COMP110: Principles of Computing

asic Principles for Computation

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Binary notation

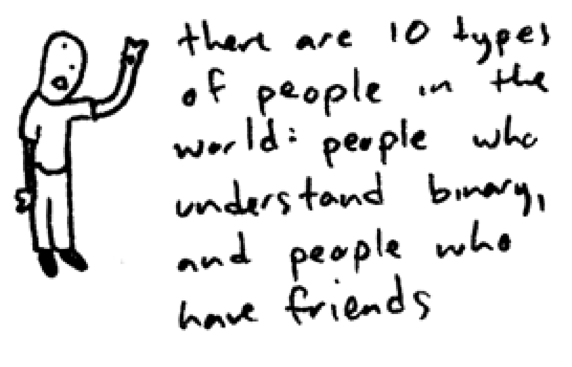

Image credit: `http://www.toothpastefordinner.com`

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- The binary digits 0 and 1 correspond to **off** and **on** respectively

Converting to binary

https://www.youtube.com/watch?v=OezK_zTyvAQ

Bits, bytes and words

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Addition with carry

In base 10:

$$\begin{array}{ccccc} & 1 & 2 & 3 & 4 \\ + & 5 & 6 & 7 & 8 \\ \hline \end{array}$$

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Hex	Dec	Hex	Dec	Hex	Dec
00	0	10	16	F0	240
01	1	11	17	F1	241
⋮	⋮	⋮	⋮	⋮	⋮
09	9	19	25	F9	249
0A	10	1A	26	FA	250
0B	11	1B	27	FB	251
0C	12	1C	28	FC	252
0D	13	1D	29	FD	253
0E	14	1E	30	FE	254
0F	15	1F	31	FF	255

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2's Complement

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- Useful for wrapping around e.g. loop indexes or screen coordinates

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- E.g. 16-bit number ranges from -32768 to $+32767$
- Note that the left-most bit can be interpreted as a **sign** bit: 1 if negative, 0 if positive or zero

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- This is also the process for converting back from 2's complement, i.e. doing it twice should give the original number

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- In fact, subtraction can just be done as addition
- I.e. $a - b$ is the same as $a + (-b)$, where a and $-b$ are just n-bit numbers

Worksheet 2

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Due next Friday!
Online quiz on LearningSpace

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Algorithms

What is an algorithm?

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A **sequence of instructions** which can be followed **step by step** to perform a **(computational) task**.

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- Computers developed as machines for carrying out mathematical algorithms

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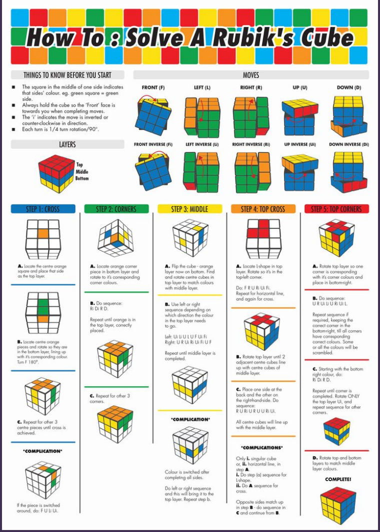
  - E.g. it implements an algorithm for determining where to break a line of text, how much space to add to centre a line, etc.

Algorithms outside computing

1. Preheat the oven to 180C, gas 4.
2. Beat together the eggs, flour, caster sugar, butter and baking powder until smooth in a large mixing bowl.
3. Put the cocoa in separate mixing bowl, and add the water a little at a time to make a stiff paste. Add to the cake mixture.
4. Turn into the prepared tins, level the top and bake in the preheated oven for about 20-25 mins, or until shrinking away from the sides of the tin and springy to the touch.
5. Leave to cool in the tin, then turn on to a wire rack to become completely cold before icing.
6. To make the icing: measure the cream and chocolate into a bowl and carefully melt over a pan of hot water over a low heat, or gently in the microwave for 1 min (600w microwave). Stir until melted, then set aside to cool a little and to thicken up.
7. To ice the cake: spread the apricot jam on the top of each cake. Spread half of the ganache icing on the top of the jam on one of the cakes, then lay the other cake on top, sandwiching them together.
8. Use the remaining ganache icing to ice the top of the cake in a swirl pattern. Dust with icing sugar to serve.

Algorithms outside computing



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- Can reason about the **complexity** (time, space etc) of an algorithm — and place **lower bounds** on the best possible algorithm
- **Computability** theory lets us reason about what computations are and are not possible