CS305 Lab assignment 2

wangw6@sustech.edu.cn,   11911827@mail.sustech.edu.cn

Using python to implement a 'DNS Client'.

NOTES:

1) **The python source file should be named as 'dns_iterative_q_client.py' using UTF-8 as file coding. There is no need to zip the source file.**

2) **Only "argparse", "sys", "socket" and "dns" in python are permitted to be used in this assignment(These python packages is optional, you are encouraged to resolve the DNS packets without dns package of python to enjoy deep practices).**

3) **Comments in code is MUST.**

1. The 'DNS Client' is expected work on the specified port and your valid IP address, its function should include:

    (1) Run the '**dns_iterative_q_client.py' with following options** to invoke the DNS **iterative** query to get the **'A' type answer** :

        ① **'-q' is used to specify the name of query**

        ② **'-s' is used to specify the source IP address of query**

        ③ **'-p' is used to specify the source port number of query**

        ④ **'-server' is used to specify the IP address of Local DNS server**

    (2) Invoke DNS iterative query **(the value of 'rd' flag is 0)**, send the query to the DNS server.

    (3) Receive and resolve the DNS responses.

    (4) Repeat the iterative queries until get the final answer.

        NOTE:

        Sometimes, the 'DNS Client' may just got 'CNAME' item while the query's type is 'A'. In this situation the 'DNS Client' should continue to do the iterative queries to the name server (whose info could be resolved from the Authority RRs and Additional RRs of the response packet) until get the A type answer.

    (5) Print the final answer.

    For example:

    ① Run the following command to invoke an iterative query about 'A' type of www.baidu.com to the specified local DNS server "8.8.8.8" with the specified source IP 10.17.88.224 and source port 1400.

    (The final answer of www.baidu.com includes both CNAME and A type)

```
C:\Users\zhq\PycharmProjects\DNSsever>python dns_iterative_q_client.py -q www.baidu.com -s 10.17.88.224 -p 14000 -server 8.8.8.8
Name: www.a.shifen.com.
Addresses:
182.61.200.7
182.61.200.6
Aliases: www.baidu.com
```

    ② Run the following command to invoke a iterative query about 'A' type of www.example.com to the specified local DNS server "8.8.8.8" with the specified source IP 10.17.88.224 and source port 1400.

(The final answer of www.examle.com only includes A type)

```
C:\Users\zhq\PycharmProjects\DNSsever>python dns_iterative_q_client.py -q www.example.com -s 10.17.88.224 -p 14000 -server 8.8.8.8
Name: www.example.com.
Addresses:
93.184.216.34
```
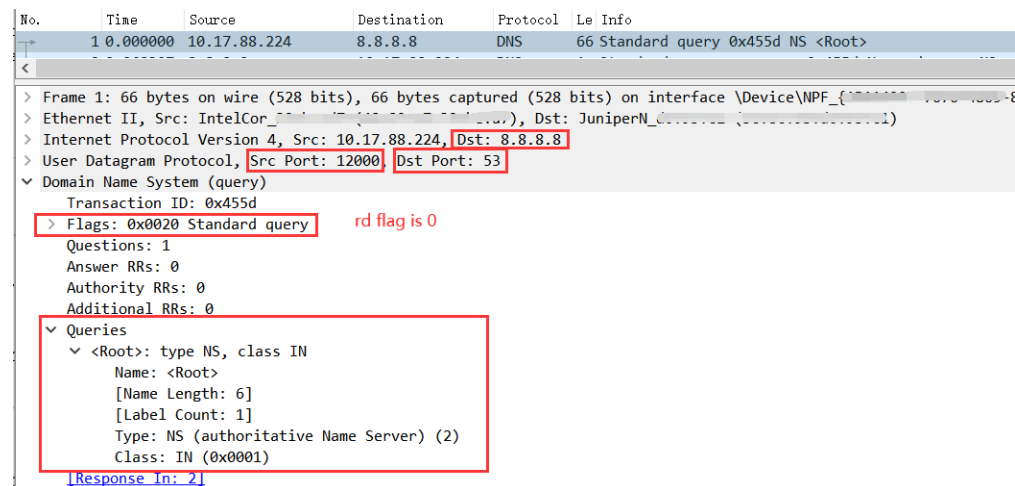
2. Tips

    (1)   using 'dig' with option '+trace' to learn the iterative DNS query between DNS client and DNS Server.

          NOTE: 'dig' usually stops the iterative DNS query as soon as it got the answer, even if the type of answer is NOT the one which is asked in the DNS query. For example, the type of query is 'A' while the final answer got by 'dig' is 'CNAME'.

    (2)   using '**Wireshark**' to trace the communication between the 'DNS Client' and the DNS servers.

3. Take a DNS query to "www.baidu.com" as an example:s

    (1)   Client send query(rd flag is 0) about Root Level DNS server to 'Local DNS server'(8.8.8.8)

```
No.      Time        Source          Destination      Protocol  Le  Info
         1 0.000000  10.17.88.224    8.8.8.8          DNS       66  Standard query 0x455d NS <Root>
<
> Frame 1: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{
> Ethernet II, Src: IntelCor_           ), Dst: JuniperN_            )
> Internet Protocol Version 4, Src: 10.17.88.224, Dst: 8.8.8.8
> User Datagram Protocol, Src Port: 12000, Dst Port: 53
v Domain Name System (query)
     Transaction ID: 0x455d
   > Flags: 0x0020 Standard query          rd flag is 0
     Questions: 1
     Answer RRs: 0
     Authority RRs: 0
     Additional RRs: 0
   v Queries
     v <Root>: type NS, class IN
          Name: <Root>
          [Name Length: 6]
          [Label Count: 1]
          Type: NS (authoritative Name Server) (2)
          Class: IN (0x0001)
     [Response In: 2]
```
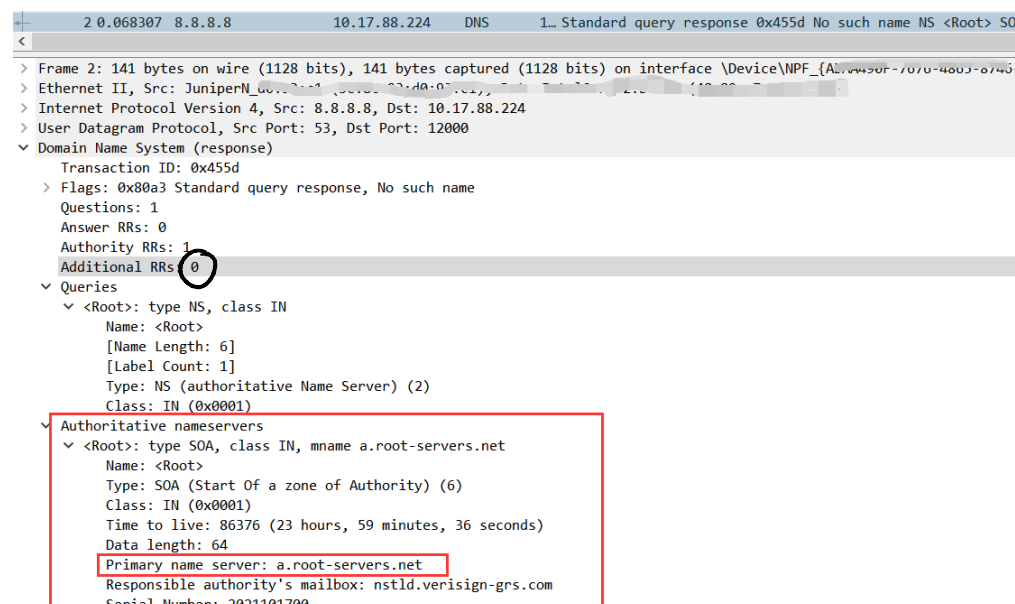
    (2)   Client received a DNS response from 'Local DNS server'. It includes the information about Primary name server while the number of answer rrs and additional rrs is 0.

```
         2 0.068307  8.8.8.8         10.17.88.224     DNS       1… Standard query response 0x455d No such name NS <Root> SO
<
> Frame 2: 141 bytes on wire (1128 bits), 141 bytes captured (1128 bits) on interface \Device\NPF_{A
> Ethernet II, Src: JuniperN_
> Internet Protocol Version 4, Src: 8.8.8.8, Dst: 10.17.88.224
> User Datagram Protocol, Src Port: 53, Dst Port: 12000
v Domain Name System (response)
     Transaction ID: 0x455d
   > Flags: 0x80a3 Standard query response, No such name
     Questions: 1
     Answer RRs: 0
     Authority RRs: 1
     Additional RRs: 0
   v Queries
     v <Root>: type NS, class IN
          Name: <Root>
          [Name Length: 6]
          [Label Count: 1]
          Type: NS (authoritative Name Server) (2)
          Class: IN (0x0001)
   v Authoritative nameservers
     v <Root>: type SOA, class IN, mname a.root-servers.net
          Name: <Root>
          Type: SOA (Start Of a zone of Authority) (6)
          Class: IN (0x0001)
          Time to live: 86376 (23 hours, 59 minutes, 36 seconds)
          Data length: 64
          Primary name server: a.root-servers.net
          Responsible authority's mailbox: nstld.verisign-grs.com
          Serial Number: 2021101700
```

(3) Client invoke a new DNS query(rd flag is 0) about the 'A' type rr of the 'Primary name server' to 'Local DNS server'.

```
   3 0.070728  10.17.88.224        8.8.8.8       DNS    78 Standard query 0xc95c A a.root-servers.net
```

```
> Frame 3: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface \Device\
> Ethernet II, Src: IntelCor_                      , Dst: JuniperN_
> Internet Protocol Version 4, Src: 10.17.88.224, Dst: 8.8.8.8
> User Datagram Protocol, Src Port: 12000, Dst Port: 53
✓ Domain Name System (query)
     Transaction ID: 0xc95c
   > Flags: 0x0020 Standard query
     Questions: 1
     Answer RRs: 0
     Authority RRs: 0
     Additional RRs: 0
   ✓ Queries
     ✓ a.root-servers.net: type A, class IN
         Name: a.root-servers.net
         [Name Length: 18]
         [Label Count: 3]
         Type: A (Host Address) (1)
         Class: IN (0x0001)
     [Response In: 4]
```

(4) Client receive the answer from the 'Local DNS server'.

```
   4 0.139683  8.8.8.8          10.17.88.224    DNS    94 Standard query response 0xc95c A a.root-servers.net A 198.41.
```

```
 Frame 4: 94 bytes on wire (752 bits), 94 bytes captured (752 bits) on interface \Device\                    0
 Ethernet II, Src: JuniperN_
 Internet Protocol Version 4, Src: 8.8.8.8, Dst: 10.17.88.224
 User Datagram Protocol, Src Port: 53, Dst Port: 12000
 Domain Name System (response)
   Transaction ID: 0xc95c
 > Flags: 0x8080 Standard query response, No error
   Questions: 1
   Answer RRs: 1
   Authority RRs: 0
   Additional RRs: 0
 > Queries
 ✓ Answers
   ✓ a.root-servers.net: type A, class IN, addr 198.41.0.4
       Name: a.root-servers.net
       Type: A (Host Address) (1)
       Class: IN (0x0001)
       Time to live: 255153 (2 days, 22 hours, 52 minutes, 33 seconds)
       Data length: 4
       Address: 198.41.0.4
   [Request In: 3]
   [Time: 0.068955000 seconds]
```

(5) Client send a new DNS query (rd flag is 0) about A type of www.baidu.com to the Root Level DNS server.

```
   5 0.140887  10.17.88.224      198.41.0.4      DNS    73 Standard query 0x6f5b A www.baidu.com
```

```
> Frame 5: 73 bytes on wire (584 bits), 73 bytes captured (584 bits)     interface \Device\NPF
> Ethernet II, Src: IntelCor_3
> Internet Protocol Version 4, Src: 10.17.88.224, Dst: 198.41.0.4
> User Datagram Protocol, Src Port: 12000, Dst Port: 53
✓ Domain Name System (query)
     Transaction ID: 0x6f5b
   > Flags: 0x0020 Standard query
     Questions: 1
     Answer RRs: 0
     Authority RRs: 0
     Additional RRs: 0
   ✓ Queries
     ✓ www.baidu.com: type A, class IN
         Name: www.baidu.com
         [Name Length: 13]
         [Label Count: 3]
         Type: A (Host Address) (1)
         Class: IN (0x0001)
     [Response In: 6]
```

(6) Client received a response message from the Root Level DNS server. It includes the information about 'com.' in authority rrs and additional rrs.

```
        6 0.196359  198.41.0.4         10.17.88.224     DNS      5… Standard query response 0x6f5b A www.baidu.com NS e.gtl
<

v Domain Name System (response)
      Transaction ID: 0x6f5b
   > Flags: 0x8200 Standard query response, No error
      Questions: 1
      Answer RRs: 0
      Authority RRs: 13
      Additional RRs: 11
   > Queries
   v Authoritative nameservers
         com: type NS, class IN, ns e.gtld-servers.net
         com: type NS, class IN, ns b.gtld-servers.net
         com: type NS, class IN, ns j.gtld-servers.net
         com: type NS, class IN, ns m.gtld-servers.net
         com: type NS, class IN, ns i.gtld-servers.net
         com: type NS, class IN, ns f.gtld-servers.net
         com: type NS, class IN, ns a.gtld-servers.net
         com: type NS, class IN, ns g.gtld-servers.net
         com: type NS, class IN, ns h.gtld-servers.net
         com: type NS, class IN, ns l.gtld-servers.net
         com: type NS, class IN, ns k.gtld-servers.net
         com: type NS, class IN, ns c.gtld-servers.net
         com: type NS, class IN, ns d.gtld-servers.net
   v Additional records
      > e.gtld-servers.net: type A, class IN, addr 192.12.94.30
      > e.gtld-servers.net: type AAAA, class IN, addr 2001:502:1ca1::30
      > b.gtld-servers.net: type A, class IN, addr 192.33.14.30
      > b.gtld-servers.net: type AAAA, class IN, addr 2001:503:231d::2:30
      > j.gtld-servers.net: type A, class IN, addr 192.48.79.30
      > j.gtld-servers.net: type AAAA, class IN, addr 2001:502:7094::30
```

(7)   Client pick one of the authority name server of 'com.', send a new query (rd flag is 0) about 'A' type of 'www.baidu.com' to it.

```
        7 0.201330  10.17.88.224       192.12.94.30     DNS      73 Standard query 0x96a1 A www.baidu.com
<

> Frame 7: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interface \D…    \N…  {AD…   …65-
> Ethernet II, Src: IntelCor…              Dst: JuniperN_…  ….c1                     )
> Internet Protocol Version 4, Src: 10.17.88.224, Dst: 192.12.94.30
> User Datagram Protocol, Src Port: 12000, Dst Port: 53
v Domain Name System (query)
      Transaction ID: 0x96a1
   > Flags: 0x0020 Standard query
      Questions: 1
      Answer RRs: 0
      Authority RRs: 0
      Additional RRs: 0
   v Queries
      v www.baidu.com: type A, class IN
            Name: www.baidu.com
            [Name Length: 13]
            [Label Count: 3]
            Type: A (Host Address) (1)
            Class: IN (0x0001)
      [Response In: 8]
```

(8)   Client received the response message which includes the information about the authority name sever about '.baidu.com.'.

```
    8 0.397692 192.12.94.30        10.17.88.224      DNS      2… Standard query response 0x96a1 A www.baidu.com
> Ethernet II, Src: JuniperN_d                      , Dst: IntelCor_52.be.u/
> Internet Protocol Version 4, Src: 192.12.94.30, Dst: 10.17.88.224
> User Datagram Protocol, Src Port: 53, Dst Port: 12000
∨ Domain Name System (response)
     Transaction ID: 0x96a1
   > Flags: 0x8000 Standard query response, No error
     Questions: 1
     Answer RRs: 0
     Authority RRs: 5
     Additional RRs: 5
   > Queries
   ∨ Authoritative nameservers
       baidu.com: type NS, class IN, ns ns2.baidu.com
       baidu.com: type NS, class IN, ns ns3.baidu.com
       baidu.com: type NS, class IN, ns ns4.baidu.com
       baidu.com: type NS, class IN, ns ns1.baidu.com
       baidu.com: type NS, class IN, ns ns7.baidu.com
   ∨ Additional records
     > ns2.baidu.com: type A, class IN, addr 220.181.33.31
     > ns3.baidu.com: type A, class IN, addr 112.80.248.64
     > ns4.baidu.com: type A, class IN, addr 14.215.178.80
     > ns1.baidu.com: type A, class IN, addr 110.242.68.134
     > ns7.baidu.com: type A, class IN, addr 180.76.76.92
     [Request In: 7]
```

(9) Client pick one authority name sever of '.baidu.com.', send a new DNS query (rd flag is 0) about about 'A' type of 'www.baidu.com' to it.

```
    9 0.398650 10.17.88.224        220.181.33.31     DNS      73 Standard query 0x93be A www.baidu.com
> Frame 9: 73 bytes on wire (584 bits), 73 bytes captured (584 bits) on interface \Device\NPF_                           /215), to 0
> Ethernet II, Src: IntelCor_                        , Dst:
> Internet Protocol Version 4, Src: 10.17.88.224, Dst: 220.181.33.31
> User Datagram Protocol, Src Port: 12000, Dst Port: 53
∨ Domain Name System (query)
     Transaction ID: 0x93be
   > Flags: 0x0020 Standard query
     Questions: 1
     Answer RRs: 0
     Authority RRs: 0
     Additional RRs: 0
   ∨ Queries
     ∨ www.baidu.com: type A, class IN
         Name: www.baidu.com
         [Name Length: 13]
         [Label Count: 3]
         Type: A (Host Address) (1)
         Class: IN (0x0001)
     [Response In: 10]
```

(10) Client receive the response message which includes the answer from the authority name sever of '.baidu.com.', but the answer's type is 'CNAME' which is NOT same with the type asked in the query. The response message also includes the information about the authority name sever of 'a.shifen.com.'.

```
    10 0.450338 220.181.33.31       10.17.88.224      DNS      2… Standard query response 0x93be A www.baidu.com CNAME www.a.
∨ Domain Name System (response)
     Transaction ID: 0x93be
   > Flags: 0x8400 Standard query response, No error
     Questions: 1
     Answer RRs: 1
     Authority RRs: 5
     Additional RRs: 5
   ∨ Queries
     ∨ www.baidu.com: type A, class IN
         Name: www.baidu.com
         [Name Length: 13]
         [Label Count: 3]
         Type: A (Host Address) (1)
         Class: IN (0x0001)
   ∨ Answers
     > www.baidu.com: type CNAME, class IN, cname www.a.shifen.com
   ∨ Authoritative nameservers
     > a.shifen.com: type NS, class IN, ns ns4.a.shifen.com
     > a.shifen.com: type NS, class IN, ns ns1.a.shifen.com
     > a.shifen.com: type NS, class IN, ns ns2.a.shifen.com
     > a.shifen.com: type NS, class IN, ns ns5.a.shifen.com
     > a.shifen.com: type NS, class IN, ns ns3.a.shifen.com
   ∨ Additional records
     > ns1.a.shifen.com: type A, class IN, addr 110.242.68.42
     > ns2.a.shifen.com: type A, class IN, addr 220.181.33.32
     > ns3.a.shifen.com: type A, class IN, addr 112.80.255.253
     > ns4.a.shifen.com: type A, class IN, addr 14.215.177.229
     > ns5.a.shifen.com: type A, class IN, addr 180.76.76.95
```

(11) Client pick one authority name sever of 'a.shifen.com.', send a new DNS query (rd flag is 0) about about 'A' type of 'www.a.shifen.com' which is the CNAME of "www.baidu.com" to it.


```
         11 0.452526  10.17.88.224         110.242.68.42    DNS      76 Standard query 0x96b8 A www.a.shifen.com
<
> Frame 11: 76 bytes on wire (608 bits), 76 bytes captured (608 bits) on interface \Device\NPF
> Ethernet II, Src: IntelCor_
> Internet Protocol Version 4, Src: 10.17.88.224, Dst: 110.242.68.42
> User Datagram Protocol, Src Port: 12000, Dst Port: 53
v Domain Name System (query)
       Transaction ID: 0x96b8
  > Flags: 0x0020 Standard query
       Questions: 1
       Answer RRs: 0
       Authority RRs: 0
       Additional RRs: 0
  v Queries
     v www.a.shifen.com: type A, class IN
          Name: www.a.shifen.com
          [Name Length: 16]
          [Label Count: 4]
          Type: A (Host Address) (1)
          Class: IN (0x0001)
       [Response In: 12]
```

(12) Client received the response message which includes the 'A' type answer from the authority name sever of 'a.shifen.com.', this answer is the final answer of the original query.


```
         12 0.507121  110.242.68.42        10.17.88.224     DNS      2… Standard query response 0x96b8 A www.a.shifen.com A 182.61.200.6 A 1
<
> Frame 12: 278 bytes on wire (2224 bits), 278 bytes captured (2224 bits) on interface \Device\NPF_{/
> Ethernet II, Src: JuniperN_
> Internet Protocol Version 4, Src: 110.242.68.42, Dst: 10.17.88.224
> User Datagram Protocol, Src Port: 53, Dst Port: 12000
v Domain Name System (response)
     Transaction ID: 0x96b8
  > Flags: 0x8400 Standard query response, No error
     Questions: 1
     Answer RRs: 2
     Authority RRs: 5
     Additional RRs: 5
  v Queries
     v www.a.shifen.com: type A, class IN
          Name: www.a.shifen.com
          [Name Length: 16]
          [Label Count: 4]
          Type: A (Host Address) (1)
          Class: IN (0x0001)
  v Answers
     > www.a.shifen.com: type A, class IN, addr 182.61.200.6
     > www.a.shifen.com: type A, class IN, addr 182.61.200.7
  > Authoritative nameservers
  > Additional records
     [Request In: 11]
```

iterative: answer数不为0就停止.