

Debugging is often done with IDEs. Standalone debuggers like GDB are also used, and these often provide less of a visual environment, usually using a command line. Programs were mostly entered using punched cards or paper tape. In the 1880s, Herman Hollerith invented the concept of storing data in machine-readable form. Also, specific user environment and usage history can make it difficult to reproduce the problem. A similar technique used for database design is Entity-Relationship Modeling (ER Modeling). Some text editors such as Emacs allow GDB to be invoked through them, to provide a visual environment. In 1801, the Jacquard loom could produce entirely different weaves by changing the "program" – a series of pasteboard cards with holes punched in them. Machine code was the language of early programs, written in the instruction set of the particular machine, often in binary notation. Some languages are very popular for particular kinds of applications, while some languages are regularly used to write many different kinds of applications. The first computer program is generally dated to 1843, when mathematician Ada Lovelace published an algorithm to calculate a sequence of Bernoulli numbers, intended to be carried out by Charles Babbage's Analytical Engine. 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. The choice of language used is subject to many considerations, such as company policy, suitability to task, availability of third-party packages, or individual preference. 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.

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. Text editors were also developed that allowed changes and corrections to be made much more easily than with punched cards. Normally the first step in debugging is to attempt to reproduce the problem. 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. 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. Ideally, the programming language best suited for the task at hand will be selected. Computer programming or coding is the composition of sequences of instructions, called programs, that computers can follow to perform tasks. Assembly languages were soon developed that let the programmer specify instruction in a text format (e.g., ADD X, TOTAL), with abbreviations for each operation code and meaningful names for specifying addresses. One approach popular for requirements analysis is Use Case analysis. Provided the functions in a library follow the appropriate run-time conventions (e.g., method of passing arguments), then these functions may be written in any other language. Implementation techniques include imperative languages (object-oriented or procedural), functional languages, and logic languages. It affects the aspects of quality above, including portability, usability and most importantly maintainability.