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## Digital Libraries and Open Source Software

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### Abstract

*Open source software (OSS) is popular with technically sophisticated users, who are often also the software developers, and has not yet made a significant impact on the desktop of most users. OSS has much potential for libraries and information centres, and there are a number of projects, including Greenstone, DSpace and Ganesha, etc that demonstrates its viability in this context. OSS is becoming an increasingly popular software development method. This paper highlights what is an OSS, its features, software licensing, advantages and disadvantages. The paper also highlights the features, functions and use of three popular digital libraries software viz. Greenstone, DSpace and Ganesha.*

**Keywords:** Digital Library, Open Source Software, Licensing, Greenstone, DSpace, Ganesha

### 0. Introduction

The implementation of OSS in libraries represents a method for improving library services and collections. A variety of interpretations exist with regard to the nature of OSS, sometimes confusing it with different kinds of gratis software or liberally using the term for either the development process, the software product or a particular licensing scheme. Free and OSS is also often mentioned in the same breath as open standards or interoperability, which are distinct issues in their own right.

OSS is built and enhanced through public collaboration. It is free in that it gives the user unrestricted access to the source code. The source code shows how the software works in a language that programmers can understand. In order to use OSS, users must agree to a license, which usually includes the ability to run the program, have the source code, change the source code, and distribute it. Collaboration is also how problems with the software are detected. Glitches are more easily detected when many people look at and use the software. However, some licenses restrict users from putting OSS into proprietary licensed software.

The most important aspect of the OSS is the participation of users. When a user(s) want a feature added or bug fixed for a program, they have traditionally been at the mercy of the software vendor. However, with open source they can modify the program to their own needs or fix what is broken. Many users will help develop the program for free, simply to improve the product and benefit the community.

### 1. What is OSS?

The term open source in common usage may also refer to any software with publicly available source code, regardless of its license, but this usage provokes strong disapproval from the OSF open source community, which may call them "disclosed source" rather than open source.

OSS means any computer software whose source code is either in the public domain or, more commonly, is copyrighted by one or more persons/entities and distributed under an open source license such as the GNU General Public License. Such a license may require that the source code be distributed along with the software, and that the source code be freely modifiable, with at most minor restrictions, such as a requirement to preserve the authors' names and copyright statement in the code.

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OSS is primarily defined as software which is freely redistributable and includes the source code. The licenses under which OSS is released vary greatly, but these two points remain consistent. This is vastly different from the mainstream software industry where source code is highly guarded and programs are only distributed in their binary, un-modifiable format.

OSS is typically created and maintained by developers crossing institutional and national boundaries, collaborating by using internet-based communications and development tools. Products are typically a certain kind of “free”, often through a license that specifies that applications and source code (the programming instructions written to create the applications) are free to use, modify, and redistribute as long as all uses, modifications, and redistributions are similarly licensed; General public licence, Berkeley Software Distribution and Mozilla Public License etc.

## 2. Features of OSS

The main features of OSS, and the mechanisms which drive the working of open source projects which enable these features are:

- ✍ One of the main attractive features of OSS is that its source code is available.
- ✍ It is possible to customize a particular software application according to local needs.
- ✍ Have the software at their disposal to fit it to their needs. Of course, this includes improving it, fixing its bugs, augmenting its functionality, and studying its operation.
- ✍ Redistribute the software to other users, who could themselves use it according to their own needs. This redistribution can be done for free, or at a charge, not fixed beforehand

## 3. OSS Licenses

With the current legal framework, the license under which a program is distributed defines exactly the rights which its users have over it. For instance, in most proprietary programs the licence withdraws the rights of copying, modification, lending, renting, use in several machines, etc. In fact, licences usually specify that the proprietor of the program is the company which publishes it, which just sells restricted rights to use it.

Authors can choose to protect their software with different licensees according to the degree with which they want to fulfill these goals, and the details which they want to ensure. In fact, authors can distribute their software with different licences through different channels. Therefore, the author of a program usually chooses very carefully the licence under which it will be distributed. And users, especially those who redistribute or modify the software, have to carefully study its licence. Under the OSS, licenses must meet ten conditions in order to be considered open source licenses:

1. Free Redistribution: the software can be freely given away or sold.
2. Source Code: the source code must either be included or freely obtainable.
3. Derived Works: redistribution of modifications must be allowed.
4. Integrity of The Author’s Source Code: licenses may require that modifications are redistributed only as patches.
5. No Discrimination Against Persons or Groups: no-one can be locked out.
6. No Discrimination Against Fields of Endeavor: commercial users cannot be excluded.

7. Distribution of License: rights must apply to everyone who receives the program.
8. License Must Not Be Specific to a Product: the program cannot be licensed only as part of a larger distribution.
9. License Must Not Restrict Other Software: the license cannot insist that any other software, it is distributed with, must also be open source.
10. License Must Be Technology-Neutral: no click-wrap licenses or other medium-specific ways of accepting the license must be required.

#### **4. OSS Licencing bodies: Some of the common OSS licenses are as follows:**

##### **4.1 Berkeley Software Distribution (BSD)**

The BSD License is similar to the GPL, but does not require derivative works to be subject to the same terms as the initial BSD License. Under the BSD Licenses, distribution of source code is permitted, but not mandated for derivative works. Programs under the BSD Licenses can be combined with proprietary software. The BSD licence is a good example of a “permissive” licence, which imposes almost no conditions on what a user can do with the software. The authors only want their work to be recognized. In some sense, this restriction ensures a certain amount of “free marketing”. It is important to notice that this kind of licence does not include any restriction oriented towards guaranteeing that derived works remain open source.

##### **4.2 General Public License (GNU) (GPL)**

This is the licence under which the software of the GNU project is distributed. The GPL is based on the international legislation on copyright, which ensures its enforceability. The main characteristics of the GPL are; it allows binary redistribution, but only if source code availability is also guaranteed; it allows source redistribution (and enforces it in case of binary distribution); it allows modification without restrictions (if the derived work is also covered by GPL); and complete integration with other software is only possible if that other software is also covered by GPL.

##### **4.3 (Mozilla Public License (MPL)**

This is the licence made by Netscape to distribute the code of Mozilla, the new version of it network navigator. It is in many respects similar to the GPL, but perhaps more “enterprise oriented”.

#### **5. Advantages of OSS**

Open source offers a radically different and exponentially better software development model. Companies can improve their products greatly and significantly increase their market share. Overall, open source is good for everyone.

- ✍ Access to source code and ability and right to modify it: The availability of the source code and the right to modify it is very important. It enables the unlimited tuning and improvement of a software product.
- ✍ Right to redistribute modifications to benefit wider community: The right to redistribute modifications and improvements to the code, and to reuse other open source code, permits all the advantages due to the modifiability of the software to be shared by large communities.

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- ✍ The right to use the software in any way: This, combined with redistribution rights, ensures a large population of users, which helps in turn to build up a market for support and customization of the software, which can only attract more and more developers to work in the project.
  - ✍ Cost effective: Usually, the first perceived advantage of open source models is the fact that OSS is made available gratis or at a low cost.
  - ✍ Customizable: Since OSS comes with the source, one can customize existing software to suit one's needs. Open source licenses typically guarantee the right to be able to customize the software.
  - ✍ Preventing re-invention of the wheel: Since we can reuse existing code, effort is not wasted re-developing software that already exists. Open source development can build on the entire body of work already released under a suitable open source license.
  - ✍ Helping the progress of technology: Effort can be concentrated in making existing software better. This helps the progress of technology.
  - ✍ More secure: Since the source code is open, more people scrutinize the source code and hence more flaws are found and corrected.
  - ✍ Technology transfer at zero cost: Since the source code is open, anyone can learn how the software was developed, thus facilitating technology transfer at zero cost.
  - ✍ Allows for easier localization: To translate a particular software package into another language using proprietary software.
  - ✍ Prevent misuse of monopoly positions: The availability of the source code dictates that software vendors will always have to follow market demands and will not be able to misuse monopoly positions.
  - ✍ Development advantages: With many open source projects, a virtual community of developers grows around the software. The company then incurs lower overhead because of unpaid, outsourced work and is closer to customers who use the product.
  - ✍ More Programmers are Better: One would think that by having more programmers, a piece of software could be created faster and better.

## 6. Disadvantages of OSS

There are several disadvantages, some of which are aspects of higher life cycle costs. Because of the disadvantages listed below, open source products for the most part have become popular as black box, server-side appliances, not as interactive applications, the main disadvantages are:

- ✍ Perceived disadvantages of open source models: Of course, open source development models lead also to the perception of some disadvantages. However, some of them are only disadvantages if we stick to classical (proprietary) development models, which is of course not the case with open source.
- ✍ Limited or no accountability: Limited domain of solutions, Limited hard real-time support
- ✍ Patented Proprietary File formats: Some file formats have been patented, or for other reasons, cannot be read by Open Source products. Software patents are often given out loosely.
- ✍ Resistance to Migration: Most of the world's offices and desktops are currently using proprietary software. The migration to open source costs money and takes efforts in the short term, before long term benefits can be obtained.

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- ✗ The Total Cost of Ownership Argument: For a long time, it was argued that although OSS was initially cheaper, the long term 'total cost of ownership' was higher. Increasingly, OSS is winning this argument.
  - ✗ Lack of Advertising: There are only a few major proprietary software companies, and they've made a lot of money, which they can then spend on advertising.
  - ✗ Fear, uncertainty and doubt: The majority of the commercial software industry finds it easier to criticize or scare people away from OSS, than embrace it, and change their business models.
  - ✗ Proprietary software offering 'open' source code: Proprietary software sometimes tries to blur the line between proprietary and free or open software. This is an attempt to show that proprietary software has the same openness as OSS.
  - ✗ Lack of an 'ecosystem': A problem often cited is the lack of an open source 'ecosystem', comprising lots of companies both large and small, willing to offer support etc. Major organisations need this before they are willing to use any product.
  - ✗ Piracy: Piracy is common in the proprietary software world, since the legally purchased software is so expensive. Piracy makes proprietary software seem cheaper than it really is. It is sometimes alleged that proprietary software vendors 'look the other way' in developing countries when they know piracy is happening, until the country is heavily locked into the proprietary software.
  - ✗ Restricted choice: In virtually every area of software there are dozens if not hundreds or even thousands of choices for different commercial packages, but rarely are there more than one or two, if any, open source options.
  - ✗ Poor integration: Open source products tend to be created by people, so as a result their products are poorly integrated.
  - ✗ Poor interactive capabilities: OSS with an interactive user interface as good as "average good" interactive packages in Windows.
  - ✗ Difficult to use: A subset of the above that should be enumerated explicitly. OSS tend to be written by engineers for other engineers and for many of them it is accepted that ordinary function will involve creation of configuration files, writing scripts, or actually editing the source code and recompiling.
  - ✗ Higher cost of installation: Commercial vendors are forced by intense competition to configure their products for easy installation. Open source tends to have much higher installation costs because a much greater degree of expertise usually is required for installation.
  - ✗ Higher cost of operation: Open source products tend to require a much higher degree of technical expertise to operate and maintain, so they end up costing more.
  - ✗ Higher cost of technical support: Open source costs more to support because the software is typically self-supporting.
  - ✗ Lack of capabilities/features: Open software packages tend to have far fewer features and capabilities than commercial equivalents.
  - ✗ Poor customer response: A well-run commercial software company will immediately turn around customer requests for enhancements. With open source, if you don't do it yourself you are at the mercy of a disjoint community of developers.
  - ✗ Lack of innovation/codification of obsolete architectures: The glacially slow pace of development within open source movements and the design by committee, consensus process tends to assure that obsolete architectures get implemented within open source.
  - ✗ No warranty: There is no single company backing the product.

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## 7. Popular OSS

### 7.1 Greenstone software (<http://www.greenstone.org/english/home.html>.)

It provides a new way of organizing information and publishing it on the Internet or on CD-ROM. It is open source, multilingual software, issued under the terms of the GNU. The system operates under UNIX, Windows, and Mac OS/X, and works with standard Web servers. The Unicode character set is used throughout, so documents - and interfaces - can be in any language. It builds collections with effective full-text searching and metadata-based browsing facilities that are attractive and easy to use. Moreover, they are easily maintained and can be augmented and rebuilt entirely automatically. The system is extensible: software "plug-in" accommodate different document and metadata types.

The aim of the Greenstone software is to empower users, particularly in universities, libraries, and other public service institutions, to build their own digital libraries. The latest version of the software is 2.52 released on October 2004. Interfaces available for the Greenstone digital library software (version 2.51 only): the four "core" languages English, French, Spanish, Russian; and interfaces for Arabic, Armenian, Chinese, Croatian, Czech, Dutch, Farsi, Finnish, Galician, Georgian, German, Greek, Hebrew, Hindi, Indonesian, Italian, Japanese, Kannada, Kazakh, Maori, Portuguese (Brazil), Portuguese (Portugal), Serbian, Thai, Turkish, Ukrainian.

The Greenstone "Collector" is an interactive subsystem for managing and accessing collections.

The Collector can be used to:

- ✍ create a new collection with the same structure as an existing one;
- ✍ create a new collection with a different structure;
- ✍ add new material to an existing collection;
- ✍ modify the structure of an existing collection;
- ✍ delete a collection;
- ✍ write an existing collection to a self-contained, self-installing Windows CD-ROM.

Greenstone is:

- ✍ Widely accessible: Collections are accessed through a standard web browser.
- ✍ Multi-platform: Collections can be served on Windows and UNIX, with an external Web server or (for Windows) a built-in one.
- ✍ Metadata-driven: Browsing (and, if desired, searching) indexes are built from metadata. Metadata may be associated with each document or with individual sections within documents. It must be provided explicitly (often in an accompanying XML or spreadsheet file) or derivable automatically from the source documents.
- ✍ Extensible: Plugins can be written to accommodate new document types. Classifiers can be written to create new kinds of browsing indexes based on metadata.
- ✍ Multi-language: Unicode is used throughout and is converted on-the-fly to an encoding supported by the user's Web browser. Separate indexes can be built for different languages: a plug-in allows automatic language identification for multilingual collections.

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- ✍ International: The interface is available in multiple languages: new ones are easy to add.
  - ✍ Large-scale: Collections containing millions of documents, and up to several gigabytes, have been built. Full-text searching is fast. Compression is used to reduce the size of the indexes and text
  - ✍ Z39.50 compatible: The Z39.50 protocol is supported for accessing external servers and (under development) for presenting Greenstone collections to external clients.

Greenstone provides:

- ✍ Flexible searching: Users can search the documents' full text, choosing between indexes built from different parts. Queries can be ranked or Boolean; terms can be stemmed or unstemmed, case-folded or not.
- ✍ Flexible browsing: Users can browse lists of authors, lists of titles, lists of dates, hierarchical classification structures, and so on. Different collections offer different browsing facilities, determined at build time.
- ✍ Zero maintenance: All structures are built directly from the documents themselves. New documents in the same format can be merged into the collection automatically. No links need be inserted by hand, but existing hypertext links in the original documents, leading both within and outside the collection, are preserved.
- ✍ Phrases and key phrases: Standard classifiers create phrase and key phrase indexes of text — or indeed any metadata.
- ✍ Sustained operation: New collections can be installed without bringing the system down. Even active users rarely notice when a collection is updated.

Greenstone enables:

- ✍ Multimedia: Collections can contain pictures, music, audio and video clips. Currently, non-textual material is either linked in to documents or accompanied by written descriptions to allow access. However, the architecture allows plugins and classifiers to be written for generalized documents.
- ✍ CD-ROM option: Collections can be published on a self-installing CD-ROM. A multi-disk solution has been implemented for larger collections.
- ✍ Distributed collections: Collections served by different computers can be presented to users as though they were part of the same library, through a flexible process structure.
- ✍ What you see — you can get!: Greenstone is available from the New Zealand Digital Library (<http://www.nzdl.org>) under the terms of the GNU. It is easy to install on Windows and UNIX.
- ✍ Easy modify: And last but not least, because Greenstone is OSS, it is easily modified!.

## 7.2 DSpace: Open Source Digital Library (DL) System (<http://www.dspace.org>)

DSpace is a groundbreaking digital institutional repository that captures, stores, indexes, preserves, and redistributes the intellectual output of a university's research faculty in digital formats. It manages and distributes digital items, made up of digital files (or bit streams) and allows for the creation, indexing, and searching of associated metadata to locate and retrieve the items.

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DSpace was designed and developed by Massachusetts Institute of Technology (MIT) Libraries and Hewlett-Packard (HP). DSpace was designed as an open source application that institutions and organizations could run with relatively few resources. It is to support the long-term preservation of the digital material stored in the repository. It is also designed to make submission easy. The latest version of the software is 1.2.1 beta2 released in November, 2004.

DSpace support the types of content

DSpace accepts all manner of digital formats. Some examples of items that DSpace can accommodate are:

- ✍ Documents, such as articles, preprints, working papers, technical reports, conference papers
- ✍ Books
- ✍ Theses
- ✍ Data sets
- ✍ Computer programs
- ✍ Visualizations, simulations, and other models
- ✍ Multimedia publications
- ✍ Administrative records
- ✍ Published books
- ✍ Overlay journals
- ✍ Bibliographic datasets
- ✍ Images
- ✍ Audio files
- ✍ Video files
- ✍ Reformatted digital library collections
- ✍ Learning objects
- ✍ Web pages

Institutional Repository

DSpace is a digital library system to capture, store, index, preserve, and redistribute the intellectual output of a university's research faculty in digital formats.

- ✍ DSpace is organized to accommodate the multidisciplinary and organizational needs of a large institution.
- ✍ DSpace provides access to the digital work of the whole institution through one interface.
- ✍ DSpace is organized into Communities and Collections, each of which retains its identity within the repository.
- ✍ Customization for DSpace communities and collections allows for flexibility in determining policies and workflow.



## Digital Preservation

DSpace identifies two levels of digital preservation. First one is Bit preservation, which ensures that a file remains exactly the same over time - not a single bit is changed - while the physical media evolve around it. - Functional preservation goes further: the file does change over time so that the material continues to be immediately usable in the same way it was originally while the digital formats (and physical media) evolve over time. One of the primary goals of DSpace is to preserve digital information.

- ✍ DSpace provides long-term physical storage and management of digital items in a secure, professionally managed repository including standard operating procedures such as backup, mirroring, refreshing media, and disaster recovery.
- ✍ DSpace assigns a persistent identifier to each contributed item to ensure its irretrievability far into the future.
- ✍ DSpace provides a mechanism for advising content contributors of the preservation support levels they can expect for the files they submit.
- ✍ For all three levels, DSpace does bit-level preservation so that “digital archaeologists” of the future will have the raw material to work with if the material proves to be worth that effort.
- ✍ Access Control: DSpace allows contributors to limit access to items in DSpace, at both the collection and the individual item levels.
- ✍ Versioning: New versions of previously submitted DSpace items can be added and linked to each other, with or without withdrawal of the older item. Multiple formats of the same content item can be submitted to DSpace, for example, a TIFF file and a GIF file of the same image.
- ✍ Search and Retrieval: The DSpace submission process allows for the description of each item using a qualified version of the Dublin Core metadata schema.

## Benefits of using DSpace

- ✍ Getting your research results out quickly, to a worldwide audience.
- ✍ Reaching a worldwide audience through exposure to search engines such as Google
- ✍ Storing reusable teaching materials that you can use with course management systems
- ✍ Archiving and distributing material you would currently put on your personal website
- ✍ Storing examples of students' projects (with the students' permission)
- ✍ Showcasing students' theses (again with permission)
- ✍ Keeping track of your own publications/bibliography
- ✍ Having a persistent network identifier for your work, as shown in this image:
- ✍ No more page charges for images. You can point to your images' persistent identifiers in your published articles.

### 7.3 Ganesha Digital Library (URL: <http://gdl.itb.ac.id/>)

Ganesha Digital Library enables institutions or personals to share their knowledge as well as simultaneously access and utilize knowledge. Ganesha Digital Library or GDL is a tool for managing and distributing digital collection using web-based technology. GDL enables institutions or persons to share

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their knowledge as well as simultaneously access and utilize knowledge in Indonesian “giant memory” in the form of network of Indonesia DLN digital libraries. The latest version of the software is 4.0 released in June, 2004.

#### Features of Ganesha digital library software

- ✍ Distributed Knowledge Management: Knowledge management done through distribution, by partner in each digital library server.
- ✍ Centralized Knowledge Distribution: To make information closer to user, GDL Partner Server can benefit GDL Hub Server (Central Server) in order to disseminate metadata to all Digital Library Partner Server within IndonesiaDLN.
- ✍ Online Member Registration: User registration can be done online on the web. Validation number sent by email to make sure to make any contact to user in the future.
- ✍ Roaming Membership: Once user is registered in any GDL server, he/she can use his/her account in every online GDL server.
- ✍ Searching: GDL 3.1 supports fast information searching and detail to all managed metadata.
- ✍ Category-Based Organization: Organizing collection done with creating category and sub-category. This makes browsing easier.
- ✍ Upload Metadata and Files: Every member can publish his/her digital collections by submitting metadata form and upload the file easily.
- ✍ Personal Directory: Every member automatically possesses personal directory which he/she can freely manage.
- ✍ Review Forum: Every uploaded article can be set whether asked for review by visitor or not. Visitor can post and read review. Contributor will receive email notification if there is any review posted.
- ✍ Access Restriction: Uploaded articles can be arranged whether accessed by Intranet (any particular group) or open to the Internet.
- ✍ Image Thumbnail: Image file (jpg and PNG) can be appeared in smaller size (thumbnail) at abstract page.
- ✍ Knowledge Organization: Member, editor, and knowledge officer can organize where to put uploaded articles to appropriate categories in regard to their privileges.
- ✍ News: Editor and knowledge officer can upload fresh news to appear in GDL News GDL easily.
- ✍ Synchronization: GDL Partner Server can upload and download file and metadata to/from GDL Central Server through Synchronization facilities. Membership and publisher information can also be synchronized.
- ✍ Member and Group Administration: Administrator can manage member data, create group, and regulate editor access right.
- ✍ Statistics: Administrator can view statistics of knowledgebase content and its contributor.
- ✍ Advertisement: Administrator can show advertisement banner completed with keyword and subject matching facilities.

- ✗ Dublin Core / IndonesiaDLN Metadata: GDL utilizes IndonesiaDLN Metadata Standard that is based on Dublin Core metadata standard. It opens possibilities of information exchange with other system on the Internet that also utilizes Dublin Core.
- ✗ XML Based Transaction: Data transaction between client and server within GDL-Network uses XML format. It makes it possible for further development of GDL to become more extensive web-based networking application in the future.
- ✗ CD-ROM Enabled: GDL uses Apache, MySQL, and PHP free-software that can be run directly from CD-ROM to make easy information dissemination.
- ✗ CD-ROM Enabled

#### Ganesha Purposes:

- ✗ Managing scholar resources: theses, dissertations, research reports, journal, publication, etc.
- ✗ Promoting the SME's products: E-Mall (currently the e-transaction is not supported).
- ✗ Managing the art work and heritage resources: pictures, songs, videos, etc.
- ✗ Managing the expertise directory of people and organizations.
- ✗ Extend the metadata schema for other purposes easily.
- ✗ And the most important, develop distributed knowledge repository network.

## 8. Conclusion

It gives library staff an option to be actively involved in development projects, and this involvement can take many forms, such as reporting bugs, suggesting enhancements, and testing new versions. Organisations adopting OSS will need to provide their staff with additional development and training to enable them to take on these new roles effectively, and will need to have a long-term commitment to the projects. Currently available open source projects cover application areas ranging from the traditional library management systems to innovations like Greenstone, DSpace and Ganesha, which complement traditional systems.

OSS is well worth considering, particularly for stand-alone applications that complement traditional commercial library management systems. Systems librarians and library managers should watch this trend for future developments. The most important resource for the whole exercise is staff time and expertise. Although there is a lot of hi-tech and computers involved in creating and running a digital library, most of it is hard work. Resources for emergencies need to be considered and contingency plans (stand-by machine(s), access to temporary staff, etc.) need to be made.

OSS is any software whose code is available for users to look at and modify freely All Open Source projects have an owner All Open Source projects are governed by some type of license agreement: General public licence, Berkeley Software Distribution and Mozilla Public License etc.

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