Binary Magic Card Trick (instructions & solution)

Perform this trick as follows: give the 6 cards to the person you're showing the trick to. Ask them to:

- Look at the cards
- Choose a number that occurs on at least one of the cards, and then
- Make 2 piles: one with all the cards that contain the chosen number, and another with the cards that don't contain the number.

A quick glance at the cards will tell you the number that they have chosen.

So how does this trick work?

The trick is to take the pile of cards that contains their number and simply add the upper-left number from each card. The sum of these values will be the number that was chosen.

For example, if the person choose the number 21, they would hand you the 3 cards that contain this number. These 3 cards have a “1”, “4” and “16” as their upper-left numbers. If you add these numbers together, you get 21.

But what does this have to do with binary?

Remember how binary numbers are constructed? Instead of 1's, 10's, 100's, ... positions, binary numbers use 1's, 2's, 4's, 8's, ...:

256	128	64	32	16	8	4	2	1

Look again at the upper-left number on each of the cards. Notice anything familiar? The 6 cards each have a different number in the upper-left position: “1”, “2”, “4”, “8”, “16” and “32”. These are (not coincidentally) the first 6 positions of a binary number.

Now, let's pick one of these cards (for example, the one with the “2” in the upper-left) and look at how the numbers on this card are encoded in binary:

#	**Binary**	**#**	**Binary**	**#**	**Binary**	**#**	**Binary**
2	000010	**18**	010010	**34**	100010	**50**	110010
3	000011	**19**	010011	**35**	100011	**51**	110011
6	000110	**22**	010110	**38**	100110	**54**	110110
7	000111	**23**	010111	**39**	100111	**55**	110111
10	001010	**26**	011010	**42**	101010	**58**	111010
11	001011	**27**	011011	**43**	101011	**59**	111011
14	001110	**30**	011110	**46**	101110	**62**	111110
15	001111	**31**	011111	**47**	101111	**63**	111111

Notice that for every single number on this card, the “2” position (shown underlined in the above table) of the binary representation is 1. Even more importantly, *every* number (between 1 and 63) with a 1 in the “2” position is on this card.

The same is true for the other cards in this trick: the card with a “4” in the upper-left contains all the numbers with a 1 in the “4” binary position; and similarly for the “1”, “8”, “16” and “32” cards.

So, when the person breaks the cards into 2 piles (those with their chosen number and those without), they are really just telling you the binary encoding for their number. You then convert this number back into decimal by adding the position value for each card – conveniently, the upper-left number on the card.

Performing

Of course, when you perform this trick (as when you do any magic trick), you need to embellish a bit to make the trick more interesting. Don't just take the pile of cards and look at them and blurt out the answer. Make it look like it requires some “magical” effort on your part – here are some suggestions:

- Ask the person to concentrate on the number that they've chosen so that you can “read their mind”.
- Pretend that you're struggling to decide between multiple answers. For example, if you know the answer is 21, pretend that you're trying to decide between 5, 21 and 43. Then, ask irrelevant questions and make up reasons to eliminate the wrong answers: “Oh, you had 5 pancakes for breakfast, then that can't possibly be the right answer”.

Another variant of this trick is to use the pile of cards that *doesn't* contain the number instead of the pile that does. In this variation, add the upper-left numbers of the cards as before, but subtract from 63 to get the chosen number. For example, if the chosen number is 21, then they will keep the “1”, “4” and “16” cards (since these all have 21 on them) and hand you the “2”, “8” and “32” cards. Add these numbers together (to get 42) and subtract from 63 to get 21.

When you perform this variant, it's fun to have them hold the pile with their number against their forehead while you do the same with the pile that doesn't contain their number. Now have them think of their number while tapping the pile of cards (still on their forehead, of course). You can tap your forehead pile as well to “help you think”. Once you're content with the amount of forehead tapping, you can “read” their mind and tell them the number they chose.

Oh, and remember not to tell people the secret to this trick. Once you know the secret, it's not nearly as mysterious (or entertaining).