LANGUAGES: NATURAL AND ARTIFICIAL

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Natural languages

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Artificial (formal) languages

Languages designed for specific applications, to help communicate specialist ideas, and to more easily reason about certain problems.

Example: algebraic notation

Quando chel cubo con le cose appresso
Se agguaglia à qualche numero discreto
Trouan dui altri differenti in esso.
Dapoi terrai questo per consueto
Che'llor produtto sempre sia eguale
Alterzo cubo delle cose neto, ...

When the cube with the cose beside it
Equates itself to some other whole number,
Find two other, of which it is the difference.
Hereafter you will consider this customarily
That their product always will be equal
The cube of the third of the unknown ...

When

$$x^3 + px = q$$

find

$$u, v \mid u - v = q$$

hence

$$uv = \left(\frac{p}{3}\right)^3$$

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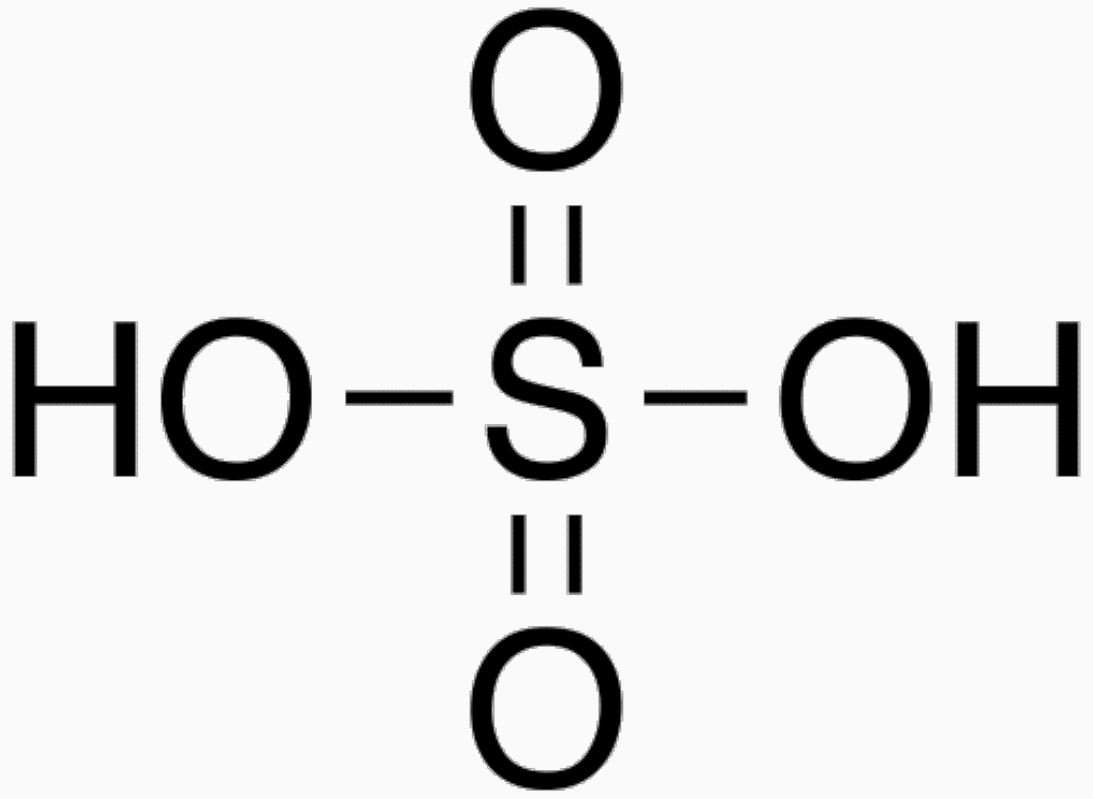
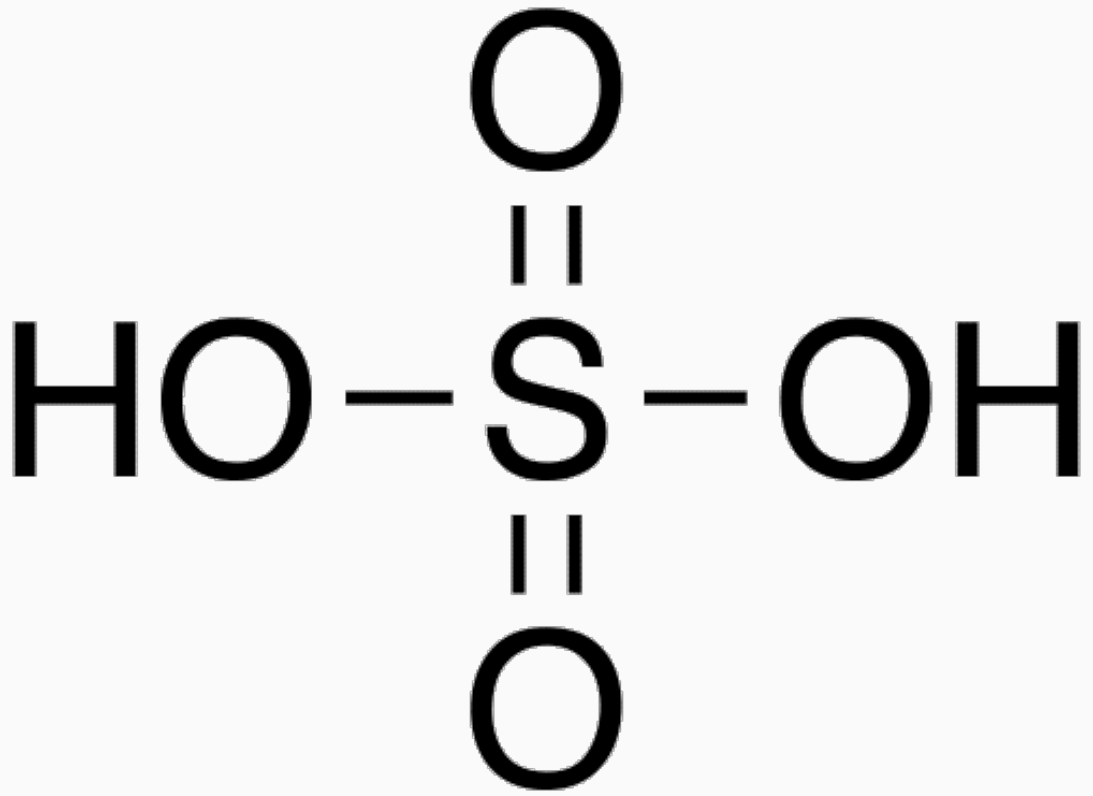
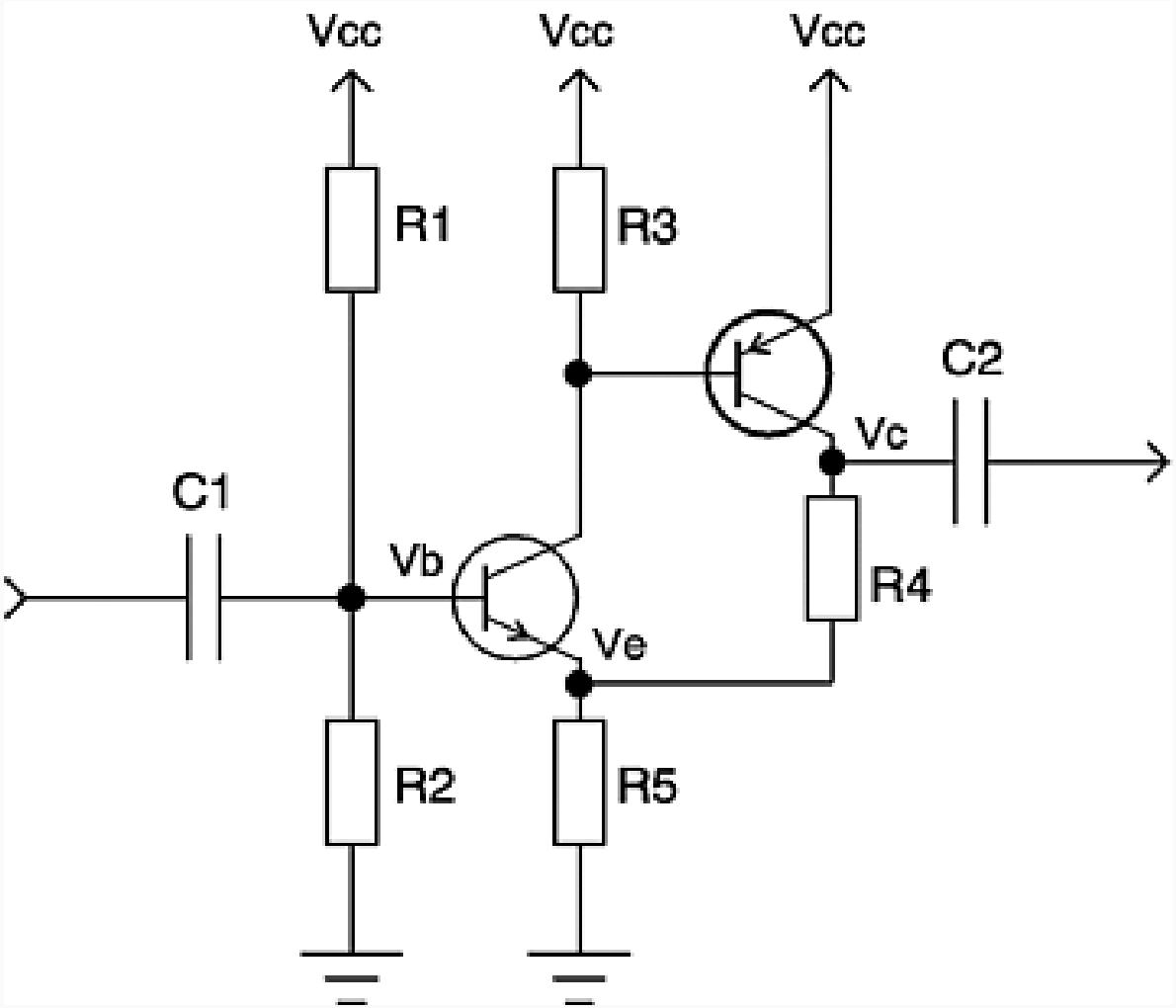
Example: chemical formulæ



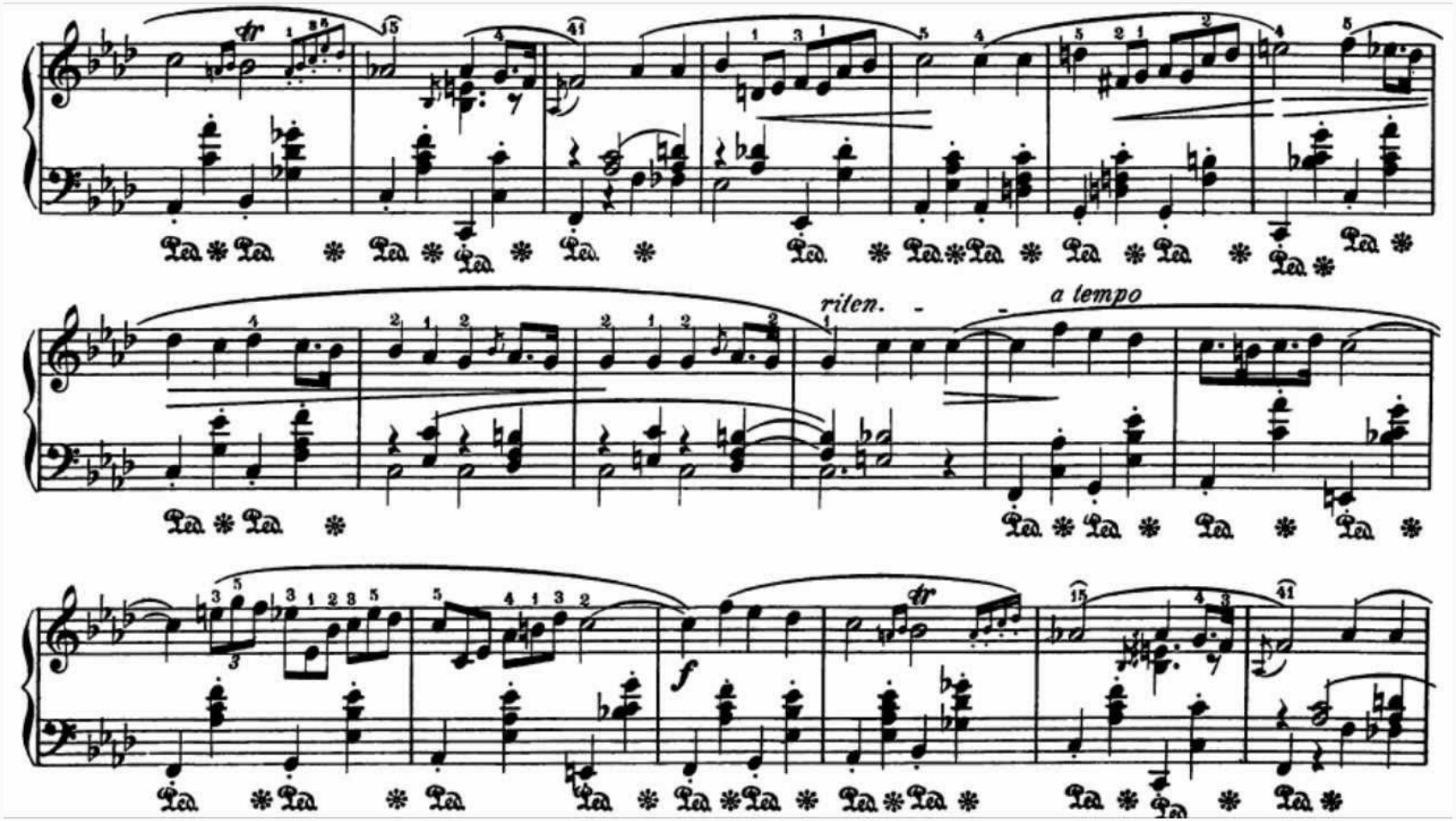


H_2SO_4

Example: electrical circuits

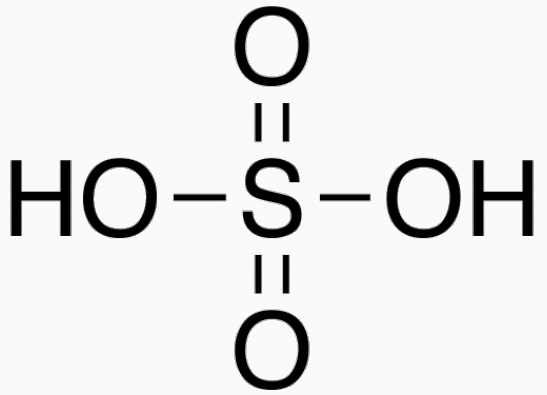


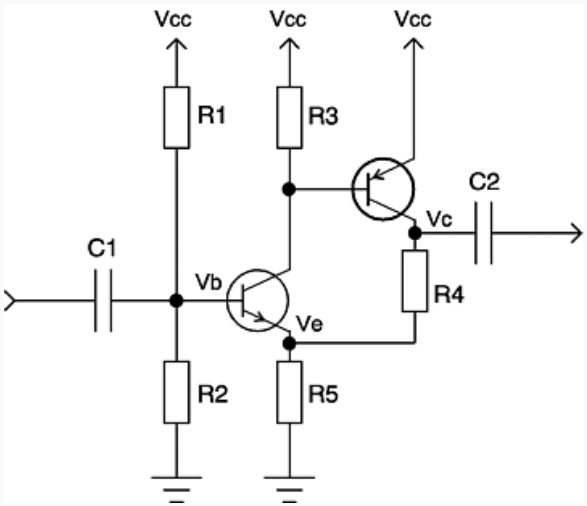
Example: music

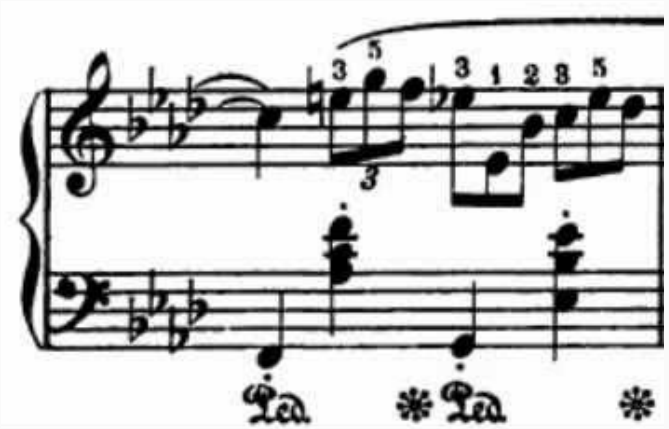


- Elementary building blocks (“atoms”, tokens)
- Rules of composition = syntax
- Semantics = meaning

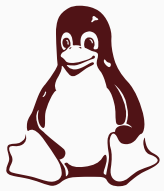
$$x^3 + px = q$$







What rules are being violated here?

$$= \sqrt{+ > 42} - \text{  }^{3}$$

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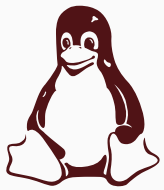
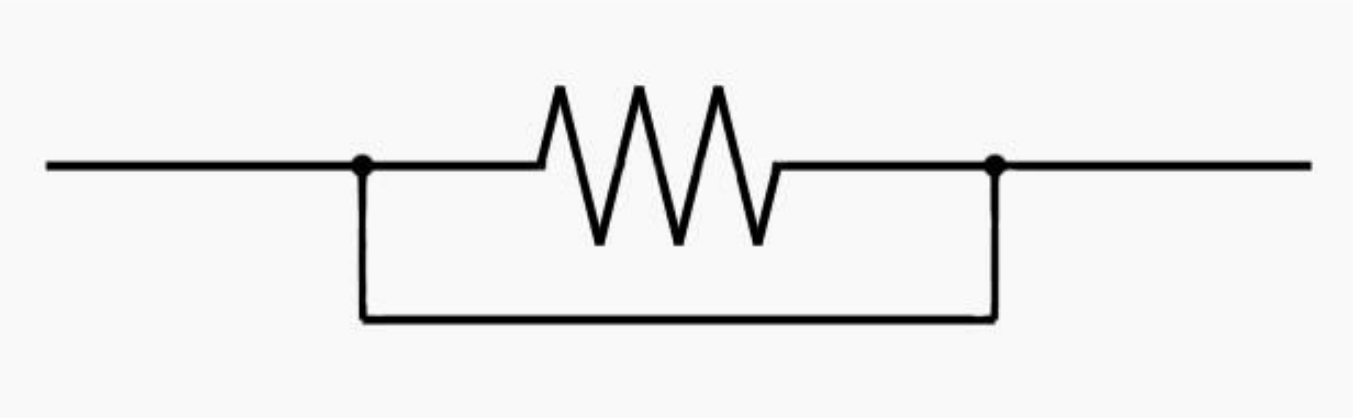
$$= \sqrt{+ > 42} - \text{  }^{3}$$



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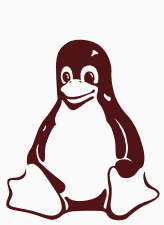
$$= \sqrt{+ > 42} - \text{  }^{3}$$

“Resistance is futile”

- *Powerful*, high-level language with excellent means of abstraction.
- *Easy* to get started!
- Named after Monty Python and the flying circus.
- Main teaching language in CM1101 and CM1103.

Where is Python used?

`en.wikipedia.org/wiki/List_of_Python_software`

- Desktop applications and development tools: BitTorrent, Blender 3D, Dropbox, Mercurial, Bazaar...
- Games: Civilization IV, Eve Online, World of Tanks, Battlefield 2...
- Web: Django, Google App Engine, web2py...
- Science: NumPy, SciPy, Sage, Matplotlib...

Python is a very versatile language!

- We write programs (in programming languages) “for” computers.
- But the *real* purpose of the programming language is to be readable and easily understandable by *humans*.
- High-level languages — provide better means of abstraction and composition → easier for humans to use (read, understand, write, design, compose).
- Low-level languages — provide poor levels of abstraction and composition → harder for humans to use.
  - But easier to translate to machine instructions.
  - *E.g.* the Assembly Language is basically mnemonic names for machine instructions, and not much more.

- Python is a high-level programming language.
- A program (in a high-level language) must be first translated into machine instructions before being executed.
- Compiler — a program that translates an entire high-level language program into machine instructions.
- Interpreter — does the same, but a little bit at a time.
  - Observe that philosophically they do the same thing; the difference is only practical.
- Python is an interpreted language. Python programs are executed by an interpreter.

In the meantime, prepare to work on the programming exercises:

- Go to
  `python.org`
  and download Python for your platform
- Make sure it is Python 3 (not Python 2)
- Get yourself a decent text editor. Some good ones are:
  - Atom
  - SublimeText
  - VS Code
  - And, of course, the classics: Emacs, Vim

- "Think Python 2e" — excellent free book:
  `greenteapress.com/wp/think-python-2e/`
- Excellent free online book of exercises:
  `https://learnpythonthehardway.org/python3`
- The "official" tutorial:
  `docs.python.org/3/tutorial/index.html`
- Language and standard library reference:
  `docs.python.org/3/reference/index.html`
  `docs.python.org/3/library/index.html`