Protocols

Write a protocol's full name and the layer it belongs to.

Protocol	Full name	TCP/IP Layer
Ethernet	*Ethernet*	*Link*
ARP	**Address Resolution Protocol**	**Link**
DNS	**Domain Name Service**	**Application**
HTTP	**Hypertext Transfer Protocol**	**Application**
ICMP	**Internet Control Message Protocol**	**Internet**
IPv4	**Internet Protocol version 4**	**Internet**
IPv6	**Internet Protocol version 6**	**Internet**
POP3	**Post Office Protocol version 3**	**Application**
TCP	**Transmission Control Protocol**	**Transport**
TFTP	**Trivial File Transfer Protocol**	**Application**
UDP	**User Datagram Protocol**	**Transport**

Look up protocols and the TCP/IP model.

Protocols (2)

Analyze the packet bytes captured by Wireshark and answer the following questions. Circle the corresponding bytes.

1. What version of IP is being used? **IPv4 (byte 14)**
2. What transport layer protocol is being used? **TCP (byte 23)**
3. What application layer protocol is being used? **Telnet (bytes 36-37)**
4. What is the transmitted message? **IA (bytes 54-55)**
5. Is the sender a client or a server? **Client (bytes 34-37)**

```
0000  60 e3 27 49 2e ee 30 85  a9 8c dd 52 08 00 45 00
0010  00 2a 6b c6 40 00 80 06  1c ff c0 a8 01 6e 26 66
0020  89 8c c6 66 00 17 45 b0  58 f4 a2 4d 2e 93 50 18
0030  01 01 bd 7c 00 00 49 41
```

Look up format of the header of IPv4, IPv6, and ICMP.

Protocol headers

What is the smallest size of an Ethernet frame sent into the wire, if the frame contains 384 bytes of data inside UDP datagram inside IP packet?

Look up size of a header of the following protocols: Ethernet, IP, IPv6, ICMP, TCP, and UDP.

384 + 8 + 20 + 14 + 4 = 430

Protocol headers (2)

What can you say about an IP datagram if the value of the first byte of its header is 0x44? Why isn't it a valid IPv4 or IPv6 datagram?
Look up format of the header of IPv4, IPv6, and ICMP.
Not IPv6 (should be 0x60); too short for IPv4 (should be 0x45)

Internet Protocol, version 6

Imagine a block of 10 billion (1 billion = 10^9) IPv6 addresses allocated every picosecond. How many years (1 year = 365 days) will pass until IPv6 address space is depleted?
Look up an approximate number of available IPv6 addresses, common prefixes for small (up to 10^{-12}) and large (up to 10^{12}) values.

$$\frac{10^{38.5}}{\frac{10^{9}}{10^{-12}}} = 10^{17.5} sec => \frac{10^{17.5}}{10^{7.5}} = 10^{10} = 10\ billion\ years$$

Internet Protocol, version 6 (2)

Are the following valid IPv6 addresses? Explain why not.

IPv6 address	Valid or not	Why not?
FF0C::B1	**Yes**	
2001:310:AB12:67:FFFFF:0:1523:1	**No**	**fffff**
2a03:2880:10:8f01:face:b00c:0:25	**Yes**	
2607:f8b0:4009:802:1004	**No**	**Too short**

Look up the format of IPv6 address.

Error messages

What is the type/code of an ICMP message sent, if any, in case of an IP checksum error?
Look up common types of ICMP messages.
No ICMP message is sent in case of an error. It's not clear where to send it to.

Forwarding

Consider the following forwarding table:

Prefix	Interface
11100000 00	0
11100000 01000000	1
1110000	2
Default	3

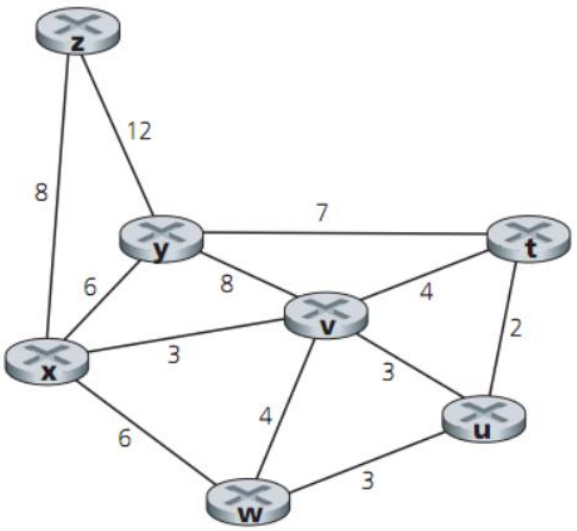
Complete the following table

Address	Outgoing interface
200.145.81.85	**3**
225.64.195.60	**2**
225.128.17.119	**2**

Look up longest prefix matching.

LS Routing (Dijkstra)

Use Dijkstra's algorithm to find the shortest paths from **v** to every other node in the network. Print each path and its cost in the following format (a path of cost 10 from a to d via b and c): a-b-c-d (10).



v-> t: 4

v -> u: 3

v -> v: 0

v -> w: 4

v -> x: 3

v -> y: 8

v -> t -> z: 11

Look up Dijkstra's Shortest Path Algorithm.

Throughput

Amazon Snowmobile can carry 100PB of data in a 45-foot long ruggedized shipping container, pulled by a semi-trailer truck. What is the throughput of this truck as it drives from Decorah to San Francisco (2700 km) at the average speed of 90 km/h?

Look up units and conversion.

$$\frac{\mathbf{80000000000000000\ bits}}{\mathbf{108000\ seconds}} = \mathbf{7407407407407.407 \approx 7.4\ Tbps}$$

Subnetting

Five departments of the company X requested 10, 15, 25, 30, and 35 host addresses respectively. Can this request be accommodated if the available subnet is 192.168.10.0/24

Department	Requested size	Allocated hosts	Subnet Address	Mask
Accounting	25	**30**	**192.168.10.96**	**/27**
Marketing	35	**62**	**192.168.10.0**	**/26**
Human Resources	30	**30**	**192.168.10.64**	**/27**
Shipping	10	**14**	**192.168.10.160**	**/28**
IT	15	**30**	**192.168.10.128**	**/27**

Look up subnetting.

This is one of many possible solutions.

Subnetting (2)

Fill the empty cells in the table. Use dotted-decimal notation for a subnet mask.

Subnet ID	Subnet Mask	Mask Bits	Host Addresses	Broadcast Address
10.0.0.0	255.255.240.0	/20	**4094**	**10.0.16.255**
3.1.0.0	255.255.255.252	**/30**	2	3.1.0.3
172.16.0.0	**255.255.255.128**	/25	**126**	172.16.0.127
191.168.100.0	255.255.255.240	**/28**	14	191.168.100.15
130.210.3.0	**255.255.252.0**	/22	1022	**130.210.6.255**

Look up subnetting.

Subnetting (3)

Luther network administrators are trying to trying to split / subnet between Olin, Valders, Miller, Dieseth, and Jenson-Noble buildings. The requested address space is as follows: Miller and Dieseth buildings – 1500 addresses each, Valders and Olin – 800 each, Jensen-Noble – 400 addresses. Additionally, each building needs 100 addresses reserved for network equipment. Considering each building will be on the same subnet, divide a 74.207.32.0/19 network to meet the needs. Print subnet ID and the broadcast address of each subnet.

Building	Subnet ID	Broadcast
Dieseth	**74.207.32.0**	**74.207.39.255**
Jensen-Noble	**74.207.56.0**	**74.207.57.255**
Miller	**74.207.40.0**	**74.207.47.255**
Olin	**74.207.48.0**	**74.207.51.255**
Valders	**74.207.52.0**	**74.207.55.255**

Look up subnetting.

This is one of many possible solutions.

Number conversion

Fill the blanks in the following table:

Binary	Octal	Decimal	Hexadecimal
11111111	*377*	*255*	*FF*
11111110	**376**	**254**	**FE**
100011000	**430**	**280**	**118**
110101110	**656**	**430**	**1AE**
10000110000	**2060**	**1072**	**430**

Look up numbering systems.