

What is computer science?

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Answer 1. Computer science is the study of computers.

What is computer science?

Answer 2. Computer science is the study of how to write computer programs.

What is computer science?

Answer 3. Computer science is the study of the uses and applications of computers and software.

These answers are not entirely wrong,
but none of them really captures the
main spirit...

Correct answer. Computer science is the study of computing, including

- its formal and mathematical properties,*
- its hardware realizations,*
- its linguistic realizations,*
- its application.*

What is computing then?

We will learn in this course!

Computing is everywhere

Computing sounds perhaps something abstract and foreign, but it is everywhere:

- Your laptop, tablet and phone
- Driver-assistance systems
- Package tracking
- Medical imaging (e.g., MRI)
- Human Genome Project
- Anything digital, such as...

Computing is everywhere

- Digital photography and videography
- News media
- Social media
- Online shopping and trading
- Business analytics
- Sports analytics
- Data science
- Artificial intelligence
- ...

Computing is old

Computing is critical to these technologies,
but computing is actually a really old idea...

At the heart of computing is this notion of

algorithms

Algorithm

A finite sequence of simple, precise and manually-executable instructions.

Examples.

- The procedure to add any given two large numbers.
- The procedure (recipe) to cook clam chowder.
- ...

Algorithm

The study of algorithms has a long history, predating the birth of computers.

- Rooted in ancient civilizations of the Middle East.
- Named after the Islamic mathematician (astronomer, astrologer and geographer) Muḥammad ibn Mūsā al-Khwārizmī (circa 780–850), who is also well-known for the invention of *algebra*.

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<https://www.routard.com/>

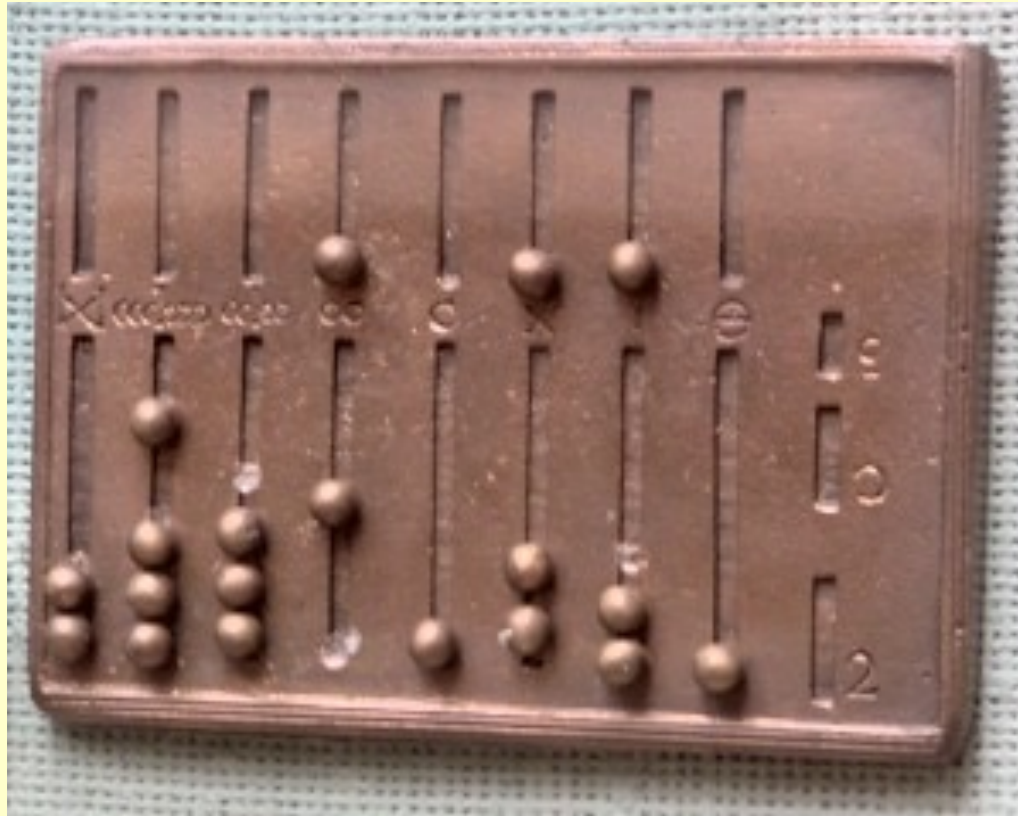
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<https://www.wikipedia.org/>

Abacus



<https://www.wikipedia.org/>

The abacist versus the algorist



Gregor Reisch, Margarita
Philosophica, Strassbourg, 1504

On to modern computer science...

Founders of computer science



Deschutes Hall
University of Oregon, Eugene

Alan Turing (1912-1954)



<https://www.turing.org.uk/>

Turing is best known for:

- During WWII, he lead a team of cipher-breakers to crack the German *Enigma* code and hastened the end of the war.
- He invented a basic prototype of today's computers. This elegant mathematical model of computation is called the *Turing machine*.

Decision problem

Entscheidungsproblem

In essence, it asks whether reasoning can be reduced to computation.

- Originally considered by Leibniz in the 17th century.
- Formalized by mathematician Hilbert in 1928.

Decision problem Entscheidungsproblem

Is there a mechanical procedure to determine whether any given proposition is true?

Proposition?

A proposition is a statement that is either true or false.

Examples.

- The sum of two odd numbers is even.
- If $x < y$, then $-y < -x$.
- The area of a circle with radius r is πr^2
- If a program P has a syntax error, then P has a semantic error.

Non-examples.

- The Boston Red Sox will win the World Series in 2026.
- My clam chowder tastes good.
- How are you?
- Please open the door for me.
- Keep it up, Joe!

Decision problem Entscheidungsproblem

Is there a mechanical procedure to determine whether any given proposition is true?

If the answer were YES, then mathematicians and most scientists would lose their jobs.

Luckily, it is NO, according to Turing's work.