Introduction to Web Science

Assignment 3

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Tutorial on: November 18, 2016, 12:00 p.m.

The main objective of this assignment is for you understand different concepts that are associated with the "Web". In this assignment we cover two topics: 1) DNS & 2) Internet.

These tasks are not always specific to "Introduction to Web Science". For all the assignment questions that require you to write a code, make sure to include the code in the answer sheet, along with a separate python file. Where screen shots are required, please add them in the answers directly and not as separate files.

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1 DIG Deeper (5 Points)

Assignment 1 started with you googling certain basic tools and one of them was "*dig*".

1. Now using that dig command, find the IP address of `www.uni-koblenz-landau.de`
2. In the result, you will find "SOA". What is SOA?
3. Copy the SOA record that you find in your answer sheet and explain each of the components of SOA with regards to your find. Merely integrating answers from the internet wont fetch you points.

Try the experiment once from University network and once from Home network and see if you can find any differences and if so, clarify why.

Answers:

1. 141.26.200.8
2. The SOA is a abbreviation for *State Of Authority* and defines how to handle zone transfers, which synchronize data in a DNS name server cluster.
3. a) `uni-koblenz-landau.de.` is the owner name (in this case the parent domain of `www.uni-koblenz-landau.de.`), the dot at the end indicates a FQDN (fully qualified domain name)

   b) `3600` is the duration a resolver may cache the record

   c) `IN` the class of the record, Internet in this case

   d) `dnsvw01.uni-koblenz-landau.de.` is the FQDN of the name server which is authoritatively responsible for the queried domain

   e) `root.dnsvw01.uni-koblenz-landau.de.` is the email address to be used for reporting errors. As the @ has another purpose in the zone file, the @ is replaced by a dot. Therefore `root.dnsvw01.uni-koblenz-landau.de` is `root@dnsvw01.uni-koblenz-landau.de`

   f) `2016110401` Is the serial number which gets increased every time the zone file is updated. Here the serial number consists of 10 digits, which indicates that the BIND implementation is used. A convention is to use date based serial numbers followed by a sequential two digit number. Therefore this zone file has last been updated once on the fourth of November in 2016.

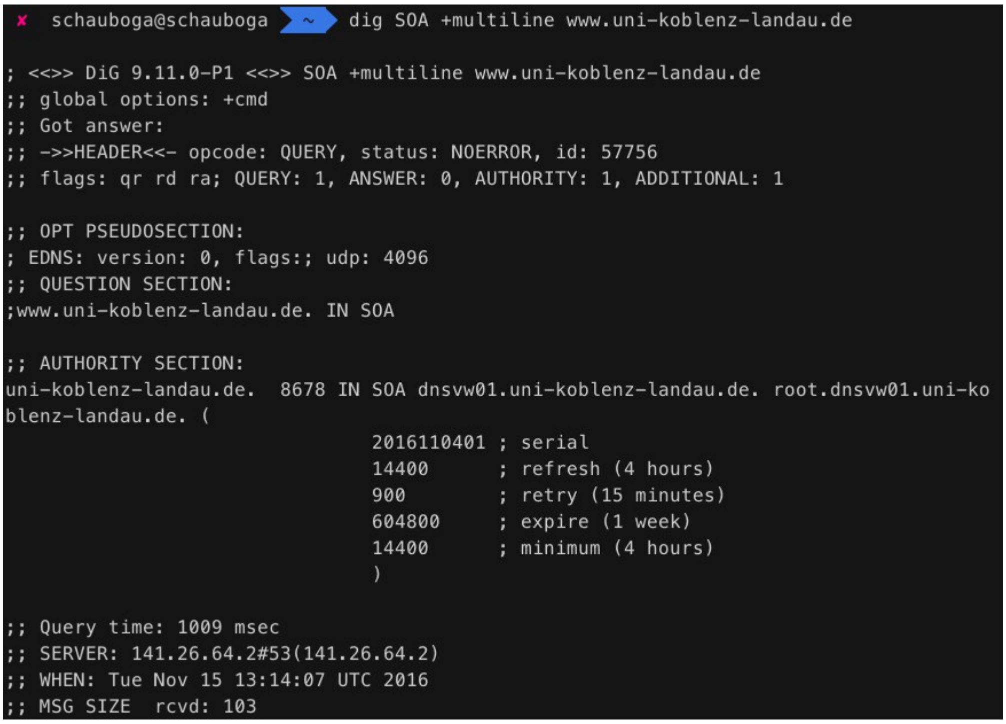
   g) `14400` Is the refresh rate in seconds a slave DNS server will try to refresh the zone file with the one from the master. 4 hours in this case.

   h) `900` Defines how long (15 minutes) a slave DNS server should wait to retry a refresh if it fails to reach the its master.

i) `604800` Is the time (1 week) the zone file is authoritative. A slave server doesn't respond to queries if the zone file is expired.

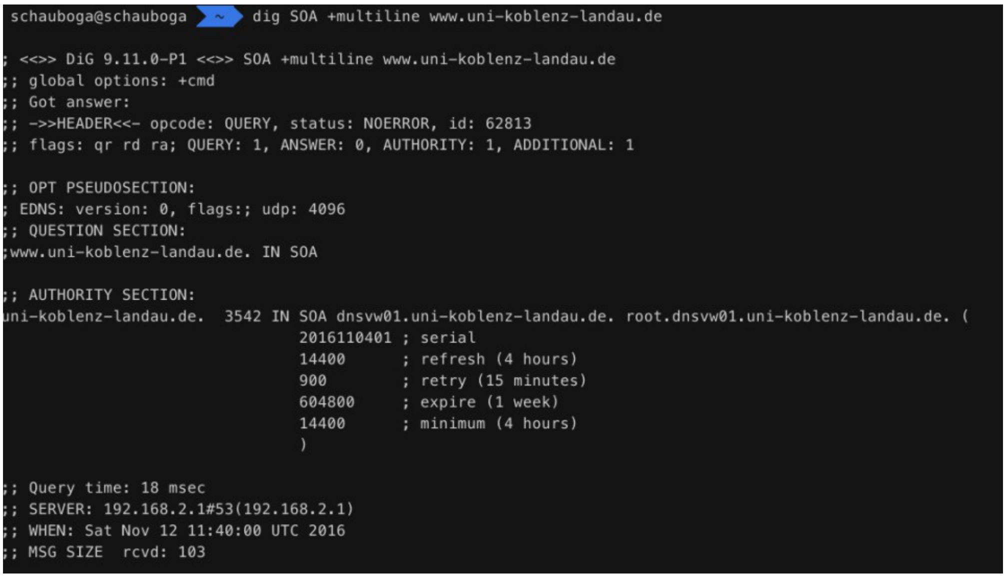
j) `14400` Is the negative caching time (4 hours). This negative caching time defines how long an unresolved name query is answered with a negative answer from the cache.

As seen in **??** and **??** there is now difference in the SOA records.



```
✘ schauboga@schauboga  ~  dig SOA +multiline www.uni-koblenz-landau.de

; <<>> DiG 9.11.0-P1 <<>> SOA +multiline www.uni-koblenz-landau.de
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 57756
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.uni-koblenz-landau.de. IN SOA

;; AUTHORITY SECTION:
uni-koblenz-landau.de.  8678 IN SOA dnsvw01.uni-koblenz-landau.de. root.dnsvw01.uni-ko
blenz-landau.de. (
                                2016110401 ; serial
                                14400      ; refresh (4 hours)
                                900        ; retry (15 minutes)
                                604800     ; expire (1 week)
                                14400      ; minimum (4 hours)
                                )

;; Query time: 1009 msec
;; SERVER: 141.26.64.2#53(141.26.64.2)
;; WHEN: Tue Nov 15 13:14:07 UTC 2016
;; MSG SIZE  rcvd: 103
```

Figure 1: dig SOA @ university



```
schauboga@schauboga  ~  dig SOA +multiline www.uni-koblenz-landau.de

; <<>> DiG 9.11.0-P1 <<>> SOA +multiline www.uni-koblenz-landau.de
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 62813
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.uni-koblenz-landau.de. IN SOA

;; AUTHORITY SECTION:
uni-koblenz-landau.de.  3542 IN SOA dnsvw01.uni-koblenz-landau.de. root.dnsvw01.uni-koblenz-landau.de. (
                                2016110401 ; serial
                                14400      ; refresh (4 hours)
                                900        ; retry (15 minutes)
                                604800     ; expire (1 week)
                                14400      ; minimum (4 hours)
                                )

;; Query time: 18 msec
;; SERVER: 192.168.2.1#53(192.168.2.1)
;; WHEN: Sat Nov 12 11:40:00 UTC 2016
;; MSG SIZE  rcvd: 103
```

Figure 2: dig SOA @ home

2 Exploring DNS (10 Points)

In the first part of this assignment you were asked to develop a simple TCP Client Server. Now, using **that** client server setup. This time a url should be send to the server and the server will split the url into the following:

`http://www.example.com:80/path/to/myfile.html?key1=value1&key2=value2#InTheDocument`

1. Protocol
2. Domain
3. Sub-Domain
4. Port number
5. Path
6. Parameters
7. Fragment

The Protocol for sending the URL will be a string terminated with \r \n.

P.S.: You are **not** allowed to use libraries like `urlparse` for this question. You will also not use "Regular Expressions" for this.

Answer:

```

# coding: utf-8

# In[ ]:

#!/usr/bin/python

import socket

IP = '127.0.0.1'
PORT = 8080
BUFFER_SIZE = 1

client_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
client_socket.connect((IP, PORT))
try:
    url = input('URL: ')+'\r\n'
    data=url.encode('UTF-8')
    client_socket.sendall(data)
finally:
    client_socket.close()
```

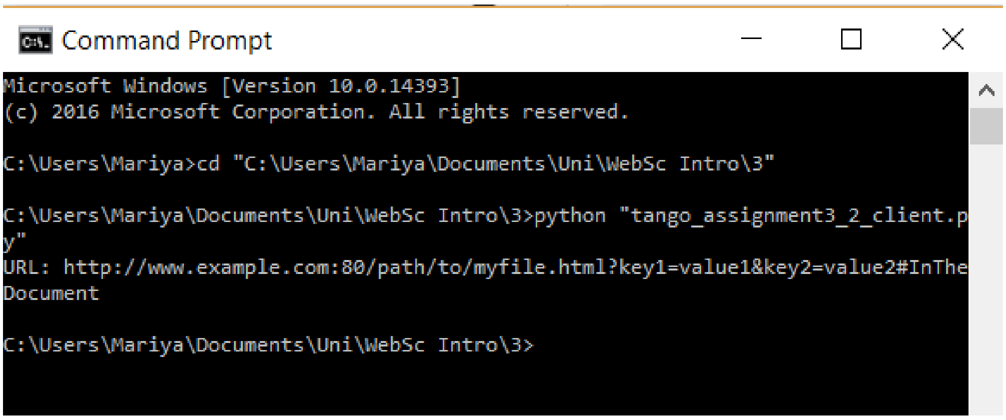


Figure 3: TCP client in action

```

# coding: utf-8

# In[ ]:

#!/usr/bin/python
import socket

IP = '127.0.0.1'
PORT = 8080
BUFFER_SIZE = 1

server_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
server_socket.bind((IP, PORT))
server_socket.listen(1)
connection, address = server_socket.accept()
data = ''
def parseUrl (url):

    protocol_rest=url.split('://')

    dict_url={}
    dict_url['protocol']=protocol_rest[0]
    host_rest=protocol_rest[1].split('/',1)

    port='Undefined'
    domains=host_rest[0]
    if ':' in domains:
        port_split=domains.split(':')
        domains=port_split[0]
        port=port_split[1]
    dict_url['port']=port
    domain_split=domains.split('.')
```

```
    subdomain='Undefined'
    domain=''

    if (len(domain_split)!=2):
        domain_parts=domains.split('.',1)
        subdomain=domain_parts[0]
        domain=domain_parts[1]
    else:
        domain=domains
    dict_url['subdomain']=subdomain
    dict_url['domain']=domain

    path_rest=host_rest[1]
    fragment='Undefined'
    if '#' in path_rest:
        rest_fragment=path_rest.split('#')
        path_rest=rest_fragment[0]
        fragment=rest_fragment[1]
    dict_url['fragment']=fragment

    path=''
    parameters='Undefined'
    if '?' in path_rest:
        path_parameters=path_rest.split('?')
        path=path_parameters[0]
        parameters=path_parameters[1]
    else:
        path=path_rest
    dict_url['path']=path
    dict_url['parameters']=parameters
    return dict_url

try:
    while True:
        buffer = connection.recv(BUFFER_SIZE)
        data += buffer.decode('UTF-8')
        if not buffer:
            dict = parseUrl(data)
            print('Protocol: %s' % dict['protocol'])
            print('Domain: %s' % dict['domain'])
            print('Sub-Domain: %s' % dict['subdomain'])
            print('Port number: %s' % dict['port'])
            print('Path: %s' % dict['path'])
            print('Parameters: %s' % dict['parameters'])
            print('Fragment: %s' % dict['fragment'])
            break
finally:
    server_socket.close()
```

Command Prompt

```
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Users\Mariya>cd "C:\Users\Mariya\Documents\Uni\WebSc Intro\3"

C:\Users\Mariya\Documents\Uni\WebSc Intro\3>python "tango_assignment3_2_server.p
y"
Protocol: http
Domain: example.com
Sub-Domain: www
Port number: 80
Path: path/to/myfile.html
Parameters: key1=value1&key2=value2
Fragment: InTheDocument


C:\Users\Mariya\Documents\Uni\WebSc Intro\3>
```

Figure 4: TCP server in action

3 DNS Recursive Query Resolving (5 Points)

You have solved the "Routing Table" question in Assignment 2. We updated the routing tables once more. resulting in the following tables creating the following topology

Table 1: Routing Table

Router1			Router2			Router3		
Destination	Next Hop	Interface	Destination	Next Hop	Interface	Destination	Next Hop	Interface
67.0.0.0	67.68.3.1	eth 0	205.30.7.0	205.30.7.1	eth 0	205.30.7.0	205.30.7.2	eth 0
62.0.0.0	62.4.31.7	eth 1	156.3.0.0	156.3.0.6	eth 1	88.0.0.0	88.6.32.1	eth 1
88.0.0.0	88.4.32.6	eth 2	26.0.0.0	26.3.2.1	eth 2	25.0.0.0	25.03.1.2	eth 2
141.71.0.0	141.71.20.1	eth 3	141.71.0.0	141.71.26.3	eth 3	121.0.0.0	121.0.3.1	eth 3
26.0.0.0	141.71.26.3	eth3	67.0.0.0	141.71.20.1	eth 3	156.3.0.0	205.30.7.1	eth 0
156.3.0.0	88.6.32.1	eth 2	62.0.0.0	141.71.20.1	eth 3	26.0.0.0	205.30.7.1	eth 0
205.30.7.0	141.71.26.3	eth 3	88.0.0.0	141.71.20.1	eth 3	141.71.0.0	205.30.7.1	eth 0
25.0.0.0	88.6.32.1	eth 2	25.0.0.0	205.30.7.2	eth 0	67.0.0.0	88.4.32.6	eth 1
121.0.0.0	88.6.32.1	eth 2	121.0.0.0	205.30.7.2	eth 0	62.0.0.0	88.4.32.6	eth 1

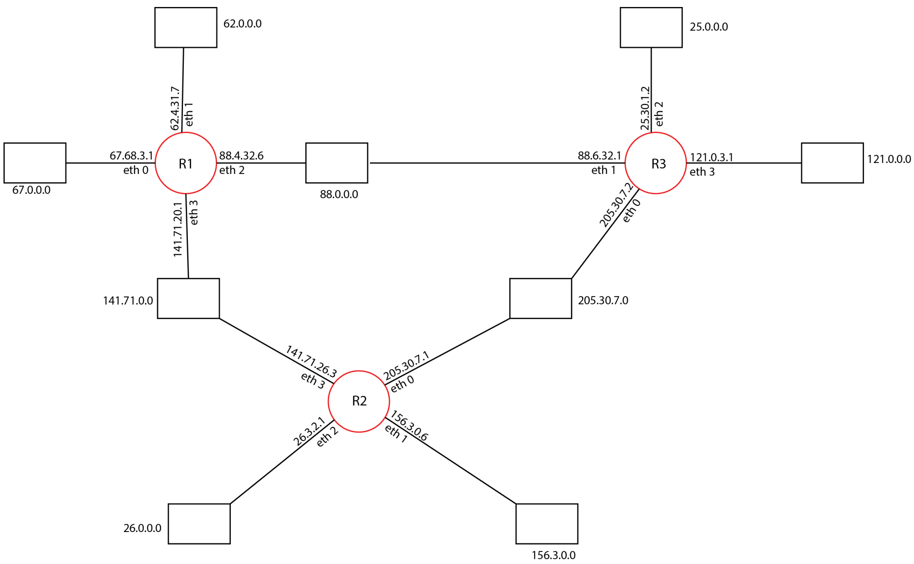


Figure 5: DNS Routing Network

Let us asume a client with the following ip address 67.4.5.2 wants to resolve the following domain `subdomain.webscienceexampledomain.com` using the DNS.

You can further assume the root name server has the IP address of 25.8.2.1 and the name-server for `webscienceexampledomain.com` has the IP address 156.3.20.2. Finally the sub-domain is handled by a name server with the IP of 26.155.36.7.

Please explain how the traffic flows through the network in order to resolve the recursive DNS query. You can assume ARP tables are cached so that no ARP-requests have to be made.

Hint: You can start like this:

67.4.5.2 creates an IP packet with the source address XXXXXX an destination address YYYYY inside there is the DNS request. This IP packet is send as an ethernet frame to ZZZZZ. ZZZZZ receives the frame and forwards the encapsulated IP packet to ....

Also you can assume the DNS requests and responses will fit inside one IP packet. You also don't have to write down the specific DNS requests and responses in hex.

Important Notes

Submission

- Solutions have to be checked into the github repository. Use the directory name `groupname/assignment3/` in your group's repository.
- The name of the group and the names of all participating students must be listed on each submission.
- Solution format: all solutions as *one* PDF document. Programming code has to be submitted as Python code to the github repository. Upload *all* `.py` files of your program! Use `UTF-8` as the file encoding. *Other encodings will not be taken into account!*
- Check that your code compiles without errors.
- Make sure your code is formatted to be easy to read.
  - Make sure you code has consistent indentation.
  - Make sure you comment and document your code adequately in English.
  - Choose consistent and intuitive names for your identifiers.
- Do *not* use any accents, spaces or special characters in your filenames.

Acknowledgment

This latex template was created by Lukas Schmelzeisen for the tutorials of "Web Information Retrieval".

LaTeX

Currently the code can only be build using LuaLaTeX, so make sure you have that installed. If on Overleaf, there's an error, go to settings and change the LaTeXengine to `LuaLaTeX`.