

In 1801, the Jacquard loom could produce entirely different weaves by changing the "program" – a series of pasteboard cards with holes punched in them. As early as the 9th century, a programmable music sequencer was invented by the Persian Banu Musa brothers, who described an automated mechanical flute player in the Book of Ingenious Devices. For this purpose, algorithms are classified into orders using so-called Big O notation, which expresses resource use, such as execution time or memory consumption, in terms of the size of an input. They are the building blocks for all software, from the simplest applications to the most sophisticated ones. Machine code was the language of early programs, written in the instruction set of the particular machine, often in binary notation. In the 9th century, the Arab mathematician Al-Kindi described a cryptographic algorithm for deciphering encrypted code, in A Manuscript on Deciphering Cryptographic Messages. Following a consistent programming style often helps readability. This can be a non-trivial task, for example as with parallel processes or some unusual software bugs. Expert programmers are familiar with a variety of well-established algorithms and their respective complexities and use this knowledge to choose algorithms that are best suited to the circumstances. Ideally, the programming language best suited for the task at hand will be selected. Proficient programming usually requires expertise in several different subjects, including knowledge of the application domain, details of programming languages and generic code libraries, specialized algorithms, and formal logic. Implementation techniques include imperative languages (object-oriented or procedural), functional languages, and logic languages. Programs were mostly entered using punched cards or paper tape. Expert programmers are familiar with a variety of well-established algorithms and their respective complexities and use this knowledge to choose algorithms that are best suited to the circumstances. For example, COBOL is still strong in corporate data centers often on large mainframe computers, Fortran in engineering applications, scripting languages in Web development, and C in embedded software. Allen Downey, in his book *How To Think Like A Computer Scientist*, writes: Many computer languages provide a mechanism to call functions provided by shared libraries. A study found that a few simple readability transformations made code shorter and drastically reduced the time to understand it. Some languages are very popular for particular kinds of applications, while some languages are regularly used to write many different kinds of applications. High-level languages made the process of developing a program simpler and more understandable, and less bound to the underlying hardware. Methods of measuring programming language popularity include: counting the number of job advertisements that mention the language, the number of books sold and courses teaching the language (this overestimates the importance of newer languages), and estimates of the number of existing lines of code written in the language (this underestimates the number of users of business languages such as COBOL). FORTRAN, the first widely used high-level language to have a functional implementation, came out in 1957, and many other languages were soon developed—in particular, COBOL aimed at commercial data processing, and Lisp for computer research. This can be a non-trivial task, for example as with parallel processes or some unusual software bugs. After the bug is reproduced, the input of the program may need to be simplified to make it easier to debug. One approach popular for requirements analysis is Use Case analysis. Many factors, having little or nothing to do with the ability of the computer to efficiently compile and execute the code, contribute to readability.