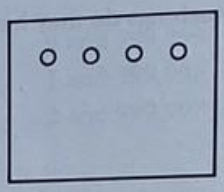
2. Experiment: *A Card Sorting System*

One application of the binary sequence is in data-processing systems. From the following experiment, you will see how it can be used to sort cards automatically.

Cut 8 file cards in half as shown in the figure above. Take one of the 16 cards produced and punch a row of four holes below a longer edge as shown in the figure below. The holes should be spaced about 1.5 centimeters apart.

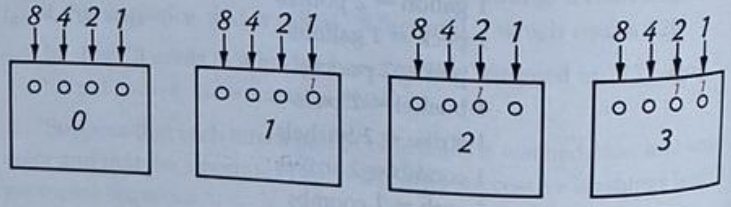


Using this card as a stencil, punch the other 15 cards to match it. Three cards can easily be punched at a time.

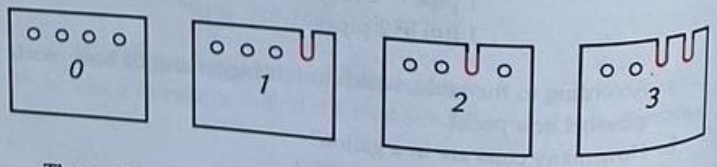
Number the cards from 0 through 15. The four holes represent the first four numbers of the binary sequence in reverse order:

8 4 2 1

Write the number 1 above the appropriate holes of each numbered card to represent the matching binary numeral. The first four cards are illustrated below.



Along the top edge of each card, cut out the space above each hole marked with a 1.



The cards are now ready to use. Shuffle them, being careful not to turn any of them over or upside down.

Make a hook out of a paper clip, something like the one illustrated at the right.

Holding the cards loosely together with one hand, put the hook through the 1-holes and lift up, shaking the hook rapidly so that the cards with notches above the 1-holes remain behind. Slide the cards that came up off the hook and place them on top of the other cards.

Next, put the hook through the 2-holes and carry out the same procedure. Be sure to place the cards that come up on *top* of the cards that remain behind. Repeat with the remaining holes (going from right to left.) When you have done this, the cards should be in correct order from 0 through 15.

After sorting the cards by this method, you might print the following words on them, reshuffle them, and sort them again.

0	This	4	cards	8	sorted	12	of
1	pack	5	has	9	automatically	13	the
2	of	6	just	10	by	14	binary
3	sixteen	7	been	11	means	15	sequence.

a. How many cards could be sorted if each one has five holes rather than four? Explain your reasoning.

b. If each card had 10 holes, more than 1,000 cards could be sorted in just 10 steps. Explain why.