

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. Following a consistent programming style often helps readability. However, with the concept of the stored-program computer introduced in 1949, both programs and data were stored and manipulated in the same way in computer memory. Use of a static code analysis tool can help detect some possible problems. New languages are generally designed around the syntax of a prior language with new functionality added, (for example C++ adds object-orientation to C, and Java adds memory management and bytecode to C++, but as a result, loses efficiency and the ability for low-level manipulation). Many applications use a mix of several languages in their construction and use. In the 9th century, the Arab mathematician Al-Kindi described a cryptographic algorithm for deciphering encrypted code, in A Manuscript on Deciphering Cryptographic Messages. A study found that a few simple readability transformations made code shorter and drastically reduced the time to understand it. For example, when a bug in a compiler can make it crash when parsing some large source file, a simplification of the test case that results in only few lines from the original source file can be sufficient to reproduce the same crash. Machine code was the language of early programs, written in the instruction set of the particular machine, often in binary notation. 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. However, readability is more than just programming style. It affects the aspects of quality above, including portability, usability and most importantly maintainability. A similar technique used for database design is Entity-Relationship Modeling (ER Modeling). Computer programmers are those who write computer software. 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). A similar technique used for database design is Entity-Relationship Modeling (ER Modeling). Many factors, having little or nothing to do with the ability of the computer to efficiently compile and execute the code, contribute to readability. Text editors were also developed that allowed changes and corrections to be made much more easily than with punched cards. Some languages are more prone to some kinds of faults because their specification does not require compilers to perform as much checking as other languages. It affects the aspects of quality above, including portability, usability and most importantly maintainability. A similar technique used for database design is Entity-Relationship Modeling (ER Modeling). Many factors, having little or nothing to do with the ability of the computer to efficiently compile and execute the code, contribute to readability. 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. In 1801, the Jacquard loom could produce entirely different weaves by changing the "program" – a series of pasteboard cards with holes punched in them.