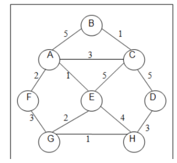
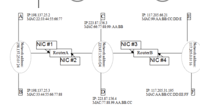
Compute the one's complement sum of the following two numbers:
10010110 + 10010000 -> 00100111
For demultiplexing, a TCP socket is identified by:
<src addr, src port, dest addr, dest port>
The UDP protocol proves error detection. True
It is acceptable to create two TCP connections on the same server/port doublet fro the same client/port doublet. False
Server X gets IP + port of Client A and Client A gets IP + port of Server X.
TCP header size: Max -> 60 bytes Min -> 20 bytes
TCP header fields: Header Length/Data Offset, Checksum, Destination Port, Sequence Number, Source Port, Window Size
The TCP countdown timer is used to implement reliable data transmission.
Pipelining is intended primarily to increase network utilization.
Event: Arrival of segment that partially or completely fills in gap in received data. TCP Receiver Action: Immediately send ACK, provided that segment starts at the lower end of the gap.
A Go-back-N type retransmission protocol will retransmit all un-ACK'd segments upon a countdown timer interrupt.
UDP header size: Max -> 8 bytes Min -> 8 bytes
UDP header fields: Length, Source Port, Checksum, Destination Port
The TCP sequence numbers are used to implement reliable data transmission.
Flow control is intended primarily to keep a TCP sender from overwhelming a receiver's buffer.
HostB has already received and acknowledged everything sent by HostA's application up to and including byte #3642. HostA now sends segments of the same application data stream in order: P-287 bytes, Q-427 bytes, R-493 bytes. What is the sequence number on segment Q? 3642 + 1 + 287 = 3930
3930 would also be the acknowledgment number for P.
Assume a TCP sender is continuously sending 1005 byte segment. If a TCP receiver advertises a window size of 5729 bytes, and with a link transmission rate of 32 Mbps, an end-to-end propagation delay of 32 ms, what is the utilization?
M=rnd_dn(5729/1005) U=[M*L*8/R]/[L*8/R+2*prop_delay]->1.9ms
The UDP protocol provides reliable, connectionless service. False
If I were going to implement a lousy VoIP connection, I would use UDP protocol.
A Selective Repeat type retransmission protocol will retransmit one segment at a time upon a countdown timer interrupt.
In a Cumulative acknowledgement scheme, a received ACK indicates all segments prior to the ACK'd segment were received.
The TCP three-way handshake is used to implement a connection.
Event: Arrival of in-order segments with expected sequence number. One other in-order segment waiting for ACK transmission. TCP Receiver Action: Immediately send single cumulative ACK, ACKing both in-order segments.
TCP Connection Initialization: Client sends segment with SYN set to 1. Server sends segment with SYN set to 1 and ACK set to the Client's SeqNum + 1. Client sends segment with SYN set to 0 and ACK set to the Server's SeqNum + 1.
The TCP sliding window is used to implement flow control.
Retransmitting a missing segment before the segment's countdown timer expires is called fast retransmission.
DevRTTn = (1 - B) * DevRTTn-1 + B * |SampleRTTnew - Estimated RTTn-1|
UDP uses an additive-increase multiplicative-decrease (AIMD) system to manage flows. False
In network-assisted congestion control, flags may be set during transit which indicate the presence and/or level of congestion in certain portions of the network.
In host-inferred congestion control, congestion is detected based on delayed and/or dropped packets.
TCP implements network fairness directly. False
What are some causes of network congestion? Dropped TCP Packets, Parallel TCP Connections, High Utilization, Reliable Data Transfer Schemes, Typical Internet Usage.
UDP has a congestion control mechanism. False
Select the appropriate new CongWin sizes for the following TCP Reno congestion scenario. Assume ssthresh is initially set to 4 MSS ->
1) Connection Established with new server host: CongWin = 1 MSS
2) ACK(s) received from first segment set: CongWin = 2 MSS
3) ACK(s) received from next segment set: CongWin = 4 MSS
4) ACK(s) received from next segment set: CongWin = 5 MSS
5) ACK(s) received from next segment set: CongWin = 6 MSS
6) Timeout occurs: CongWin = 1 MM. ssthresh = 3 MSS
7) ACK(s) received from next segment set: CongWin = 2 MSS
Given an effective delay of 90ms when network usage is 79%, what is the effective delay when network usage = 15%
Effective Delay = (90ms * (1 - 0.79)) / (1 - 0.15)
EstimatedRTTn = (1-A)*EstimatedRTTn-1 + A*SampleRTTnew
A host starts a TCP transmission with an EstimatedRTT of 47.8ms (from the handshake). The host then sends 3 packets and records the RTT for each:
SampleRTT1 = 25.7 ms, SampleRTT2 = 45.1 ms, SampleRTT3 = 26.8 ms
Using an exponential weighted moving average with a weight of 0.4 given to the most recent sample, what is the EstimatedRTT for packet #4?
EstimatedRTT2 = (1-.4)*47.8 + .4*25.7
EstimatedRTT3 = (1-.4)* EstimatedRTT2 + .4*45.1
EstimatedRTT4 = (1-.4)* EstimatedRTT3 + .4*26.8 -> 35.6 ms
Imagine a mythical set of protocols with the following details ->
Maximum Link-Layer data frame: 1431 bytes
Network-Layer header size: 19 bytes
Transport-Layer header size: 29 bytes
What is the size, in bytes, of the MSS? -> 1431 - 19 - 29 = 1383
Given a 4 Gbps link with TCP applications A, B, and C. Application A has 47 TCP connections to a remote web server. Application B has 4 TCP connections to a mail server. Application C has 3 TCP connections to a remote web server.
According to TCP "fairness", during times when all connections are transmitting, how much bandwidth should Application C have? (3/54)*4Gbps = 222.2 Mbps
TCP has a congestion control mechanism. True
In a datagram network, the responsibilities of the network layer include: host-to-host communication, packet forwarding, packet routing.
Which of the following are benefits of a datagram network? Faster delivery, Less overhead than a VC network.
The IP header may be 21 bytes long. False
The process of moving a datagram from a router's input port to output port is handled by the switching fabric.
What can cause packet queueing at a router's output port? Slow outbound link transmission rate, Multiple data flows requiring the same outbound link.
When a host in a network needs to obtain a valid IP address for itself, it broadcasts a "discover" message that can be handled by a Dynamic Host Configuration Protocol (DHCP) server, which will "offer" an IP address within the correct domain.
The IP implements data reliability services. False
The IP implements timing controls. False
A router's routing table is used by a routing algorithm.
In addition to a "default" entry, routing tables in an internet store the "first hop" in a path to each of the networks known to the router.
The IP implements flow control. False
What can cause queueing at a router's input ports? Head of line blocking, slow outbound link transmission rate, output port contention.
The process of moving a datagram from a router's input port to output port is called forwarding.
Given a router with 5 input ports and 5 output ports. If the switching fabric is 5 times as fast as the input/output line speed, queueing can occur at both an input port and output port.
Upon encountering a router with the following routing table:

Prefix Match	Port
10011110 00011110 10001111	0
10011110 00011110 10001111 000	1
10011110 00011110 10001111 01	2
10011110 00011110 10001110 0001	3
Default	4

A datagram with the destination IP address 158.30.142.90 would be routed to Port 4.
A datagram with the destination IP address 158.30.143.10 would be routed to Port 1.
A datagram with the destination IP address 158.30.142.30 would be routed to Port 3.

For the IPv4 CIDR address 153.10.22.56/22 what is the:
Netmask: 22 ones, the rest zeros
11111111 11111111 11111100 00000000 ->
to dotted-decimal -> 255.255.252.0
Network Address: turn 153.10.22.56 to binary ->
10011001 00001010 00010110 00111000
11111111 11111111 11111100 00000000 AND
10011001 00001010 00010100 00000000 ->
to dotted-decimal -> 153.10.20.0
Host Mask: 22 zeros and the rest ones
00000000 00000000 00000011 11111111 ->
to dotted-decimal -> 0.0.3.255
Broadcast Address: turn 153.10.22.56 to binary ->
10011001 00001010 00010110 00111000
00000000 00000000 00000011 11111111 OR
10011001 00001010 00010111 11111111 ->
to dotted-decimal -> 153.10.23.255
Number of possible hosts: 2^(32-22) - 2 = 1022
Host Number:
10011001 00001010 00010110 00111000
00000000 00000000 00000011 11111111 AND
00000000 00000000 00000010 00111000 ->
to decimal -> 568





Put the following steps in the correct order for new host "Jetpack" joining a network with a DHCP-enabled server "Rhino".
Jetpack sends DHCP Discover to MAC broadcast address.
Rhino sends DHCP Offer to Jetpack's MAC address.
Jetpack sends DHCP Request to MAC broadcast address.
Rhino sends DHCP Acknowledgement to Jetpack's MAC address.
UDP implements network fairness. False
The process of determining a path through the internet is handled by the routing algorithm.
Routing would be more complicated if we used hardware addresses as network addresses. True
A network with a connectionless network layer is called a datagram network.
The network layer manages communications from host to host.
The transport layer manages communications from process to process.
The data-link layer provides logical communications between adjacent node and adjacent node.
Which of the following are benefits of a virtual circuit network? Connection states are preserved, Guaranteed bandwidth, Guaranteed timing.
A network with a connection-oriented network layer is called a virtual circuit network.
A group of hosts sharing a common address prefix, behind a router, is called a/an subnet.
In a subnet, there are 2 reserved IP address.
It is the responsibility of a routing algorithm to correlate MAC addresses with IP addresses. False
When a destination host's IP fragment timer expires, it drops all accumulated fragments corresponding to that timer. True
If hosting a server inside a NATed network, how do clients outside the NAPT router connect to the server? Using Universal Plug and Play (UPnP), By using the NAPT devices IP address, and a port number pre-configured to correspond to the server, Through a connection relay service.
Network address translation is strictly a Layer-3 protocol. False
The path MTU is the largest MTU on a path from sender to receiver. False
IP datagrams fragments cannot be fragmented again. False
It is the responsibility of a routing algorithm to find a datagram's path through a network. True
In a fragmented IP datagram, the "offset" IP header field value is equal to the number of bytes of fragmented data preceding this fragment. False
The path MTU is the smallest MTU on a path from sender to receiver. True
For a TCP/IP datagram coming into a home network through a NAPT device, which of the following header fields (IP and/or TCP) are altered? Destination IP address, Destination port, Header checksum.
The largest amount of data, in bytes, which can be accommodated throughout a datagram's route from sender to receiver is called the Path Maximum Transmission Unit (Path MTU)
The "ping" application (on Windows) uses ICMP echo request/reply. True
The IP header is encapsulated in IP datagram fragments. False
The "Identification" header field is unchanged by IP datagram fragmentation. True
The transport-layer header is encapsulated in every IP datagram fragment. False
Suppose that a 1600-byte datagram (identification #20) must transit a network which has a 740-byte MTU. Assume the minimum IP and TCP header sizes, i.e., the IP header is 20 bytes and the TCP header is 20 bytes.
1) How many fragments are created? (1600 - 20) / (740 - 20) = 3
2) How many bytes of application data are carried in the first fragment?
740 - 20 - 20 = 700
3) How many bytes of application data are carried in the second fragment?
740 - 20 = 720
4) How many bytes of application data are carried in the last fragment?
1600 - 20 - 720 - 720 = 140
5) What is the identification number of the second fragment? 20
6) What is the fragment offset in the last fragment? 180
720 / 8 = 90 0 -> 90 - > 180
Using the version of Dijkstra's Algorithm discussed in the lectures, and the network configuration in the graph, to calculate the shortest path from node H to node B.
What is the 3rd node to be eliminated from the set S = {A,B,C,D,E,F,G}? E
What is the full shortest path from node H to node B? H-G-E-A-C-B
What is the cost of the shortest path from node H to node B? 8
Fill in the complete routing table for node H, as it would be calculated by Dijkstra's algorithm and stored inside router H.
Destination: A B C D E F G
First Hop: G G G D G G G
In a subnet, the reserved addresses are the subnet address (with a lowest subnet IP address) and the broadcast address (with a highest subnet IP address).
Where do network-layer protocols run? PCs, Laptops, Routers, Mobile devices
The "traceroute" application (on Windows) sends UDP messages by default. False
The "traceroute" application (on Windows) sends ICMP messages by default. True
The largest amount of data, in bytes, which can be accommodated by a particular network, link, or physical-layer is called the Maximum Transmission Unit (MTU).
In a prefix-matching network, a routing table stores: Next-Hop link information and IP Prefixes.
NAPT devices translate IP address and port numbers. True
Network address translation alters IP to add new IP addresses. False
For a TCP/IP datagram leaving a home network through a NAPT device, which of the following header fields (IP and/or TCP) are altered? Source IP address, Source Port, Header Checksum
The transport-layer header is encapsulated in the first fragmented IP datagram. True
Network address translation has ameliorated the IP address shortage problem. True
When a destination host's IP fragment timer expires, it drops all accumulated fragments corresponding to that timer. True
It is the responsibility of a routing algorithm to determine a datagram's next hop information. True
The IP header may be 28 bytes long. True
It is the responsibility of a routing algorithm to forward packets to the appropriate output link. False
Re-assembly of fragmented IP datagrams is handled by the destination host.
The "time to live" field in a modern IPv4 datagram header specifies the number of remaining hops before the datagram is dropped.
The "Hop Limit" IPv6 header field indicates how many remaining hops to the destination. False
IPv6 datagrams cannot be converted to IPv4 datagrams without losing any information. True
The IPv6 header does not have a checksum. True
Select all features explicit in IPv6 which are not explicitly available in IPv4. Flow labeling, 128-bit addresses, Extension Headers, Explicit Payload Length
In IPv6, there is no datagram fragmentation performed in the network core. True

The IPv6 address size is 128 bites.
A "collision" is best described as when a node receives two or more frames at the same time.
Ethernet provides error detection via CRC check.
It is fairly easy to detect collisions in wireless networks. False
There are reserved MAC addresses unusable for devices. True
On the sending or receiving host, most of the protocol tasks "below" the application layer of the protocol stack (data encapsulation, IP addressing, etc) are handled by the network interface controller (NIC).
A multiple access scheme with uses a master node to poll each slave node, and control who has "permission" to transmit at any given time is called "taking turns" protocol.
A MAC address is permanent and unique. False
In a CSMA/CD system, when a collision is detected, the sender will cut off transmission and wait for some time before retransmitting.
A link-layer link between only two adjacent nodes is called a/an point to point link.
Star Ethernet uses the same multiple access control as Bus Ethernet. False
Select all Channel Partitioning schemes: TDMA, FDMA, WDMA
To retrieve an adjacent node's MAC address, ARP is used.
In Random Access multiple access schemes, no two nodes will ever transmit at the same time. False
A switch is a network-layer device. False
A network with a bus topology must terminate the endpoints, but with a ring topology they are connected so there is no endpoint.
Select words/phrases from the dropdown menus to define the process of sending a message from host A to host D in the diagram below. Each phrase may be used zero or more times.
1) A finds that D belongs to a different subnet by checking D's IP address.
2) A looks up RouterA's NIC#1 IP address in its routing table.
3) A uses ARP to get RouterA's NIC#1 MAC address
4) A creates frame with RouterA's NIC#1 MAC address as destination. Frame contains IP datagram with D's IP address as destination.
5) A's NIC sends frame and RouterA's NIC receives it.
6) RouterA removes IP datagram from frame, learns that its destination is D's IP address.
7) RouterA uses ARP to get D's MAC address.
8) RouterA creates frame with D's MAC address as destination. Frame contains IP datagram with D's IP address as destination.
9) RouterA's NIC sends frame and D's NIC receives it.
Select all features explicitly available in IPv6 which were already available explicitly in IPv4. Source/Destination Addressing, Version, Hop Limit, Traffic Type
When encountering an IPv4-only router, an IPv6 datagram is dropped. False
Convert the following IPv4 address to its corresponding IPv6-mapped address, with proper formatting. 192.123.33.1 -> ::ffff:192.123.33.1
Bus Ethernet uses a random access scheme. True
MAC addresses are redundant because of IP addresses. False
The link-layer device at the center of an ethernet start is a switch.
Select all "Taking Turns" schemes: Polling Multiple Access, Token Run Multiple Access
There are reserved MAC addresses unusable for devices. True
The method by which a MAC protocol coordinates access to a broadcast medium to prevent and/or reduce collisions is most commonly called multiple access.
When sending a message to all devices on a link, you would send it to the broadcast MAC address: 00-00-00-00-00-00. False
A multiple access scheme which listens to the channel to make sure it is empty, prior to transmitting, is called Carrier sense protocol.
A MAC address was originally designed to be permanent and unique. True
The address table shown below would be maintained by a host, router or switch by ARP. Hardware Address IP - Address
When encountering an IPv4-only router, an IPv6 datagram is encapsulated in an IPv4 datagram, with the next in-line IPv6 router as its destination.
Which of the following are used in a wired Ethernet network? Exponential back-off/retry for collision resolution, Carrier Sense Multi-Access (CSMA), Collision Detection (CD)
Which are functions of the Ethernet preamble? Clock synchronization, Start signal, Circuit wake-up
For a 10Mbps link, 1000 bit times is 0.1ms. True (1000 * .0001ms)
If an Ethernet sender senses a clear channel, and begins transmission, but shortly thereafter detects a collision, it will Terminate transmission and enter exponential backoff.
Given the following diagram of typical Ethernet hardware frame:
A B C D Data A
Hardware framing character(s) - hardware frame header(s) - IP header(s) - TCP/UDP header(s)
Given the following "byte stuffing" scheme:

Character in data	Characters sent
soh	esc x
eot	esc y
esc	esc z

Character	Hex code
soh	01h
eot	04h
esc	1Bh
'x'	78h
'y'	79h
'z'	7Ah

Data: 79h 01h 78h 1Bh
Answer: 01h 79h 1Bh 78h 78h 1Bh 7Ah 04h
In indirect routing, after the initial contact with the home network, the correspondent sends packets to the permanent address.
In one type of wireless network, hosts communicate directly with other hosts that are within range. This communication model forms a "grid" called an ad-hoc network.
A device which is connected to the network through a link which does not utilize any physical connection is a Wireless device.
Which of the following are used in a wireless network such as 802.11n? Carrier Sense Multiple Access, Reservation system with Request to Send (RTS) and Clear to Send (CTS), Collision Avoidance, Exponential back-off/retry for collision resolution.
When a mobile unit moves from a home or foreign agent to another (foreign) agent, the new agent must assign a new "care-of" address to the mobile unit.
S represents a source host and D represents a destination host. Which of the following is the most typical use of public key encryption, when S sends an authenticated (digitally signed) message to D? S encrypts a signature using S's private key, and D decrypts the signature using S's public key.
When an organization establishes a network security policy, which of the following should be considered? The value of the information that is stored or transmitted by the site. The cost of damage control after various types of security breaches. The cost of installing "secure" systems.
S represents a source host and D represents a destination host. Which of the following is the most typical use of public key encryption, when S sends an encrypted message to D? *S* encrypts a message using *D*'s public key, and *D* decrypts the message using *D*'s private key.
In IPv6, datagram fragmentation is handled at the network edge.
A link-layer link between more than two adjacent nodes is called a broadcast link.
Select all Random Access schemes: CSMA, ALOHA
In an Ethernet network, after 8 collisions, the range of wait times will be [0,1,…255]*512 bit times -> 2^8 - 1 = 255
Ethernet uses a RTS/CTS contention-free period. False
The default multiple access scheme of 802.11g is RTS/CTS. False
Which of the following are major issues that must be handled in wireless networks Obstacles that block radio signals, Hosts may frequently move from one network to another, Multi-path propagation when radio signals bounce off obstacles, The "hidden node" problem, Radio waves are more susceptible to interference than signals carried on cable.
When using an RSA algorithm to construct private and public keys for a public key encryption system, choose prime numbers p and q, and then calculate n = pq, z = (p-1)(q-1). Then choose e and d to create the public key and the private key . Suppose that p = 5, and q = 11. Which of the following values will work for d and e? e = 7, d = 63 ((e*d) -1) mod z = 0