2852    IN      A       192.155.82.178
ns3.unsw.edu.au.        7171    IN      AAAA    2600:3c01::f03c:91ff:fe73:5f10

;; Query time: 0 msec
;; SERVER: 129.94.242.2#53(129.94.242.2)
;; WHEN: Sat Aug 11 14:53:38 2018
;; MSG SIZE  rcvd: 330
```

Q7:

```
z5166834@vx4:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @129.94.242.33 yahoo.com MX

; <<>> DiG 9.7.3 <<>> @129.94.242.33 yahoo.com MX
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 15118
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 5, ADDITIONAL: 8

;; QUESTION SECTION:
;yahoo.com.                     IN      MX

;; ANSWER SECTION:
yahoo.com.              1800    IN      MX      1 mta6.am0.yahoodns.net.
yahoo.com.              1800    IN      MX      1 mta7.am0.yahoodns.net.
yahoo.com.              1800    IN      MX      1 mta5.am0.yahoodns.net.

;; AUTHORITY SECTION:
yahoo.com.              294     IN      NS      ns5.yahoo.com.
yahoo.com.              294     IN      NS      ns3.yahoo.com.
yahoo.com.              294     IN      NS      ns4.yahoo.com.
yahoo.com.              294     IN      NS      ns1.yahoo.com.
yahoo.com.              294     IN      NS      ns2.yahoo.com.

;; ADDITIONAL SECTION:
ns1.yahoo.com.          221991  IN      A       68.180.131.16
ns1.yahoo.com.          9130    IN      AAAA    2001:4998:130::1001
ns2.yahoo.com.          503627  IN      A       68.142.255.16
ns2.yahoo.com.          4934    IN      AAAA    2001:4998:140::1002
ns3.yahoo.com.          265714  IN      A       203.84.221.53
ns3.yahoo.com.          6151    IN      AAAA    2406:8600:b8:fe03::1003
ns4.yahoo.com.          510431  IN      A       98.138.11.157
ns5.yahoo.com.          496502  IN      A       119.160.253.83

;; Query time: 157 msec
;; SERVER: 129.94.242.33#53(129.94.242.33)
;; WHEN: Sat Aug 11 15:07:44 2018
;; MSG SIZE  rcvd: 360
```

No, I did not get an authoritative answer. Because in the response from CSE nameserver, the flags do not include aa, which represents the authoritative answer. This is because this server has authority for only the cse.unsw.edu.au domain and not for the Yahoo domain.

Q8:

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @ns2.cecs.anu.edu.au yahoo.com MX

; <<>> DiG 9.7.3 <<>> @ns2.cecs.anu.edu.au yahoo.com MX
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: REFUSED, id: 17064
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;yahoo.com.                     IN      MX

;; Query time: 26 msec
;; SERVER: 150.203.161.36#53(150.203.161.36)
;; WHEN: Sat Aug 11 16:49:26 2018
;; MSG SIZE  rcvd: 27
```

I did not get a response when I try with one of the nameservers obtained in Question 5. The status of the reply is REFUSED, the reason may be that these nameservers do not reply to DNS queries that are sent from devices that are not part of the ANU network as a security measure.

Q9:

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @ns2.yahoo.com yahoo.com MX

; <<>> DiG 9.7.3 <<>> @ns2.yahoo.com yahoo.com MX
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 60980
;; flags: qr aa rd; QUERY: 1, ANSWER: 3, AUTHORITY: 5, ADDITIONAL: 8
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;yahoo.com.                     IN      MX

;; ANSWER SECTION:
yahoo.com.              1800    IN      MX      1 mta6.am0.yahoodns.net.
yahoo.com.              1800    IN      MX      1 mta5.am0.yahoodns.net.
yahoo.com.              1800    IN      MX      1 mta7.am0.yahoodns.net.

;; AUTHORITY SECTION:
yahoo.com.              172800  IN      NS      ns2.yahoo.com.
yahoo.com.              172800  IN      NS      ns4.yahoo.com.
yahoo.com.              172800  IN      NS      ns1.yahoo.com.
yahoo.com.              172800  IN      NS      ns5.yahoo.com.
yahoo.com.              172800  IN      NS      ns3.yahoo.com.

;; ADDITIONAL SECTION:
ns1.yahoo.com.          1209600 IN      A       68.180.131.16
ns2.yahoo.com.          1209600 IN      A       68.142.255.16
ns3.yahoo.com.          1209600 IN      A       203.84.221.53
ns4.yahoo.com.          1209600 IN      A       98.138.11.157
ns5.yahoo.com.          1209600 IN      A       119.160.253.83
ns1.yahoo.com.          86400   IN      AAAA    2001:4998:130::1001
ns2.yahoo.com.          86400   IN      AAAA    2001:4998:140::1002
ns3.yahoo.com.          86400   IN      AAAA    2406:8600:b8:fe03::1003

;; Query time: 149 msec
;; SERVER: 68.142.255.16#53(68.142.255.16)
;; WHEN: Sat Aug 11 17:03:59 2018
;; MSG SIZE  rcvd: 360
```

For this query, a MX type DNS query is sent to obtain this information.

Q10:

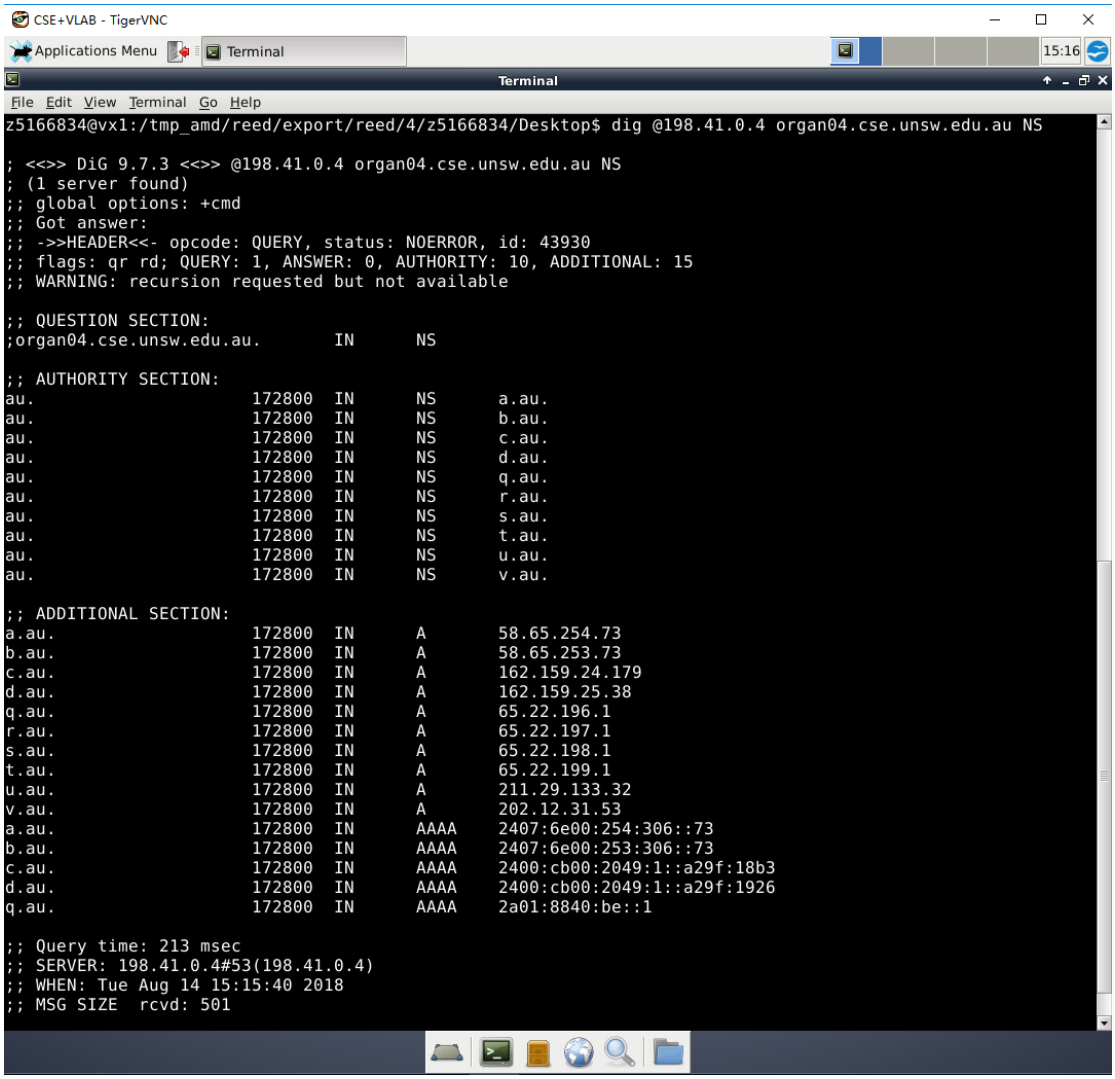
I am doing this exercise using VLAB + CSE to connect to CSE server,

I was sitting in organ, so I assumed I was using organ04.

We first need to query for the IP address of the root nameservers. The results are shown in the picture below.

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834$ dig . NS

; <<>> DiG 9.7.3 <<>> . NS
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 850
;; flags: qr rd ra; QUERY: 1, ANSWER: 13, AUTHORITY: 0, ADDITIONAL: 13

;; QUESTION SECTION:
;.                              IN      NS

;; ANSWER SECTION:
.                       354210  IN      NS      d.root-servers.net.
.                       354210  IN      NS      e.root-servers.net.
.                       354210  IN      NS      g.root-servers.net.
.                       354210  IN      NS      j.root-servers.net.
.                       354210  IN      NS      b.root-servers.net.
.                       354210  IN      NS      a.root-servers.net.
.                       354210  IN      NS      h.root-servers.net.
.                       354210  IN      NS      i.root-servers.net.
.                       354210  IN      NS      m.root-servers.net.
.                       354210  IN      NS      k.root-servers.net.
.                       354210  IN      NS      f.root-servers.net.
.                       354210  IN      NS      l.root-servers.net.
.                       354210  IN      NS      c.root-servers.net.

;; ADDITIONAL SECTION:
a.root-servers.net.     433760  IN      A       198.41.0.4
a.root-servers.net.     421567  IN      AAAA    2001:503:ba3e::2:30
b.root-servers.net.     341714  IN      A       199.9.14.201
b.root-servers.net.     11336   IN      AAAA    2001:500:200::b
c.root-servers.net.     88146   IN      A       192.33.4.12
c.root-servers.net.     11336   IN      AAAA    2001:500:2::c
d.root-servers.net.     21204   IN      A       199.7.91.13
d.root-servers.net.     11336   IN      AAAA    2001:500:2d::d
e.root-servers.net.     31071   IN      A       192.203.230.10
e.root-servers.net.     73197   IN      AAAA    2001:500:a8::e
f.root-servers.net.     387175  IN      A       192.5.5.241
f.root-servers.net.     11336   IN      AAAA    2001:500:2f::f
g.root-servers.net.     11336   IN      A       192.112.36.4

;; Query time: 0 msec
;; SERVER: 129.94.242.45#53(129.94.242.45)
;; WHEN: Sat Aug 11 17:06:37 2018
;; MSG SIZE  rcvd: 508
```

And then I choose to query the first nameserver 198.41.0.4. The result is shown below.



As we can see that we have been referred to the .au nameservers, so we continue to query one of these .au nameservers. I choose 58.65.254.73. And the result is shown below.

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @58.65.254.73 organ04.cse.unsw.edu.au NS

; <<>> DiG 9.7.3 <<>> @58.65.254.73 organ04.cse.unsw.edu.au NS
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 5744
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 4, ADDITIONAL: 8
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;organ04.cse.unsw.edu.au.       IN      NS

;; AUTHORITY SECTION:
edu.au.                 86400   IN      NS      s.au.
edu.au.                 86400   IN      NS      t.au.
edu.au.                 86400   IN      NS      q.au.
edu.au.                 86400   IN      NS      r.au.

;; ADDITIONAL SECTION:
q.au.                   86400   IN      A       65.22.196.1
r.au.                   86400   IN      A       65.22.197.1
s.au.                   86400   IN      A       65.22.198.1
t.au.                   86400   IN      A       65.22.199.1
q.au.                   86400   IN      AAAA    2a01:8840:be::1
r.au.                   86400   IN      AAAA    2a01:8840:bf::1
s.au.                   86400   IN      AAAA    2a01:8840:c0::1
t.au.                   86400   IN      AAAA    2a01:8840:c1::1

;; Query time: 16 msec
;; SERVER: 58.65.254.73#53(58.65.254.73)
;; WHEN: Tue Aug 14 15:35:03 2018
;; MSG SIZE  rcvd: 281
```

We can see that we are being leaded to the edu.au. nameservers, so we continue to query one of these, I choose 65.22.196.1.

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @65.22.196.1 organ04.cse.unsw.edu.au NS

; <<>> DiG 9.7.3 <<>> @65.22.196.1 organ04.cse.unsw.edu.au NS
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 10082
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 3, ADDITIONAL: 5
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;organ04.cse.unsw.edu.au.       IN      NS

;; AUTHORITY SECTION:
unsw.edu.au.            900     IN      NS      ns3.unsw.edu.au.
unsw.edu.au.            900     IN      NS      ns1.unsw.edu.au.
unsw.edu.au.            900     IN      NS      ns2.unsw.edu.au.

;; ADDITIONAL SECTION:
ns1.unsw.edu.au.        900     IN      A       129.94.0.192
ns2.unsw.edu.au.        900     IN      A       129.94.0.193
ns3.unsw.edu.au.        900     IN      A       192.155.82.178
ns1.unsw.edu.au.        900     IN      AAAA    2001:388:c:35::1
ns2.unsw.edu.au.        900     IN      AAAA    2001:388:c:35::2

;; Query time: 15 msec
;; SERVER: 65.22.196.1#53(65.22.196.1)
;; WHEN: Tue Aug 14 15:39:09 2018
;; MSG SIZE  rcvd: 199
```

Now we are being referred to the UNSW nameservers, we continue to query, this time I choose 129.94.0.192. As is shown in following picture.

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @129.94.0.192 organ04.cse.unsw.edu.au NS

; <<>> DiG 9.7.3 <<>> @129.94.0.192 organ04.cse.unsw.edu.au NS
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 9262
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 2, ADDITIONAL: 4
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;organ04.cse.unsw.edu.au.       IN      NS

;; AUTHORITY SECTION:
cse.unsw.edu.au.        10800   IN      NS      maestro.orchestra.cse.unsw.edu.au.
cse.unsw.edu.au.        10800   IN      NS      beethoven.orchestra.cse.unsw.edu.au.

;; ADDITIONAL SECTION:
beethoven.orchestra.cse.unsw.edu.au. 10800 IN A 129.94.242.2
beethoven.orchestra.cse.unsw.edu.au. 10800 IN A 129.94.172.11
beethoven.orchestra.cse.unsw.edu.au. 10800 IN A 129.94.208.3
maestro.orchestra.cse.unsw.edu.au. 10800 IN A   129.94.242.33

;; Query time: 5 msec
;; SERVER: 129.94.0.192#53(129.94.0.192)
;; WHEN: Tue Aug 14 15:43:01 2018
;; MSG SIZE  rcvd: 161
```

We are currently being referred to the CSE nameservers, so we do the same query as above. But we cannot use a NS type query, we now need a type A query to get the IP address of organ04. And we can see from the ANSWER SECTION that the IP address of organ04 is 129.94.209.164.

```
z5166834@vx1:/tmp_amd/reed/export/reed/4/z5166834/Desktop$ dig @129.94.242.2 organ04.cse.unsw.edu.au A

; <<>> DiG 9.7.3 <<>> @129.94.242.2 organ04.cse.unsw.edu.au A
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 49670
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 2

;; QUESTION SECTION:
;organ04.cse.unsw.edu.au.       IN      A

;; ANSWER SECTION:
organ04.cse.unsw.edu.au. 3600   IN      A       129.94.209.164

;; AUTHORITY SECTION:
cse.unsw.edu.au.        3600    IN      NS      beethoven.orchestra.cse.unsw.edu.au.
cse.unsw.edu.au.        3600    IN      NS      maestro.orchestra.cse.unsw.edu.au.

;; ADDITIONAL SECTION:
maestro.orchestra.cse.unsw.edu.au. 3600 IN A    129.94.242.33
beethoven.orchestra.cse.unsw.edu.au. 3600 IN A  129.94.242.2

;; Query time: 1 msec
;; SERVER: 129.94.242.2#53(129.94.242.2)
;; WHEN: Tue Aug 14 15:45:33 2018
;; MSG SIZE  rcvd: 145
```

Q11:

Of course, it can have several names and/or IP addresses associated with it. A physical machine may have several network interfaces, and a network interface can have several IP addresses associated with it at any given time. Moreover, an IP addresses may be associated with few hostnames.

Exercise4:

The code is included in the .tar file.