

# Computer Network

## Lecture-45

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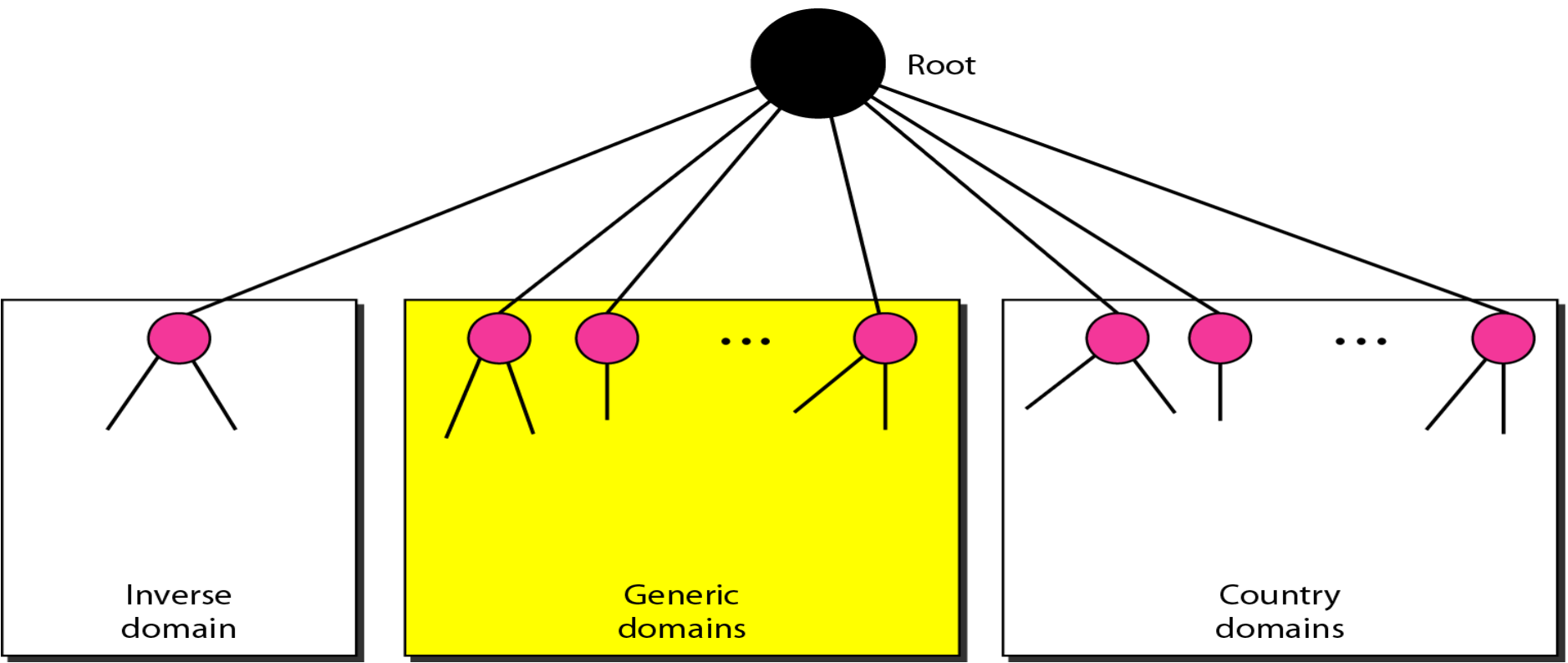
United College of Engineering and Research,

Prayagraj

# Domain Name System(DNS)

## DNS IN THE INTERNET

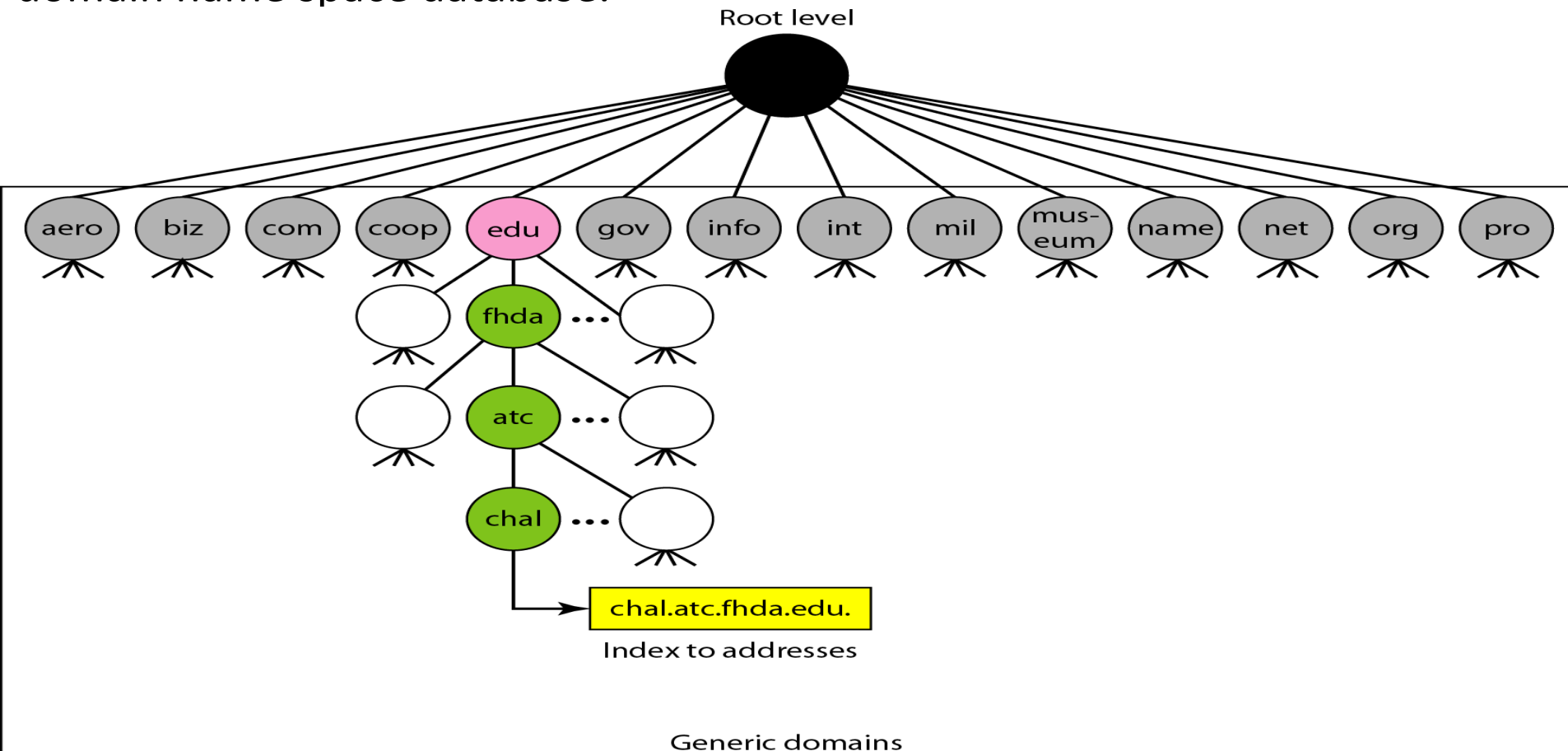
- DNS is a protocol that can be used in different platforms.
- In the Internet, the domain name space (tree) is divided into three different sections: generic domains, country domains, and the inverse domain.



# Domain Name System(DNS)

## Generic Domains

The generic domains define registered hosts according to their generic behavior. Each node in the tree defines a domain, which is an index to the domain name space database.



# Domain Name System(DNS)

- In the tree, the first level in the generic domains section allows 14 possible labels. These labels describe the organization types.

<i>Label</i>	<i>Description</i>
<b>aero</b>	Airlines and aerospace companies
<b>biz</b>	Businesses or firms (similar to “com”)
<b>com</b>	Commercial organizations
<b>coop</b>	Cooperative business organizations
<b>edu</b>	Educational institutions
<b>gov</b>	Government institutions
<b>info</b>	Information service providers
<b>int</b>	International organizations
<b>mil</b>	Military groups
<b>museum</b>	Museums and other nonprofit organizations
<b>name</b>	Personal names (individuals)
<b>net</b>	Network support centers
<b>org</b>	Nonprofit organizations
<b>pro</b>	Professional individual organizations

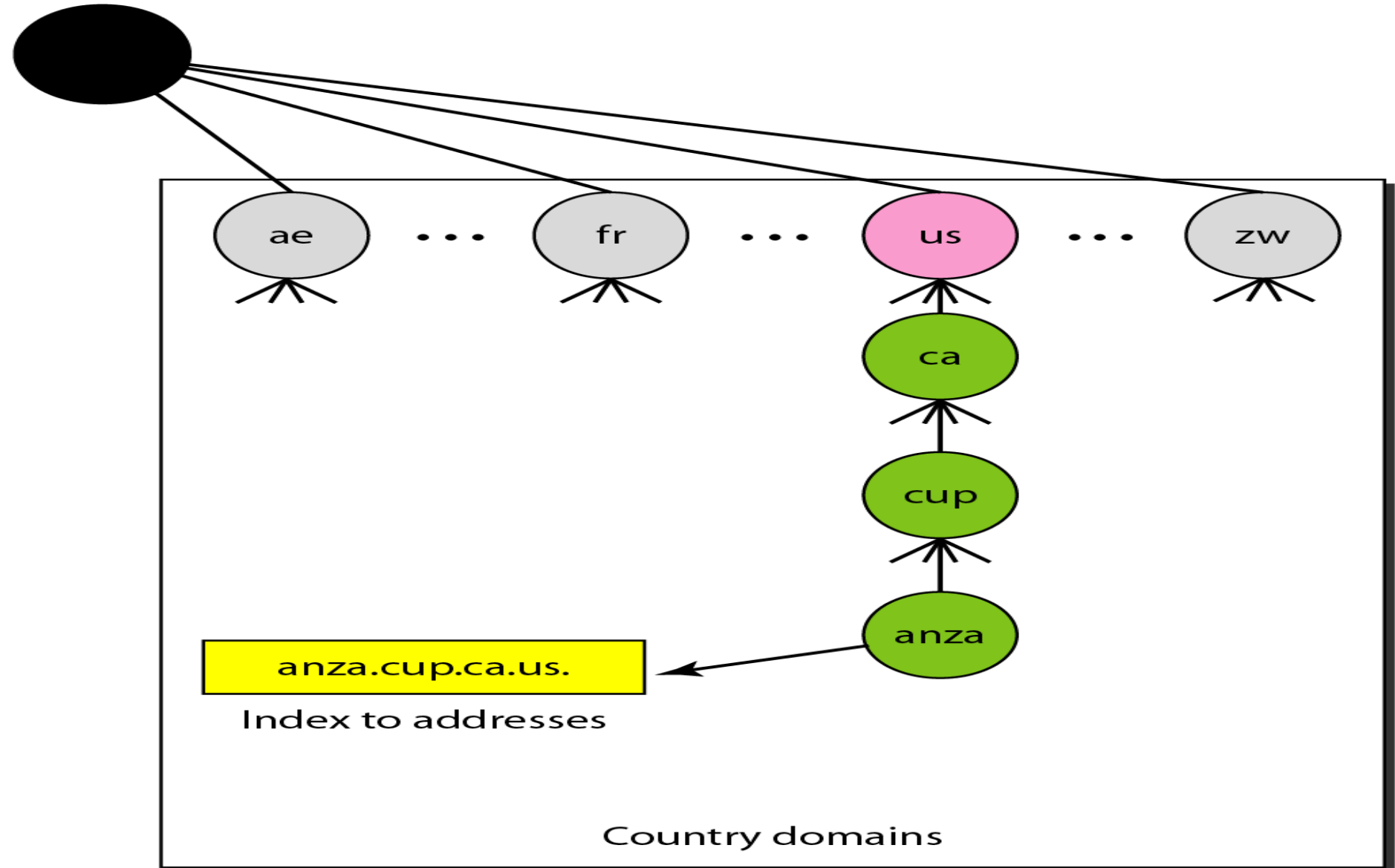
# Domain Name System(DNS)

## Country Domains

- The country domains section uses two-character country abbreviations (e.g., us for United States). Second labels can be organizational, or they can be more specific, national designations.
- Following figure shows the country domains section.
- The address **anza.cup.ca.us** can be translated to De Anza College in Cupertino, California, in the United States.

# Domain Name System(DNS)

Root level



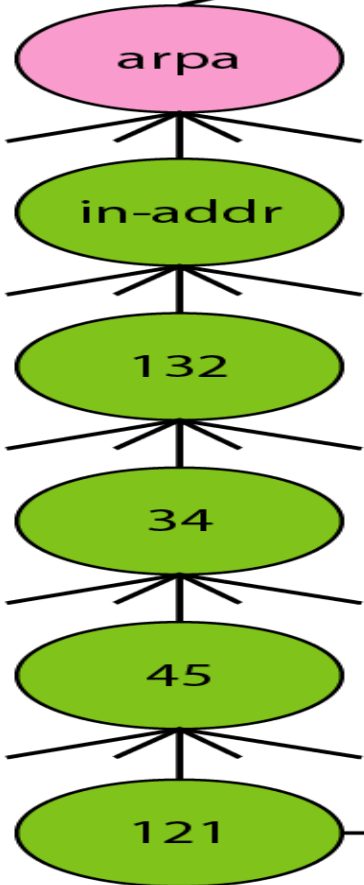
# Domain Name System(DNS)

## Inverse Domain

- The inverse domain is used to map an address to a name.
- This may happen, for example, when a server has received a request from a client to do a task.
- The server asks its resolver to send a query to the DNS server to map an address to a name to determine if the client is on the authorized list. This type of query is called an inverse or pointer (PTR) query.
- To handle a pointer query, the inverse domain is added to the domain name space with the first-level node called **arpa**. The second level is also one single node named **in-addr** (for inverse address). The rest of the domain defines IP addresses.

# Domain Name System(DNS)

Root level



Inverse domain

121.45.34.132.in-addr.arpa.

Index to names



# Domain Name System(DNS)

## RESOLUTION

Mapping a name to an address or an address to a name is called name-address resolution.

### Resolver

- DNS is designed as a client/server application.
- A host that needs to map an address to a name or a name to an address calls a DNS client called a resolver.
- The resolver accesses the closest DNS server with a mapping request. If the server has the information, it satisfies the resolver; otherwise, it either refers the resolver to other servers or asks other servers to provide the information.
- After the resolver receives the mapping, it interprets the response to see if it is a real resolution or an error, and finally delivers the result to the process that requested it.

# Domain Name System(DNS)

## Mapping Names to Addresses

- The resolver gives a domain name to the server and asks for the corresponding address. In this case, the server checks the generic domains or the country domains to find the mapping.
- If the domain name is from the generic domains section, the resolver receives a domain name such as "chal.atc.jhda.edu.". The query is sent by the resolver to the local DNS server for resolution. If the local server cannot resolve the query, it either refers the resolver to other servers or asks other servers directly.
- If the domain name is from the country domains section, the resolver receives a domain name such as "ch.jhda.cu.ca.us.". The procedure is the same.

# Domain Name System(DNS)

## Mapping Addresses to Names

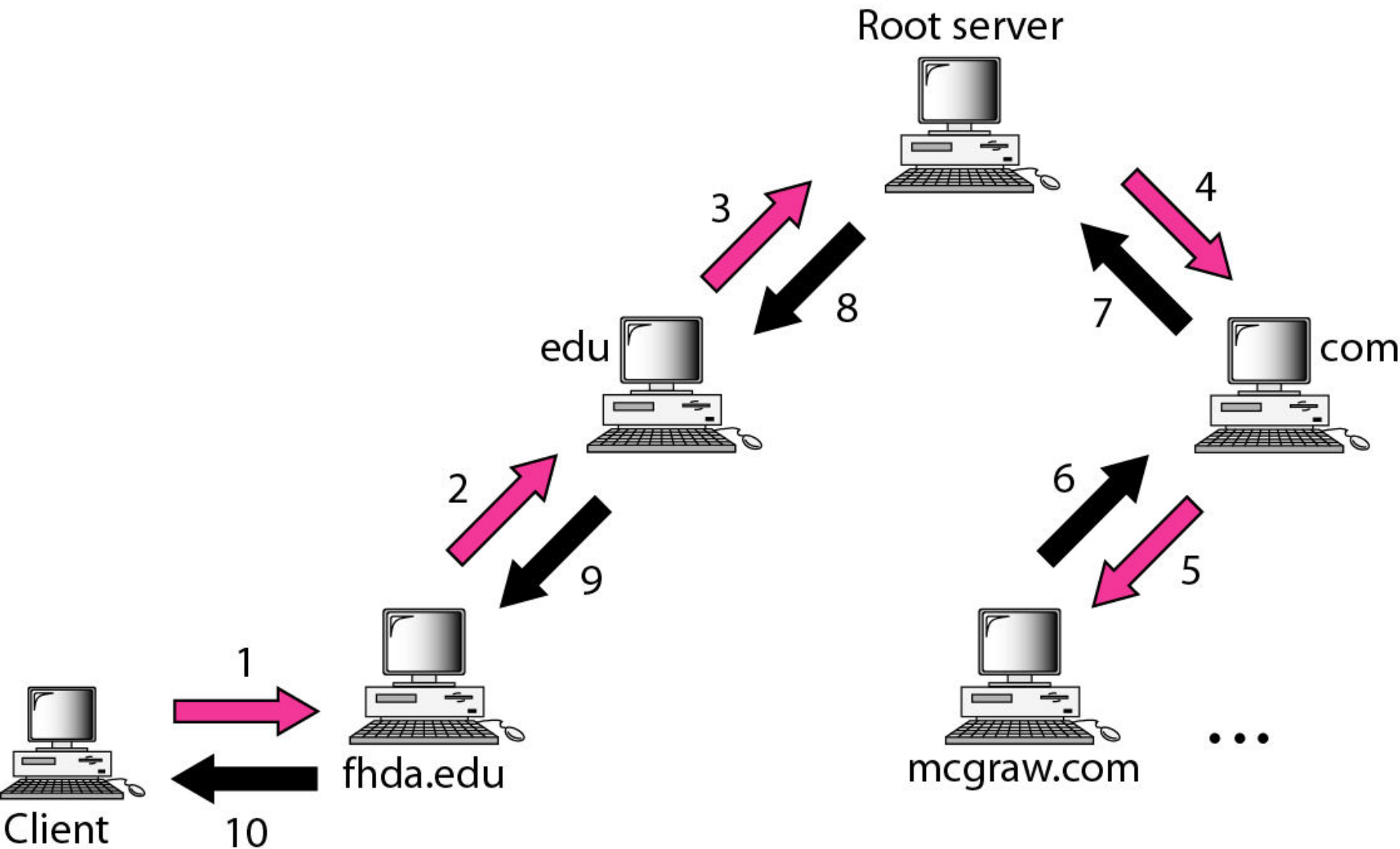
- A client send an IP address to a server to be mapped to a domain name. This is called a PTR query.
- To answer queries of this kind, DNS uses the inverse domain. However, in the request, the IP address is reversed and the two labels in-addr and arpa are appended to create a domain acceptable by the inverse domain section.
- For example, if the resolver receives the IP address 132.34.45.121, the resolver first inverts the address and then adds the two labels before sending. The domain name sent is "121.45.34.132.in-addr.arpa." which is received by the local DNS and resolved.

# Domain Name System(DNS)

## Recursive Resolution

- The client (resolver) can ask for a recursive answer from a name server. This means that the resolver expects the server to supply the final answer.
- If the server is the authority for the domain name, it checks its database and responds.
- If the server is not the authority, it sends the request to another server (the parent usually) and waits for the response. If the parent is the authority, it responds; otherwise, it sends the query to yet another server. When the query is finally resolved, the response travels back until it finally reaches the requesting client. This is called recursive resolution and is shown in the following figure:-

# Domain Name System(DNS)

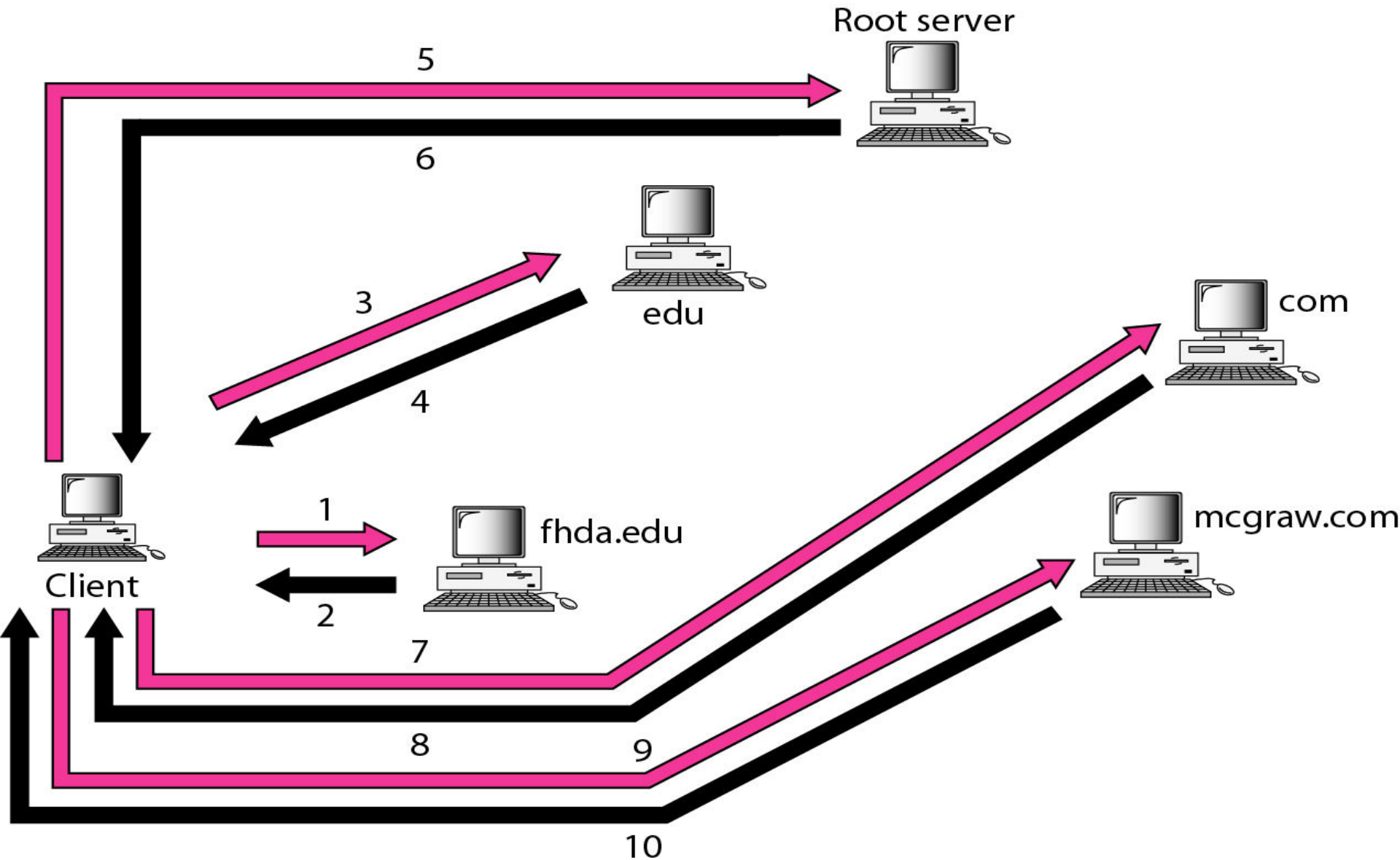


# Domain Name System(DNS)

## Iterative Resolution

- In this approach, if the server is an authority for the name, it sends the answer. If it is not, it returns (to the client) the IP address of the server that it thinks can resolve the query. The client is responsible for repeating the query to this second server.
- If the newly addressed server can resolve the problem, it answers the query with the IP address; otherwise, it returns the IP address of a new server to the client.
- Now the client must repeat the query to the third server. This process is called iterative resolution because the client repeats the same query to multiple servers.
- In following figure, the client queries four servers before it gets an answer from the **mcgraw.com** server.

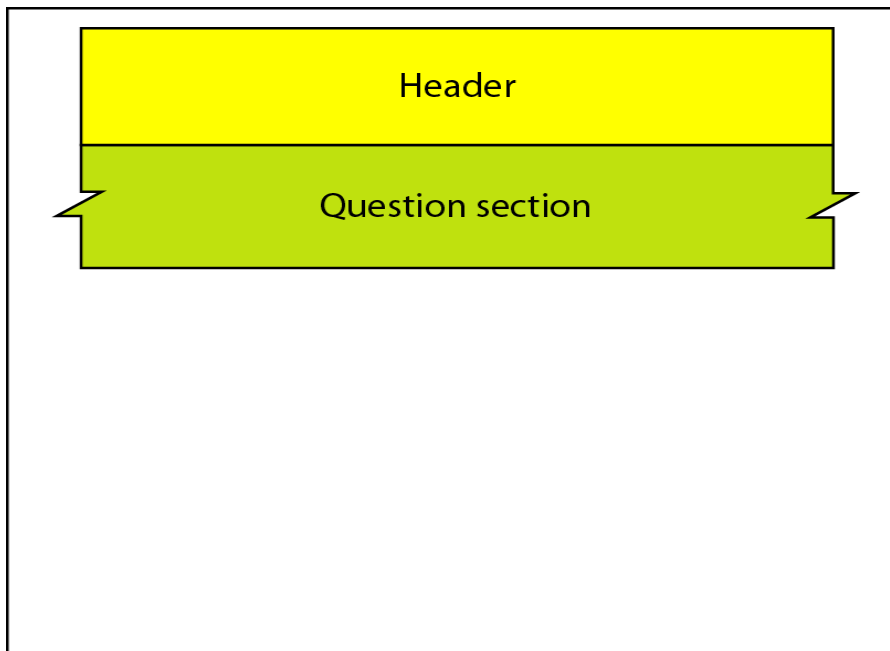
# Domain Name System(DNS)



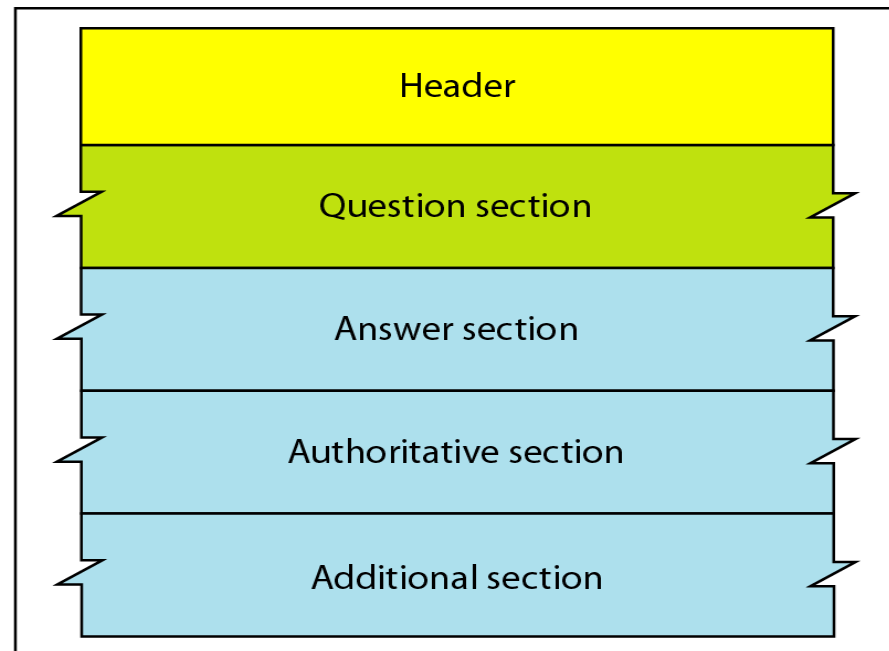
# Domain Name System(DNS)

## DNS MESSAGES

- DNS has two types of messages: **query** and **response**.
- Both types have the same format. The query message consists of a header and question records; the response message consists of a header, question records, answer records, authoritative records, and additional records.



a. Query



b. Response



# Domain Name System(DNS)

## Header

Both query and response messages have the same header format with some fields set to zero for the query messages. The header is 12 bytes, and its format is shown in the following figure:-

Identification	Flags
Number of question records	Number of answer records (all 0s in query message)
Number of authoritative records (all 0s in query message)	Number of additional records (all 0s in query message)

# Domain Name System(DNS)

- The **identification subfield** is used by the client to match the response with the query. The client uses a different identification number each time it sends a query. The server duplicates this number in the corresponding response.
- The **flags subfield** is a collection of subfields that define the type of the message, the type of answer requested, the type of desired resolution (recursive or iterative), and so on.
- The **number of question records subfield** contains the number of queries in the question section of the message.

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- The **number of answer records subfield** contains the number of answer records in the answer section of the response message. Its value is zero in the query message.
- The **number of authoritative records subfield** contains the number of authoritative records in the authoritative section of a response message. Its value is zero in the query message.
- Finally, the **number of additional records subfield** contains the number additional records in the additional section of a response message. Its value is zero in the query message.

# Domain Name System(DNS)

## **Question Section**

This is a section consisting of one or more question records. It is present on both query and response messages.

## **Answer Section**

This is a section consisting of one or more resource records. It is present only on response messages. This section includes the answer from the server to the client (resolver).

## **Authoritative Section**

This is a section consisting of one or more resource records. It is present only on response messages. This section gives information (domain name) about one or more authoritative servers for the query.

# Domain Name System(DNS)

## Additional Information Section

This is a section consisting of one or more resource records. It is present only on response messages. This section provides additional information that may help the resolver.

For example, a server may give the domain name of an authoritative server to the resolver in the authoritative section, and include the IP address of the same authoritative server in the additional information section.

# Domain Name System(DNS)

## TYPES OF RECORDS

Two types of records are used in DNS.

### **Question Record**

- The question records are used in the question section of the query and response messages.
- A question record is used by the client to get information from a server. This contains the domain name.

### **Resource Record**

- The resource records are used in the answer, authoritative, and additional information sections of the response message.
- Each domain name (each node on the tree) is associated with a record called the resource record. The server database consists of resource records. Resource records are also what is returned by the server to the client.