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period: 3

2.2.2 and 2.2.3B part 1: How the Internet Works

We might come back to look at 2.2.1 later when we look at Computational Innovations during the 4th quarter. But for the rest of this quarter I would like to focus on how the internet works.

It's video time! A lot of this information will be presented to you through videos (and more professionally done than the ones I make!) I want you to be able to understand some of the basics and basic terminology around the internet. The videos and PLTW activities will help you do that.

2.2.2 A quick review

This is basically a review of decimal and binary number systems and how characters and images can be represented by binary numbers. You will not have to answer questions for the first half of the activity in PLTW, but look through it to make sure you understand all of the concepts.

12-15.

a)What is ASCII (don't tell me the abbreviation, just tell me what it is used for)?
It is used for representing characters that aren't numbers.
b) What is Unicode? How is it different from ASCII?
Unicode is similar, but it uses multiple bytes to support most languages.
c) How does a CPU know whether to evaluate a byte as a number or as a character?
The software distinguishes between numbers and characters.
d) What is a bitmap file?
A file where an image is stored by saving every pixel as an rgb value.
16. What will the bitmap file given in PLTW render on the screen?
A diamond
17. a) Let's now consider a bitmap that has a 2-bit color scheme. How many unique colors can be represented using 2 bits? List them here.
4, white, light gray, dark gray, black
b) Explain how vector images can be used to render images in a file of smaller size than if the file were a bitmap image.
They render images in smaller size by defining them using shapes and lines, instead of by pixels.

Conclusion

C1. *Without* converting the numbers to decimal, sort the following binary numbers in descending order (largest to smallest):

a. 10100101
b. 10100011
c. 10001100
d. 10001010
e. 01000100

C2. Create your own numbering system:

a. Choose a single-digit base that is greater than 2.
   3
b. Identify all the available digits in your system.
   012
c. Create a table showing the first four place values of your system.

0000	0001	0002
0010	0011	0012
0020	0021	0022
0100	0101	0102
0110	0111	0112
0120	0121	0122
0200	0201	0202
0210	0211	0212
0220	0221	0222
1000	1001	1002
1010	1011	1012
1020	1021	1022
1100	1101	1102
1110	1111	1112
1120	1121	1122
1200	1201	1202
1210	1211	1212
1220	1221	1222
2000	2001	2002
2010	2011	2012

2020	2021	2022
2100	2101	2102
2110	2111	2112
2120	2121	2122
2200	2201	2202
2210	2211	2212
2220	2221	2222

d. Show an example of a number in your number system and its conversion to decimal.
1221 --> 52

2.2.3B part 1

Time to watch some videos.

We will watch the first video from this PLTW activity, as well as The Dawn of the Internet in class. There are a couple other videos in this activity in steps 2 and 3 you will watch. There is also a great collection of videos put out by code.org that I have linked in the Modules in Canvas. All of these should help you understand the basics of how a computer works and how data is transmitted across the internet.

2.

a. What is metadata and where is it found in a packet?
It is information used to transmit the packet, and it is found in the IP header.

b. Give an example of IP packet metadata.
The packet length, the source IP address, and the receiving IP address.

c. What does a packet's payload contain?
The data being sent.

d. What is the main difference between an IPv4 and an IPv6 packet?
Ipv4 uses 4 byte addresses, and IPv6 uses 16 bytes.

e. Roughly how many people are there in the world?
7.9 billion

f. Roughly how many computer devices that can be connected to the internet do you think there are in the world?
10 billion?

g. Why did we have to come up with another version of IP after IPv4?
Because IPv4 only supports about 4 billion addresses, which is not enough nowadays.

h. How many times more IPv6 addresses are there than IPv4 addresses?
1028 times more

i. Do you ever think we will run out of IPv6 addresses? Why or why not?
I don't think we will because I don't think that the earth could even support the amount of humans and devices it would take to fill all of them up.

3. a) What are the two main protocols on the Transport layer and how do they differ?
TCP makes sure all of the packets are received and lets the sending server know, UDP basically just throws a bunch of packets at you and hopes you got them, but it's faster.
b) Under Figure 4 in the Other Protocols section of the PLTW activity, there is a little multiple choice quiz. If you didn't get 6 out of 6 and can't re-set the quiz, take it again in activity 2.2.3A (they have the same quiz in there in the same section). Paste a snip of your 6 out of 6 question quiz here:

You answered 6 of 6 correctly. Congratulations!
To pass, you need to get 6 correct.

<u>Mr. W's conclusion</u>

1. What does it mean that the internet has built-in redundancy which makes it fault-tolerant?
It means that there are a lot of different routes packets can take, so even if one goes down, packets can still get to their destination.

2. Fill in the following phrases in red after the appropriate term in blue that follows. You may also fill in what the acronym stands for if it helps you to remember, but you must include the phrase given here, as well:

G - software that uses rules to determine whether or not data shall pass from one device to another.

X - a device which acts as an access point for wireless devices to connect to a network.

A - the amount of bits available for data to be used during a session in which applications are run (RAM)

C - The part of the computer that does the processing of data: it receives input, sends out output, puts data in storage and processes data. It's really the computing part of the computer.

D - The system in which destination IP addresses are found for data transmission to the correct destination.

F - A relatively cheap medium for physically sending bits between devices over a short distance, for example in your house or in the classroom or business office.

E - An expensive medium for physically sending bits between devices over long distances, very quickly and with very little data loss.

H - A standardized set of rules for transferring a file across the internet.

I - A standardized set of rules related to transferring html files (web pages) across the internet securely.

T - A standardized set of rules related to transferring emails across the internet.

K - A standardized set of rules related to ensuring that information about packet source, destination and other key information is included in the packet.

V - A standardized set of rules that includes identifying the packet sequence number and ensures that an established connection has been made and that all packets have been received at the destination.

W - A standardized set of rules that sits on top of IP that is typically used in situations where a lot of data is being streamed and thus shortening the amount of time it takes to deliver packets is more important than verifying their sequence and confirming their delivery.

Z - A relatively cheap medium for sending bits between devices over a short distance via radio waves.

L - A company that provides a service of connecting people's devices in their homes to the internet through the company's servers.

J - The large, decentralized, relatively leaderless network of networks that are connected to each other throughout the world, allowing data to be transmitted from one device through to another through the billions of paths available to make this transmission possible.

Y - The collection of files, servers and protocols which make up the web pages people can access and visit for everything from looking at colleges to shopping to watching movies and playing games.

M - A device used to modulate discrete digital data (binary) into continuous wave data (analog) so that it can be transmitted better, and to demodulate analog to digital data so that it can format carried data to be read by the CPU.

U - The amount of persistent data that can be kept on a device.

B - The amount of data that can be transmitted through a medium per second; the "thickness of the pipe" using a plumbing analogy.

Q - Standardized sets of rules.

O - A collection of bytes that is transmitted through the internet.

R - A device used to send packets onto an appropriate path towards its destination.

S - A computer customized to hold a lot of a particular type of data (e.g. database files, web pages or mail folders)

N - Devices that can exchange data with each other.

P - The route that a packet takes from the source to its destination.

A. active memory
B. bandwidth
C. CPU
D. DNS
E. ethernet
F. fiber-optic cable
G. firewall
H. FTP
I. HTTPS
J. the internet
K. IP
L. ISP
M. modem
N. network
O. packet
P. path
Q. protocols
R. router
S. server

T. SMTP
U. storage
V. TCP
W. UDP
X. WAP
Y. the web
Z. wifi