



The concept of the amount of information

Bit – Byte

- 180 kilobyte file
- 80 gigabyte hard disk
- 512 megabyte memory
- 64-bit Windows Vista

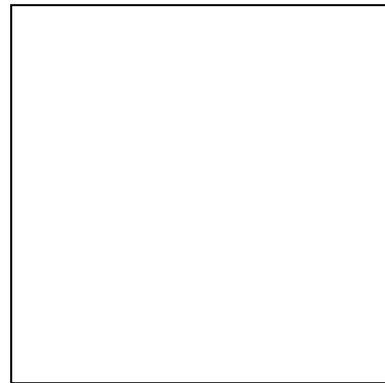
Bit and Byte are units which show
“the amount of information”

What is the amount of information

- The amount that can distinguish how many kinds of information
- Units of the amount of information
 - bit
 - Stands for “binary digit”
 - byte
 - 8 bits = 1 byte

Bit - the smallest unit of information

- Distinguish two possible states:
 - E.g.: A card whose front is white and back is black holds 1 bit amount of information.



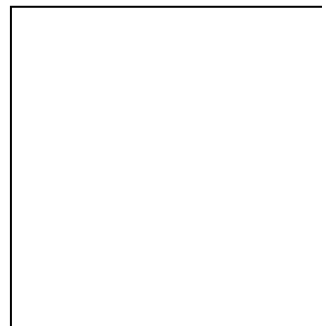
front



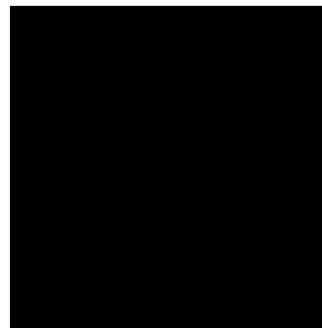
back

Representing the weather in one card

- One card can represent two kinds of weather



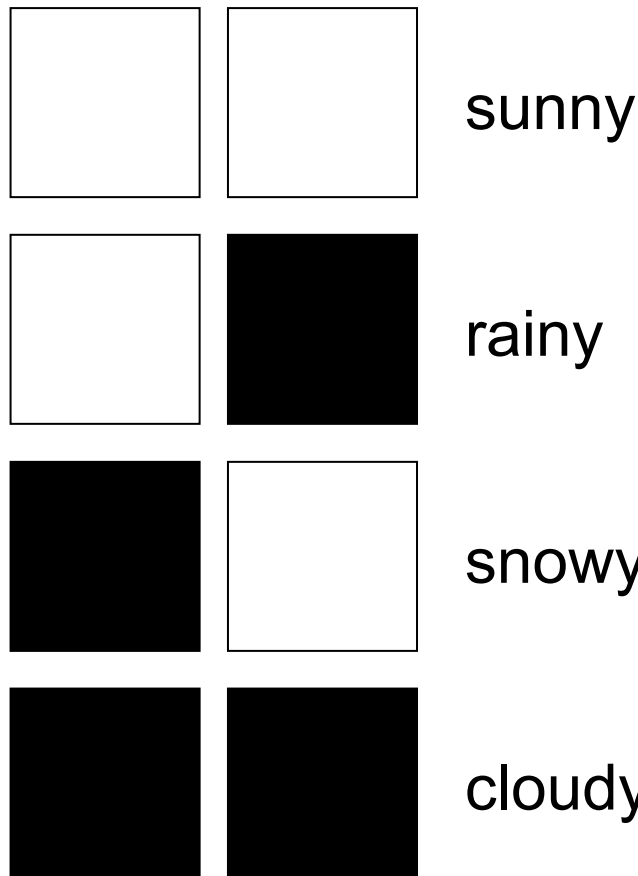
sunny



rainy

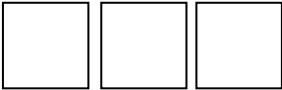
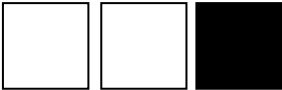



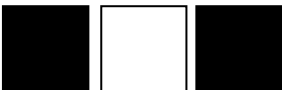


Representing the weather in two cards

- Two cards can represent 4 kinds of weather



Representing the weather in three cards ⁷ cards

- Three cards can represent 8 kinds of weather

	sunny
	rainy
	snowy
	cloudy
	foggy
	stormy
	sleet
	hail

The relation between the number of cards and the amount of information

- One card
 - Holds 1 bit information, distinguishes 2 kinds of information
- Two cards
 - Hold 2 bit information, distinguish 4 kinds of information
- Three cards
 - Hold 3 bit information, distinguish 8 kinds of information
- N cards
 - Hold N bit information, distinguish 2^N kinds of information

【 Exercise 1 】

Expressing the weather set by the Japan Meteorological Agency

- Japan Meteorological Agency defined 15 different types of weather for using domestically.
- How many cards are needed to express these 15 types of weather?

1	Fine	9	Misty rain
2	sunny	10	rainy
3	slightly cloudy	11	sleet
4	cloudy	12	snowy
5	foggy	13	hailstone
6	dust storm	14	hail
7	Drifting rain	15	Thunder storm
8	Mist		

Ref. JMA page

http://www.jma.go.jp/jma/kishou/known/yougo_hp/tenki.html

Prefix

- Put prefix in front of unit to express the number of digits

	SI Prefix	Binary prefix
G (Giga)	10^9	2^{30} (1073741824)
M (Mega)	10^6	2^{20} (1048576)
k/K (kilo)	10^3	2^{10} (1024)

※ Prefix kilo in SI is “k”, in binary is “K”

Must be careful when writing prefix (SI prefix or binary prefix)

【Exercise 2】

Calculate bit and byte

- How many elements can be distinguished with 5-digit binary number (00000~11111)?
- There are 9 faculties in Keio University: Law, Letters, Economics, Business and Commerce, Science and Technology, Policy Management, Environment and Information Studies, Nursing and Medical Care, Pharmacy. How many digits are needed to represent this amount of information?
- Assumption that we want to download a 3-megabyte file. The average downloading speed is 5 kilobits in one second (5Kbps). How long does it take to download this file?
- There are 94 English characters (letters, numbers and symbols). How many digits are needed to represent?

【Exercise 3】

“Guess the number” Game (1)

- Guess the number game
 - Pick one's birth date
 - Select cards among 5 following cards that contains the date.

<u>1</u>	3	5	7	<u>2</u>	3	6	7	<u>4</u>	5	6	7	<u>8</u>	9	10	11	<u>16</u>	17	18	19
9	11	13	15	10	11	14	15	12	13	14	15	12	13	14	15	20	21	22	23
17	19	21	23	18	19	22	23	20	21	22	23	24	25	26	27	24	25	26	27
25	27	29	31	26	27	30	31	28	29	30	31	28	29	30	31	28	29	30	31

- The sum of all the top left numbers (underlined numbers) in those selected cards is the birth date.

【Exercise 3】

“Guess the number” Game (2)

- Why only by adding the top left numbers together, we can get the correct birth date?
- Hint
 - The top left numbers are 1, 2, 4, 8, 16.
 - The numbers written on each card are different
 - 31 numbers can be represented using 5 cards.
(for birth month, only need 4 cards)