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Open Source GIS: A Review

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Abstract

Open source software is computer software that can be freely used, changed, and distribute by anyone. Open source software is made by many people or organizations and distributed under licenses that comply with the Open Source Definition. Recently open source software start playing vital role in industry, academics and research. In last few decades, field of GIS has witnessed a very high growth rate and is encompassed with various proprietary and open source GIS software. In this paper we will explore open source GIS software and present an analysis of open source software against the proprietary software available for GIS. Strengths, weaknesses and future scope of open source GIS software will be discussed in detail. In the last, salient comparison between two most popular proprietary and open source GIS software namely ArcGIS and QGIS will be done.

Keywords: *Open Source GIS, ArcGIS, QGIS.*

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1. Introduction

The growth of open-source software has received substantial attention in last few years. The adoption of open-source software systems in developing nations, as a means of reducing licensing costs and of promoting indigenous technological development by having access to the source code of these systems(Camara and Onsrud, 2004). Free and open source software for geospatial applications (FOSS4G) is the annual recurring global event hosted by OSGeo since its inception in 2006 which encourage to open source software and its development.

It is general perception that the only distinction between open source and proprietary software is that one is free and the other is not which is not true at all. They each are based on differing philosophies, methodologies and business models. Open source software is, almost by definition, more flexible but requires more effort to use, whereas the opposite is true for proprietary software in general. All open source software is required to be "licensed". The procedure of implementing "free software licenses" is necessary to protect their users' legal rights and to ensure the freedoms of the software. With open source software the user can access the source code and redistribute it.

2. Criteria for Open Source Software

There is misconception among users and developers about the actual meaning of Open source software. An open source doesn't just mean access to the source code. Moreno (2015)deliberate the criteria for open-source software which are as follows.

- **Free Redistribution**
  The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.
- **Source Code**
  The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable

reproduction cost preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

- **Derived Works**
  The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.
- **Integrity of the Author's Source Code**
  The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.
- **No Discrimination against Persons or Groups**
  The license must not discriminate against any person or group of persons.
- **No Discrimination against Fields of Endeavor**
  The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.
- **Distribution of License**
  The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.
- **License Must Not Be Specific to a Product**
  The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.
- **License Must Not Restrict Other Software**
  The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.
- **License Must Be Technology-Neutral**
  No provision of the license may be predicated on any individual technology or style of interface.

2. Open Source Software

GIS applications have been observed significant increment in terms of desktop application, mobile applications and web applications. These applications are developed using various GIS software and open source software played important role in it. Open source software is available free and required to be “licensed”. The procedure of implementing “free software licenses” is necessary to protect their users’ legal rights and to ensure the freedoms of the software. There are several organizations that can provide free software license templates, such as General Public License (GPL), Lesser General Public License (LGPL) and Berkeley Software Distribution (BSD) (Tsou and Smith, 2011).STEFAN STEINIGER and ERWAN BOCHER (2009)listed several open source GIS software which is presented here in the extended form in Table 1 with details.

Table1: Details about different Open Source Software

Software/Release year	Developed by	Useful for application	Development Platform/ Language support	Software License
GRASS, 1982	Research institutes, universities, companies, volunteers worldwide	Analysis and scientific visualization, cartography, modeling and simulation	C, Shell, Tcl/Tk, Python	GPL
ILWIS, 1985	Universities, companies,	(Raster) Analysis	MS Visual C	GPL
FalconView, 1994	Georgia Tech Research Institute	Map display, Overlay analysis	JAVA	LGPL
MapWindow,1998	Universities, companies, volunteers worldwide	Providing core GIS and GUI functions, developing decision support systems	MS Visual Studio.NET (C+ +, C#, VB.NET)	Mozilla Public License
TerraView, 2001	Brazilian National Institute for SpaceResearch (INPE)	Vector and Raster analysis, Statistical analysis	C++, R	GPL
SAGA, 2001	Universities	Analysis, modeling, scientific visualisation	C+ + (MS Visual C+ +)	LGPL (API), GPL
Geoserver, 2001	Open Planning Project (TOPP),NY	WFS,WMS,WCS,WPS	JAVA	GPL
JUMP/Open Jump,2002	Company, government	Viewing, Editing, Analysis	JAVA	
QGIS, 2002	Universities, companies, volunteers worldwide	Viewing, Editing, Analysis, Grass-GUI, SAGA-GUI,	C+ +, Qt4, Python	GPL
DivaGIS, 2003		Biodiversity Analysis	Delphi/Kylix, Java	GPL
gvSIG, 2003	Companies, universities, government	Viewing, Editing, Analysis (Mobile Applications)	JAVA	GPL
JGrass, 2004	Companies	Interface and GUI for GRASS, raster analysis, 3D visualization, hydrologic analysis	C, Python	GPL
uDig, 2004	Companies, government	Viewing, Editing, Analysis	JAVA (Eclipse RCP)	Core Eclipse RCP is EPL
deeJump,2004	Company	OGC Standards	------	------

SkyJump,2004	Company	Military facility management	-------	GPL
Kosmo, 2005	Companies (project-driven, utilities), government	Viewing, Editing, Analysis	JAVA	GPL
Mapserver,2005	University of Minnesota	Webserver	C	GPL
Geonetwork, 2007	Companies, government	OGC Web catalog services	JAVA	GPL
Capeware, 2007	Government	3D virtual terrain mapping	C++	GPL
Kalypso, 2007	Companies, universities	inundation and flood risk mapping	Fortran, Java	LGPL
Whitebox, 2009	University of Guelph	Geospatial Analysis	Groovy, JavaScript, and Python.	GPL

3. Strengths and Weaknesses of Open Source GIS software

Open source have several facilities for their users and the developers:

Easy to start with: If you're starting a small company, a private venture, or even a project within a large company, you'll appreciate the ability to be able to freely experiment with technologies without paying any royalties.

Community support: Perhaps the greatest FOSS advantage. There's virtually no question regarding a popular open source project that hasn't got a profound answer in the web. For the undocumented questions, you'll probably get an answer within 24 hours in a professional forum.

Scalability: If you are using OpenSource software, you can switch over to a more powerful server or add a second server behind a load balancer. If you are paying licenses based on the number of cores or the number of users hitting the app, you are looking at a significant increase in license costs.

Trying before implementing: If you want to convert a software component to another infrastructure, technology or environment you can have a free sandbox to play with before converting and you can always go back. This allows priceless experience with cutting-edge technologies without the financial risks involved with trying new pricy products.

Easy to port: When your data is kept in open formats, translating from one data type to another is straight forward, and there is probably a piece of software that does exactly that. Figuring out closed format is a truly embarrassing experience.

Maximal Control: Open source software allows extensive configurability, which means that you can fine-tune the product to your exact needs. For niche demands, hiring a software developer to change the product will be considerably cheaper than paying a software company for changing the product (and they probably *Just Don't Do this kind of things*).

Attracts better developers. Open Source software developers seem to better perform, be more independent, productive and curious than developers under proprietary software infrastructure.

Great web tools: There's a plethora of web-oriented open source tools: mapping, tiles, databases, webservers, web framework and web authoring tools. Building your first GIS website will be very easy.

4. Comparison of Open Source Softwarewith proprietary software.

There are many open source GIS software are available but QGIS is most popular among them. ArcGIS is most popular proprietary software in the field of GIS so at few places we try to compare it with QGIS.

Too Many Projects: There are many open source projects for every niche, and you'll have to spend some time picking the best one, because other will be abandoned.

Graphical User Interface: This is probably because software developers are familiar with command-line tools, and there are not enough open source GUI designers. The resulting GUI (e.g., GRASS GIS) is often slow, ugly, and have counterintuitive interface. ArcGIS have excellent GUI in compare to any open source software.

User platform: Most of the users, and many developers, will consider this as an advantage.Windows Open Source software tools have gone a long way in the past years, but the best-of-breed software is almost always in the Linux world. Whereas ArcGIS is MS-Windows based software.

Documentation: Documentation is superb in ArcGIS. QGIS has lots of documentation; well written. There are numerous tutorials you can download and try for yourself. There are excellent introduction videos. QGIS does not lack documentation at all.

Support: If you're going to pay for it, you'll probably get good telephone support from the vendor. Whereas in open source probably no tech support or SLA, unless you pay a consultant.

Cost: With proprietary software, when you need an extra software component that would fit to your existing infrastructure, it's probably going to cost you a lot more.

Effort: Open source software is, almost by definition, more flexible but requires more effort to use, whereas the opposite is true for proprietary software in general.

Performance:QGIS is somehow faster than ArcGIS for most operations considering QGIS' newer architecture and code base it's not difficult to understand why it is faster.(it's often difficult to improve performance of a large codebase application without using new technologies). QGIS is much faster working with PostGIS than ArcGIS, unless you opt-out and store your data in PostgreSQL using ESRI’s own spatial format.

Availability of tools: QGIS does have less available operations and algorithms than ArcGIS, mainly if you consider advanced ArcGIS Extensions like 3D Analyst, Geostatistical and Network i.e. QGIS just support Dijkstra’s algorithm for solving network problems while ArcGIS extends it and solve more network problems.

License: This is a huge advantage that open source software can be licensed and can be distributed whereas proprietary software can’t be distributed.

Completeness: ArcGIS is a set of products that obviously work very well together. QGIS was born to work with PostGIS. There is also a set of products similar to ESRI 's that pack QGIS as the desktop component.

Operating system dependency: Although Open Source software tools have gone a long way with Windows in the past years, but the best-of-breed software is almost always in the Linux world. Migliaccio et al. (2007) experimentally prove it for the case study of CO emission under INTERMEDE BBSO project, it is observed that results generated with GRASS under Linux environment were better. Thus, there is reinforcement of the belief that free/open source GIS

software is most effective and displays the maximum of its capabilities when running in a UNIX or Linux environment.

5. Conclusion

The idea that proprietary and open source solutions are polar opposites is certainly not true.Although many of the characteristics of open source versus proprietary software packages clearly set them far apart, they also share several features too.Software vendors have built proprietary solutions that they have later released as open source. Similarly, there are distributors of license-free, open source packages who also offer a for-profit, licensed and proprietary version built upon the original open source platform. It is really difficult to decide without qualifications which model is the best software development model for your organization to adopt: open source or proprietary.

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