1.1

Which of the following descriptions below correspond to a "nuts-and-bolts" view of the Internet?

* A "network of networks".
* A platform for building network applications.
* A place I go for information, entertainment, and to communicate with people.
* A collection of hardware and software components executing protocols that define the format and the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event.
* A collection of billions of computing devices, and packet switches interconnected by links.

Which of the following descriptions below correspond to a "services" view of the Internet?

* A platform for building network applications.
* A collection of hardware and software components executing protocols that define the format and the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event.
* A "network of networks".
* A collection of billions of computing devices, and packet switches interconnected by links.
* A place I go for information, entertainment, and to communicate with people.

Which of the following human scenarios involve a protocol (recall: "Protocols define the format, order of messages sent and received among network entities, and actions taken on message transmission, receipt")?

* One person asking, and getting, the time to/from another person.
* Two people introducing themselves to each other.
* A person sleeping.
* A person reading a book.
* A student raising her/his hand to ask a really insightful question, followed by the teaching acknowledging the student, listening carefully to the question, and responding with a clear, insightful answer. And then thanking the student for the question, since teachers love to get questions.

1.2

Match the access network with the approximate speeds that a subscriber might experience. (Note: if you look these up, do so in the 8E textbook, slides,or video -- not in the 7E or earlier versions, since link access speeds are always increasing over the years).

* Ethernet
  + Wired. Up to 100s Gbps per link
* 802.11 WiFi
  + Wireless 10’s to 100’s of Mbps per device
* Cable access network
  + Wired. Up to 10’s to 100’s of Mbps downstream per user.
* Digital subscriber Line
  + Wired. Up to 10’s of Mbps downstream per user
* 4G cellular LTE
  + Wireless. Up to 10’s Mbps per device.

Which of the following physical layer technologies has the highest transmission rate and lowest bit error rate in practice?

* 4G/5G cellular
* Coaxial cable
* 802.11 WiFi Channel
* Fiber optic cable
* Satellite channel
* Twisted pair (e.g., CAT5, CAT6)

1.3

Choose one the following two definitions that makes the correct distinction between routing versus forwarding.

* Forwarding is the local action of moving arriving packets from router’s input link to appropriate router output link, while routing is the global action of determining the source-destination paths taken by packets.
* Routing is the local action of moving arriving packets from router’s input link to appropriate router output link, while forwarding is the global action of determining the source-destination paths taken by packets.

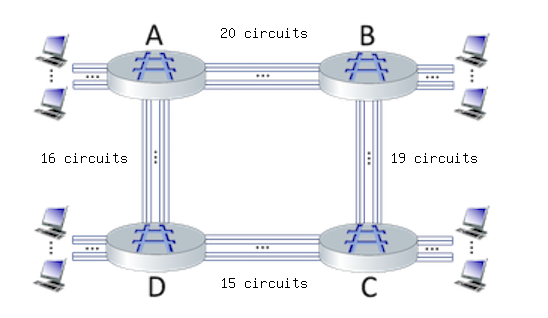
Which of the characteristics below are associated with the technique of *packet switching*?

* Resources are used on demand, not reserved in advance.
* This technique was the basis for the telephone call switching during the 20th century and into the beginning of this current century.
* Congestion loss and variable end-end delays are possible with this technique.
* Data may be queued before being transmitted due to other user’s data that’s also queueing for transmission.
* This technique is used in the Internet.
* Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) are two approaches for implementing this technique.
* Reserves resources needed for a call from source to destination.

Which of the characteristics below are associated with the technique of circuit switching?

* Resources are used on demand, not reserved in advance.
* This technique was the basis for the telephone call switching during the 20th century and into the beginning of this current century.
* Congestion loss and variable end-end delays are possible with this technique.
* Data may be queued before being transmitted due to other user’s data that’s also queueing for transmission.
* This technique is used in the Internet.
* Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) are two approaches for implementing this technique.
* Reserves resources needed for a call from source to destination.

Consider the circuit-switched network shown in the figure below, with  four circuit switches A, B, C, and D. Suppose there are 20 circuits between A and B, 19 circuits between B and C, 15 circuits between C and D, and 16 circuits between D and A.



What is the maximum number of connections that can be ongoing in the network at any one time?

[Note: you can find more questions like this one [here.](http://gaia.cs.umass.edu/kurose_ross/interactive/?q=c1q1)

* 16
* 39
* 70
* 31
* 20

Perform a traceroute from your computer (on whatever network you happen to be on) to gaia.cs.umass.edu. Use traceroute (on Mac terminal) or tracert (on Windows command line) or tracepath (on a Linux command line). Enter the missing part of the name of the router just before the host gaia.cs.umass.edu is reached:

??.cs.umass.edu  
  
Note: Routing may change, so the answer here may not be correct anymore.  Also, if you are a Verizon user, there are known problems using traceroute with Verizon - if traceroute shows you two hops only to gaia.cs.umass.edu or any destination, skip this question.

* nscs1bbs1

When we say that the Internet is a “network of networks,” we mean? Check all that apply (hint: check two or more).

* The Internet is made up of access networks at the edge, tier-1 networks at the core, and interconnected regional and content provider networks as well.
* The Internet is made up of a lot of different networks that are interconnected to each other.
* The Internet is the fastest network ever built.
* The Internet is the largest network ever built.

Consider a scenario in which 5 users are being multiplexed over a channel of 10 Mbps.  Under the various scenarios below, match the scenario to whether circuit switching or packet switching is better.

* Each user generates traffic at an average rate of 2.1 Mbps, generating traffic at a rate of 15 Mbps when transmitting
  + Neither works well in this overload scenario
* Each user generates traffic at an average rate of 2 Mbps generating traffic at a rate of 2 Mbps when transmitting
  + Circuit switching
* Each user generates traffic at an average rate of 0.21 Mbps, generating traffic at a rate of 15 Mbps when transmitting
  + Packet switching

1.4

Match the description of each component of packet delay to its name in the pull down list.

* Time needed to perform an integrity check, lookup packet information in a local table and move the packet from an input link to an output link in a router.
  + Processing delay
* Time spent waiting in packet buffers for link transmission.
  + Queueing delay
* Time spent transmitting packets bits into the link.
  + Transmission delay
* Time need for bits to physically propagate through the transmission medium from end one of a link to the other.
  + Propagation delay

Suppose a packet is*L* = 1500 bytes long (one byte = 8 bits), and link transmits at R = 1 Gbps (i.e., a link can transmit bits 1,000,000,000 bits per second).  What is the transmission delay for this packet? [Note: you can find more problems like this one [here](http://gaia.cs.umass.edu/kurose_ross/interactive/one-hop-delay.php).]

Graphical user interface, text

Description automatically generated

* 666,666 secs
* .00012 secs
* .0000015 secs
* .000012 secs
* .0015 secs

Suppose a packet is*L* = 1200 bytes long (one byte = 8 bits), and link transmits at R = 100 Mbps (i.e., a link can transmit bits 100,000,000 bits per second).  What is the transmission delay for this packet? [Note: you can find more problems like this one [here](http://gaia.cs.umass.edu/kurose_ross/interactive/one-hop-delay.php).]

Graphical user interface, text

Description automatically generated

* .00096 secs
* .0012 secs
* .000015 secs
* 8,333 secs
* .000096 secs

Consider the network shown in the figure below, with three links, each with the specified transmission rate and link length. Assume the length of a packet is 8000 bits.  
  
What is the transmission delay at link 2?  [Note: you can find more problems like this one [here](http://gaia.cs.umass.edu/kurose_ross/interactive/one-hop-delay.php).]

Diagram

Description automatically generated

* 12.5 secs
* 100 secs
* .00096 secs
* 12,500 secs
* 8\*10^-5 secs

Consider the network shown in the figure below, with three links, each with the specified transmission rate and link length. Assume the length of a packet is 8000 bits. The speed of light propagation delay on each link is 3x10^8 m/sec  
  
What is the propagation delay at (along) link 2?

Diagram

Description automatically generated

* 3 secs
* 3\*10^8 secs
* .0033 secs
* .33 secs

What is the maximum throughput achievable between sender and receiver in the scenario shown below?

Diagram

Description automatically generated

* 11.5 Mbps
* 1.5 Mbps
* 10 Mbps

Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 300 Mbps. The four links from the servers to the shared link have a transmission capacity of RS = 50 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of RC = 90 Mbps.  
  
What is the maximum achievable end-end throughput (an integer value, in Mbps) for each of four client-to-server pairs, assuming that the middle link is fairly shared (divides its transmission rate equally) and all servers are trying to send at their maximum rate?

Your answer: [A] Mbps

Diagram

Description automatically generated

* 50

Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 300 Mbps. The four links from the servers to the shared link have a transmission capacity of RS = 50 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of RC = 90 Mbps.  
  
Assuming that the servers are all sending at their maximum rate possible, what are the link utilizations for the server links (with transmission capacity RS)? Enter your answer in a decimal form of 1.00 (if the utilization is 1) or 0.xx (if the utilization is less than 1, rounded to the closest xx).

Your answer: The utilization of the server links is: [A]

Diagram

Description automatically generated

* 1.00

Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 300 Mbps. The four links from the servers to the shared link have a transmission capacity of RS = 50 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of RC = 90 Mbps.  
  
Assuming that the servers are all sending at their maximum rate possible, what are the link utilizations of the shared link (with transmission capacity R)? Enter your answer in a decimal form of 1.00 (if the utilization is 1) or 0.xx (if the utilization is less than 1, rounded to the closest xx).

Your answer: The utilization of shared link is: [A]

Diagram

Description automatically generated

[Note: more questions like this one can be found [here](http://gaia.cs.umass.edu/kurose_ross/interactive/end-end-throughput-simple.php).]

* 0.67 (Add up the 50s and divide by 300)

Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 300 Mbps. The four links from the servers to the shared link have a transmission capacity of RS = 50 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of RC = 90 Mbps.

Assuming that the servers are all sending at their maximum rate possible, what are the link utilizations of the client links (with transmission capacity RC)? Enter your answer in a decimal form of 1.00 (if the utilization is 1) or 0.xx (if the utilization is less than 1, rounded to the closest xx).

Your answer: The utilization of client link is: [A]

Diagram

Description automatically generated

* 0.56 (50/90)

1.5

Match the function of a layer in the Internet protocol stack to its its name in the pulldown menu.

* Protocols that are part of a distributed network application.
  + Application layer
* Transfer of data between one process and another process (typically on different hosts).
  + Transport layer
* Delivery of datagrams from a source host to a destination host (typically).
  + Network layer
* Transfer of data between neighboring network devices.
  + Link layer
* Transfer of a bit into and out of a transmission media.
  + Physical layer

Match the name of an Internet layer with unit of data that is exchanged among protocol entities at that layer, using the pulldown menu.

* Application layer
  + Message
* Transport layer
  + Segment
* Network layer
  + Datagram
* Link layer
  + Frame
* Physical layer
  + Bit

Consider the figure below, showing a link-layer frame heading from a host to a router.  There are three header fields shown.  Match the name of a header with a header label shown in the figure.

Diagram

Description automatically generated

* Header H1
  + Link layer
* Header H2
  + Network layer
* Header H3
  + Transport layer

Which of the definitions below describe what is meant by the term "encapsulation"?

* Receiving a “packet” from the layer below, extracting the payload field, and after some internal actions possibly delivering that payload to an upper layer protocol.
* Determining the name of the destination host, translating that name to an IP address and then placing that value in a packet header field.
* Taking data from the layer above, adding header fields appropriate for this layer, and then placing the data in the payload field of the “packet” for that layer.
* Computing the sum of all of the bytes within a packet and placing that value in the packet header field.
* Starting a transport layer timer for a transmitted segment, and then if an ACK segment isn’t received before the timeout, placing that segment in a retransmission queue.

1.6

Match the description of a security defense with its name.

* Specialized “middleboxes” filtering or blocking traffic, inspecting packet contents inspections
  + Firewall
* Provides confidentiality by encoding contents
  + Encryption
* Used to detect tampering/changing of message contents, and to identify the originator of a message.
  + Digital signatures
* Limiting use of resources or capabilities to given users.
  + Access control
* Proving you are who you say you are.
  + Authentication

1.7

Match the networking event with the time frame when the event occurred.

* Early studies of packet switching by Baran, Davies, Kleinrock.
  + Early 1960’s
* First ARPAnet node operational.
  + Late 1960’s
* Internetting: DARPA researchers connect three networks together.
  + 1970’s
* The Internet Protocol (IP) is standardized in RFC 791.
  + Early 1980’s
* Congestion control is added to the TCP protocol.
  + Late 1980’s
* The WWW starts up (note: the WWW design started at the end of previous decade).
  + 1990’s
* Software-defined networking begins.
  + 2000-2010
* The number wireless Internet-connected devices surpasses the number of connected wired devices.
  + 2010-2020

2.1

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

* There is a server with a well known server IP address.
* HTTP uses this application structure.
* There is not a server that is always on.
* 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.

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

* There is a server with a well known server IP address.
* HTTP uses this application structure.
* There is not a server that is always on.
* 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.

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

* Congestion control. The service will control senders so that the senders do not collectively send more data than links in the network can handle.
* 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.
* 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.
* Real-time delivery. The service will guarantee that data will be delivered to the receiver within a specified time bound.
* Throughput guarantee. The socket can be configured to provide a minimum throughput guarantee between sender and receiver.

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

* Congestion control. The service will control senders so that the senders do not collectively send more data than links in the network can handle.
* 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.
* 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.
* Real-time delivery. The service will guarantee that data will be delivered to the receiver within a specified time bound.
* Throughput guarantee. The socket can be configured to provide a minimum throughput guarantee between sender and receiver.

2.2

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.

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

What is an HTTP cookie used for?

* A cookie is used to spoof client identity to an HTTP server.
* A cookie is a code used by a client to authenticate a person’s identity to an HTTP server.
* 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.]
* Like dessert, cookies are used at the end of a transaction, to indicate the end of the transaction.
* 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.]

What is the purpose of the HTTP GET message?

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

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 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.
* 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 the client has never requested that object before.

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](http://gaia.cs.umass.edu/kurose_ross/interactive/http-get.php).]

* 1.1
* 1
* 2
* 2.1

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](http://gaia.cs.umass.edu/kurose_ross/interactive/http-get.php).]

* US English
* United Kingdom English
* Hindi
* Finnish
* Farsi
* Mandarin
* French
* Spanish

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](http://gaia.cs.umass.edu/kurose_ross/interactive/http-get.php).]

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

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](http://gaia.cs.umass.edu/kurose_ross/interactive/http-response.php).]

* 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.
* Yes, because the HTTP response indicated that only one object was requested in the HTTP GET request.
* There's not enough information in the response message to answer this question.

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

* Caching allows an origin server to more carefully track which clients are requesting and receiving which web objects.
* 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.
* Caching uses less bandwidth coming into an institutional network where the client is located, if the cache is also located in that institutional network.
* Overall, caching requires fewer devices/hosts to satisfy a web request, thus saving on server/cache costs.

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

* HTTP/2 allows objects in a persistent connection to be sent in a client-specified priority order.
* 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.
* HTTP/2 provides enhanced security by using transport layer security (TLS).
* HTTP/2 has many new HTTP methods and status codes.

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)
* A response phrase associated with a response code
* A response code
* A checksum
* The server's IP address
* A sequence number

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 allow the server to indicate to the client that it (the client) should cache this object.
* 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 it until it which it will cache the returned object
* To indicate to the server that the client has cached this object from a previous GET, and the time it was cached.

What is the purpose of a cookie value in the HTTP 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 is an encoding of a user email address associated with the GET request.
* The cookie value encodes a default set of preferences that the user has previously specified for this web site.

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?

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

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?

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

2.3

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:

Diagram

Description automatically generated

* 3
* 1
* 2
* 0
* 2.5

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

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

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

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

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

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

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

* Pushes email from a mail client to a mail server
  + SMTP
* Pulls mail from one mail server to another mail server
  + Neither SMTP nor IMAP does this
* Pulls email to a mail client from a mail server
  + IMAP

2.4

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

* Provides authoritative hostname to IP mappings for organization’s named hosts
  + Authoritative DNS server
* Replies to DNS query by local host, by contacting other DNS servers to answer the query.
  + Local DNS server
* Responsible for a domain (e.g., \*.com, \*.edu); knows how to contact authoritative name servers.
  + Top Level Domain (TLD) servers
* Highest level of the DNS hierarchy, knows how to reach servers responsible for a given domain (e.g., \*.com, \*.edu).
  + DNS root server

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

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

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

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

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/response, and that there is only one authoritative name server (each) for any .edu or .com domain.

Diagram

Description automatically generated  
  
  
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?

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

[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/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 6 time units to be resolved?

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

[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/response, and that there is only one authoritative name server (each) for any .edu or .com domain.

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

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

* The local DNS server record for a remote host is sometimes different from that of the authoritative server for that host.
* The local DNS server holds hostname-to-IP translation records, but not other DNS records such as MX records.
* 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.
* 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.

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

* 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.
* 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.
* It provides the definitive answer to the query with respect to a name in the authoritative name server's domain.
* It provides the IP address of the DNS server that can provide the definitive answer to the query.

2.6

**Manifest file.** What is the purpose of a *manifest file*in a streaming multimedia setting?

* To let a client know where it can retrieve different video segments, encoded at different rates
* Allows a video service to log the video and the server from which a client streams a video.
* To let a OTT (Over-the-top) video server know the video that the client wants to view.
* To allow a client to reserve bandwidth along a path from a server to that client, so the client can view a stream video without impairment.

What approach is taken by a CDN to stream content to hundreds of thousands of simultaneous users?

* Serve video from a single central “mega-server” with ultra-high-speed network connectivity, and high-speed storage.
* Store/serve multiple copies of videos at multiple geographically distributed sites.
* Proactively push videos to a client device before they’re requested, using machine learning to predict requested videos.
* Allow client devices to send requested content to each other, in order to offload the CDN infrastructure.

Match the definition/function of an element or approach in a networked streaming video system, with its name.

* A unit of video, each of which may be encoded at multiple different rates, stored in different files.
  + Chunk
* A file containing the location and encoding rate of files corresponding to video segments in a video.
  + Manifest
* An approach that allows a client to adapt the encoding rate of retrieved video to network congestion conditions.
  + DASH
* A CDN approach that stores content in access networks, close to clients.
  + Enter deep

In DASH (Dynamic, Adaptive Streaming over HTTP), a server divides a video file into chunks that ... (pick best completion from below)

* ... are stored, each encoded at multiple rates (video quality). The client plays the video chunk-by-chunk, with each chunk requested at encoding rate that fits the available bandwidth at the time.
* ... are downloaded just before their playout time. Chunking is used primarily because a viewer may jump around (e.g., fast forward) in a video.
* ... are download smallest-chunk-first in order to maximize the number of chunks received.
* ... are stored, each encoded at multiple rates (video quality). The client receives multiple video chunks (encoded at different rates) and plays out the chunks that best fit the screen size.
* ... allow premium users to avoid watching chunks that contain commercials.

2.7

Which of the following characteristics below are associated with a UDP socket? Check one or more that apply.

* provides reliable, in-order byte-stream transfer (a “pipe”), from client to server
* the application must explicitly specify the IP destination address and port number for each group of bytes written into a socket
* socket(AF\_INET, SOCK\_STREAM) creates this type of socket
* data from different clients can be received on the same socket
* a server can perform an accept() on this type of socket
* when contacted, the server will create a new server-side socket to communicate with that client
* provides unreliable transfer of a groups of bytes (“a datagram”), from client to server
* socket(AF\_INET, SOCK\_DGRAM) creates this type of socket

Which of the following characteristics below are associated with a TCP socket? Check one or more that apply.

* provides reliable, in-order byte-stream transfer (a “pipe”), from client to server
* the application must explicitly specify the IP destination address and port number for each group of bytes written into a socket
* socket(AF\_INET, SOCK\_STREAM) creates this type of socket
* data from different clients can be received on the same socket
* a server can perform an accept() on this type of socket
* when contacted, the server will create a new server-side socket to communicate with that client
* provides unreliable transfer of a groups of bytes (“a datagram”), from client to server
* socket(AF\_INET, SOCK\_DGRAM) creates this type of socket

How does the networked application running on a server know the client IP address and the port number to reply to in response to a received datagram?

* As the result of performing the accept() statement, the server has created a new socket that is bound to that specific client, and so sending into this new socket (without explicitly specifying the client IP address and port number) is sufficient to ensure that the sent data will be addressed to the correct client.
* The server will know the port number being used by the client since all services have a well-known port number.
* The server will query the DNS to learn the IP address of the client.
* The application code at the server determines client IP address and port # from the initial segment sent by client, and must explicitly specify these values when sending into a socket back to that client.

Suppose a Web server has *five* ongoing connections that use TCP receiver port 80, and assume there are no other TCP connections (open or being opened or closed) at that server.  How many TCP sockets are in use at this server?

* 1
* 4
* 5
* 6

What happens when a socket connect() procedure is called/invoked?

* This causes the server to create a connection with a TCP client. The server does so by creating a new socket for communication back to that client.
* This procedure creates a new socket at the client, and connects that socket to the specified server.
* This causes the client to reach out to a TCP server to establish a connection between that client and the server. There can be at most one server on the connection.
* This causes the client to reach out to a TCP server to establish a connection between that client and the server. If there is already one or more servers on this connection, this new server will also be added to this connection.