

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. While these are sometimes considered programming, often the term software development is used for this larger overall process – with the terms programming, implementation, and coding reserved for the writing and editing of code per se. In the 1880s, Herman Hollerith invented the concept of storing data in machine-readable form. Sometimes software development is known as software engineering, especially when it employs formal methods or follows an engineering design process. Text editors were also developed that allowed changes and corrections to be made much more easily than with punched cards. A study found that a few simple readability transformations made code shorter and drastically reduced the time to understand it. Implementation techniques include imperative languages (object-oriented or procedural), functional languages, and logic languages. Languages form an approximate spectrum from "low-level" to "high-level"; "low-level" languages are typically more machine-oriented and faster to execute, whereas "high-level" languages are more abstract and easier to use but execute less quickly. 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. 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. Auxiliary tasks accompanying and related to programming include analyzing requirements, testing, debugging (investigating and fixing problems), implementation of build systems, and management of derived artifacts, such as programs' machine code. 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. Many factors, having little or nothing to do with the ability of the computer to efficiently compile and execute the code, contribute to readability. Unreadable code often leads to bugs, inefficiencies, and duplicated code. Trial-and-error/divide-and-conquer is needed: the programmer will try to remove some parts of the original test case and check if the problem still exists. 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. 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). 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. It affects the aspects of quality above, including portability, usability and most importantly maintainability. There are many approaches to the Software development process. After the bug is reproduced, the input of the program may need to be simplified to make it easier to debug. When debugging the problem in a GUI, the programmer can try to skip some user interaction from the original problem description and check if remaining actions are sufficient for bugs to appear. 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. Some languages are very popular for particular kinds of applications, while some languages are regularly used to write many different kinds of applications.