

Normally the first step in debugging is to attempt to reproduce the problem. The following properties are among the most important: In computer programming, readability refers to the ease with which a human reader can comprehend the purpose, control flow, and operation of source code. Popular modeling techniques include Object-Oriented Analysis and Design (OOAD) and Model-Driven Architecture (MDA). Trade-offs from this ideal involve finding enough programmers who know the language to build a team, the availability of compilers for that language, and the efficiency with which programs written in a given language execute. 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. In the 9th century, the Arab mathematician Al-Kindi described a cryptographic algorithm for deciphering encrypted code, in *A Manuscript on Deciphering Cryptographic Messages*. The academic field and the engineering practice of computer programming are both largely concerned with discovering and implementing the most efficient algorithms for a given class of problems. A similar technique used for database design is Entity-Relationship Modeling (ER Modeling). However, because an assembly language is little more than a different notation for a machine language, two machines with different instruction sets also have different assembly languages. Trade-offs from this ideal involve finding enough programmers who know the language to build a team, the availability of compilers for that language, and the efficiency with which programs written in a given language execute. Debugging is a very important task in the software development process since having defects in a program can have significant consequences for its users. Many programmers use forms of Agile software development where the various stages of formal software development are more integrated together into short cycles that take a few weeks rather than years. 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. 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. 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. A similar technique used for database design is Entity-Relationship Modeling (ER Modeling). In 1206, the Arab engineer Al-Jazari invented a programmable drum machine where a musical mechanical automaton could be made to play different rhythms and drum patterns, via pegs and cams. Programmable devices have existed for centuries. After the bug is reproduced, the input of the program may need to be simplified to make it easier to debug. However, because an assembly language is little more than a different notation for a machine language, two machines with different instruction sets also have different assembly languages. It involves designing and implementing algorithms, step-by-step specifications of procedures, by writing code in one or more programming languages. There exist a lot of different approaches for each of those tasks. Code-breaking algorithms have also existed for centuries. Text editors were also developed that allowed changes and corrections to be made much more easily than with punched cards. 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).