How Computers Count

Name:

Class:

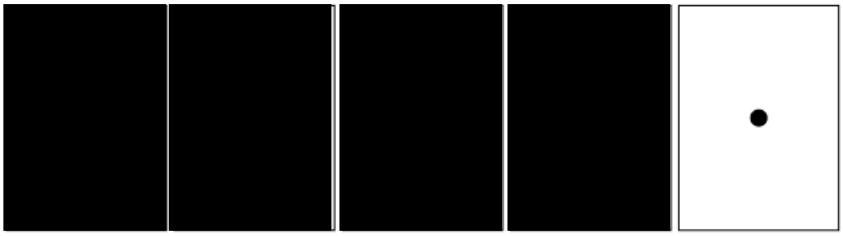
Pages 5 & 6 produced by Michael Edwards

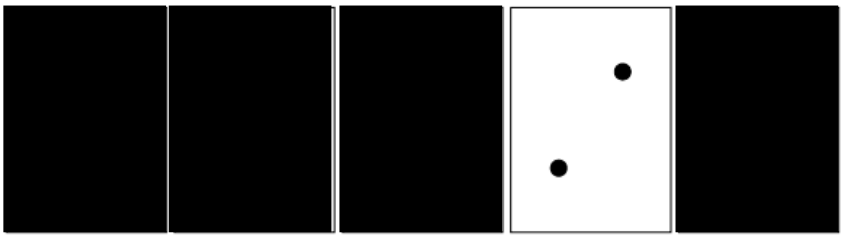
Page 7 taken from Computer Science Unplugged - http://csunplugged.org

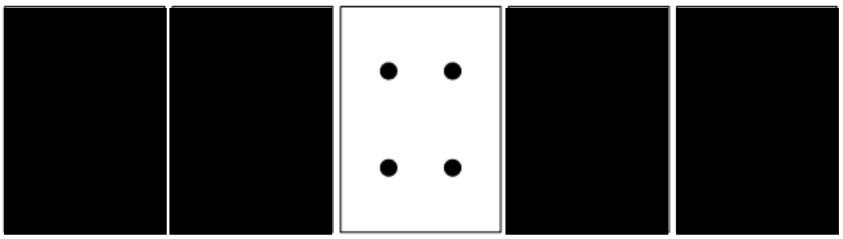
How Do Computers Count?

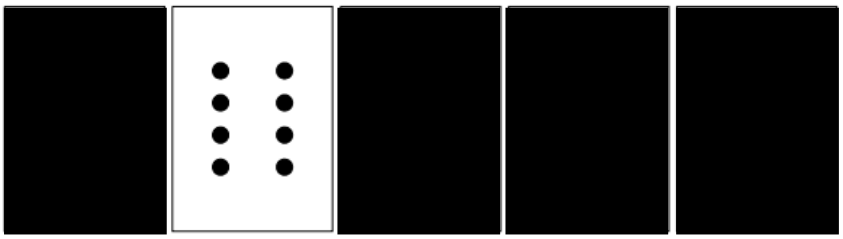
Count how many dots are in each picture:

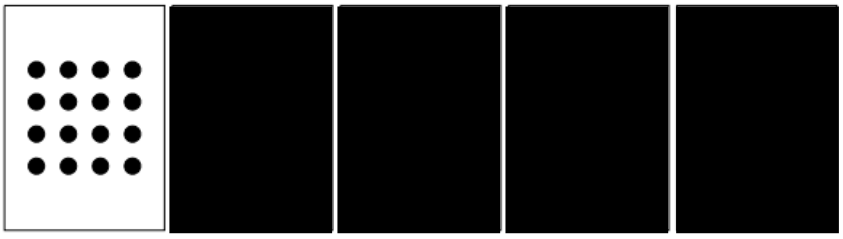
Number of dots

1. 

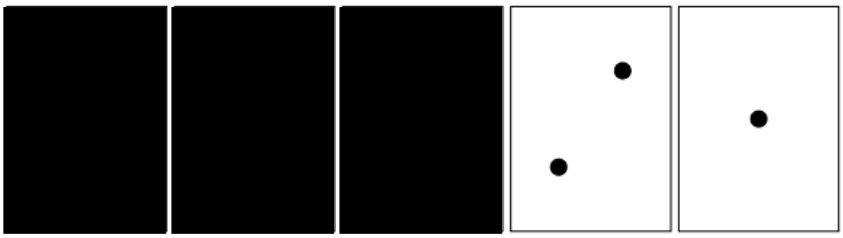
2. 

3. 

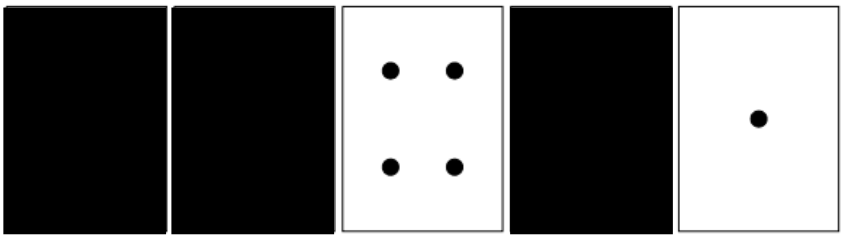
4. 

5. 

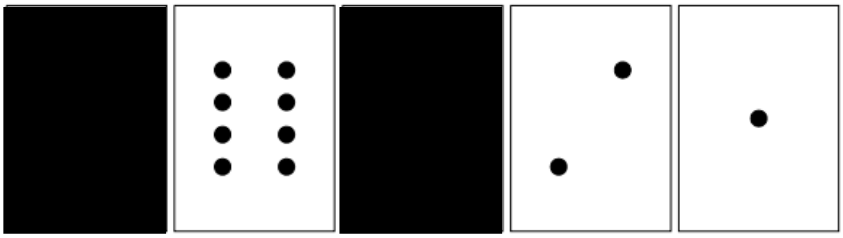
Now you know how many dots are on each card, try to work out how many dots there are in total for each question.



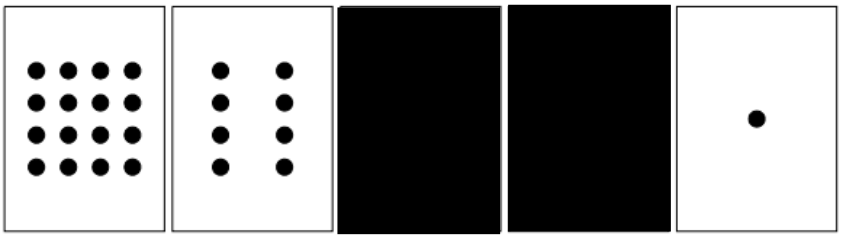
0	0	0	1	1



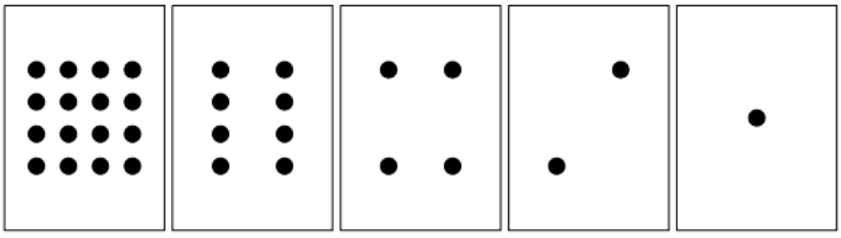
0	0	1	0	1



0	1	0	1	1



1	1	0	0	1



1	1	1	1	1

Now try adding the cards yourself to make these number (you can just write the values on)

16				1
1	0	0	0	1

17

3

5

10

27

DECIMAL	BINARY				CORRECT?
0	8	4	2	1	
1	8	4	2	1	
2	8	4	2	1	
3	8	4	2	1	
4	8	4	2	1	
5	**8**	**4**	**2**	**1**	**Example**
	0	**1**	**0**	**1**	
6	8	4	2	1	
7	8	4	2	1	
8	8	4	2	1	
9	8	4	2	1	
10	8	4	2	1	
11	8	4	2	1	
12	8	4	2	1	
13	8	4	2	1	
14	8	4	2	1	
15	8	4	2	1	

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TOTAL OUT OF 15:

BINARY NUMBERS

Binary means two. All numbers in the binary system are made up of either a **0** or a **1**.

To work out the equivalent of a decimal number in binary we need to use a grid like the one below:

8	4	2	1

We are going to work out the equivalent of the decimal number :

5

Are there any eights in **5**? NO! So we put a **0** in the eights column.

Are there any fours in **5**? Yes! So we put a **1** in the fours column.
(THIS LEAVES REMAINDER 1)

Are there any twos in **1**? No! So we put a **0** in the twos column.

This leaves '**1**' for the one column.

8	4	2	1
0	1	0	1

5 in decimal is 0101 in binary!

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TOTAL OUT OF 12:

More Binary Numbers

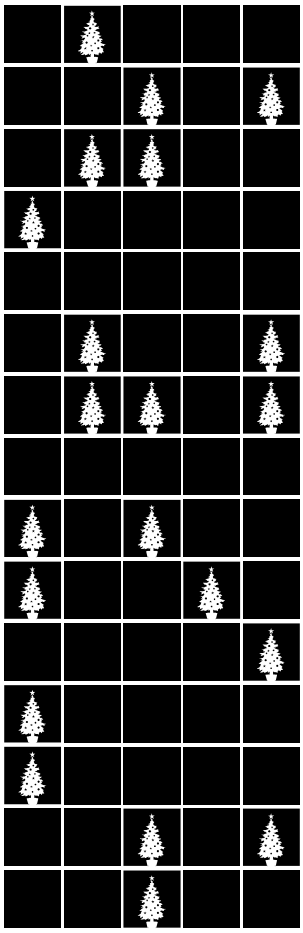
This works exactly the same way as the smaller numbers, only now you have a larger grid to work with. **Example: 124 = 0-1-1-1-1-1-0-0**

Each number (**0** or **1**) is called a '**bit**' short for 'binary digit'. Each block of 4 bits is called a "**nybble**". Each block of 8 bits is called a "**byte**".

DECIMAL	BINARY CONVERSION								CORRECT?
123	128	64	32	16	8	4	2	1	
156	128	64	32	16	8	4	2	1	
84	128	64	32	16	8	4	2	1	
37	128	64	32	16	8	4	2	1	
255	128	64	32	16	8	4	2	1	
12	128	64	32	16	8	4	2	1	
	0	1	0	1	0	1	0	1	
22	128	64	32	16	8	4	2	1	
191	128	64	32	16	8	4	2	1	
243	128	64	32	16	8	4	2	1	
16	128	64	32	16	8	4	2	1	
178	128	64	32	16	8	4	2	1	
92	128	64	32	16	8	4	2	1	
46	128	64	32	16	8	4	2	1	

Worksheet Activity: Sending Secret Messages

Tom is trapped on the top floor of a department store. It's just before Christmas and he wants to get home with his presents. What can he do? He has tried calling, even yelling, but there is no one around. Across the street he can see some computer person still working away late into the night. How could he attract her attention? Tom looks around to see what he could use. Then he has a brilliant idea—he can use the Christmas tree lights to send her a message! He finds all the lights and plugs them in so he can turn them on and off. He uses a simple binary code, which he knows the woman across the street is sure to understand. Can you work it out?



1	2	3	4	5	6	7	8	9	10	11	12	13
a	b	c	d	e	f	g	h	i	j	k	l	m
14	15	16	17	18	19	20	21	22	23	24	25	26
n	o	p	q	r	s	t	u	v	w	x	y	z

Make up a secret message of your own. Write the binary values here **(not the actual letters!)**, then pass the sheet to the person on your RIGHT and see if they can decode it.

The person on your LEFT should pass you their message any time now...

Secret Message In Binary **Number** **Actual Letter**

16	8	4	2	1	Number	Actual Letter
1	*0*	*0*	*1*	*0*	*18*	*r*