

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. In 1801, the Jacquard loom could produce entirely different weaves by changing the "program" – a series of pasteboard cards with holes punched in them. It is very difficult to determine what are the most popular modern programming languages. In the 9th century, the Arab mathematician Al-Kindi described a cryptographic algorithm for deciphering encrypted code, in *A Manuscript on Deciphering Cryptographic Messages*. 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. It involves designing and implementing algorithms, step-by-step specifications of procedures, by writing code in one or more programming 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. In 1801, the Jacquard loom could produce entirely different weaves by changing the "program" – a series of pasteboard cards with holes punched in them. Implementation techniques include imperative languages (object-oriented or procedural), functional languages, and logic languages. This can be a non-trivial task, for example as with parallel processes or some unusual software bugs. 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. Different programming languages support different styles of programming (called programming paradigms). 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. Techniques like Code refactoring can enhance readability. This can be a non-trivial task, for example as with parallel processes or some unusual software bugs. Use of a static code analysis tool can help detect some possible problems. 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). 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*. This can be a non-trivial task, for example as with parallel processes or some unusual software bugs. Some languages are very popular for particular kinds of applications, while some languages are regularly used to write many different kinds of applications. Many factors, having little or nothing to do with the ability of the computer to efficiently compile and execute the code, contribute to readability. Some of these factors include: The presentation aspects of this (such as indents, line breaks, color highlighting, and so on) are often handled by the source code editor, but the content aspects reflect the programmer's talent and skills. 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. 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.