

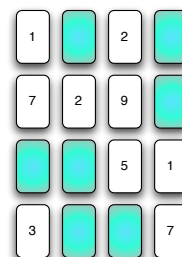
Activity description: Magic with Parity and Secret Messages with Binary

Age level: 8+

Computer scientists use math in ways that you might not have encountered before. We'll show you some of these uses in these activities.

Activity 1: Magic with Parity

- using a deck of cards place 16 cards on a table or some flat surface laid out as shown on the right (the students can do this). Some cards should be face up and some should be face down, but the values on the cards don't matter. The trick involves the magician "memorizing" which cards are face-up and which are face down, she leaves the room and one card is flipped, and then she comes back and, "using her mental powers", she identifies the exact card that was flipped.
- But first the magician says "This is too easy", and then adds a card at the end of each row
- She then says "This is STILL too easy", so she adds a card to the bottom of each column (now there are 25 cards)
- Now for the magic: the magician says: I WILL NOW LEAVE THE ROOM, AND YOU CAN TURN OVER ONE OF CARDS. I HAVE MEMORIZED THE LAYOUT AND WHEN I RETURN I WILL TELL YOU WHICH CARD HAS BEEN FLIPPED. (it is a good idea to put a sticky note on the back of the card that gets flipped, but it's not necessary for the trick) She will leave the room, ONE card can be flipped by an audience member, and the computer scientist (I mean, magician) will return and identify which card was flipped.
- This can be repeated until the audience gets bored, or better yet, figures out the trick.



HOW DOES IT WORK?

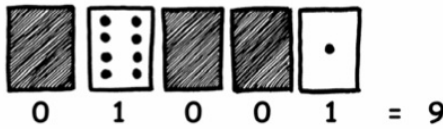
- the extra card was added to each row either face up or face down to make sure that each row had an even number of face up cards
- then the extra card was added to each column either face up or face down to make sure that each column had an even number of face up cards
- then you can tell which card has been flipped by looking at which row and column have an odd number of face-up cards.

WHAT DID WE LEARN?

- This is called PARITY, and it is used in data transmission to check if data has been transmitted correctly. Usually instead of a deck of cards we have 0s and 1s, and an odd number of 1s is called ODD parity; an even number of 1s is called EVEN parity.
- now hand out extra cards, and see if the students can play the trick on e.g. their teacher!!

Activity 2: Secret Messages with Binary

- each student (or pair of students) will get 5 cards with dots from 1 to 16 (see next page for cards to print)
- students should then arrange the cards from lowest on the right to highest on the left
- can they use the cards to give their age? E.g. if you are 9 your cards should look like this:



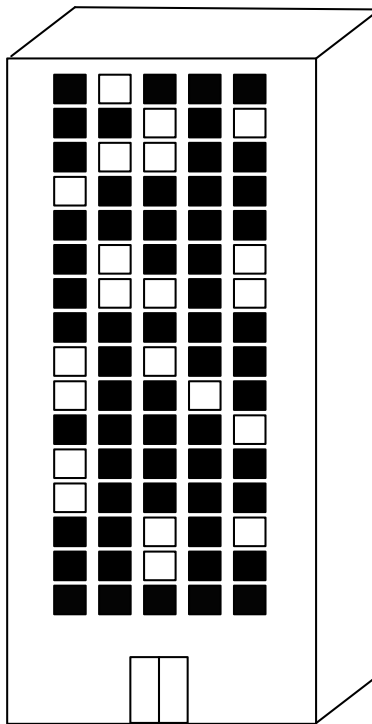
- Interesting things
 - o the dots on each card are a power of 2 ($2^0, 2^1, 2^2, 2^3, 2^4$)
 - o we can represent any number up to $2^0 + 2^1 + 2^2 + 2^3 + 2^4$ using these 5 cards (HOW?)

So now let's get fancy! What if we had a chart that converted our numbers to letters?

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

And let's say we could control the lights on a large building that looks like this:



Assuming the dark windows are flipped over cards (0s) and the light windows are face up cards (1s), what message is someone trying to send?

Can you write your own message?

