

# Network Programming in Python

Prepared by Dr. Hamada I. AbdulWakel

## Lecture 7





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الجميع الذكية  
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# Domain Name System

## Lecture 7

Prepared by  
**Dr. Hamada I. AbdulWakel**

[www.midocean.ae](http://www.midocean.ae)

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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.

## NAME RESOLUTION

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



# 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.

## 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`

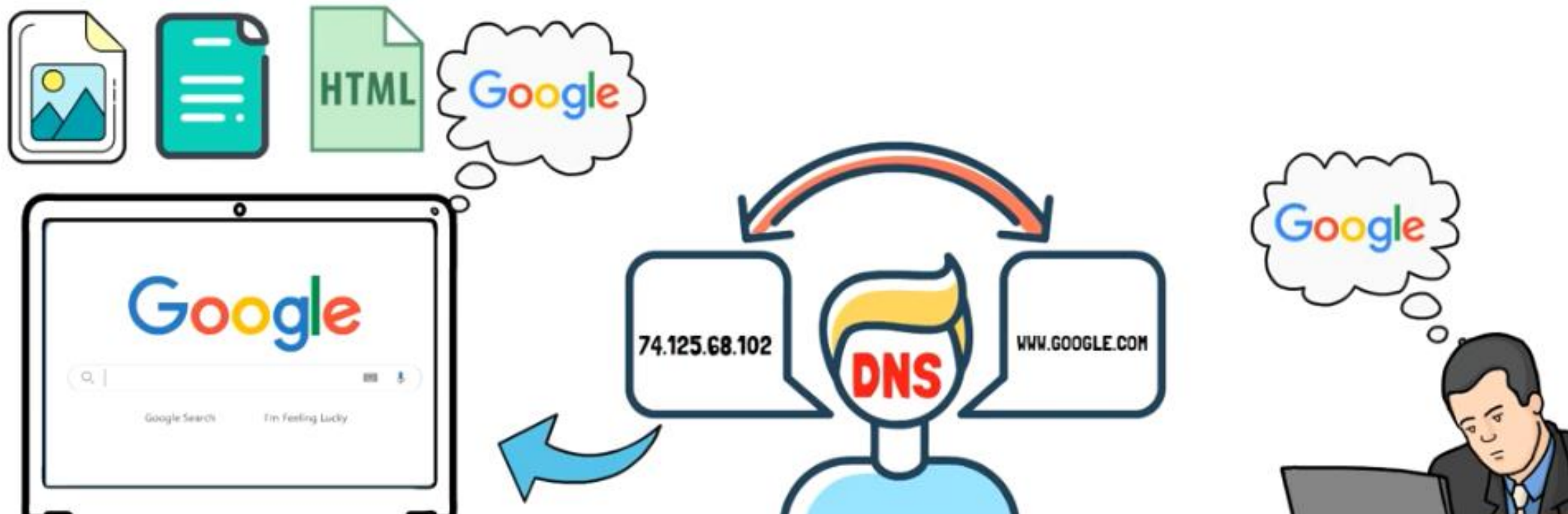
```
drhamada@drhamada-Latitude-E6520:~$ nslookup google.com
Server:                127.0.0.53
Address:               127.0.0.53#53

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

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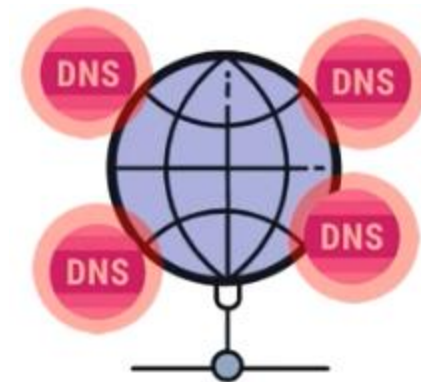
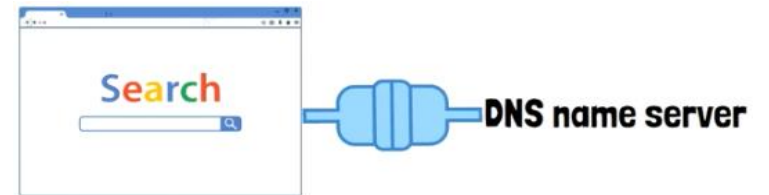
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# DOMAIN NAME SYSTEM



## DNS SERVERS

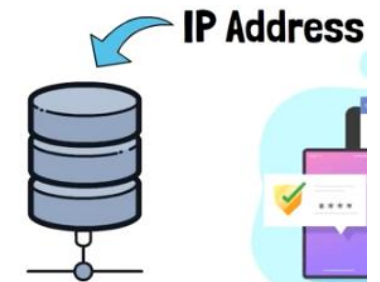
- There are four types of DNS servers:
  - **DNS Resolver:**
    - Provided by Internet Service Provider (ISP).
    - Connects machines with DNS name server.
  - **Root Name Server (RNS):**
    - Identical 13 DNS servers around the world.
    - Keep tracking of new added domains names.



## DNS SERVERS

Cont'd

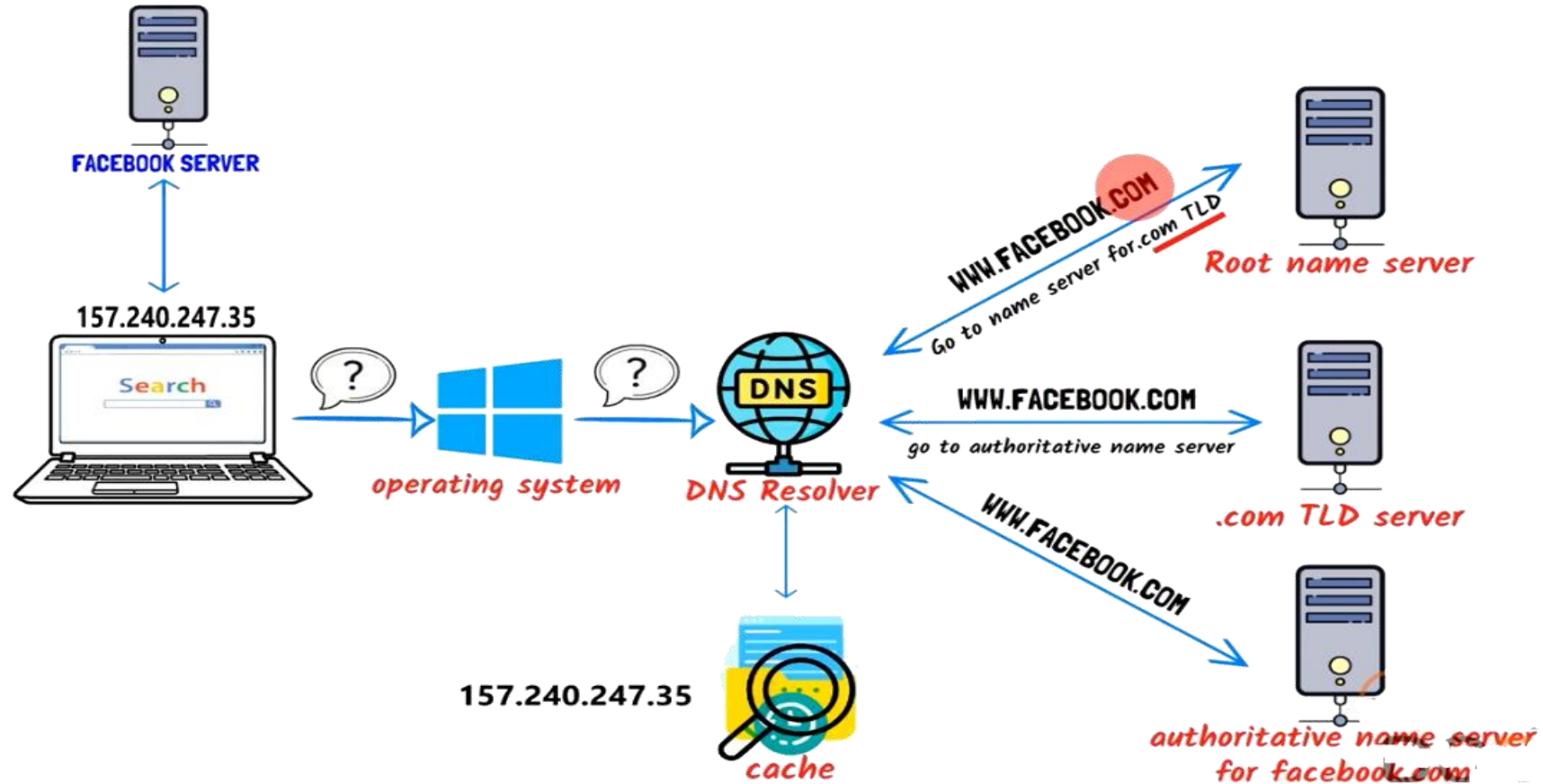
- There are four types of DNS servers:
  - **Top-level Domain Server (TLD):**
    - Stores all domain names with the same extension.
      - Domain extensions like .com, .net, .info, .org, .edu, .....
      - Extension together with country code like ae form the set of possible suffixes for valid domain 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



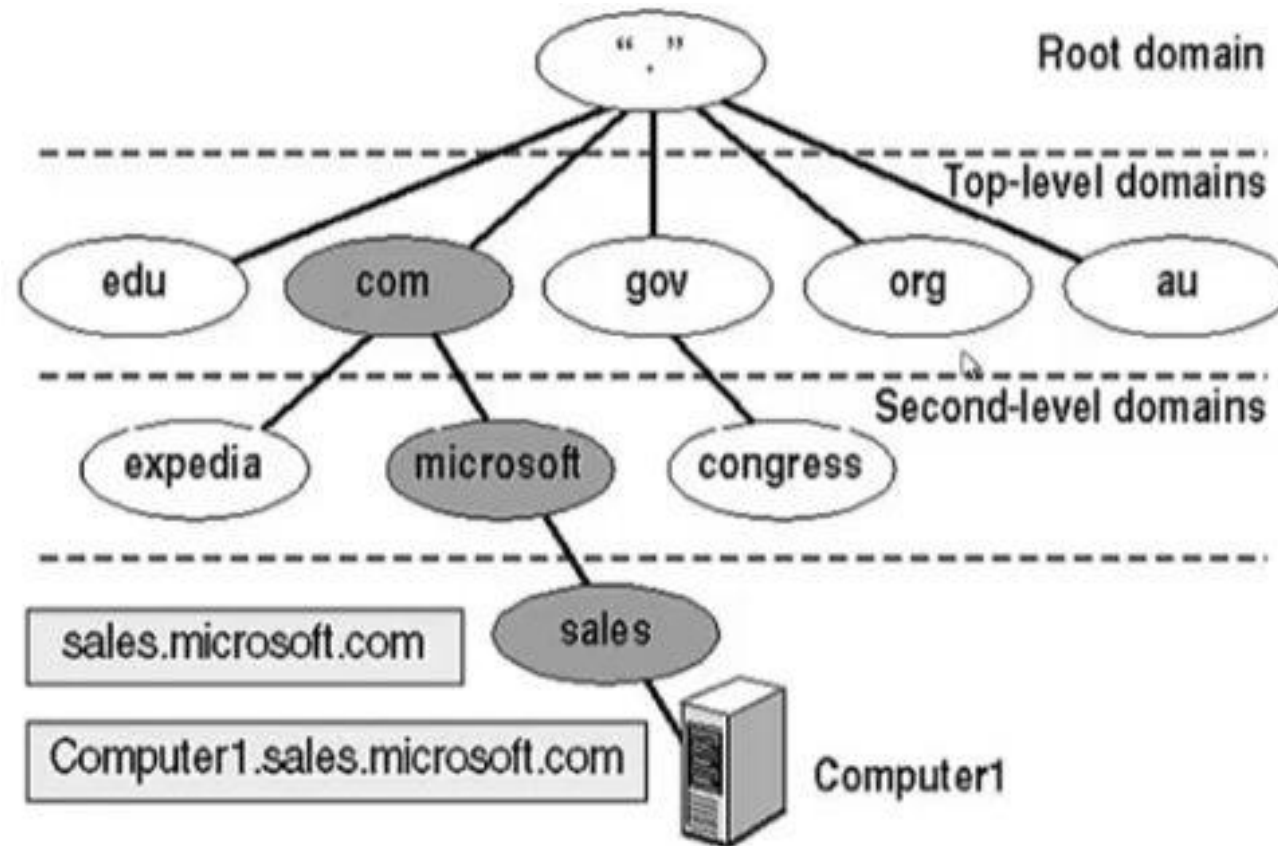
## INTERNAL WORK OF DNS

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.

## INTERNAL WORK OF DNS

Cont'd



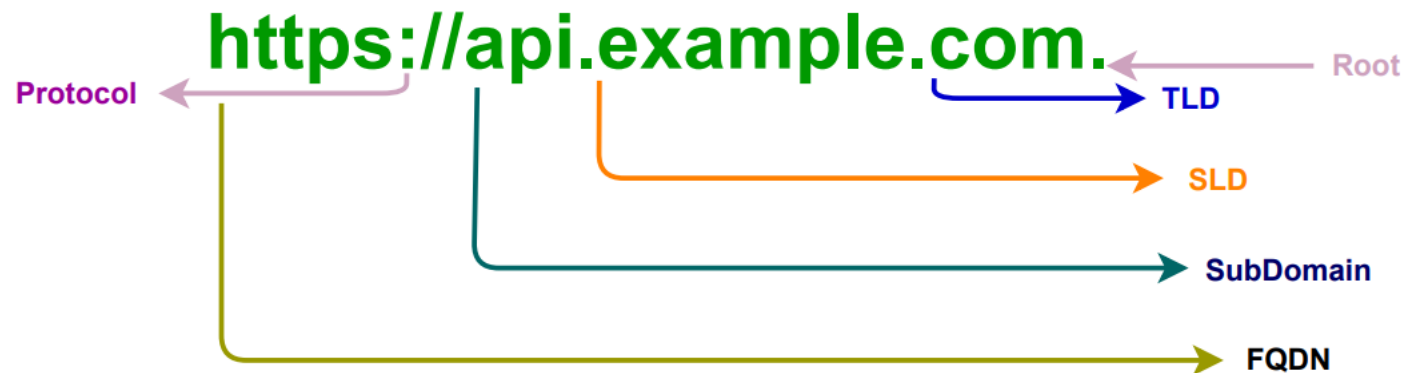
## INTERNAL WORK OF DNS

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.

## 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.



## 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.

## 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.

## 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')
```

## 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')
```

## 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.

# 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())
```

## 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.

## 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.



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Thank You

