

GIS Training with Open Source Software

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Abstract

GIS theory can be put to its full training potential either by using commercial GIS software or Open Source. As far as Open Source is concerned, there are currently quite a few packages that can provide for and cover all the needs required for training in GIS techniques and technologies. Some of these have been under development and testing for more than fifteen years and are in the position to provide potential customers with high profile, professional productivity solutions and tools.

Viewing GIS software packages under the training and educational aspect one can understand the amounts of money that an institute has to spend from its budget in order to provide its students with the latest in GIS tech. This, in addition to subscription fees, initial training etc, is a standard cost when using commercial GIS software. A viable solution is to use Open Source software. It must be pointed out that by the term GIS software, a more general approach is being taken and the term is used to describe spatial DBMSs, data viewers, GIS packages and so on.

It is important to provide students with a full theoretical background about Geographic Information Systems, but it is equally important to give them and a more hands on experience under simulated real world situations in laboratory exercises. Using Open Source software there is the ability not only to train someone on GIS techniques but also show the inner workings of many algorithms used in such software solutions just by explaining the source code of that particular algorithm.

This paper sums up the ongoing efforts to provide students in our department with high end training in GIS using Open Source GIS software like GRASS, QGIS, uDIG, PostgreSQL/PostGIS, MapServer, MapGuide Open Source and others both in the undergraduate and postgraduate programs of the School of Rural and Surveying Engineering at the Aristotle University of Thessaloniki in Greece.

1. Introduction

Open Source Software has been around for quite a while. The start was in 1983 with the Free Software Movement. Because the term Free Software is ambiguous, in 1998 it was replaced by the term Open Source Software (OSS) which is more comfortable for the corporate world (Raymond, 1998). Open Source licenses allow software developers to publish their software's source code so that anybody may

also develop the same software or understand its internal functioning. A most valuable advantage of Open Source Software is that its licenses allow anyone to modify the software, port it from one operating system to another, share it and above all receive the benefits of the added value from the modifications and use.

The same principle stands for Open Source Geospatial Software. The term Geospatial Software refers to any type of software that is used under the spatial and geospatial aspect. Geographic Information Systems, Spatial Database Management Systems, Remote Sensing Software, Image Viewers etc are used by GI scientists and professionals in every GI related work. Of course Geospatial Software is not only used for professional and scientific related work but also for training and hands on experience. Open Source Geospatial Software provides people with such tools, free for development, use and modification.

2. Open Source Initiative

The Open Source Initiative (OSI) formed in February 1998 is an organization leading the industry in open source software development and distribution. It primarily focuses in promoting the open source model as a viable solution to businesses in the software development sector. OSI's founding members, Eric S. Raymond and Bruce Perens began their effort by approaching Netscape, a company that produced the Navigator, an internet browser. They presented their idea under the scope of an antagonistic solution eliminating any anti-commercial notion connected with the term free software instead of open source, supported by years of experiences and many case histories of closed software development versus open development already provided by the Internet developer community. The effort was met with success and good results especially after Netscape provided the source code for the Navigator suite, openly.

The Open Source Initiative was formed in the era of Internet free software, free ideas and software distribution, hackers and a computer culture closely related to an underground approach. As in Michael Tiemann's words, to "dump the moralizing and confrontational attitude that had been associated with 'free software' in the past and sell the idea strictly on the same pragmatic, business-case grounds that had motivated Netscape.", it chose the Open Source term to relate itself to the notion and the idea of openly developed and available software (Tiemann, 2006).

3. Geospatial Open Source Software Foundations and Organizations

Two of the most important organizations promoting and supporting open source geospatial software and standards are the Open Source Geospatial Foundation

(OSGeo) and the Open Geospatial Consortium Inc (OGC). They are in constant collaboration to achieve better awareness and greater infiltration of open source geospatial software and open standards in everyday professional and educational function of geospatial businesses, organizations and universities.

3.1 Open Source Geospatial Foundation (OSGeo)

In an effort to develop and support open source geospatial software of the highest quality, the OSGeo was founded. The OSGeo Foundation promotes the collaboration between developers and projects, the incubation of already running projects according to its rules and normalization forms and the support of businesses running open source geospatial software. OSGeo is a non-profit organization and provides a reliable and stable base for the development and promotion of open source geospatial software (OSGeo, 2010).

3.1.1 OSGeo Incubator

One of the most important parts of OSGeo is the Incubator (OSGeo, 2010). The Incubator is run by a committee responsible for the preparation of the incubation process and all the relevant criteria to the appropriate board, the recommendation of the incubation rules and standards to be applied to any process. It also handles the reviewing of all the relevant applications ready for the incubation process and recommends projects and applications that are considered to be ready and appropriate to be included in the incubator. After this step is taken it monitors and mentors the incubating projects and applications through an advisory process while maintaining and reviewing the progress of all the projects according to the requirements of the incubation process and periodically reporting on the status of projects in incubation and the incubation process itself (OSGeo, 2010).

3.1.2 OSGeo Software

Everyday many new projects enter the incubator. There are many programs ready and available to the public via the OSGeo website (OSGeo, 2010). These software packages include WebGIS and Web Mapping Software, Desktop GIS applications, geospatial software libraries and metadata management and cataloging applications. A complete list of the available software is given below as presented at the OSGeo website.

1. Web Mapping Software which is used to provide the clients with Web Map and Web Feature Services (WMS and WFS)

- deegree
- geomajas
- GeoServer

- Mapbender
 - MapBuilder
 - MapFish
 - MapGuide Open Source
 - MapServer
 - OpenLayers
2. *Desktop GIS and Remote Sensing Applications*
 - GRASS GIS
 - OSSIM
 - Quantum GIS
 - gvSIG
 3. *Geospatial Software Libraries to provide the appropriate tools for development of geospatial applications and the support of other applications mentioned in this list.*
 - FDO
 - GDAL/OGR
 - GEOS
 - GeoTools
 - MetaCRS
 - PostGIS
 4. *Metadata Management and Cataloging to provide the tools required for the creation, management and distribution of spatial metadata according to various metadata standards.*
 - GeoNetwork

All the software provided by the OSGeo website is open source and also thoroughly tested through the incubation process.

3.2 Open Geospatial Consortium (OGC)

Setting standards is an important aspect of the interoperability case. According to the OGC website, the Open Geospatial Consortium, Inc.® (OGC) is leading the development of standards for geospatial and location based services (OGC, 2010). As made clear by the title it is a consortium of 400 companies, government agencies and universities that participate in the developmental process of publicly available standards.

The standards provided by OGC are called OpenGIS® Standards. These standards are used in geo-services through the web, wireless and location-based services. Through the standards described in documentation provided by the OGC,

technical details are easily made available to the software developers about the realization and implementation of the standards to real life applications. The main purpose of the standards and the specification is to address the matter of interoperability between geospatial data and geospatial software applications (Nogueras-Iso et al, 2005). All the specifications' and standards' documents are freely and without cost available to everyone through the OGC website (OGC, 2010).

4. Using Open Source Geospatial Software in GI related training

Is it possible to use Open Source Geospatial Software to teach GIS? It is widely known that although many employers require from their employees to have a good and solid theoretical background on G.I. Sciences, they tend to employ people with real world GIS applications' experience (Rogerson, 1992). It is obvious that the educational system, in an effort to assist its students, turns to a more market oriented curricular circle parallel to providing the students with all the necessary assets by using theory in conjunction with practical and hands on training in real world scenarios.

The approach has a dual form. The university or the training organization can use either proprietary software or open source software. Sometimes a third solution is used but only when it fits the profile and needs of the education and training process. In this case both proprietary and open source software is used. There are benefits in all the forms but also some disadvantages.

4.1 Geographic Information Systems

Open Source Geographic Information Systems Software is one of the most important steps in the direction of Open Source in GI related education. Currently there are many available software packages that can be used but most of them seem to lack some abilities. In the next paragraphs software packages used at the School of Rural and Surveying Engineering are presented in short.

4.1.1 GRASS GIS

The most known and widely used either in education or in professional work is GRASS. GRASS stands for Geographic Resources Analysis Support System. GRASS provides a wide range of GIS tools, algorithms, analysis functions, spatial database management abilities, image analysis, map production, thematic mapping and visualization. (GDF, 2005).

4.1.2 QGIS

QGIS is another GIS software package that was used during the courses of the School. It is very user friendly and able to connect to various data sources and

manage them via the use of plug-ins. It does not pack the functionality and tools of GRASS GIS but there is a very important ability in it. It can be used as an interface to GRASS GIS. It calls up to the various GRASS commands and executes them through its own GUI making it much easier to work with GRASS (QGIS Development Team, 2010).

QGIS is also very easily extendable with plug-ins. It also has a very familiar (at least to the ArcGIS users) Graphical User Interface which proves to be a great advantage in many cases.

4.2 Spatial Database Management System (SDBMS)

To completely support a GIS application a spatial database is required. Spatial databases come in different flavors with the more important right now being relational and/or object oriented. Relational Spatial Databases and in accordance Spatial Relational Database Management Systems (SRDBMS) are used in the same way as (Non Spatial) Relational Databases with the addition of the ability to read, write and manage spatial data in any compatible spatial format.

4.2.1 PostgreSQL - PostGIS

PostgreSQL is an Object Relational Database Management System. It does not have its own spatial abilities. PostGIS provides the spatial extensions for PostgreSQL following the OGC's OpenGIS standards. Apart from the Well Known Text and Well Known Binary standards (OGC, 2006) PostGIS also incorporates the ISO SQL/MM Part 3 (ISO, 2006) standard which complements WKT and WKB (Refractions Research, 2010).

5. Results at the School of Rural and Surveying Engineering (AUTH)

The results coming from the use of Open Source Geospatial Software at the school of Rural and Surveying Engineering are very promising. The use of such software was required by the various exercises and laboratory sessions in the undergraduate and the postgraduate programs of the School.

GRASS GIS has been successfully used in the Postgraduate Courses of the School of Rural and Surveying Engineering at the Aristotle University of Thessaloniki in Greece. The students were required to use the software package in order to assess its abilities in Network Analysis, 3D Visualization and Image Analysis. The students reported that although in the beginning it was a bit difficult to use the software mostly because of the command line requirement and some Graphical User Interface hindrances, the software itself was fast and reliable. Most of all they reported very positively about the community support which is a characteristic of

all the Open Source Software packages communities.

There has also been an effort to use it in the undergraduate courses but the acceptance was not big and the students reported that it was not an easy software package to use due to the Graphical User Interface which was out of the ordinary software packages they were accustomed to. But on the positive side, they realized the practicality of the existence of Open Source software and the huge gain from the no-price tag approach and the support of the community.

There was great success in both undergraduate and postgraduate courses on the use of PostGIS in combination with QGIS playing the role of the effective spatial data viewing and analysis software. For the undergraduate courses, the laboratory exercises required the students to create a GIS application for the University. The exercise included the creation of a spatial database using PostgreSQL and PostGIS, georeferencing an image of the University Campus using QGIS, digitizing the various features required by the database, creating spatial queries, use the analysis features of QGIS and PostGIS and finally create thematic maps. As mentioned earlier the effort was met with high success. The students reported on the ease and friendliness of use of both PostGIS and QGIS (always through the GUIs) and also on the stability, reliability and speed of PostGIS.

The approach was more specific for the postgraduate students. They were required to assess the Network Analysis abilities of QGIS through the various plugins, the use of GRASS through QGIS and the transformations functionality of PostGIS. Students that had previously worked with GRASS reported that QGIS made a great difference in their work and that they can now use GRASS GIS in a more productive way through this interface. On the fly transformations are a most effective way of transforming or translating coordinates from one system to another. The students reported on the ease of the transformation syntaxing and the resulting accuracy very positively.

6. Advantages and Disadvantages of using Open Source Geospatial Software – Conclusions

Using Open Source Geospatial Software in GI related training and education is an application that requires support from the educational system and of course from the academic community itself. If the community lacks the effort to push for such type of software use then it is quite difficult to accomplish the task.

Economically and legally there is almost no cost in acquiring the software to be used and the license management is more simplified than in proprietary software. The reason for this is that since the software can be obtained freely, once downloaded or obtained through other means; it can be installed as many times and in as many places as needed. So there is a sound economic benefit and there also is less managerial effort required. Generally, less hardware power is required for

Open Source applications because of their programming architecture and this also adds to the low or no cost benefit because there isn't frequent need for hardware upgrades.

Another important aspect is support and service. The Open Source Community can provide support for any software package free of charge through the appropriate Internet channels. There is also professional support available under a price tag.

Of course there are always disadvantages. Open Source Software is not a panacea. The fact that the source code is publicly and openly available creates a drive for excellence that sometimes is not documented properly creating difficulties for people not accustomed to such software. Alas, software developers are now using installers that provide the administrator with a friendlier environment for installation and application setup.

The only apparent requirement is the training of the personnel that will teach GIS using such software, in the software itself. One has to learn something before one can teach others. Universities and other institutes now provide training programs on Open Source GIS software. There are quite a few companies training people in such matters and also there are many on line and off line schools and numerous tutorials openly available to anyone.

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