

Network Programming in Python

Prepared by Dr. Hamada I. AbdulWakel

Lecture 7



Domain Name System

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RECAP: LECTURE 6

- Broadcasting client/server model.
- Securing Sockets and SSL module.

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LECTURE MAIN POINTS

- Domain Name System (DNS).
- DNS module in Python.
- The `getaddrinfo()` method.

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NAME RESOLUTION

- Although TCP/IP uses IP addresses to locate and connect to hosts, users typically prefer to use friendly names.



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NAME RESOLUTION

Cont'd



- **Name resolution systems** provide the translation between alphanumeric names and numerical addresses.

NAME RESOLUTION

Cont'd

- There are two common methods for implementing name resolution:
 - A **static file** on each host on the network, containing all the name-to-address translations.
 - Like HOSTS file in Windows/Linux.
 - If a change occurs, every device's HOSTS file must be updated.
 - A **centralized server** that all hosts on the network connect to for name resolution.
 - All devices point to this centralized DNS server for name resolution, ensuring that changes only need to occur in one place.

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DOMAIN NAME SYSTEM

- **DNS** is used on the Internet to provide a standard naming convention for locating IP-based computers.
- **DNS servers:** connected servers have powerful computing resources, storing data, and providing IP addresses for requested domains.
- On Windows/Linux
 - **NOTE:** IP may vary
`nslookup google.com`

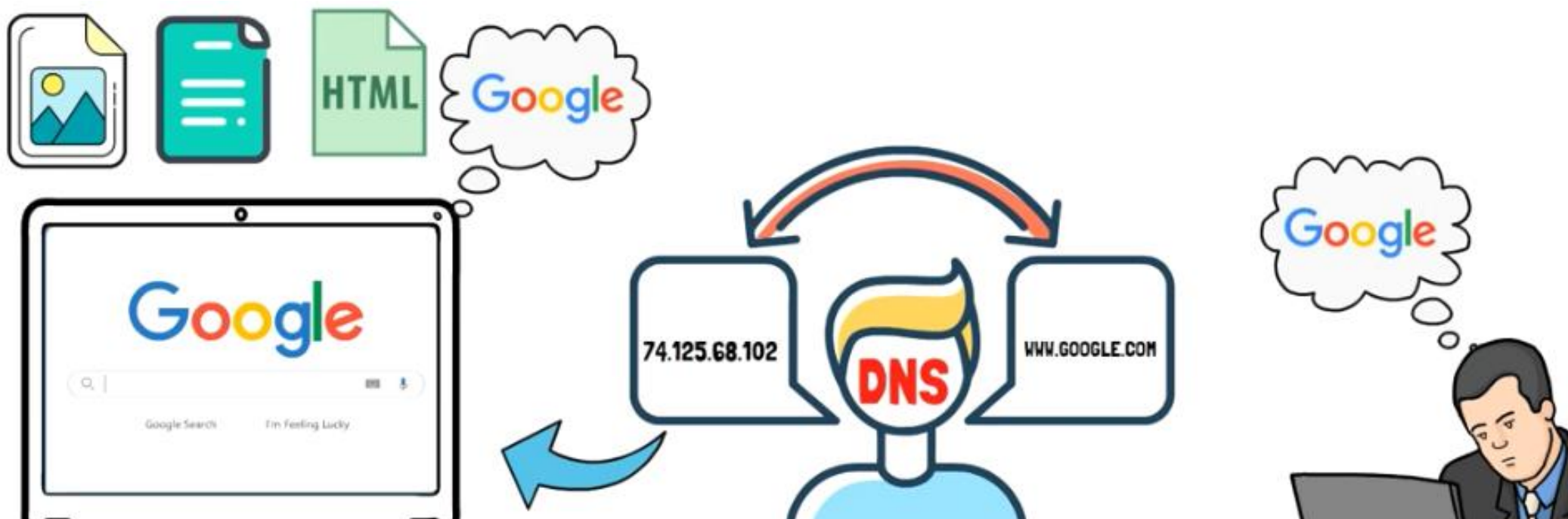
```
drhamada@drhamada-Latitude-E6520:~$ nslookup google.com
Server:          127.0.0.53
Address:         127.0.0.53#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.200.206
Name:   google.com
Address: 2a00:1450:4006:80c::200e
```

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DOMAIN NAME SYSTEM

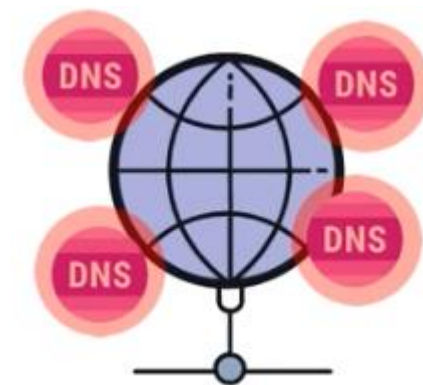
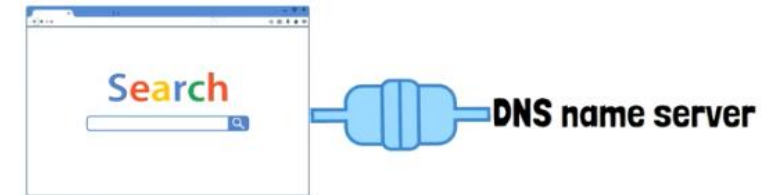


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DNS SERVERS

- There are four types of DNS servers:
 - **DNS Resolver:**
 - Provided by Internet Service Provider (ISP).
 - Connects machines with DNS name server.
 - **Root Name Server (RNS):**
 - Identical 13 DNS servers around the world.
 - Keep tracking of new added domains names.



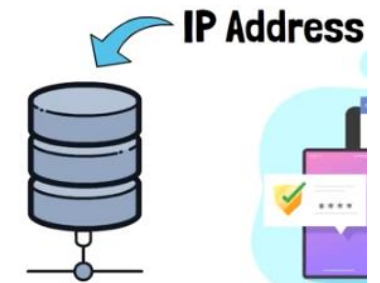
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DNS SERVERS

Cont'd

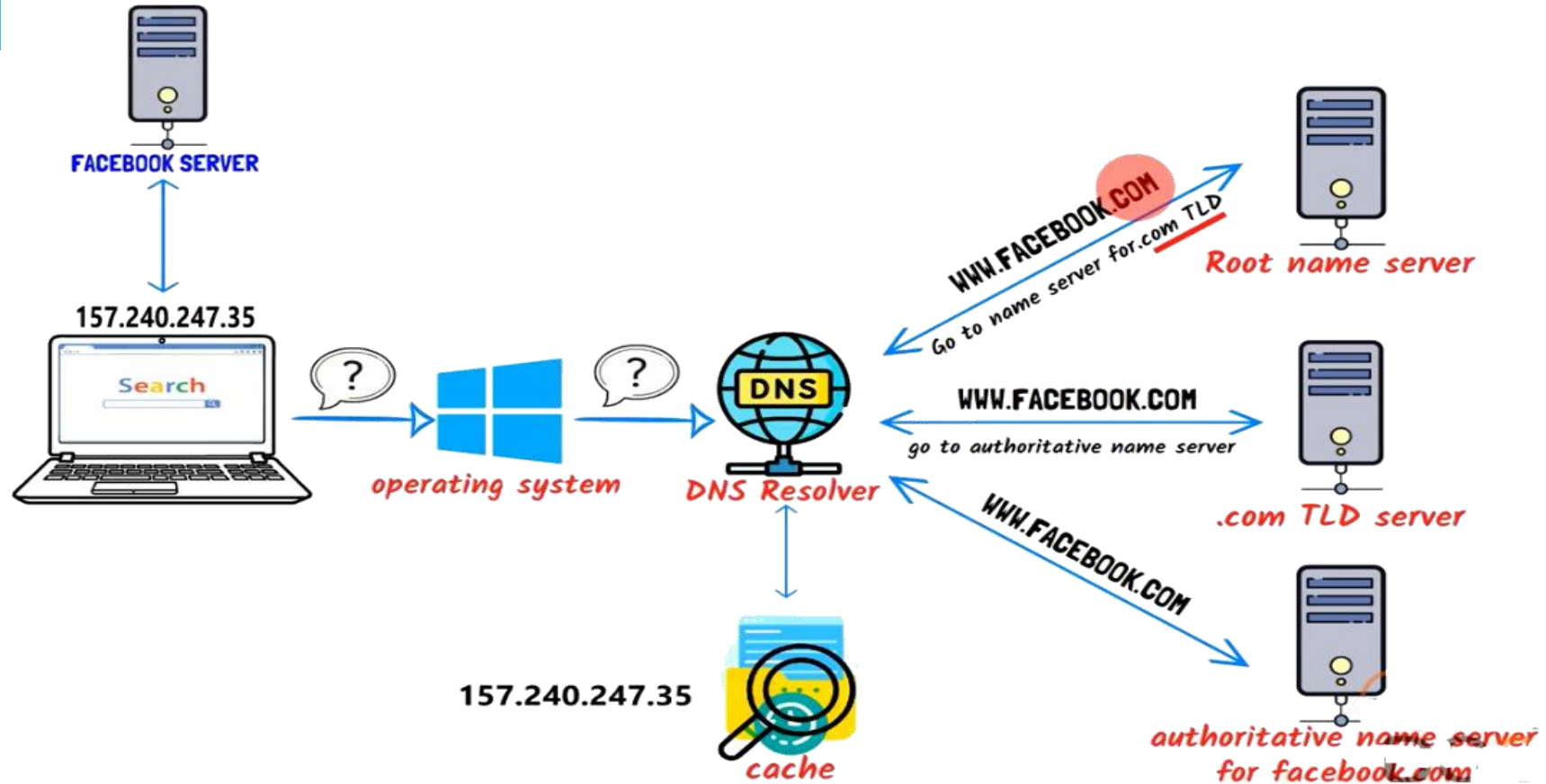
- There are four types of DNS servers:
 - **Top-level Domain Server (TLD):**
 - Stores all domain names with the same extension.
 - Domain extensions like .com, .net, .info, .org, .edu,
 - Extension together with country code like ae form the set of possible suffixes for valid domain names.
 - **Authoritative Name Server (ANS):**
 - Stores the IP address of the requested website.
 - Ensures if the user has the permissions to access IP or not.



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INTERNAL WORK OF DNS



INTERNAL WORK OF DNS

Cont'd

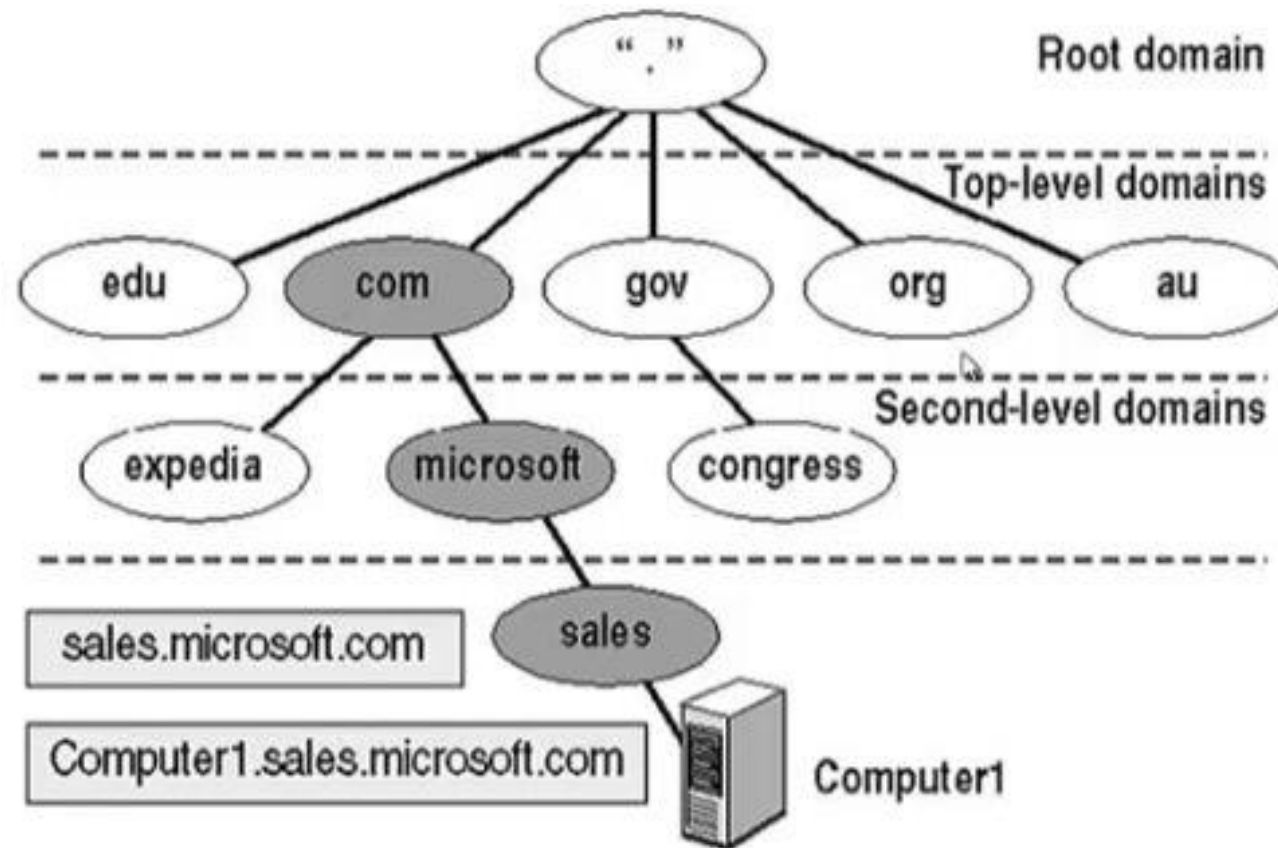
- Writing a website URL, browsers does not understand it, it needs IP address, So:
 - Browser sends a query to OS which forwards it to the DNS resolver.
 - DNS resolver checks if it has the requested IP in its cache or not.
 - If it is in the cache, it gets IP address and sends it back to the browser.
 - If not, the query will be sent to the RNS which checks for the domain extension and sends back the IP address for the corresponding TLD.
 - The DNS resolver query the given TLD to get the IP address for the authoritative name server, which contains the IP address for the requested website.

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INTERNAL WORK OF DNS

Cont'd



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INTERNAL WORK OF DNS

Cont'd

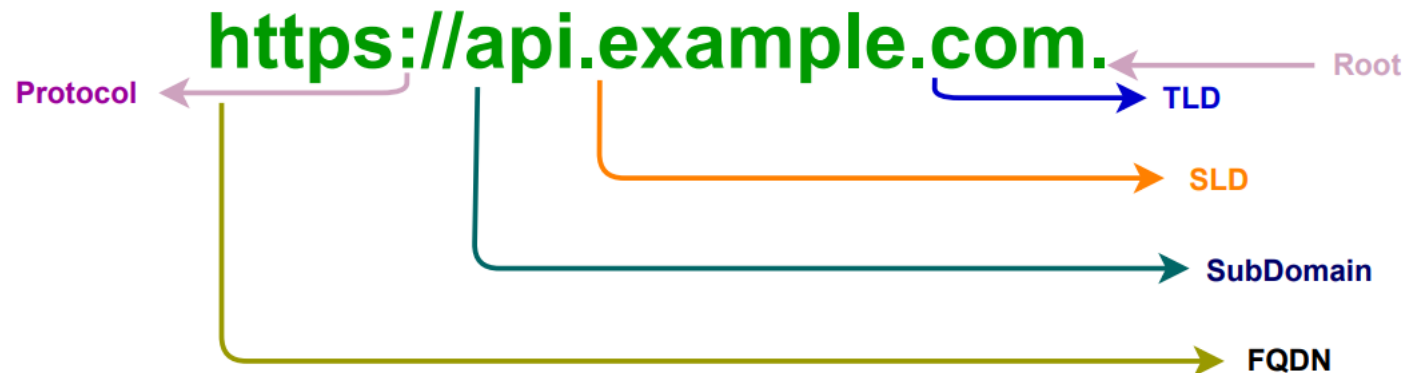
- The naming system on which DNS is based is a hierarchical and logical tree structure called **the domain namespace**.
- Every node in the DNS domain tree can be identified by a fully qualified domain name (FQDN).
- To allow computers to properly recognize a fully qualified domain name:
 - Dots are placed between each part of the name.
 - All resolvers start their lookups at the root.
 - The resolver navigates its way down the tree until it gets to the left-most part of the domain name.

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FULLY QUALIFIED DOMAIN NAME

- Fully qualified domain name (FQDN): names an internet site or host by appending its organization's full domain name to the name of a particular machine in that organization.



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DNS RECORD INFORMATION

- **A:** used for converting domain name to IPv4 address.
- **AAAA:** used for converting domain name to IPv6 host address.
- **PTR (Pointer)** : used for converting IP to a domain name.
- **CNAME (Canonical Name):** used to map a domain name as an alias for another domain.
- **MX (Mail eXchanger):** specifies a mail server responsible for accepting email messages on behalf of a recipient's domain.
- **NS (Name Server):** gives a name for each group of servers used in a domain.
- **TXT (Descriptive Text):** lets the administrator insert into the DNS record.

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DNS RECORD INFORMATION

Cont'd

- Install DNS corresponding module.

- In Windows:

```
python -m pip install dnspython3
```

- In Linux:

```
pip install dnspython3
```

```
python3 -m pip install dnspython3
```

- Do not name your code file with **dns.py**, because the import statement will give more errors.

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DNS RECORD INFORMATION

Cont'd

- Code:

```
import dns.resolver as dns
def lookup(name):
    NSrecord = dns.query(name, 'NS')
    for ns in NSrecord:
        print(ns)
```

```
lookup('google.com')
lookup('matrix219.com')
```

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DNS RECORD INFORMATION

Cont'd

- Code:

```
import dns.resolver
def lookup(name):
    for qtype in 'A', 'AAAA', 'CNAME', 'MX', 'NS':
        answer = dns.resolver.query(name, qtype, raise_on_no_answer=False)
        for val in answer:
            print(val)

lookup('google.com')
```

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SOCKETS WITH GETADDRINFO METHOD

- The `getaddrinfo()` uses the DNS protocol to talk to your name servers, which are configured using their IP address.
- The `getaddrinfo()` method returns a list of tuples - `[((), ()), ...]` - for a given network service with which socket objects can be created to connect to that service.

```
socket.getaddrinfo(host, port, family=0, type=0, proto=0, flags=0)
```

SOCKETS WITH GETADDRINFO METHOD

Cont'd

```
socket.getaddrinfo(host, port, family=0, type=0, proto=0, flags=0)
```

- Host: IP address or host name.
- Port: could be a number or service name like http and www.
- Family: IP version.
- Type: Stream or Datagram.
- Proto: TCP or UDP.
- Flags: used for filtering the addresses.

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SOCKETS WITH GETADDRINFO METHOD

Cont'd

- Code.

```
import socket
infolist = socket.getaddrinfo('google.com', 'www')
print(infolist)
info = infolist[0]
print(*info[0:2])
sok = socket.socket(*info[0:2])
print(info[4])
sok.connect(info[4])
```

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CLIENT/SERVER USING GETADDRINFO METHOD

- If you want an address to provide to `bind()`, then you will call `getaddrinfo()` with `None` as the hostname.

```
Infolist = socket.getaddrinfo(None, 'www', socket.AF_INET)
```

CLIENT/SERVER USING GETADDRINFO METHOD

Cont'd

- Code: the server.

```
import socket
infolist = socket.getaddrinfo(None, 'www', socket.AF_INET)
info = infolist[0]
soc = socket.socket(*info[0:2])
soc.bind(info[4]); soc.listen();
con, addr = soc.accept()
con.send("Server: Hello".encode())
msg = con.recv(1024).decode()
print(msg)
```

CLIENT/SERVER USING GETADDRINFO METHOD

Cont'd

- Code: the client.

```
import socket
infolist = socket.getaddrinfo(None, 'www', socket.AF_INET)
info = infolist[0]
soc = socket.socket(*info[0:2])
soc.connect(info[4])
msg = soc.recv(1024).decode()
print(msg)
soc.send("client: I received your msg".encode())
```

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SOCKETS FILTERS

- To able to use `AF_INET6` with socket object, you should first test if the python supports IPv6 by checking the `has_ipv6`.

```
print(socket.has_ipv6)
```

- Using the `getaddrinfo()` with `AI_ADDRCONFIG` flag, will filter out any IPv6 addresses that are impossible for your computer to reach.
- If the service that you are connecting supports only IPv4, you will also want to specify `AI_V4MAPPED` to return the IPv4 addresses.

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SOCKETS FILTERS

Cont'd

- Code:

```
import socket
print(socket.getaddrinfo('fedoraproject.org', 'ftp')
print(socket.getaddrinfo('fedoraproject.org',
                           'ftp',
                           socket.AF_INET,
                           socket.SOCK_STREAM,
                           0,
                           socket.AI_ADDRCONFIG |
                           socket.AI_V4MAPPED))
```

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QUESTIONS FOR ONLINE DISCUSSION

- Try to modify the `getaddrinfo()` client/server program to allow the server to accept multiple clients.



Thank You

