

Hello Charlotte, Mary and Stephen,

We begin Lesson 3 with one of my favorite topics of all times, binary numbers. Here is my binary watch and if you are normal, you probably cannot tell what time it is!



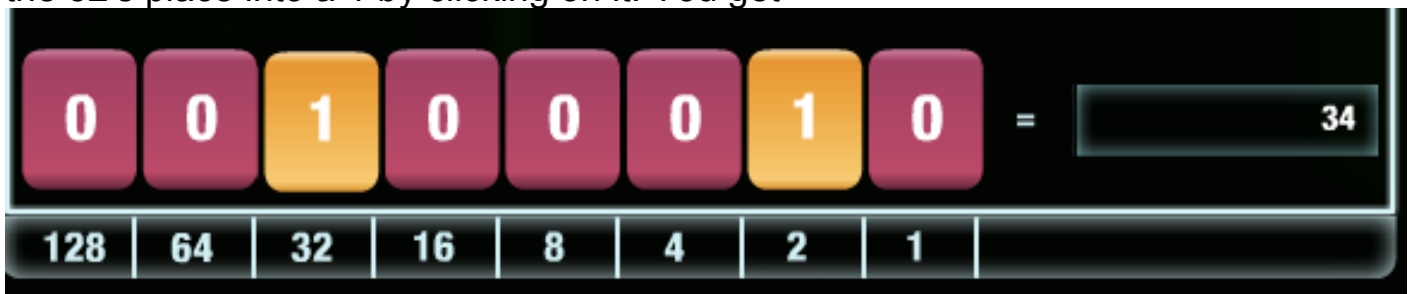
Do you see two rows? The top row shows the hours and hopefully you can see the light underneath 2, so that means it is shortly after 2 o'clock. The minutes are more complicated because there are lights above the 1, the 4 and the 16. Since $1+2+16$ adds up to 19, that means the time is 2:19.

You are on your way to understanding binary, the language of computers!

Let us look at another example from my favorite online binary game at tinyurl.com/binarygame33:



The challenge is to figure out how to put 34 into the red and yellow tiles. You might be surprised, but there is only one way to do this: $32 + 2$. Some people think there are two solutions, but not true. So if you are playing this game, you need to change the 32's place into a 1 by clicking on it. You get

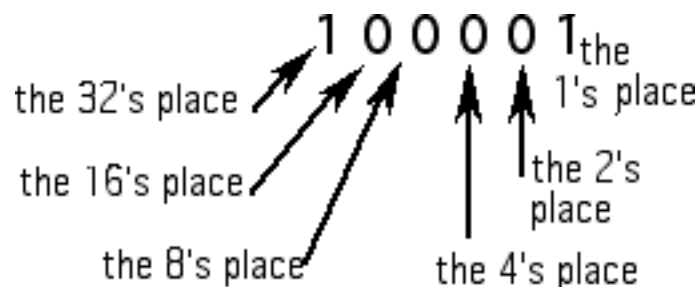


and you are now on your way. Do you see the numbers from 1 to 128 in the bottom row? Try to look away from this page and see if you can say in ten seconds the numbers aloud from 1 to 128, doubling each time. Now do it from 128 to 1, going back and forth a few times. These are the 8 places that make the 8 bits of binary. Yes 8 bits equal 1 byte and the eight bits correspond to these eight 1's and 0's.

Here is some reading explanation using one of my favorite graphics with Larry Bird's uniform number (33) written as a BASE TWO number: **100001**



Each position stands for a power of TWO instead of a power of TEN:



Another Example: let us change 89 from decimal to binary

The typical strategy is to write down 8 places, labeling them from 1 on the right to 128 on the left:

128	64	32	16	8	4	2	1
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We now distribute the 89 (as if we playing the role of the banker in monopoly and have to pay \$89 but can use only \$128 bills, \$64 bills, \$32 bills, etc. and just ONE of



each). We first put a 1 in the 64's place which leaves $89 - 64$ or 25 left to distribute. We next put a 1 in the 16's place, leaving 9 dollars and so on. We get an answer of 01011001 which means there is a 1 in the 64's place, the 16's place, the 8's place and the 1's place. Note that $64 + 16 + 8 + 1$ makes 89.

Now let's change 01000101 from binary to decimal

We begin with our 8 positions and now translate our 01000101 number into 1 in the 64 place PLUS 1 in the 4 place PLUS 1 in

128	64	32	16	8	4	2	1
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the 1's place, i.e. with our "monopoly money analogy" $\$64 + \$4 + \$1$. We get an answer of 69.

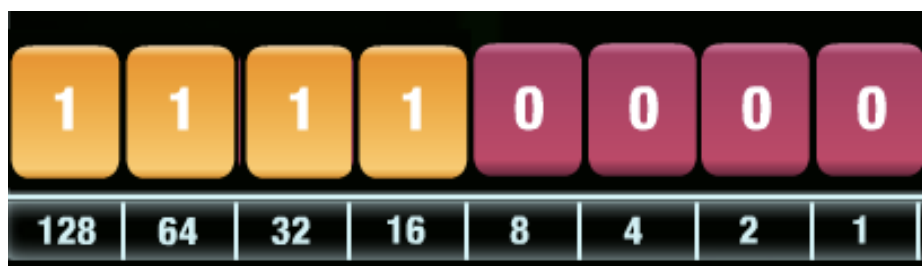
Let's try again with another example from the online binary game.



Because the 240 is on the right, you need to flip the red and yellow tiles to make the number 240. Again, like the monopoly game, please pretend that you are the banker and you owe me \$240. All you have are the denominations of

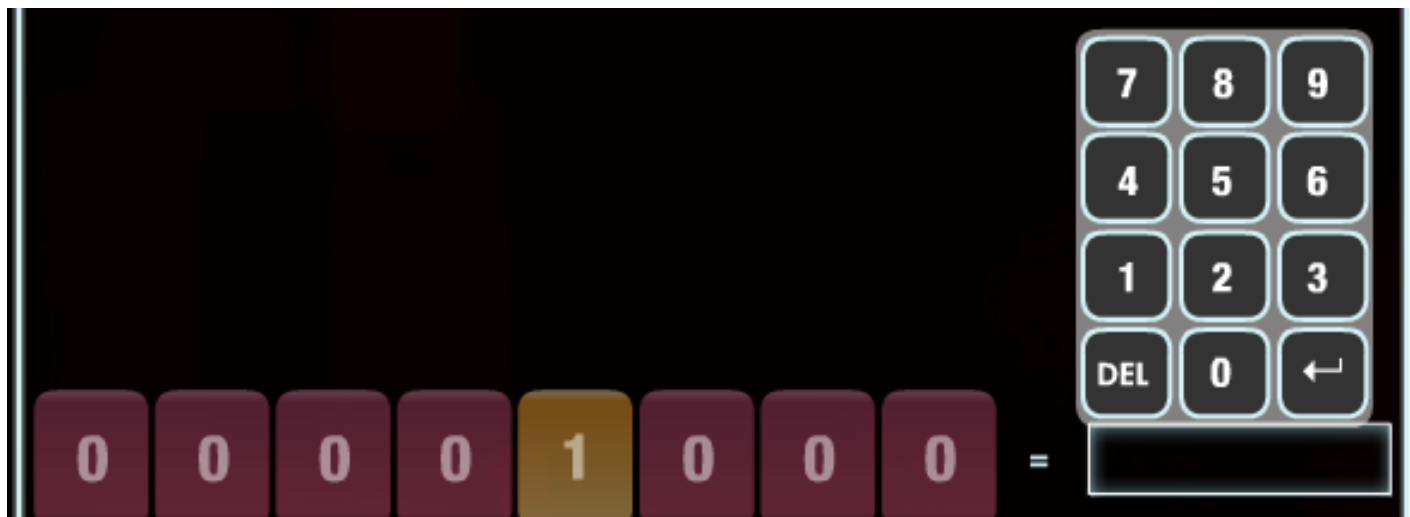
\$128 \$64 \$32 \$16 \$8 \$4 \$2 \$1

How are you going to give me \$240? You are allowed to give me just 1 or none of each bill. If you give me a \$128 bill and a \$64, that means I now have \$192. So you give me a \$32 and I now have \$224. You owe me how much? ____ Yes, you owe me \$16 and so you give me that and you are done. Here is the answer.

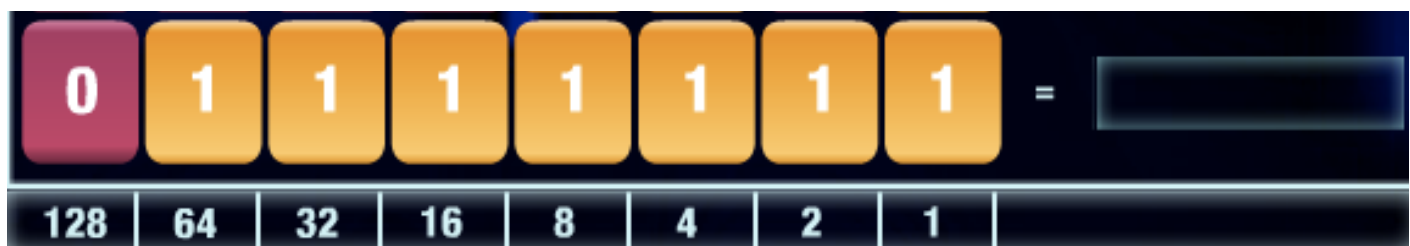


Got it? I hope so, but if not, I will help you more when we talk/skype next.

The binary game has two types of problems. If you see a number on the right (like the 240) then you have to turn over the red and yellow tiles to make that number. If you see NO NUMBER on the right, then you need to figure out what the existing tiles make. Here is one of THOSE examples.



When you click the empty black rectangle you get a numeric keypad to type in the answer. Can you figure out the answers to the above problem (easy) and the below one (hard)? Answers are on the next page.



Why do computers use binary? Because the inside of a RAM chip is a huge grid of thousands of horizontal wires and 8 vertical wires so that each place where the wires cross is either a 0 or 1. The word BIT is short for BInary digiT and that is how words are stored on a computer. My name is STEVE and it has 5 bytes or 40 bits. Each letter takes up 1 row on a computer chip with 8 codes that make up the letter. There is a famous code system called ASCII code that makes each letter into a unique number. The letter "S" is code 83 for example. The letter "T" is code 84. This web site at <http://slayeroffice.com/tools/ascii/> shows the ASCII codes from A-Z and also has a converter up top that lets you convert letters to ASCII or visa versa.

Answers from previous page are 8 and 127.

Use this form to quickly find an ASCII value or the character assigned to that value.

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TINYURL.COM/ASCII33

Code	Value	Code	Value	Code	Value	Code	Value	Code	Value	Code	Value
33	!	34	"	35	#	36	\$	37	%	38	&
39	'	40	(41)	42	*	43	+	44	,
45	-	46	.	47	/	48	0	49	1	50	2
51	3	52	4	53	5	54	6	55	7	56	8
57	9	58	:	59	:	60	<	61	=	62	>
63	?	64	@	65	A	66	B	67	C	68	D
69	E	70	F	71	G	72	H	73	I	74	J
75	K	76	L	77	M	78	N	79	O	80	P
81	Q	82	R	83	S	84	T	85	U	86	V
87	W	88	X	89	Y	90	Z	91	[92	\

I have highlighted in red the fact that the code for A is 65 (01000001) and the code for Z is 90 (01011010). These ASCII codes represent the way that text is stored in the computer. Please note that the digital computer was invented in 1946 but that this ASCII system came out of an agreement (and fight) in the 1960s.

Assignment 1A: Read this handout

Assignment 1B: Watch the video below

http://www.youtube.com/watch?v=_qNUvQWDRL8&feature=youtu.be

Assignment 1C: Schedule a 30 minute phone call or skype with me

Assignment 1D: Please contribute to our WIKI located at the

tinyurl.com/sconlineplunge webpage. The new words for this week are ASCII, binary, decimal, base 2, base 10. Additionally, I have put your names on the bottom of the WIKI and you must go there and give me the ASCII codes and binary codes for the letters in your first name.

Assignment 1E: Play the binary game at tinyurl.com/binarygame33 and see if you can get a high school over 2000?



Assignment 1F: Find someone you know (student, friend, relative, neighbor, colleague) and teach that person about binary. I will initiate a REPLY ALL email thread and ask you to write about your conversation with that person later in the week.

Have a good week! I look forward to our 30 minute talk.

Steve



phone = 781-953-9699

skype name = stevebergen (no spaces)

Email = sbergen33@gmail.com