

Veamos todos los *root-servers* con el comando *dig*:

```
cdimatteo@Carolinas-MacBook-Air ~ % dig

; <>> DiG 9.10.6 <>>
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 13380
;; flags: qr rd ra ad; QUERY: 1, ANSWER: 13, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;.

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

;; Query time: 25 msec
;; SERVER: 181.30.140.199#53(181.30.140.199)
;; WHEN: Wed Apr 12 22:21:44 -03 2023
;; MSG SIZE  rcvd: 239
```

Rastreemos, por ejemplo, cómo hace la computadora para obtener el contenido de la URL <https://campus.fi.uba.ar/>. Para esto, pedimos a algún *root-server* la dirección en cuestión de la mano del comando *+trace* que nos va a ayudar a detectar el camino recorrido hasta el objetivo. Mientras, iniciamos la captura de paquetes en Wireshark para poder visualizar el contenido de los paquetes en cuestión:

```
cdimatteo@Carolinas-MacBook-Air ~ % dig @k.root-servers.net campus.fi.uba.ar +trace

; <>> DiG 9.10.6 <>> @k.root-servers.net campus.fi.uba.ar +trace
; (1 server found)
;; global options: +cmd
.          518400  IN      NS  a.root-servers.net.
.          518400  IN      NS  b.root-servers.net.
.          518400  IN      NS  c.root-servers.net.
.          518400  IN      NS  d.root-servers.net.
.          518400  IN      NS  e.root-servers.net.
.          518400  IN      NS  f.root-servers.net.
.          518400  IN      NS  g.root-servers.net.
.          518400  IN      NS  h.root-servers.net.
.          518400  IN      NS  i.root-servers.net.
.          518400  IN      NS  j.root-servers.net.
.          518400  IN      NS  k.root-servers.net.
.          518400  IN      NS  l.root-servers.net.
.          518400  IN      NS  m.root-servers.net.
.          518400  IN      RRSIG  NS  8 0 518400 20230425200000 20230412190000 60955 . 1RKAKJzrGLTPtZcq7UgPCVhFBoFhHaaOa4MFEML1k
wF4hUqV2mbsg8a5 jC55dbgoKqndQw1G8KpGgi17x2QWyiFp1q+pDpcF8Kfk+rLxUyNQYDZ dRqdJFPCe0jZLgvTFIC0cKEJe8a574jKK08Act5Yq1bPgTQ1FF62qac7 BaeGtHuKxzW
VZrVArJHgKvYhlmySBnJXuypclzEKCFLcBtTv0cFyUM82 H/mRhg312aNShSrc/5ZlI0+7M+YML6HzqpCe8wmkvX443wxHj7nHEU+j 1N+7wm3zE5t0qaBwdF8j8UHGPxuBkgm5/Ed+hm
GZ4IJDJ79ebQFmdQ/U IvnG1Q==
;; Received 1097 bytes from 193.0.14.129#53(k.root-servers.net) in 22 ms

ar.          172800  IN      NS  a.dns.ar.
ar.          172800  IN      NS  b.dns.ar.
ar.          172800  IN      NS  c.dns.ar.
ar.          172800  IN      NS  d.dns.ar.
ar.          172800  IN      NS  e.dns.ar.
ar.          172800  IN      NS  f.dns.ar.
ar.          172800  IN      NS  ar.ctld.authdns.ripe.net.
ar.          86400   IN      DS  19606 8 2 4415CF1A2CF10DE94B92BC020F21D1BF4163B2E90F2A6F6A5D2A1740 339D566C
ar.          86400   IN      RRSIG  DS 8 1 86400 20230425200000 20230412190000 60955 . koebuKJwqLcjkf3GT2Nwg6ytY0/UHyxSZUTRfi5hEL
awAoATELpqhn9s 0qIgILw02+95Xfm6Ik1xY7nw6Rr50KBBB0ts+b75VmHkHdgmgJS/yu3 wKIGH+PCNFnOL9a51TarcWcnpl/pEmZ68pAUQqFn7f140qDirC/v7+yJ bhMPZwKjj0Xk
vUS8ghWdQBsShxOPJwk0JbixMFp9Y/PdyY7Mx/jVtgz 5mquK9haYxSdxM1xrplcLycyuGtcSOhr7Vkj7jaueS38RmsKraCoiCgc Bt9Vrc5mowXyyUwz1mADSwtYGrUL3HrpmsxHImG
vRRfWS8bBBJksnTB1 hZBhwQ=-
;; Received 827 bytes from 192.5.5.241#53(f.root-servers.net) in 23 ms

uba.ar.      86400  IN      NS  dns33.cloudns.net.
uba.ar.      86400  IN      NS  dns31.cloudns.net.
```

```
cdimatteo@Carolinias-MacBook-Air ~ % 
ar.          172800  IN      NS      f.dns.ar.
ar.          172800  IN      NS      ar.cctld.authdns.ripe.net.
ar.          86400   IN      DS      19606 8 2 4415CF1A2CF10DE94B92BC020F21D1BF4163B2E90F2A6F6A5D2A1740 339D566C
ar.          86400   IN      RRSIG   DS 8 1 86400 20230425200000 20230412190000 60955 . koebuKJWqLCjkf3GT2Nwg6ytY0/UHysXZUTRfi5hEl
awAoATELpqhn9s 0qIgILwO2++95Xfm6IK1xY7nw6Rr50KBBB0ts+b75VmHkHdgmgJS/yu3 wKIGH+PCNFn0L9a51TarcWcnpl/pEmZ68pAUQqFn7f14QqDirC/v7+yJ bhMPZwKj0XK
vUS8gHuWdQBsHx0Pjwk0JbixMFP9Y/Pdy7Mx/jVtzg 5mquK9haYxSxDxM1xrplcLycyuqGtcS0Hr7vk7jaueS38RmsKraCoiCgc Bt9VRc5mowXyyUwz1mADSwtYGrUL3HrpmsxHIMG
vRrfWS8bBBJksnTB1 hZBHwQ==

;; Received 827 bytes from 192.5.5.241#53(f.root-servers.net) in 23 ms

uba.ar.      86400   IN      NS      dns33.cloudns.net.
uba.ar.      86400   IN      NS      dns31.cloudns.net.
uba.ar.      86400   IN      NS      ns3.uba.ar.
uba.ar.      86400   IN      NS      ns1.uba.ar.
uba.ar.      86400   IN      NS      dns34.cloudns.net.
uba.ar.      86400   IN      NS      ns2.uba.ar.
uba.ar.      86400   IN      NS      dns32.cloudns.net.

B9HQC4JQNHCSGIAE55QFI803CHTTAG2L.ar. 86400 IN NSEC3 1 0 10 - B9ID70DGTIIJOE1DCUK51JC63KT2PJE2 NS
B9HQC4JQNHCSGIAE55QFI803CHTTAG2L.ar. 86400 IN RRSIG NSEC3 8 2 86400 20230502040251 20230402230345 14574 ar. DXjjCh0eLCAaggKcN9j9e0wLnn6W4jG71+
X+RDNcZxtq9NkINjxMkOxxn Bh9DRP5mdqzcvrbNcW4+Sus5LRnkvoVrDv5uGu1ZhEDodd1fBjAS xr+zNmppOH1NwRP1uig3Bmb/zRzqHMYP2g/BC1KYV20YkBGB8SKMZ9mG8 co5
2Laj0HYRPAJdsXcZUkdHvar0DTqYHuziM1AQOg0MDr7kDmpjHL+L x4E0Zgx/vy4iwXWqUwkPiWP610uoSjOikUeL4FJ39YAkih/CLQNo5F1 Hfu5t3eDwQf01+FSphFNPLk/UWL/IM
tRGA/zBs4SOXYbRi0011XQaiEE RD5ofA==

couldn't get address for 'ns3.uba.ar': not found
;; Received 664 bytes from 130.59.31.20#53(f.dns.ar) in 251 ms

fi.uba.ar.   7200    IN      NS      ns2.fi.uba.ar.
fi.uba.ar.   7200    IN      NS      ns2.uba.ar.
fi.uba.ar.   7200    IN      NS      ns1.uba.ar.
fi.uba.ar.   7200    IN      NS      ns4.fi.uba.ar.
fi.uba.ar.   7200    IN      NS      ns1.fi.uba.ar.

;; Received 271 bytes from 185.136.98.100#53(dns33.cloudns.net) in 177 ms

campus.fi.uba.ar. 3600   IN      A      186.33.228.41
fi.uba.ar.      1      IN      NS      ns2.uba.ar.
fi.uba.ar.      1      IN      NS      ns1.uba.ar.
fi.uba.ar.      1      IN      NS      ns2.fi.uba.ar.
fi.uba.ar.      1      IN      NS      ns1.fi.uba.ar.
fi.uba.ar.      1      IN      NS      ns4.fi.uba.ar.

;; Received 199 bytes from 190.2.38.186#53(ns4.fi.uba.ar) in 21 ms

cdimatteo@Carolinias-MacBook-Air ~ %
```

En particular, veamos el camino realizado:

```
;; Received 1097 bytes from 193.0.14.129#53(k.root-servers.net) in 22 ms
;; Received 827 bytes from 192.5.5.241#53(f.root-servers.net) in 23 ms
;; Received 664 bytes from 130.59.31.20#53(f.dns.ar) in 251 ms
;; Received 271 bytes from 185.136.98.100#53(dns33.cloudns.net) in 177 ms
;; Received 199 bytes from 190.2.38.186#53(ns4.fi.uba.ar) in 21 ms
```

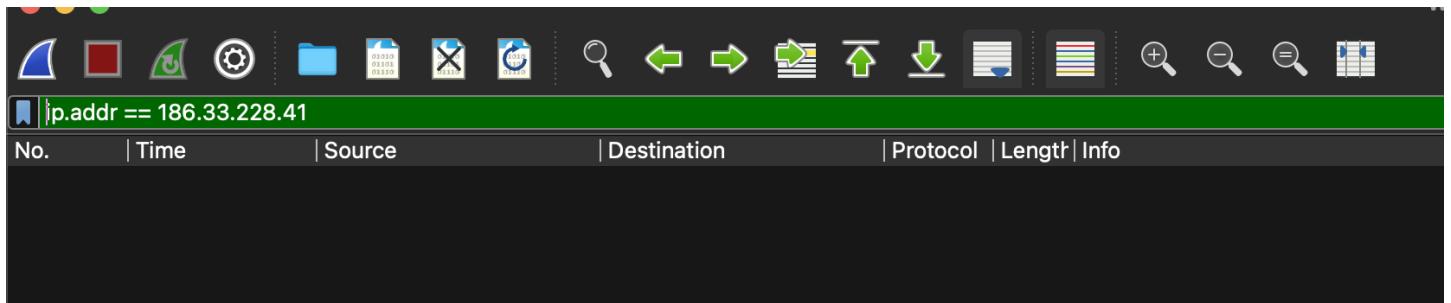
Resultando que la IP del servidor donde se encuentra alojada la URL en cuestión es **186.33.228.41**.

Si estudiamos este camino con los paquetes leídos por Wireshark, podemos ver:

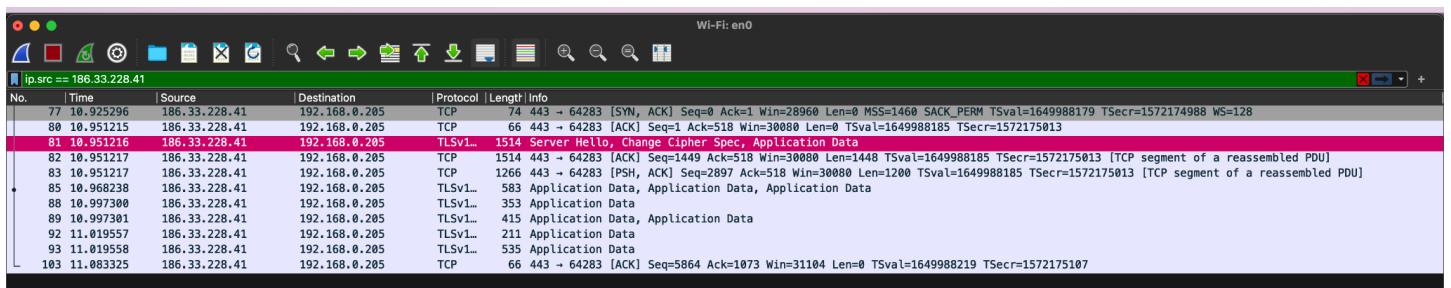
| ip.addr == 193.0.14.129 or ip.addr == 192.5.5.241 or ip.addr == 130.59.31.20 or ip.addr == 185.136.98.100 or ip.addr == 190.2.38.186 | | | | | | | | | |
|--|----------|----------------|----------------|----------|--------|---|----|-------------------------------------|--|
| No. | Time | Source | Destination | Protocol | Length | Info | 70 | Standard query 0x78c3 NS <Root> OPT | |
| 42 | 7.679549 | 192.168.0.205 | 193.0.14.129 | DNS | 1139 | Standard query response 0x78c3 NS <Root> NS a.root-servers.net NS b.root-servers.net NS c.root-servers.net NS d.root-servers.net NS e.root... | | | |
| 62 | 7.702138 | 193.0.14.129 | 192.168.0.205 | DNS | 87 | Standard query 0x0c02 A campus.fi.uba.ar OPT | | | |
| 66 | 7.713037 | 192.168.0.205 | 192.5.5.241 | DNS | 87 | Standard query 0x0c02 A campus.fi.uba.ar OPT | | | |
| 71 | 7.736016 | 192.5.5.241 | 192.168.0.205 | DNS | 869 | Standard query response 0x0c02 A campus.fi.uba.ar NS a.dns.ar NS b.dns.ar NS c.dns.ar NS d.dns.ar NS e.dns.ar NS f.dns.ar NS ar.ctld.aut... | | | |
| 80 | 7.741798 | 192.168.0.205 | 130.59.31.20 | DNS | 87 | Standard query 0x947 A campus.fi.uba.ar OPT | | | |
| 112 | 7.993086 | 130.59.31.20 | 192.168.0.205 | DNS | 706 | Standard query response 0x947 A campus.fi.uba.ar NS dns33.cloudns.net NS dns31.cloudns.net NS ns3.uba.ar NS ns1.uba.ar NS dns34.cloudns... | | | |
| 115 | 8.851468 | 192.168.0.205 | 185.136.98.100 | DNS | 87 | Standard query 0xb75c A campus.fi.uba.ar OPT | | | |
| 121 | 8.229024 | 185.136.98.100 | 192.168.0.205 | DNS | 313 | Standard query response 0xb75c A campus.fi.uba.ar NS ns2.fi.uba.ar NS ns2.uba.ar NS ns1.uba.ar NS ns4.fi.uba.ar NS ns1.fi.uba.ar A 157.92... | | | |
| 128 | 8.234298 | 192.168.0.205 | 190.2.38.186 | DNS | 87 | Standard query 0x9a9e A campus.fi.uba.ar OPT | | | |
| 123 | 8.255668 | 190.2.38.186 | 192.168.0.205 | DNS | 241 | Standard query response 0x9a9e A campus.fi.uba.ar A 186.33.228.41 NS ns2.uba.ar NS ns1.uba.ar NS ns2.fi.uba.ar NS ns1.fi.uba.ar NS ns4.fi... | | | |

de los que, por ejemplo, una información que podríamos requerir sería:

Una última búsqueda que podríamos realizar por curiosidad, sería ver qué paquetes recibimos de la IP registrada:



Ahora bien, cabe mencionar que NO hay ningún navegador abierto en esta computadora, en este preciso momento, con una búsqueda hacia la URL <https://campus.fi.uba.ar/>. Probemos ahora levantando la URL, si Wireshark detecta paquetes recibidos:



¡Efectivamente vemos paquetes recibidos!

Finalmente, veamos qué ocurre con los comandos +recurse, +authorithy y +nsid:

```
cdimatteo@Carolinas-MacBook-Air ~ % dig @k.root-servers.net campus.fi.uba.ar +recurse
; <>> DiG 9.10.6 <>> @k.root-servers.net campus.fi.uba.ar +recurse
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 15050
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 7, ADDITIONAL: 15
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;campus.fi.uba.ar.           IN      A

;; AUTHORITY SECTION:
ar.          172800  IN      NS      a.dns.ar.
ar.          172800  IN      NS      b.dns.ar.
ar.          172800  IN      NS      c.dns.ar.
ar.          172800  IN      NS      d.dns.ar.
ar.          172800  IN      NS      e.dns.ar.
ar.          172800  IN      NS      f.dns.ar.
ar.          172800  IN      NS      ar.cctld.authdns.ripe.net.

;; ADDITIONAL SECTION:
a.dns.ar.    172800  IN      A      200.108.145.50
b.dns.ar.    172800  IN      A      200.108.147.50
c.dns.ar.    172800  IN      A      200.108.148.50
d.dns.ar.    172800  IN      A      192.140.126.50
e.dns.ar.    172800  IN      A      170.238.66.50
f.dns.ar.    172800  IN      A      130.59.31.20
ar.cctld.authdns.ripe.net. 172800  IN      A      193.0.9.59
a.dns.ar.    172800  IN      AAAA   2801:140::10
b.dns.ar.    172800  IN      AAAA   2801:140:11::50
c.dns.ar.    172800  IN      AAAA   2801:140:10::10
d.dns.ar.    172800  IN      AAAA   2801:140:ddd::50
e.dns.ar.    172800  IN      AAAA   2801:140:eeee::50
f.dns.ar.    172800  IN      AAAA   2001:620:0:ff::20
ar.cctld.authdns.ripe.net. 172800  IN      AAAA   2001:67c:ie0::59
```

```
● ● ● cdimatteo --zsh -- 141x40
; <>> Dig 9.10.6 <>> @k.root-servers.net campus.fi.uba.ar +authority
; (1 server found)
;; global options: +cmd
;; Got answer:
;-->HEADER<<- opcode: QUERY, status: NOERROR, id: 22144
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 7, ADDITIONAL: 15
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;campus.fi.uba.ar.           IN      A

;; AUTHORITY SECTION:
ar.          172800  IN      NS      a.dns.ar.
ar.          172800  IN      NS      b.dns.ar.
ar.          172800  IN      NS      c.dns.ar.
ar.          172800  IN      NS      d.dns.ar.
ar.          172800  IN      NS      e.dns.ar.
ar.          172800  IN      NS      f.dns.ar.
ar.          172800  IN      NS      ar.cctld.authdns.ripe.net.

;; ADDITIONAL SECTION:
a.dns.ar.    172800  IN      A      200.108.145.50
b.dns.ar.    172800  IN      A      200.108.147.50
c.dns.ar.    172800  IN      A      200.108.148.50
d.dns.ar.    172800  IN      A      192.140.126.50
e.dns.ar.    172800  IN      A      170.238.66.50
f.dns.ar.    172800  IN      A      130.59.31.20
ar.cctld.authdns.ripe.net. 172800  IN      A      193.0.9.59
a.dns.ar.    172800  IN      AAAA   2801:140::10
b.dns.ar.    172800  IN      AAAA   2801:140:11::50
c.dns.ar.    172800  IN      AAAA   2801:140:10::10
d.dns.ar.    172800  IN      AAAA   2801:140:ddd::50
e.dns.ar.    172800  IN      AAAA   2801:140:eeee::50
f.dns.ar.    172800  IN      AAAA   2001:620:0:ff::20
ar.cctld.authdns.ripe.net. 172800  IN      AAAA   2001:67c:e0::59

;; Query time: 49 msec
;; SERVER: 193.0.14.129#53(193.0.14.129)
```

```
● ● ● cdimatteo --zsh -- 141x40
; <>> Dig 9.10.6 <>> @k.root-servers.net campus.fi.uba.ar +nsid
; (1 server found)
;; global options: +cmd
;; Got answer:
;-->HEADER<<- opcode: QUERY, status: NOERROR, id: 24282
;; flags: qr rd; QUERY: 1, ANSWER: 0, AUTHORITY: 7, ADDITIONAL: 15
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; NSID: 6e 73 31 2e 61 72 2d 62 75 65 2e 6b 2e 72 69 70 65 2e 6e 65 74 ("ns1.ar-bue.k.ripe.net")
;; QUESTION SECTION:
;campus.fi.uba.ar.           IN      A

;; AUTHORITY SECTION:
ar.          172800  IN      NS      a.dns.ar.
ar.          172800  IN      NS      b.dns.ar.
ar.          172800  IN      NS      c.dns.ar.
ar.          172800  IN      NS      d.dns.ar.
ar.          172800  IN      NS      e.dns.ar.
ar.          172800  IN      NS      f.dns.ar.
ar.          172800  IN      NS      ar.cctld.authdns.ripe.net.

;; ADDITIONAL SECTION:
a.dns.ar.    172800  IN      A      200.108.145.50
b.dns.ar.    172800  IN      A      200.108.147.50
c.dns.ar.    172800  IN      A      200.108.148.50
d.dns.ar.    172800  IN      A      192.140.126.50
e.dns.ar.    172800  IN      A      170.238.66.50
f.dns.ar.    172800  IN      A      130.59.31.20
ar.cctld.authdns.ripe.net. 172800  IN      A      193.0.9.59
a.dns.ar.    172800  IN      AAAA   2801:140::10
b.dns.ar.    172800  IN      AAAA   2801:140:11::50
c.dns.ar.    172800  IN      AAAA   2801:140:10::10
d.dns.ar.    172800  IN      AAAA   2801:140:ddd::50
e.dns.ar.    172800  IN      AAAA   2801:140:eeee::50
f.dns.ar.    172800  IN      AAAA   2001:620:0:ff::20
ar.cctld.authdns.ripe.net. 172800  IN      AAAA   2001:67c:e0::59

;; Query time: 25 msec
```