

Some Comments about use of Open Source Software in the Classroom at University of Toronto (Geography)

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The use of open source geospatial software such as GRASS has been ongoing in some form in the Department of Geography at University of Toronto since the late 1980's. Today the use of open source geospatial software is concentrated at the Mississauga campus of the University of Toronto. An important component of how we have incorporated OSGeo software has been our philosophy on lab layout, hardware, and operating environment. Hence, first I will make some comments about our infrastructure. Comments on the courses that I teach with some comments about other uses will follow the section on infrastructure.

Geocomputation Lab

From the beginning of our use of OSGeo the basic operating environment has been Unix-based. A Sun server running Solaris supports 30-35 Sun Ray thin-clients. This has profound implications on the ease with which the system, software, data, and student accounts can be managed. Recently, we have added a Windows server to the infrastructure that students access from the same thin-clients as they do the Unix system. As an aside, there was a time in the past when about 12 thin-clients were run from a Dell server running RedHat Linux, GRASS, R, etc.

Recently we briefed a group from Michigan (including Michigan State University) on our use of this infrastructure. I illustrated to them how I use the Unix-based operating system features to manage course activity. I am able to view and upload students' scripts, view their mapsets, monitor some of their activity through history etc.

Layout

The lab layout that I initially designed is basically still in use, with different hardware (Figure 1). It is designed to maximize the ability of the instructor to view students working at their terminals while exploiting the fact that we have a server-client architecture. The “U” shaped arrangement allows the instructor easy access (visual and physical) to all workstations without unnecessary impact on others as seen in the usual linear arrangement. The tables in the center allow students to use them for notetaking. With increased wifi coverage on campus many students set up their notebooks on the tables.

Access to the room is limited to students enrolled in Geography courses that hold their lectures/labs in this room.

A swipe card system is used to control and monitor access. A CCTV is also present for security reasons.

Two courses that I teach are GIS-intensive. Both the lecture and lab portions are held in this room. Once the lecture is finished a short break and the lab portion can begin. Since these courses involve script writing this has proven most effective in getting most students to immediately work on the problems thereby reinforcing topics covered in lecture. Lectures can also include “live” demonstrations of how

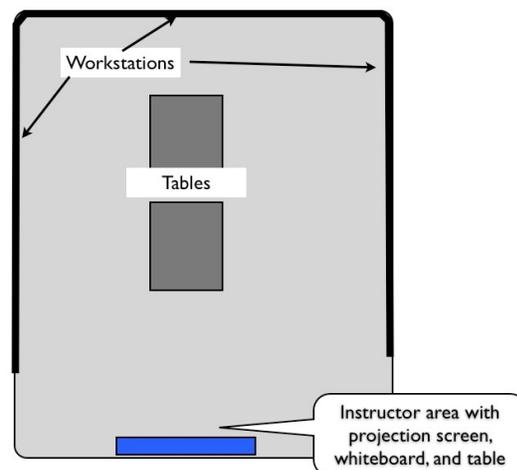


Figure 1. Concept of the “U” shaped arrangement of workstations

concepts are implemented using GRASS or R.

Undergraduate Courses

Courses that use FOSS such as GRASS or R are of two types:

- (1) Those that USE GRASS/R to introduce students to GIS in the context of a topic such as landscape ecology and allow students to run prepared scripts (they do not write them) as programs to support lab assignments.
- (2) Those that DO GRASS/R. Here I teach two courses that are tightly linked the Third year course introduces GIS majors/minors to writing shell scripts.

In neither of these cases do I use the graphical user interface (GUI) for GRASS. I found that it generally takes too much time to explain to the students new to GRASS and often detracts from them focusing on the problem at hand. This may be controversial but I have yet to be convinced otherwise after 15+ years of classroom experience. Hence, GRASS never starts in the GUI.

In all the courses using GRASS I place a short script in their path (usually in /usr/local/bin). An example of such a script is here:

```
#!/bin/csh
# ggr463 opening script

unset noclobber

#
# make their defaults come up right when they start GRASS
#
echo "GISDBASE: /courses/ggr463/" > $HOME/.grassrc6
echo "LOCATION_NAME: niag02" >> $HOME/.grassrc6
echo "MAPSET: $USER" >> $HOME/.grassrc6
echo "GRASS_GUI: text" >> $HOME/.grassrc6
#
# normal GRASS startup
xterm -tn vt100 -bg white -fg black -fn 9x15 -geometry 85x40 -sb -sl 2048 -title "ggr463:$USER" -e
grass62 /courses/ggr463/niag02/$USER &
```

It opens a separate window and the students do not need to 'remember' the dataset information. It provides more control by the instructor over course-specific student behavior.

Data sets in all courses are not the Spearfish or North Carolina data sets that are publicly available. I use data sets that we can control access to. Students are not allowed to download the data to their personal systems. The potential for unethical student behavior is always present. This provides one additional hurdle for those seeking to have others do their work for them.

Courses that USE GRASS/R

I teach several courses that use GRASS to introduce students to how GIS relates to their topical area. In these courses the emphasis is not on teaching them how to “do” GIS as much as the basic concepts and using the software in a carefully scripted manner to address a question in their assignment. In this regard, I have written scripts that perform a series of commands that ease their use of GRASS. It is very tightly scripted as an assignment, but challenging as far using the results of GRASS to answer the question(s).

Some course assignments use software that makes use of GRASS. For example, in one assignment there is a metapopulation simulation program that takes data from GRASS passes to a C program that produces numerical results that can be converted to GRASS raster layers. In another course students use R to learn more advanced concepts of spatial analysis such as interpolation and spatial autocorrelation. They do not use GRASS directly. GRASS is used to provide the data for the R analysis. They do however use R as well as R scripts I have prepared. Using instructor prepared scripts in this context help keep the students focused on the problem at hand rather than become distracted by trying to also learn “the intricacies” of R programming.

Courses that DO GRASS/R

In these 3rd and 4th year undergraduate courses students **must** write shell scripts to address assignments that are constructed to mimic “projects” in the real-world (e.g. locating a cell tower). In addition to scripts they must write reports according to strict format and style guidelines. They are marked on the scripts and the reports combined. We use the Blackboard Learning management system so this is a paperless course. I have access to their scripts (they do not have access to each other's scripts).. Currently we run using GRASS 6.2.3 compiled a Sun server running Solaris. Once 6.4 is stable we will spend a summer compiling it and testing it for instructional purposes. For now 6.2.3 serves our instructional purposes.

Students are marked on the quality of their reports and scripts. The report plus scripts are returned on blackboard as PDF with embedded comments and marking scheme. The third year course is a prerequisite to a fourth year course that follows a similar way of using the Blackboard learning system. However, this-course takes a fuzzy landscape classification article and students are given a successive set of assignments that mimic (different data set among other parameters) the reading(s) they have. The end result is something similar to an abbreviated version of the kind of journal article they have used as resource. This course starts with GRASS to create many of the attribute layers, giving them experience in looping as part of their script writing experience. A significant part of this course is having them use both GRASS and R. R scripts are also required. Reports and scripts are handled much like in the third year course. Hence it is also paperless but very challenging. The emphasis in all these courses is analysis. Maps are usually not required as part of any of the assignments. They can be included in the report or students can refer me to the layers by name (i.e., I have access to their mapsets and can easily view them using d.mon). Note that currently the 'mapping' course in our curriculum uses ESRI and MapInfo products.