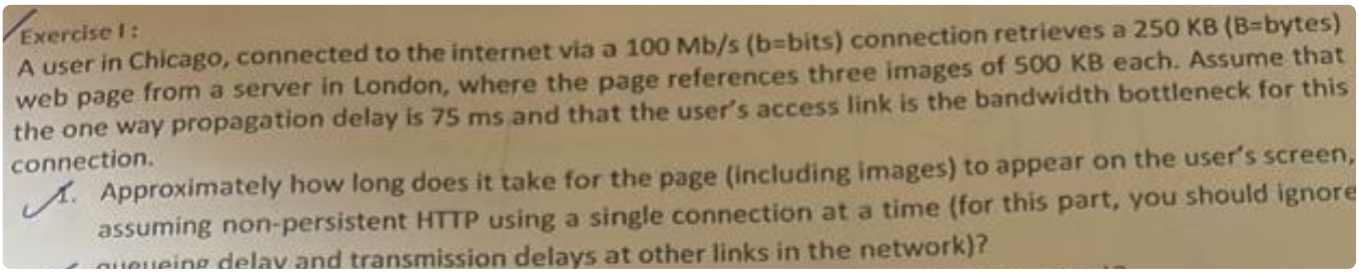
# 2021-2022 Session 1 SOLUTION

# Exercise 1



Exercise I :
A user in Chicago, connected to the internet via a 100 Mb/s (b=bits) connection retrieves a 250 KB (B=bytes) web page from a server in London, where the page references three images of 500 KB each. Assume that the one way propagation delay is 75 ms and that the user's access link is the bandwidth bottleneck for this connection.

1. Approximately how long does it take for the page (including images) to appear on the user's screen, assuming non-persistent HTTP using a single connection at a time (for this part, you should ignore queueing delay and transmission delays at other links in the network)?

To calculate the approximate time it would take to load the page using a non-persistent HTTP using a single connection at a time, we can use the following steps:

Step 1: Calculate the total size of the page and its components

Total size of page = Size of page + (Number of images x Size of each image)
Total size of page = 250KB + (3 x 500KB)
Total size of page = 1750KB

Step 2: Convert the total size of the page to bits

Total size of page in bits = Total size of page x 8
Total size of page in bits = 1750KB x 8 x 1024
Total size of page in bits = 14336000 bits

Step 3: Calculate the time it takes to transmit the page

Time to transmit page = Total size of page in bits / Internet speed
Time to transmit page = 14336000 bits / 100Mb/s
Time to transmit page = 143.36ms

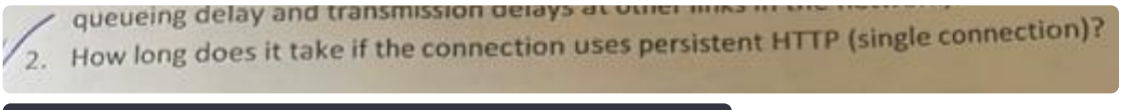
Step 4: Add the round trip time (RTT) for each request

Total RTT for one request = 2 x RTT
Total RTT for one request = 2 x 150ms
Total RTT for one request = 300ms

Step 5: Calculate the total time it takes to load the page

Total time to load page = Time to transmit page + (Number of requests x Total RTT for one request)
Total time to load page = 143.36ms + (1 + 3) x 300ms
Total time to load page = 143.36ms + 1200ms
Total time to load page = 1343.36ms

Therefore, it would take approximately 1.3 seconds (1343.36ms) to load the page using a non-persistent HTTP using a single connection at a time, given the specified internet speed, page size, image sizes, and RTT.



queueing delay and transmission delays at other links in the network)?
2. How long does it take if the connection uses persistent HTTP (single connection)?

and say if we are using a persistent HTTP, then we would get:
Total time to load page = 143.36ms + 300ms right ?

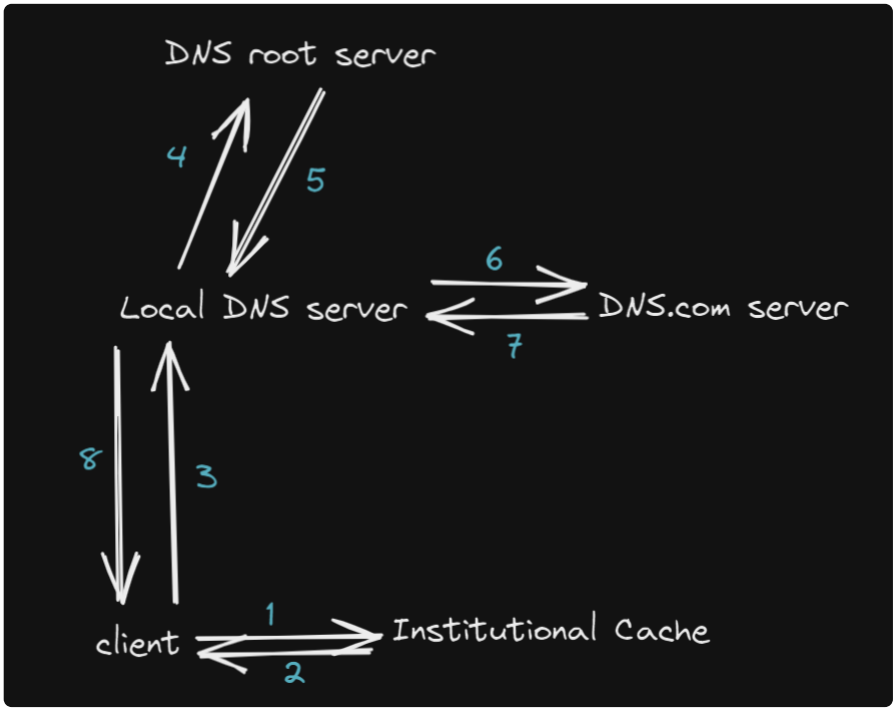
No, if we are using persistent HTTP, we can reuse the same TCP connection to retrieve all the components of the page, so we would not need to add the RTT for each request as we did in the non-persistent case.

Total time to load page = 143.36ms + 150ms
Total time to load page = 293.36ms

This is actually incorrect, in our course we took that once the client receives a response, then it requests data (in both persistent and non-persistent), so my response to GPT was the correct answer

# Exercise 2

## Nb 1




*(institutional cache tells the client to ask the local DNS server)*

## Nb 2

The DNS load balancing process typically involves the following steps:

1. The domain owner creates multiple A records with the same name but different IP addresses in the DNS server. These IP addresses correspond to the multiple servers that will handle client requests.
2. When a client sends a DNS query for the domain name, the DNS resolver randomly selects one of the IP addresses associated with the domain name and returns it as the answer to the client. The client uses this IP address to establish a connection to the server.

# Exercise 3

## Nb 1

- Flow control:
  When a TCP connection is established between the client and the receiver. The receiver allocates a buffer for the client called `rwnd` for the received data to be stored in, and the sender has to send data of size less than `rwnd`
- Congestion control:
  This type of control deals with traffic on the network to reduce congestion and packet drop off. It controls how many packets are sent at a time using a congestion window `cwnd`.

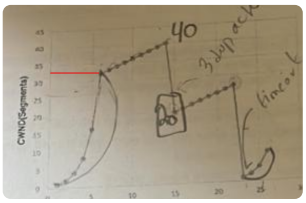
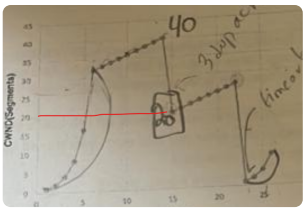
Flow control is used to regulate the flow of data between a sender and receiver to ensure that the receiver can handle the data being sent, while congestion control is used to prevent the network from becoming congested with too much traffic.

### Nb 2

There a couple of way to detect losses:

1. A packet is sent but the ACK is timed out
2. The sender receives duplicate ACKs

### Nb 3

1. Cant see the numbers very well but like 33 or something
   
2. 20 ish
   
3. Sender received a duplicate ACK
4. ACK timed out
5. 45 *(it is the same as in the start of the graph)*
6. 60 000 / 1 000 = 60 segments, the cwnd size is increasing in powers of 2, so first 1 segment is sent and then when an ack is received 2 segments are sent and so on, so we need to send 1+2+4+8+16+32 > 60 ⇒ we need to send segments in the cwnd 5 times (2^5 = 32) ⇒ 5 * 2ms = 10ms

## Exercise 4

### Nb 1

To have all networks connected together in a static route, the following are the main steps:

1. Determine the network topology: Identify all the networks and routers in the topology, and determine the IP addresses and subnet masks for each network.
2. Assign IP addresses to the interfaces: Assign unique IP addresses to the interfaces of each router in the topology, based on the network address and subnet mask.
3. Configure the routing tables: Configure the routing tables on each router to include static routes for all the networks in the topology. Each router should have a static route for every network it is directly connected to, as well as a default route for networks it is not directly connected to.

### Nb 2

- In very large networks
- Dynamic networks *(got it from GPT)*

cant find anything else about this in the course

## Nb 3

In link state routing protocols (such as OSPF) the router keeps a complete topology of the entire network and keeps updating its routing table periodically.
In distance vector algorithms (such as RIP) on the other hand, the router sends update to its neighboring routers whenever an update happens in its routing table (i.e. a distance change) instead of searching the whole network topology for the best path.

## Nb 4

it means this network is more reliable and trustworthy.

## Nb 5

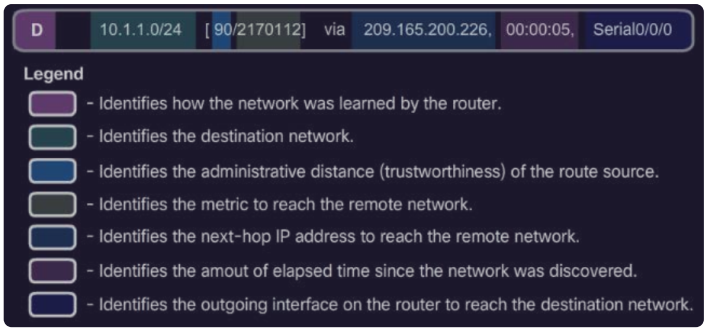
Not required in our course

## Nb 6

In the given networks, all the computers are known, so they exist in the routing table. However if we need to communicate to a host with an IP that doesnt exist in the network then we need to setup a default static route / a default gateway,

## Nb 7

basically this:




## Nb 8

The goal is to advertise to all the other routers the designated router information so that each router can have a complete topology of the autonomous system.

## Nb 9

c. the one with the least cost duhh