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For other uses, see API (disambiguation)."Api.php" redirects here. For the Wikipedia API, see Special:ApiHelp.An application programming interface (API) is a connection between computers or between computer programs. It is a type of software interface, offering a service to other pieces of software.[1] A document or standard that describes how to build such a connection or interface is called an API specification. A computer system that meets this standard is said to implement or expose an API. The term API may refer either to the specification or to the implementation.In contrast to a user interface, which connects a computer to a person, an application programming interface connects computers or pieces of software to each other. It is not intended to be used directly by a person (the end user) other than a computer programmer[1] who is incorporating it into software. An API is often made up of different parts which act as tools or services that are available to the programmer. A program or a programmer that uses one of these parts is said to call that portion of the API. The calls that make up the API are also known as subroutines, methods, requests, or endpoints. An API specification defines these calls, meaning that it explains how to use or implement them.One purpose of APIs is to hide the internal details of how a system works, exposing only those parts a programmer will find useful and keeping them consistent even if the internal details later change. An API may be custom-built for a particular pair of systems, or it may be a shared standard allowing interoperability among many systems.The term API is often used to refer to web APIs.[2] It details how communication between computers that are joined by the internet. There are also APIs for programming languages, software libraries, computer operating systems, and computer hardware. APIs originated in the 1940s, though the term did not emerge until the 1960s and 70s.An API opens a software system to interactions from the outside. It allows two software systems to communicate across a boundary or interface using mutually agreed-upon signals.[3] In other words, an API connects software modules together. Unlike a user interface, an API is typically not visible to users – it is an "under the hood" portion of a software system, used for machine-to-machine communication.[4]A well-designed API exposes only objects or actions needed by software or software developers that it uses to perform. This abstraction simplifies programming.[5]Metaphorically, APIs connect software like interlocking blocks. Building software using APIs has been compared to using building blocks, such as Lego bricks. Software services or software libraries are analogous to the bricks; they may be joined together via their APIs, composing a new software product.[6]The process of joining is called integration.[3]As an example, consider a weather sensor that offers an API. When a certain message is transmitted to the sensor, it will detect the current weather conditions and reply with a weather report. The message that activates the sensor is an API call, and the weather report is an API response.[7] A weather forecasting app might integrate with a number of weather sensor APIs, gathering weather data from throughout a geographical area.An API is often compared to a contract. It represents an agreement between parties: a service provider who offers the API and the software developers who rely upon it. If the API remains stable, or if it changes only in predictable ways, developers' confidence in the API will increase. This may increase their use of the API.[8]A diagram from 1978 proposing the expansion of the idea of the API to become a general programming interface, beyond application programs alone[9]The term API initially described an interface only for end-user-facing programs, known as application programs. This origin is still reflected in the name "application programming interface." Today, the term is broader, including also utility software and even hardware interfaces.[10]The idea of the API is much older than the term itself.[9]British computer scientists Maurice Wilkes and David Wheeler worked on a modular software library in the 1940s for EDSAC, an early computer. The subroutines in this library were stored on punched paper tape organized in a filing cabinet. This cabinet also contained what Wilkes and Wheeler called a "library catalog" of notes about each subroutine and how to incorporate it into a program. Today, such a catalog would be called an API specification or documentation, because it instructs a programmer on how to use the software. [10]Wilkes and Wheeler's book on Computer Preparation Program for an Electronic Digital Computer, published API criticism in 1945. Block and Wheeler "clearly intended" the API, because it is more of a concept than an invention.[10]Although the people who coined the term were inventing software on Univac 1108, the goal of the API was to make hardware independent programming possible.[11]The term "application program interface" (without an -ing suffix) is first recorded in a paper called Data structures and techniques for remote computer graphics presented at an AFIPS conference in 1968.[12][10] The authors of this paper use the term to describe the interaction of an applications graphics program in this case with the rest of the computer system. A consistent application interface (consisting of Fortran subroutine calls) was intended to free the programmer from dealing with idiosyncrasies of the graphics display device, and to provide hardware independence if the computer or the display were replaced.[11]The term was introduced to the field of databases by C. J. Date.[13] In a 1974 paper called The Relational and Network Approaches: Comparison of the Application Programming Interface.[14] An API became a part of the ANSI/SPARC framework for database management systems. This framework treated the application programming interface separately from other interfaces, such as the query interface. Database professionals in the 1970s observed these different interfaces could be combined; a sufficiently rich application interface could support the other interfaces as well.[9]This observation led to APIs that supported all types of programming, not just application programming. By 1990, the API was defined simply as "a set of services available to a programmer for performing certain tasks" by technologist Carl Malamud.[15]Screenshots of Web API documentation written by NASAThe idea of the API was expanded again with the dawn of remote procedure calls and web APIs. As computer networks became common in the 1970s and 80s, programmers wanted to call libraries located not only on their local computers, but on computers located elsewhere. Each remote procedure call was supported by the availability of a network protocol. In the 1990s, widespread use of standardized network protocols like TCP/IP, HTTP, CORBA and DCOM compelled developers to provide API services over the Internet. [16]Roy Fielding's dissertation, Architectural Styles and the Design of Network-based Software Architectures at UC Irvine in 2000 outlined Representational state transfer (REST) and described the idea of a "network-based Application Programming Interface" that Fielding contrasted with traditional "library-based" APIs.[17]XML and JSON web APIs saw widespread commercial adoption beginning in 2000 and continuing as of 2021. The web API is now the most common meaning of the term API.[2]The Semantic Web proposed by Tim Berners-Lee in 2001 included "describing APIs" that recast the API as an open, distributed data interface rather than a software behavior interface.[18] Proprietary interfaces and agents became more widespread than open ones, but the idea of the API as a data interface took hold. Because web APIs are widely used to exchange data of all kinds online, API has become a broad term semantic much of the communication on the internet.[16] When used in this way, the term API has overlap in meaning with the term communication protocol.The interface to a software library is one type of API. The API describes and prescribes the "expected behavior" (a specification) while the library is an "actual implementation" of this set of rules.A single API can have multiple implementations (or none, being abstract) in the form of different libraries that share the same programming interface. The separation of the API from its implementation can allow programs written in one language to use a library written in another. For example, because Scala and Java compile to compatible bytecode, Scala developers can take advantage of any Java API.[19]API use can vary depending on the type of programming language involved.An API for a procedural language such as Lua could consist primarily of basic routines to execute code, manipulate data or handle errors while an API for an object-oriented language, such as Java, would provide a specification of classes and its class methods.[20][21] Hyrum's law states that "With a sufficient number of users of an API, it does not matter what you promise in the contract: all observable behaviors of your system will eventually be used when developing in another language.[24] Tools such as SWIG and F2PY, a Fortran-to-Python interface generator, facilitate the creation of such interfaces.[25]An API can also be related to a software framework: a framework can be based on several libraries implementing several APIs, but unlike the normal use of an API, the access to the behavior built into the framework is mediated by extending its content with new classes plugged into the framework itself.Moreover, the overall program flow of control can be out of the control of the caller and in the framework's hands by inversion of control or a similar mechanism.[26][27]An API can specify the interface between an application and the operating system.[28] POSIX, for example, specifies a set of common APIs that aim to enable an application written for a POSIX conformant operating system to be compiled for another POSIX conformant operating system.Linux and Berkeley Software Distribution are examples of operating systems that implement the POSIX APIs. [29]Microsoft has shown a strong commitment to a backward-compatible API, particularly within its Windows API (Win32) library, so older applications may run on newer versions of Windows using an executable-specific setting called "Compatibility Mode".[30] How much Microsoft developers' access to the company's operating systems' internal APIs is an advantage in unclear. Richard A. Shaffer of Technologic Computer Letter in 1987 compared the situation to a baseball game in which "Microsoft owns all the bats and the field" [31] but Ed Esber of Ashton-Tate said in an interview that year that Bill Gates told him that his developers sometimes had to rewrite software based on early APIs. Gates noted in the interview that Microsoft's Apple Macintosh applications were more successful than those for MS-DOS, because his company did not have to also devote resources to Mac OS.[32]An API differs from an application binary interface (ABI) in that an API is source code based while an ABI is binary based. For instance, POSIX provides APIs for file operations, but the actual implementation of these operations is left to the programmer. In contrast, the ABI defines the exact resources that the application must use to interact with the operating system. The ABI defines the different types of databases with the same set of functions, while the Java remote method invocation API uses the Java Remote Method Protocol to allow invocation of functions that operate remotely, but appear local to the developer.[35][36]Therefore, remote APIs are useful in maintaining the object abstraction in object-oriented programming; a method call, executed locally on a proxy object, invokes the corresponding method on the remote object, using the remoteing protocol, and acquires the result to be used locally as a return value.A modification of the proxy object will also result in a corresponding modification of the remote object.[37]Main article: Web APIWeb APIs are the defined interfaces through which interactions happen between an enterprise and applications that use its assets, which also is a Service Level Agreement (SLA) to specify the functional provider and expose the service path or URL for its API users. An API approach is an architectural approach that revolves around providing a program interface to a set of services to different applications serving different types of consumers.[38]When used in the context of web development, an API is typically defined as a set of specifications, such as Hypertext Transfer Protocol (HTTP) request messages, along with a definition of the structure of response messages, usually in an Extensible Markup Language (XML) or JavaScript Object Notation (JSON) format. An example might be a shipping company API that can be added to an eCommerce-focused website to facilitate ordering shipping services and automatically include current shipping rates, without the site developer having to enter the shipper's rate table into a web database. While "web API" historically has been virtually synonymous with web service, the recent trend (so-called Web 2.0) has been moving away from Simple Object Access Protocol (SOAP) based web services and service-oriented architecture (SOA) towards more direct representational state transfer (REST) style web resources and resource-oriented architecture (ROA).[39] Part of this trend is related to the Semantic Web movement toward Resource Description Framework (RDF) concept-driven web-based data models that allow the combination of multiple APIs into new applications such as mashups.[40] The social media space and APIs have allowed users to create content and share it with other users, and content and data between communities and applications. In this way, content that is created in one place dynamically can be posted and updated to multiple locations on the web.[41] For example, Twitter's REST API allows developers to access core Twitter data and the Search API provides methods for developers to interact with Twitter Search and trends data.[42]The design of an API has significant impact on its usage.[5] The principle of information hiding describes the role of programming interfaces as enabling modular programming by hiding the implementation details of the modules so that users of modules need not understand the complexities inside the modules.[43] Thus, the design of an API attempts to provide only the tools a user would expect.[5] The design of programming interfaces represents an important part of software architecture, the organization of a complex piece of software.[44]APIs are one of the more common ways technology companies integrate. Those that provide and use APIs are considered as being members of a business ecosystem.[45]The main policies for releasing an API are:[46]Private: The API is for internal company use only.Partner: Only specific business partners can use the API. For example, vehicle for hire companies such as Uber and Lyft allow approved third-party developers to directly order rides from within their apps. This allows the companies to exercise quality control by curating which apps have access to the API, and provides them with an additional revenue stream.[47]Public: The API is available for use by the public. For example, Microsoft makes the Windows API public, and Apple releases its API Cocoa, so that software can be written for their platforms. Not all public APIs are generally accessible by everybody. For example, Internet service providers like Cloudflare or Voxelity, use RESTful APIs to allow customers and resellers access to their infrastructure information, DDoS stats, network performance or dashboard controls.[48] Access to such APIs is granted either by API tokens, or customer status validations.[49]An important factor when an API becomes public is its "interface stability". Changes to the API often require making the API user aware of the changes. It can take a number of forms, including instructional documents, tutorials, and reference works. It will also include a variety of information types and functionalities.Restrictions and limitations on how the API can be used are also covered by the documentation. For instance, documentation for an API function could note that its parameters cannot be null, that the function itself is not thread safe.[58] Because API documentation tends to be comprehensive, it is a challenge for writers to keep the documentation updated and for users to read it carefully, potentially yielding bugs.[50]API documentation can be enriched with metadata information like Java annotations. This metadata can be used by the compiler, tools, and by the run-time environment to implement custom behaviors or custom handling.[59]It is possible to generate API documentation in a data-driven manner. By observing many programs that use a given API, it is possible to infer the typical usages, as well the required contracts and directives.[60] Then, templates can be used to generate natural language from the mined data.Main article: Google LLC v. Oracle America, Inc.In 2010, Oracle Corporation sued Google for having distributed a new implementation of Java embedded in the Android operating system.[61] Google had not acquired any permission to reproduce the Java API, although permission had been given to the similar OpenJDK project. Judge William Alsup ruled in the Oracle v. Google case that APIs cannot be copyrighted in the U.S. and that a victory for Oracle would have widely expanded copyright protection to a "functional set of symbols" and allowed the copyrighting of simple software commands>To accept Oracle's claim would be to allow anyone to copy one version of code to carry out a system of commands and thereby bar all others from writing its different versions to carry out all or part of the same commands.[62][63]Alsup's ruling was overturned in 2014 on appeal by the Court of Appeals for the Ninth Circuit. The court's question was whether APIs could be copyrighted. The Supreme Court ruled in favor of Google, stating that APIs are not copyrightable. The Supreme Court's ruling was based on the Copyright Act of 1976, which states that copyright protection is granted to original works of authorship fixed in a tangible medium of expression. The Court found that APIs are not original works of authorship, but rather are functional tools that facilitate interoperability between different systems and applications. The Court also found that APIs are not fixed in a tangible medium of expression, as they are constantly updated and modified. Therefore, the Court ruled that APIs are not eligible for copyright protection. This ruling was a significant victory for Google and other software developers, as it allowed them to continue to use APIs without fear of being sued for copyright infringement. The ruling also clarified the scope of copyright protection for software developers, and it is expected to have a significant impact on the future of API development. 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