PRINCIPLES OF NETWORK APPLICATIONS

THE CLIENT-SERVER PARADIGM.

Which of the characteristics below are associated with a client-server approach to structuring network applications (as opposed to a P2P approach)?

- [x] There is a server that is always on.
- [x] There is a server with a well known server IP address.
- [x] HTTP uses this application structure.
- [ ] A process requests service from those it contacts and will provide service to processes that contact it.
- [ ] There is *not* a server that is always on.

That's Correct!

CHECK →

1/4

THE PEER-TO-PEER (P2P) PARADIGM.

Which of the characteristics below are associated with a P2P approach to structuring network applications (as opposed to a client-server approach)?

- [x] A process requests service from those it contacts and will provide service to processes that contact it.
- [ ] There is a server that is always on.
- [ ] There is a server with a well known server IP address.
- [x] There is *not* a server that is always on.
- [ ] HTTP uses this application structure.

That's Correct!

← CHECK →

2/4

UDP SERVICE.

When an application uses a UDP socket, what transport services are provided to the application by UDP? Check all that apply.

- [ ] *Throughput guarantee.* The socket can be configured to provide a minimum throughput guarantee between sender and receiver.
- [ ] *Real-time delivery.* The service will guarantee that data will be delivered to the receiver within a specified time bound.
- [ ] *Loss-free data transfer.* The service will reliably transfer all data to the receiver, recovering from packets dropped in the network due to router buffer overflow.
- [ ] *Congestion control.* The service will control senders so that the senders do not collectively send more data than links in the network can handle.
- [x] *Best effort service.* The service will make a best effort to deliver data to the destination but makes no guarantees that any particular segment of data will actually get there.
- [ ] *Flow Control.* The provided service will ensure that the sender does not send so fast as to overflow receiver buffers.

That's Correct!

← CHECK →

3/4

TCP SERVICE.

When an application uses a TCP socket, what transport services are provided to the application by TCP? Check all that apply.

- [x] *Loss-free data transfer.* The service will reliably transfer all data to the receiver, recovering from packets dropped in the network due to router buffer overflow.
- [ ] *Throughput guarantee.* The socket can be configured to provide a minimum throughput guarantee between sender and receiver.
- [x] *Congestion control.* The service will control senders so that the senders do not collectively send more data than links in the network can handle.
- [x] *Flow Control.* The provided service will ensure that the sender does not send so fast as to overflow receiver buffers.
- [ ] *Best effort service.* The service will make a best effort to deliver data to the destination but makes no guarantees that any particular segment of data will actually get there.
- [ ] *Real-time delivery.* The service will guarantee that data will be delivered to the receiver within a specified time bound.

That's Correct!

← CHECK

THE WEB AND HTTP

“HTTP IS STATELESS.”

What do we mean when we say “HTTP is stateless”? In answering this question, assume that cookies are not used. Check all answers that apply.

- [x] An HTTP *server* does not remember anything about what happened during earlier steps in interacting with this HTTP client.
- [ ] An HTTP client does not remember the identities of the servers with which it has interacted.
- [ ] The HTTP protocol is not licensed in any country.
- [ ] An HTTP *client* does not remember anything about what happened during earlier steps in interacting with any HTTP server.
- [ ] We say this when an HTTP server is not operational.

That's Correct!

CHECK →

1/15

HTTP COOKIES.

What is an HTTP cookie used for?

- ○ Like dessert, cookies are used at the end of a transaction, to indicate the end of the transaction.
- ○ A cookies is a code used by a server, carried on a client's HTTP request, to access information the server had earlier stored about an earlier interaction with this *person*. [Think about the distinction between a *browser* and a *person*.]
- ○ A cookie is used to spoof client identity to an HTTP server.
- ◉ A cookie is a code used by a server, carried on a client's HTTP request, to access information the server had earlier stored about an earlier interaction with this Web *browser*. [Think about the distinction between a *browser* and a *person*.]
- ○ A cookie is a code used by a client to authenticate a person's identity to an HTTP server.

That's Correct!

← CHECK →

2/15

THE HTTP GET.

What is the purpose of the HTTP GET message?

- ○ The HTTP GET request message is sent by a web server to a web client to get the next request from the web client.
- ◉ The HTTP GET request message is used by a web client to request a web server to send the requested object from the server to the client.
- ○ The HTTP GET request message is sent by a web server to a web client to get the identity of the web client.
- ○ The HTTP GET request message is used by a web client to post an object on a web server.

That's Correct!

← CHECK →

3/15

CONDITIONAL HTTP GET.

What is the purpose of the conditional HTTP GET request message?

- ○ To allow a server to only send the requested object to the client if the client has never requested that object before.
- ○ To allow a server to only send the requested object to the client if the client is authorized to received that object.
- ◉ To allow a server to only send the requested object to the client if this object has changed since the server last sent this object to the client.
- ○ To allow a server to only send the requested object to the client if the server is not overloaded.

That's Correct!

← CHECK →

4/15

A DETAILED LOOK AT AN HTTP GET (1).

Suppose a client is sending an HTTP GET request message to a web server, gaia.cs.umass.edu. Suppose the client-to-server HTTP GET message is the following:

```
GET /kurose_ross_sandbox/interactive/quotation2.htm HTTP/1.1
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, text/xml, image/jpeg, image/gif, audio/mpeg, audio/mp4, video/wmv, video/mp4,
Accept-Language: en-us, en-gb;q=0.1, en;q=0.7, fr, fr-ch, da, de, fi
If-Modified-Since: Wed, 09 Sep 2020 16:06:01 -0700
User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/535.11 (KHTML, like Gecko) Chrome/17.0.963.56 Safari/535.11
```

What version of HTTP is the client using?

[Note: you can find additional questions similar to this here.]

- ○ 1
- ○ 2.1
- ◉ 1.1
- ○ 2

That's Correct!

← CHECK →

5/15

A DETAILED LOOK AT AN HTTP GET (2).

Again, suppose a client is sending an HTTP GET request message to a web server, gaia.cs.umass.edu. The client-to-server HTTP GET message is the following (same as in previous problem):

```
GET /kurose_ross_sandbox/interactive/quotation2.htm HTTP/1.1
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, text/xml, image/jpeg, image/gif, audio/mpeg, audio/mp4, video/wmv, video/mp4,
Accept-Language: en-us, en-gb;q=0.1, en;q=0.7, fr, fr-ch, da, de, fi
If-Modified-Since: Wed, 09 Sep 2020 16:06:01 -0700
User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/535.11 (KHTML, like Gecko) Chrome/17.0.963.56 Safari/535.11
```

What is the language in which the client would least prefer to get a response? [You may have to search around the Web a bit to answer this.]

[Note: you can find additional questions similar to this here.]

- ○ Hindi
- ○ US English
- ○ Farsi
- ○ Mandarin
- ○ French
- ○ Spanish
- ○ Finnish
- ◉ United Kingdom English

That's Correct!

← CHECK →

A DETAILED LOOK AT AN HTTP GET (3).

Again, suppose a client is sending an HTTP GET request message to a web server, gaia.cs.umass.edu. Suppose the client-to-server HTTP GET message is the following (same as in previous problem):

```
GET /kurose_ross_sandbox/interactive/quotation2.htm HTTP/1.1
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, text/xml, image/jpeg, image/gif, audio/mpeg, audio/mp4, video/wmv, video/mp4,
Accept-Language: en-us, en-gb;q=0.1, en;q=0.7, fr, fr-ch, da, de, fi
If-Modified-Since: Wed, 09 Sep 2020 16:06:01 -0700
User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/535.11 (KHTML, like Gecko) Chrome/17.0.963.56 Safari/535.11
```

Does the client have a cached copy of the object being requested?

[Note: you can find additional questions similar to this here.]

- ◉ Yes, because this is a conditional GET, as evidenced by the If-Modified-Since field.
- ○ No, because a client would not request an object if it had that object in its cache.
- ○ Yes, because HTTP 1.1 is being used.
- ○ There's not enough information in the header to answer this question.

That's Correct!

← CHECK →

A DETAILED LOOK AT AN HTTP REPLY.

Suppose now the server sends the following HTTP response message the client:

HTTP/1.0 200 OK
Date: Wed, 09 Sep 2020 23:46:21 +0000
Server: Apache/2.2.3 (CentOS)
Last-Modified: Wed, 09 Sep 2020 23:51:41 +0000
ETag:17dc6-a5c-bf716880.
Content-Length: 418
Connection: Close
Content-type: image/html

Will the web server close the TCP connection after sending this message?

[Note: you can find more questions like this one here.]

- ○ No, the server will leave the connection open as a persistent HTTP connection.
- ◉ Yes, the server will close this connection because version 1.0 of HTTP is being used, and TCP connections do not stay open persistently.
- ○ There's not enough information in the response message to answer this question.
- ○ Yes, because the HTTP response indicated that only one object was requested in the HTTP GET request.

That's Correct!

← CHECK →

8/15

WHY WEB CACHING?

Which of the following are advantages of using a web cache? Sselect one or more answers.

- ☑ Caching generally provides for a faster page load time at the client, if the web cache is in the client's institutional network, because the page is loaded from the nearby cache rather than from the distant server.
- ☐ Overall, caching requires fewer devices/hosts to satisfy a web request, thus saving on server/cache costs.
- ☑ Caching uses less bandwidth coming into an institutional network where the client is located, if the cache is also located in that institutional network.
- ☐ Caching allows an origin server to more carefully track which clients are requesting and receiving which web objects.

That's Correct!

← CHECK →

9/15

HTTP/2 VERSUS HTTP/1.1.

Which of the following are changes between HTTP 1.1 and HTTP/2? Note: select one or more answers.

- [ ] HTTP/2 provides enhanced security by using transport layer security (TLS).
- [x] HTTP/2 allows objects in a persistent connection to be sent in a client-specified priority order.
- [ ] HTTP/2 has many new HTTP methods and status codes.
- [x] HTTP/2 allows a large object to be broken down into smaller pieces, and the transmission of those pieces to be interleaved with transmission other smaller objects, thus preventing a large object from forcing many smaller objects to wait their turn for transmission.

That's Correct!

← CHECK →

10/15

WHAT'S IN AN HTTP REPLY?

Which of the following pieces of information will appear in a server's application-level HTTP reply message? (Check all that apply.)

- [ ] The name of the Web server (e.g., gaia.cs.umass.edu)
- [x] A response code
- [x] A response phrase associated with a response code
- [ ] The server's IP address
- [ ] A sequence number
- [ ] A checksum

That's Correct!

← CHECK →

11/15

IF-MODIFIED-SINCE.

What is the purpose of the *If-Modified-Since* field in a HTTP GET request message

- ○ To inform the HTTP cache that it (the cache) should retrieve the full object from the server, and then cache it until the specified time.
- ◉ To indicate to the server that the client has cached this object from a previous GET, and the time it was cached.
- ○ To indicate to the server that the server should replace this named object with the new version of the object attached to the GET, if the object has not been modified since the specified time
- ○ To indicate to the server that the client wishes to receive this object, and the time until which it will cache the returned object in the browser's cache.
- ○ To allow the server to indicate to the client that it (the client) should cache this object.

That's Correct!

← CHECK →

12/15

COOKIES.

What is the purpose of a cookie value in the HTTP GET request?

- ○ The cookie value is an encoding of a user email address associated with the GET request.
- ○ The cookie value encodes the format of the reply preferred by the client in the response to this GET request.
- ○ The cookie value indicates whether the user wants to use HTTP/1, HTTP/1.1, or HTTP/2 for this GET request.
- ◉ The cookie value itself doesn't mean anything. It is just a value that was returned by a web server to this client during an earlier interaction.
- ○ The cookie value encodes a default set of preferences that the user has previously specified for this web site.

That's Correct!

← CHECK →

13/15

WHAT HAPPENS AFTER AN HTTP REPLY?

Suppose an HTTP server sends the following HTTP response message a client:

```
HTTP/1.0 200 OK
Date: Wed, 09 Sep 2020 23:46:21 +0000
Server: Apache/2.2.3 (CentOS)
Last-Modified: Wed, 09 Sep 2020 23:51:41 +0000
ETag:17dc6-a5c-bf716880.
Content-Length: 418
Connection: Close
Content-type: image/html
```

Will the web server close the TCP connection after sending this message?

- ◉ Yes, because this is HTTP 1.0
- ○ No, this is a persistent connection, and so the server will keep the TCP connection open.
- ○ There's not enough information to answer this question.

That's Correct!

← CHECK

15/15

HTTP GET (EVEN MORE).

Suppose a client is sending an HTTP GET message to a web server, gaia.cs.umass.edu. Suppose the client-to-server HTTP GET message is the following:

```
GET /kurose_ross_sandbox/interactive/quotation2.htm HTTP/1.1
Host: gaia.cs.umass.edu
Accept: text/plain, text/html, text/xml, image/jpeg, image/gif, audio/mpeg, audio/mp4, video/wmv, video/mp4,
Accept-Language: en-us, en-gb;q=0.1, en;q=0.7, fr, fr-ch, da, de, fi
If-Modified-Since: Wed, 09 Sep 2020 16:06:01 -0700
User Agent: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/535.11 (KHTML, like Gecko) Chrome/17.0.963.56 Safari/535.11
```

Does the client have a cached copy of the object being requested?

- ○ There's not enough information to answer this question.
- ◉ Yes, because this is a conditional GET.
- ○ No, because the client would not request an object if it were cached.

That's Correct!

← CHECK →

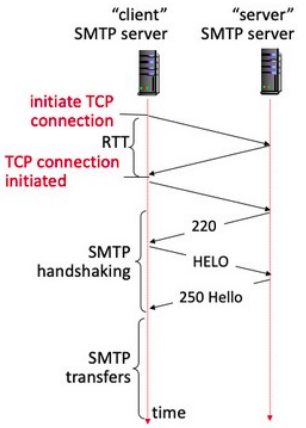
14/15

EMAIL

E-MAIL DELAYS.

How many RTTs are there from when a client first contacts an email server (by initiating a TCP session) to when the client can begin sending the email message itself – that is following all initial TCP or SMTP handshaking required?

Recall the figure below from our class notes:



- 2.5
- 3
- 0
- 1
- 2

That's Correct!

COMPARING AND CONTRASTING HTTP AND SMTP.

Which of the following characteristics apply to HTTP only (and do *not* apply to SMTP)? Note: check one or more of the characteristics below.

- [ ] Operates mostly as a "client push" protocol.
- [x] Uses server port 80.
- [x] Operates mostly as a "client pull" protocol.
- [ ] Uses server port 25.
- [ ] Uses CRLF.CRLF to indicate end of message.
- [ ] Has ASCII command/response interaction, status codes.
- [ ] Is able to use a persistent TCP connection to transfer multiple objects.
- [x] Uses a blank line (CRLF) to indicate end of request header.

That's Correct!

← CHECK →

COMPARING AND CONTRASTING HTTP AND SMTP (2).

Which of the following characteristics apply to SMTP only (and do *not* apply to HTTP)? Note: check one or more of the characteristics below.

- [ ] Uses server port 80.
- [ ] Operates mostly as a “client pull” protocol.
- [x] Operates mostly as a “client push” protocol.
- [ ] Is able to use a persistent TCP connection to transfer multiple objects.
- [x] Uses CRLF.CRLF to indicate end of message.
- [ ] Has ASCII command/response interaction, status codes.
- [x] Uses server port 25.
- [ ] Uses a blank line (CRLF) to indicate end of request header.

That's Correct!

← CHECK →

3/5

COMPARING AND CONTRASTING HTTP AND SMTP (3).

Which of the following characteristics apply to both HTTP and SMTP? Note: check one or more of the characteristics below.

- [x] Is able to use a persistent TCP connection to transfer multiple objects.
- [ ] Uses CRLF.CRLF to indicate end of message.
- [ ] Operates mostly as a “client push” protocol.
- [x] Has ASCII command/response interaction, status codes.
- [ ] Uses a blank line (CRLF) to indicate end of request header.
- [ ] Operates mostly as a “client pull” protocol.

That's Correct!

← CHECK →

4/5

WHICH E-MAIL PROTOCOL?

Match the functionality of a protocol with the name of a the email protocol (if any) that implements that functionality.

QUESTION LIST:

Pushes email from a mail client to a mail server.

B

Pulls mail from one mail server to another mail server.

C

Pulls email to a mail client from a mail server.

A

ANSWER LIST:

A. IMAP

B. SMTP

C. Neither SMTP nor IMAP does this.

Note: SMTP PUSHES from mail server to another
Nothing *pulls*

That's Correct!

← CHECK

5/5

DNS

DNS FUNCTIONS.

Match the function of a server to a given type of DNS server in the DNS server hierarchy.

QUESTION LIST:

Provides authoritative hostname to IP mappings for organization's named hosts.

C

Replies to DNS query by local host, by contacting other DNS servers to answer the query.

B

Responsible for a domain (e.g., *.com, *.edu); knows how to contact authoritative name servers.

D

Highest level of the DNS hierarchy, knows how to reach servers responsible for a given domain (e.g., *.com, *.edu).

A

ANSWER LIST:

A. DNS root servers

B. Local DNS server

C. Authoritative DNS server

D. Top Level Domain (TLD) servers

That's Correct!

CHECK →

WHY DOES THE DNS PERFORM CACHING?

What is the value of caching in the local DNS name server? Check all that apply.

- [x] DNS caching results in less load elsewhere in DNS, when the reply to a query is found in the local cache.
- [ ] DNS caching provides the ability to serve as authoritative name server for multiple organizations.
- [ ] DNS caching provides prioritized access to the root servers, since the DNS request is from a local DNS cache.
- [x] DNS caching provides for faster replies, if the reply to the query is found in the cache.

That's Correct!

← CHECK →

WHAT'S IN THE DNS TYPE A RESOURCE RECORD?

What information does the type "A" resource record hold in the DNS database? Check all that apply.

- [ ] An alias name and a true name for a server.
- [x] A hostname and an IP address.
- [ ] A domain name and the name of the authoritative name server for that domain.
- [ ] A name and the name of the SMTP server associated with that name.

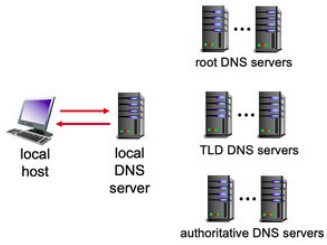
That's Correct!

← CHECK →

3/9

DNS IN ACTION (1).

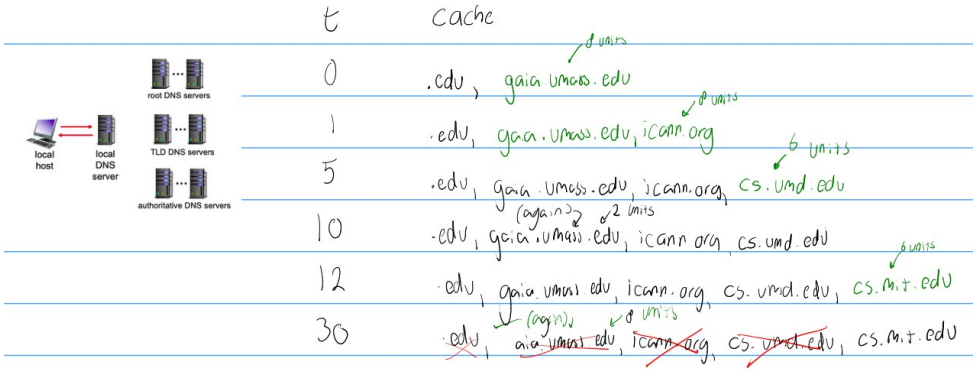
Suppose that the local DNS server caches all information coming in from all root, TLD, and authoritative DNS servers for 20 time units. (Thus, for example, when a root server returns the name and address of a TLD server for .com, the cache remembers that this is the TLD server to use to resolve a .com name). Assume also that the local cache is initially empty, that iterative DNS queries are always used, that DNS requests are just for name-to-IP-address translation, that 1 time unit is needed for each server-to-server or host-to-server (one way) request or response, and that there is only one authoritative name server (each) for any .edu or .com domain.



Consider the following DNS requests, made by the local host at the given times:

- *t=0*, the local host requests that the name gaia.cs.umass.edu be resolved to an IP address.
- *t=1*, the local host requests that the name icann.org be resolved to an IP address.
- *t=5*, the local host requests that the name cs.umd.edu be resolved to an IP address. (Hint: be careful!)
- *t=10*, the local host *again* requests that the name gaia.cs.umass.edu be resolved to an IP address.
- *t=12*, the local host requests that the name cs.mit.edu be resolved to an IP address.
- *t=30*, the local host *again* requests that the name gaia.cs.umass.edu be resolved to an IP address. (Hint: be careful!)

Which of the requests require 8 time units to be resolved?



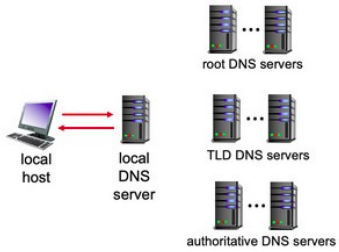
- [x] The request at *t=30*.
- [ ] The request at *t=5*.
- [ ] The request at *t=12*.
- [ ] The request at *t=10*.
- [x] The request at *t=0*.
- [x] The request at *t=1*.

That's Correct!

← CHECK →

DNS IN ACTION (2).

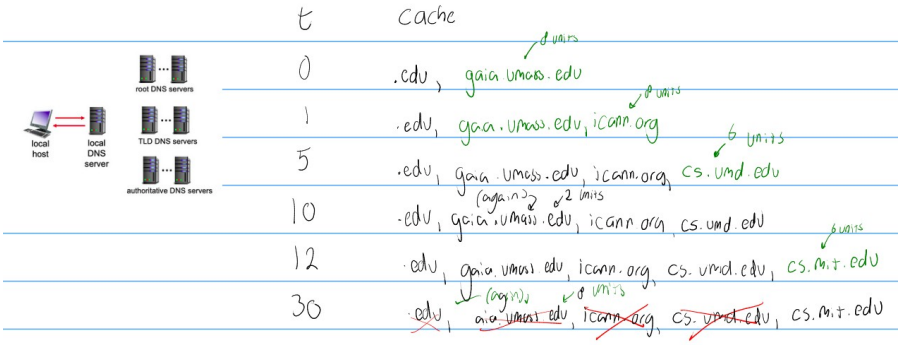
[This question is the same as an earlier question, except for the question statement at the very end.] Suppose that the local DNS server caches all information coming in from all root, TLD, and authoritative DNS servers for 20 time units. (Thus, for example, when a root server returns the name and address of a TLD server for .com, the cache remembers that this is the TLD server to use to resolve a .com name). Assume also that the local cache is initially empty, that iterative DNS queries are always used, that DNS requests are just for name-to-IP-address translation, that 1 time unit is needed for each server-to-server or host-to-server (one way) request or response, and that there is only one authoritative name server (each) for any .edu or .com domain.



Consider the following DNS requests, made by the local host at the given times:

- *t=0*, the local host requests that the name gaia.cs.umass.edu be resolved to an IP address.
- *t=1*, the local host requests that the name icann.org be resolved to an IP address.
- *t=5*, the local host requests that the name cs.umd.edu be resolved to an IP address. (Hint: be careful!)
- *t=10*, the local host *again* requests that the name gaia.cs.umass.edu be resolved to an IP address.
- *t=12*, the local host requests that the name cs.mit.edu be resolved to an IP address.
- *t=30*, the local host *again* requests that the name gaia.cs.umass.edu be resolved to an IP address. (Hint: be careful!)

Which of the requests require 6 time units to be resolved?



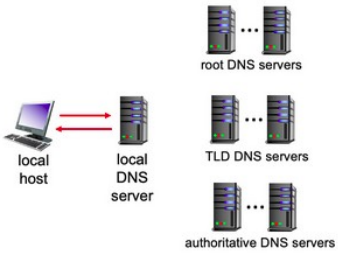
- ☐ The request at *t=0*.
- ☐ The request at *t=30*.
- ☐ The request at *t=1*.
- ☑ The request at *t=5*.
- ☐ The request at *t=10*.
- ☑ The request at *t=12*.

That's Correct!

← CHECK →

DNS IN ACTION (3).

[This question is the same as an earlier question, except for the question statement at the very end.] Suppose that the local DNS server caches all information coming in from all root, TLD, and authoritative DNS servers for 20 time units. (Thus, for example, when a root server returns the name and address of a TLD server for .com, the cache remembers that this is the TLD server to use to resolve a .com name). Assume also that the local cache is initially empty, that iterative DNS queries are always used, that DNS requests are just for name-to-IP-address translation, that 1 time unit is needed for each server-to-server or host-to-server (one way) request or response, and that there is only one authoritative name server (each) for any .edu or .com domain.



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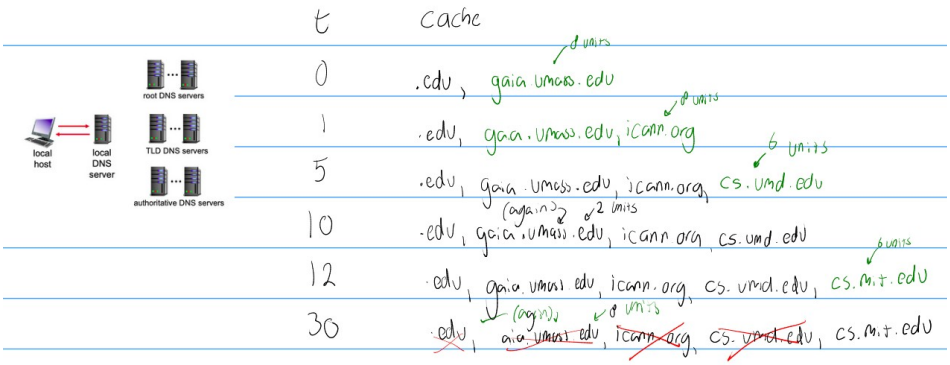
- *t=5*, the local host requests that the name cs.umd.edu be resolved to an IP address. (Hint: be careful!)
- *t=10*, the local host *again* requests that the name gaia.cs.umass.edu be resolved to an IP address.
- *t=12*, the local host requests that the name cs.mit.edu be resolved to an IP address.
- *t=30*, the local host *again* requests that the name gaia.cs.umass.edu be resolved to an IP address. (Hint: be careful!)

Which of the requests require 2 time units to be resolved?



- [ ] The request at *t=1*.
- [x] The request at *t=10*.
- [ ] The request at *t=5*.
- [ ] The request at *t=12*.
- [ ] The request at *t=0*.
- [ ] The request at *t=30*.

That's Correct!

← CHECK →

THE LOCAL DNS SERVER.

Check all of the phrases below that state a true property of a *local* DNS server.

- [ ] The local DNS server holds hostname-to-IP translation records, but not other DNS records such as MX records.
- [x] The local DNS server record for a remote host is sometimes different from that of the authoritative server for that host.
- [x] The local DNS server can decrease the name-to-IP-address resolution time experienced by a querying local host over the case when a DNS is resolved via querying into the DNS hierarchy.
- [ ] The local DNS server is only contacted by a local host if that local host is unable to resolve a name via iterative or recursive queries into the DNS hierarchy.

That's Correct!

← CHECK →

7/9

THE DNS AUTHORITATIVE NAME SERVER.

What is the role of an authoritative name server in the DNS? (Check all that apply)

- [ ] It provides the IP address of the DNS server that can provide the definitive answer to the query.
- [ ] It provides a list of TLD servers that can be queried to find the IP address of the DNS server that can provide the definitive answer to this query.
- [x] It provides the definitive answer to the query with respect to a name in the authoritative name server's domain.
- [ ] It is a local (to the querying host) server that caches name-to-IP address translation pairs, so it can answer authoritatively and can do so quickly.

That's Correct!

← CHECK →

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DNS AND HTTP CACHING.

We learned that in HTTP web browser caching, HTTP local web server caching, and in local DNS caching, that a user benefits (e.g., shorter delays over the case of no caching) from finding a local/nearby copy of a requested item. In which of the following forms of caching does a user benefit from its not only from its own recent requests (and cached replies) *but also from recent requests made from other users*?

- [ ] HTTP browser caching
- [x] Local DNS server caching
- [x] HTTP local web caching

That's Correct!

← CHECK

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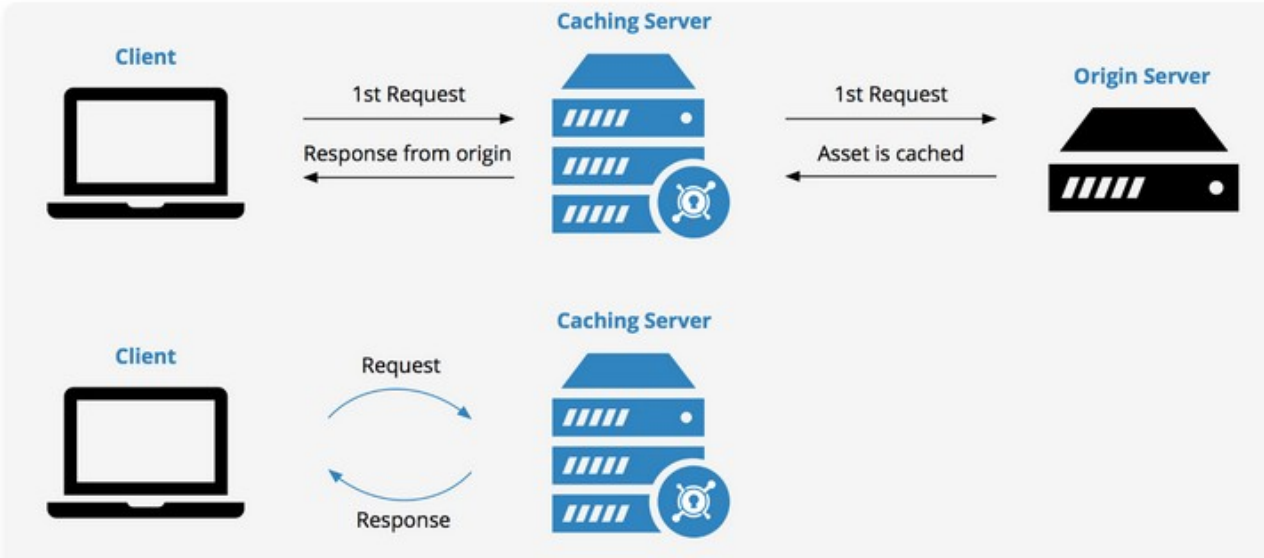
Server-side caching:



Client-side caching: