Binary numbers and data types

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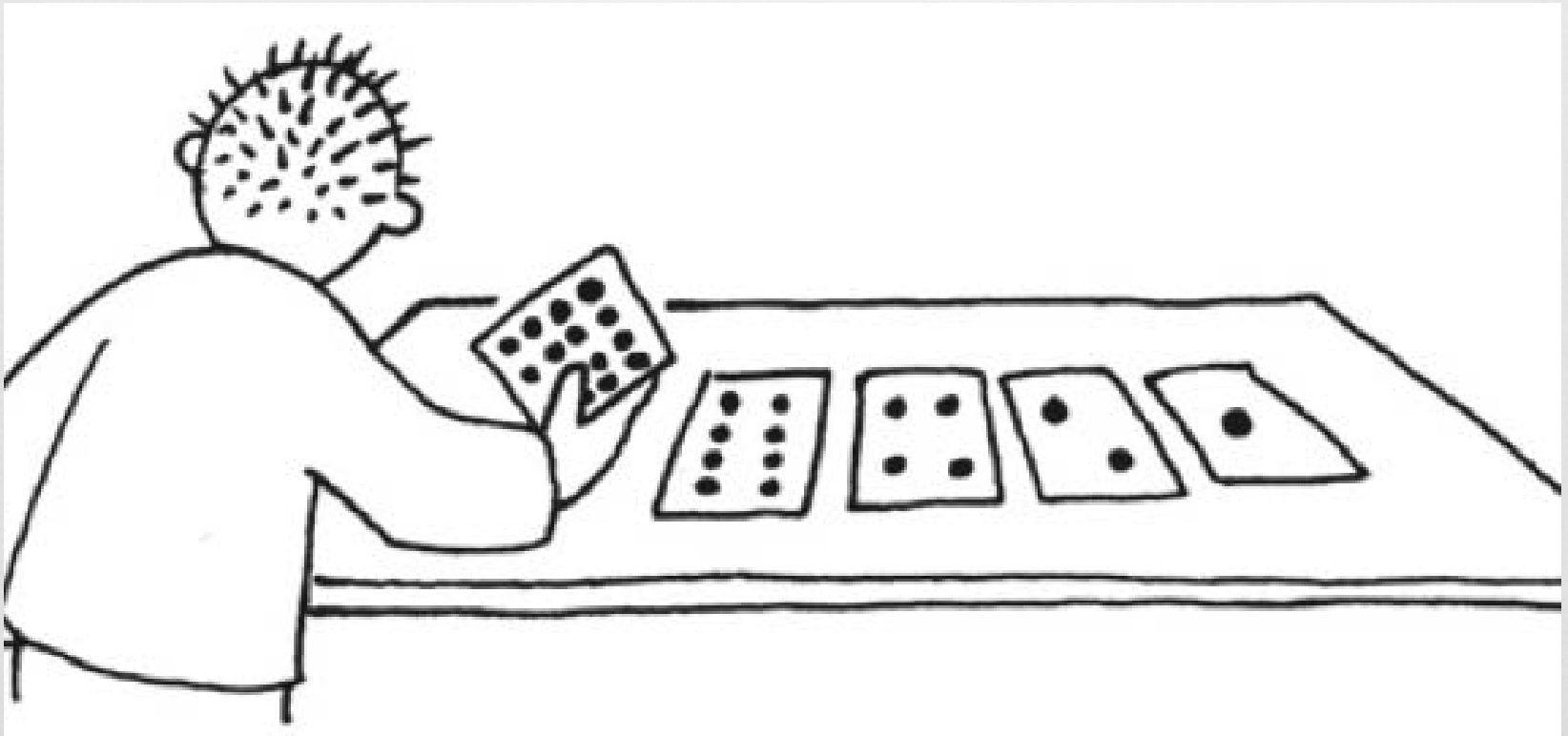
Credits: CS Unplugged - http://csunplugged.org

How is data stored?

- Data is stored on a computer in the form of bits
- What is a bit?
  - A unit of information expressed as either a 0 or 1 in binary notation
- Everything on a computer (music, photos, text, movies, spreadsheets, etc) is represented and stored in binary form (as a combination of 0's and 1's)

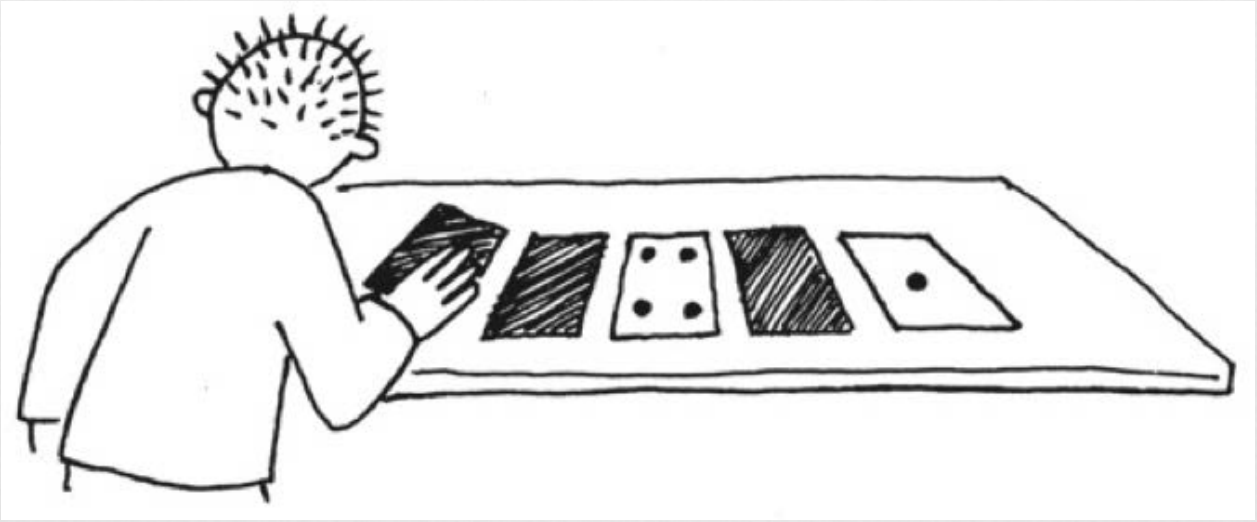
Activity

Take your deck of cards and lay them out exactly as shown in the figure below



Binary representation - Activity

- Now flip the cards so exactly 5 dots show—keep your cards in the same order!

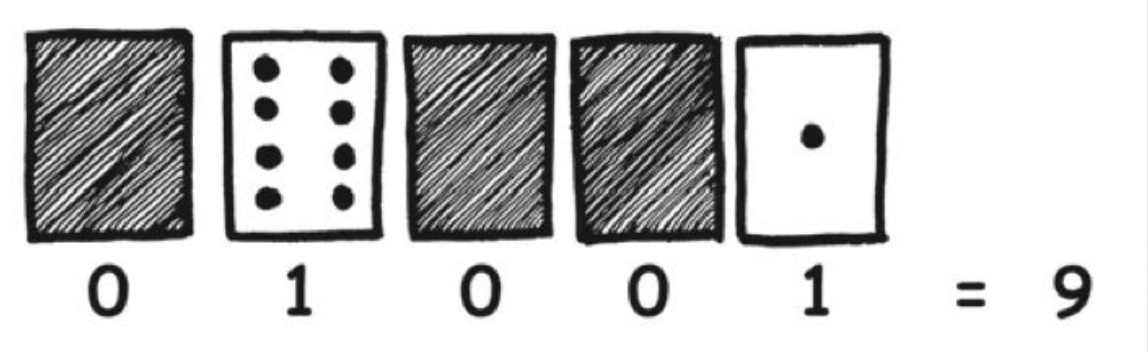


Try more examples

- Find out how to make the numbers 3, 12, 19.
- Is there more than one way to make any number?
- What is the biggest number you can make?
- What is the smallest?
- Is there any number you can't make between the smallest and biggest numbers?

Binary system

- The binary system uses zero and one to represent whether a card is face-up or not. 0 shows that a card is hidden, and 1 means that it is face-up and you can see the dots.
- For example, 01001 = 9



Working with binary representations

- Can you work out what 10101 is?
- Can you work out what 11111 is?
- What day of the month were you born? Write it in binary
- Find out what your neighbor's birthday is and represent it in binary

Counting beyond 31

- Look at the binary cards again. If you were going to make the next card in the sequence, how many dots would it have?
  - If you look at the sequence carefully, you can find a very interesting relationship:
  - 1, 2, 4, 8, 16, …
- What about the next card after that?
- What is the rule that you are following to make your new cards?

Counting beyond 31

- As you can see, only a few cards are needed to count up to very big numbers.
- 6 cards can count up to 64
- 10 cards can count up to 1024

Bits, Bytes and so on

- One bit on its own can't represent much, so they are usually grouped together in groups of eight, which can represent numbers from 0 to 255.
- A group of eight bits is called a byte.
- A thousand bytes form a Kilo-byte (Kb)
- A thousand Kilobytes form a Mega-byte (Mb)
- A thousand Megabytes form a Giga-byte (Gb) and so on (Terabyte, Petabyte, …)

Binary system

- The binary system uses powers of 2 to represent the numbers
- $2 = 10 = 1*2^1 + 0*2^0$
- $3 = 11 = 1*2^1 + 1*2^0$
- $4 = 100 = 1*2^2 + 0*2^1 + 0*2^0$
- $7 = 111 = 1*2^2 + 1*2^1 + 1*2^0$

A Byte

- A byte can store 8-bits of information
- Has a range from 0-255
- Any character (A, 1, $, ; …) can be stored in a byte
- An integer can be stored in 2-bytes
  - Can represent numbers from 0-65535. Alternately, you can represent numbers between -32768 to 32767

Floating point

- As you have seen, integer data types (int) are used to store integer values (3, 6, 121, 5423, etc.)
- To store decimal values, you use the floating point data type (float)
- float e = 2.718;
- float area = 22.14;
- Any other examples for floating point values?