EE4204 Question & Answer Session 1

In a txt or word document, please write your answers and then submit the file to the Question-Answer-Session-1 folder in LumiNUS Files.

Q1

The ____ layer lies between the network layer and the application layer.

A: None of the choices
B: Transport
C: Data link
D: Physical

TCP/IP Network Stack

Application
Transport
Network
Data link (Medium Access Control)
Physical

Q2

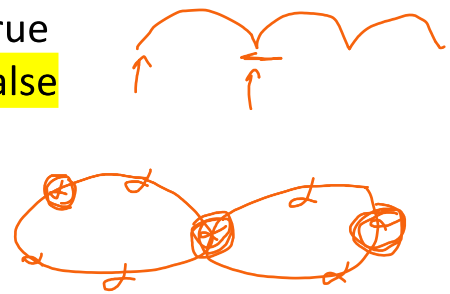
The ____ layer lies between the transport layer and the link layer.

A: None of the choices
B: Transport
C: Network
D: Data link

Q3

When an IP router between two Ethernet segments forwards an IP packet, it does not modify the destination MAC address.

A: True
B: False



Q4

When an IP router between two Ethernet segments forwards an IP packet, it does not modify the destination IP address.

A: False
B: True

Q5

The value in the sequence number field of a TCP segment defines the number of the ____ data byte contained in that segment.

~~A: None of the choices~~
B: last
C: next
D: first

Q6

The value of the acknowledgment field in a TCP segment defines the number of the ____ byte a party expects to receive.

A: ~~None of the choices~~
B: next
C: first
D: last

Q7

Explain the TCP slow-start. What is its goal and how does it work?

TCP slow-start is a mechanism to quickly increase the congestion window to …

Q8

Which of the following is a valid IP address?

A: ~~100.200.300.400~~
B: 1.2.3.4
C: ~~www.google.com~~
D: ~~AB:45:65:FF:F8:80~~

IPv4 address is 32 bits, represent as 4 8-bit chunks, Convert the 8-bit chunk to decimal, dotted decimal notation. There are 2^32~4 billion IPv4 addresses.

Ipv6 address is 128 bits. There are 2^128 IPv6 addresses.

The number of IPv6 addresses is more than the number atoms in the northern hemisphere.

Q9

An organization is granted a block of classless addresses with the starting address 199.34.32.0/27. How many addresses are granted?

A: None of the choices
B: 32
C: 8
D: 16

199.34.32.0/27 is a block of IPv4 addresses.
27 bits identify the subnet
The remaining 5 bits are for hosts in that subnet.
There are 2^5 IPv4 addresses.

Q10

A router with the following forwarding table receives a packet with destination 128.195.3.10. Which will be the outgoing interface of the packet?

128.195.0.0/8	eth2
128.195.0.0/16	eth0
~~128.195.0.0/24~~	eth1
~~0.0.0.0/0~~	eth3

How does a router do forwarding?

Longest prefix matching.

In a txt or word document, please write your answers and then submit the file to the Question-Answer-Session-2 folder in LumiNUS Files.

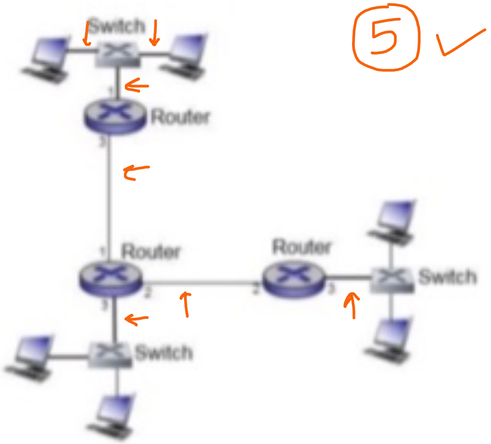
Q11

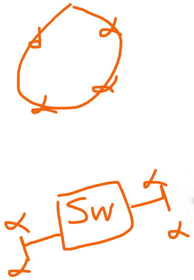
- Recall IP addresses are 32 bit addresses with a subnet part and host part
- Classless Interdomain Routing (CIDR) Notation
- Consider the subnet: 50.150.250.0/24
  - Explain what /24 means
    - 24 bits to identify the subnet.
  - How many IP addresses in this subnet?
    - 2^8, because there are 32-24 bits in the host part
  - How many hosts can this subnet support?
    - 2^8-2, because all zeros and all ones in the host part are reserved addresses.

Q12

How many subnets are in the network below?

5





Q13

- Consider the CIDR address: 206.68.149.103 / 21
- What is the first address in the range?
  11001110 01000100 10010101 01100111
  206 68 144 0 is the first address
  206 68 144 1 is the first assignable address
- What is the broadcast address?
  11001110 01000100 10010111 11111111
  206 68 151 255
- What is the subnet mask (in binary)?
  11111111 11111111 11111000 00000000
  255 255 248 0

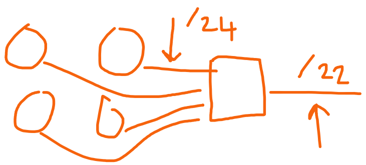
Q14

- What is the CIDR aggregation on the following /24 IP addresses?

137.132.24.0/24
137.132.25.0/24
137.132.26.0/24
137.132.27.0/24

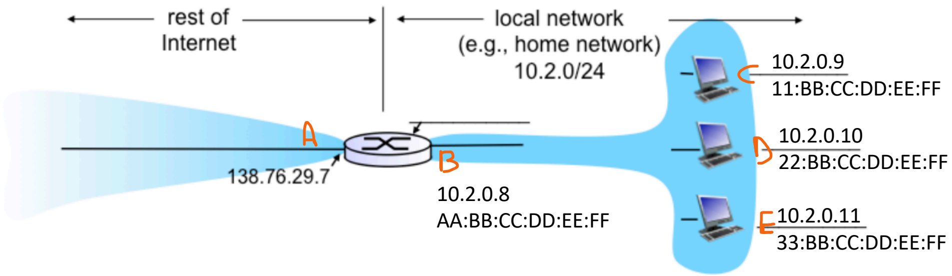
The CIDR aggregation is: 137.132.24.0/22.

24: 0001 1000
25: 0001 1001
26: 0001 1010
27: 0001 1011



Q15

- Consider the network below. Specify IP addresses for all interfaces of the local network. Also assign MAC addresses to these interfaces.

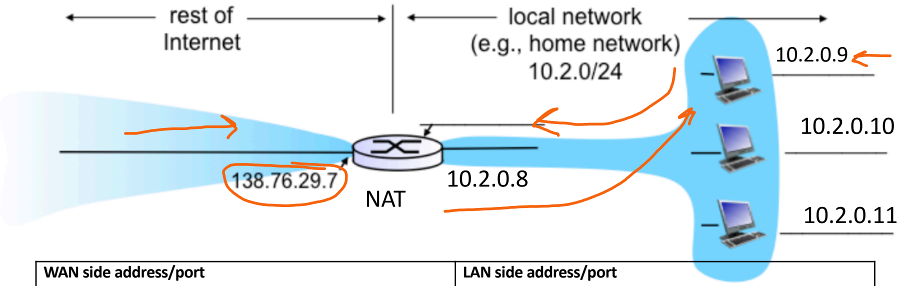


Port number is a 16-bit field → 2^16 port numbers
But some port numbers are reserved

Reserved Ports
HTTP, port 80, SMTP port 25
SSH, port 22, FTP, port 21
DNS, port 53, SSL, port 443

Q16

- Now assume that the top-most client in the local network sends an HTTP request to http://www.umass.edu (IP addr: 128.119.103.148) and the local port for the TCP connection for this HTTP request is 7000. Fill out the NAT table below with the information that would be entered in that table after the HTTP request has been forwarded from the NAT router into the WAN. Do the same for all hosts in the local home network.



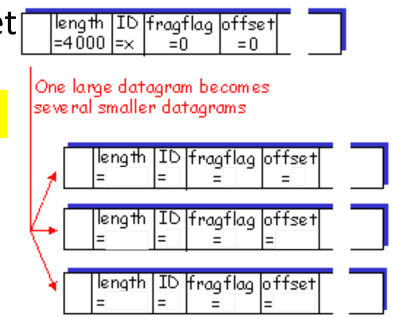
WAN side address/port	LAN side address/port
138.76.29.7, port 80900	10.2.0.9, port 7000
138.76.29.7, port 80999	10.2.0.10, port 7000

In a txt or word document, please write your answers and then submit the file to the Question-Answer-Session-3 folder in LumiNUS Files.

Q17

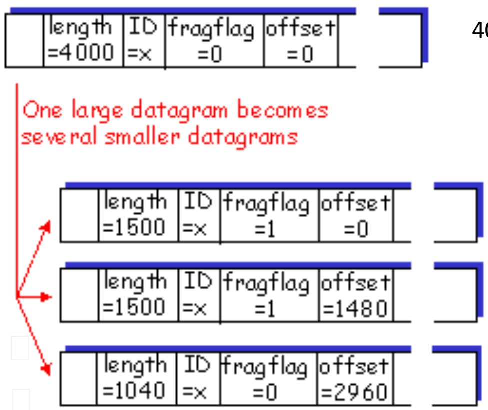
An IPv4 datagram is fragmented into three smaller datagrams. Which of the following is true?

A: The do not fragment bit is set to 1 for all three datagrams.
B: The identification field is the same for all three datagrams.
C: The more fragment bit is set to 0 for all three datagrams.
D: The offset field is the same for all three datagrams.



Q18

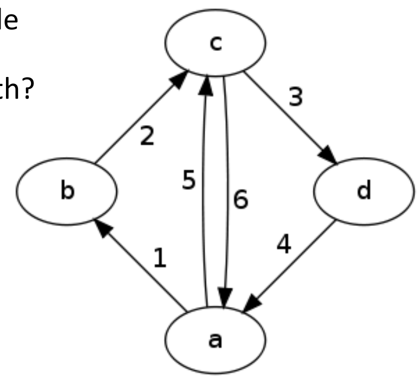
- Suppose an IPv4 datagram is fragmented into three datagrams. The MTU is 1500 bytes. Fill in the information in the diagram below.



4000=20+3980
1500=20+1480
1500=20+1480
1040=20+1020

Q19

What is the shortest path from node a to node d?
What is the cost of the shortest path?

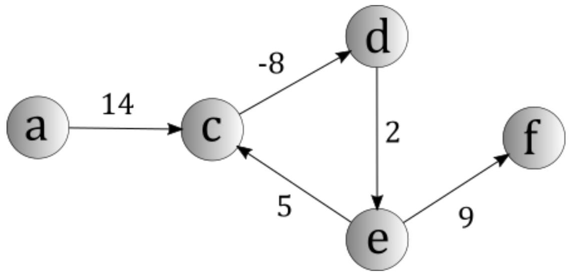


The shortest path from node a to node d is:
a – b – c – d with cost 6.

Q20

What is the shortest path from node a to node f?

What is the cost of the shortest path?



The notion of shortest path does not make sense here since one can keep going around the negative cycle over and over again.

In a txt or word document, please write your answers and then submit the file to the Question-Answer-Session-4 folder in LumiNUS Files.

Q21

Which of the following algorithms solves the single source shortest path routing problem?

A: Shor’s algorithm

B: Fast Fourier Transform

C: Dijkstra’s algorithm

D: A* algorithm

Q22

Dijkstra’s algorithm may not terminate if the graph contains negative-weight edges.

A: False

B: True

Since Dijkstra is greedy, the answer computed by Dijsktra may be incorrect.

Dijkstra is only guaranteed to be correct if the graph has non-negative edge labels.

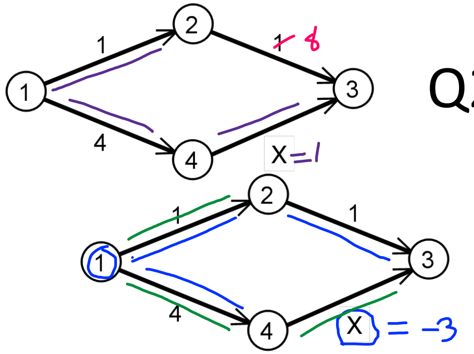
Q23

Differences between Link State, Distance-Vector and Path-Vector routing protocols

- Which generates more network traffic in a large network? *Link State*
- Which protocol uses the least router memory? Distance Vector
- Which protocol handles link additions and failures?

  Distance Vector
- Which protocol handles routing loops better?

  Path-vector



Q24

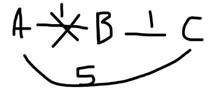
$x \leq -3$

$x = -2$ ✓

For what values of x will Dijkstra's algorithm work correctly and not work correctly?

$x > -2$ ✓

```
* Since Dijsktra is greedy, it will always choose
the path 1–2–3.
* For X < −2, Dijkstra will not find the shortest
path, because it is greedy and will choose link 1– 2
over 1– 4. In this case, the shortest path is 1–4–3.
* For X > −2, Dijkstra will find the shortest path
which is 1–2–3.
* For X = −2, both paths have the same cost, so
there is no unique shortest path. We say Dijkstra
works because it returns one of them.
```

Q25

Q: The fundamental reason for which loops form in the Distance Vector protocol is that a node A decides to use a neighbor B as the next hop for a destination based on routing information that was, at some point, propagated by A itself.

Give an example of this - draw a simple topology, break a link, and show a sequence of updates triggered by the distance vector protocol.

Before break:
At C: d(ca)=2
After break: At B: d(ba)=infinity
At B: d(ca)=2, run BF, d(ba)=2+1=3, inform c
At C: run BF, d(ca)=4, inform b
At B: run BF, d(ba)=5, inform c
At C: run BF, d(ca)=min(5+1,5}=5
At B: run BF, d(ba)=6
Everything stabilizes.

```
A—B—C

If B–C breaks, then B will notice,
recompute its route to C using A,
which will then update its route to C
using B, and so on forever. This is
the count–to–infinity problem in DV
routing.
```

Poisoned reverse partially fixes this: B lies to A.

In Path vector, nodes also exchange path information. This fixes the routing loop problem once and for all.

Q26

As an ISP, you have been assigned the 198.42.180.0/22 block of IP addresses. Suppose we want to create some subnets.

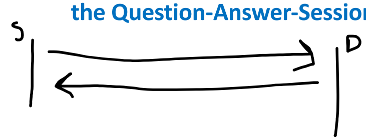
a. What is the subnet mask if you want 200 hosts in each subnet. 255.255.255.0
b. What is the maximum number of hosts per subnet? 2^8-2=254
c. What is the maximum number of subnets you can have? 2^2=4
d. Specify the CIDR address and broadcast address of the subnets?

a. Need /24 subnet, 255.255.255.0
b. 2^8 -2 = 254
c. 2^2 = 4
d.

198.42.180.0/24	198.42.180.255
198.42.181.0/24	198.42.181.255
198.42.182.0/24	198.42.182.255
198.42.183.0/24	198.42.183.255

180 = 10110100

In a txt or word document, please write your answers and then submit the file to the Question-Answer-Session-5 folder in LumiNUS Files.



Q27

TCP uses a 3-way handshake to open a connection. A two-way handshake could be potentially even more practical in terms of saving packets. Think about routing on the internet and suggest why a 3-way handshake is used rather than a 2-way or ~~4-way~~ handshake.

```
One reason is that the return route might not be
good and with a 2 way handshake, the contacted
host might start sending data on a connection
that is not up because the originating host has
not received a response.
```

Q28

If TCP provides reliable, in-order delivery of bytes end-to-end, why would you want to use UDP? Give an application that might be better off using UDP. Explain why?

```
Less overhead, faster processing, control
over timing.
Lower latency, no need for lossless data
transmission
Application: Video streaming, gaming
```


W=1, send 1 packet
After 1 RTT → W=2, send 2 packets
After 2 RTT → W=4, send 4 packets
After 3 RTT → W=8, send 3 packets

Q29

- Assuming that the available link capacity and the receiver window are infinite how many round-trip times does it take in TCP to send the first 10 packets?
- In general, how many round-trip times does it take to send the first *k* packets?

After 2 RTTs the TCP flow sends 1+2+4=7 packets. After the third RTT, the TCP's cwnd becomes 8. As a result, the TCP will send the remaining 3 packets. Thus TCP needs 3 RTTs to send 10 packets by using slow-start.

1+2^1 + 2^2 + ...2^(m-1) < k <= 1 + 2^1 + 2^2 + ...2^m,
(2^m) - 1 < k <= 2^(m+1) - 1,
m-1 < log2(k+1) -1 <= m,
m = ceiling(log2(k+1)-1) = ceiling(log2(k+1)) - 1
where ceiling(x) denotes the smallest integer that is greater or equal to x.

Max-min fair mean to maximize the minimum that any user gets. It maximize the "happiness" for all users.

Q30

1 1 1 1	2.5 2.5 2.5 2.5
1 2 2 2	1 2 2 2
1 2 3 3	1 2 3 3
1 2 3 4	1 2 3 4

- Suppose we have a single link with capacity C=10 Mbps
- Suppose we have 4 flows with requirements of (f1, f2, f3, f4).
- Compute the equal rate, max-min fair, proportional allocation if we have the following:
  - (f1, f2, f3, f4)=(3, 4, 5, 6)
  - (f1, f2, f3, f4)=(1, 2, 3, 6)
  - By allocation, we mean a vector: r=(r1, r2, r3, r4)

(f1, f2, f3, f4)=(3, 4, 5, 6)
Equal: r=(2.5, 2.5, 2.5, 2.5)
Max-min: r=(2.5, 2.5, 2.5, 2.5)
Proportional: r=5/9*(3, 4, 5, 6)

(f1, f2, f3, f4)=(1, 2, 3, 6)
Equal: r=(2.5, 2.5, 2.5, 2.5)
Max-min: r=(1, 2, 3, 4)
Proportional: r=5/6*(1, 2, 3, 6)

Q31

- In 2008, a Pakistani ISP was able to prevent about two thirds of the Internet from reaching a slice of YouTube's addresses, by hijacking part of YouTube's prefix. What does this mean?
- Explain how preference for more specific routes makes this easier. What do we call this preference for more specific routes?

```
The Pakistani ISP advertised a more specific route
to YouTube. This combined with Longest Prefix
Matching caused the outage.
```