FOSS4G software in university geomatics education
A case study integrating teaching and research

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FOSS4G in academia

• advantages
• case study
• challenges
• responses
Advantages

• the usual suspects?
• transparency (Open Source)
  • others, yours
• portability, feasibility*
• support (speed)*
Example: map comparison

- Research project investigating correspondence between alternative forest cover databases
- Initial contract with Canadian Forest Service, papers
- 3 undergraduate thesis projects
- Contribute back a GRASS module
Land use / land cover maps

- Important in many applications
- Often created using per-pixel image classification
  - Convenient
  - Standardized methods
  - Data availability
Where do the maps come from?
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- some classification scheme which identifies clusters in n-D space
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- assessments typically global; useless for judging how reliable a prediction is at a particular point
- for each pixel, there are likelihoods of belonging to all possible classes based on distance away from the clusters
Mahalanobis Distance

$P(X|c) = \log(\text{det} |V_c|) + (X-m_c)^T V_c^{-1} (X-m_c)$

- $P(X|c) =$ likelihood of a pixel belonging to class
- $V_c =$ variance-covariance matrix
- $X-m_c =$ distance between the pixels and the cluster centroids
- classification provides $m_c$ and $v_c$
Standardized distance \( (x-m_c) \)

How far to the closest cluster?

\[
Dist = \sqrt{\left( \frac{X - m_1}{v_1} \right)^2 + \ldots + \left( \frac{X - m_n}{v_n} \right)^2}
\]

\( n = \# \text{classes} \)

```r
r.mapcalc cluststddist = sqrt(exp((tm1 - cluster.tm1avg) / cluster.tm1stddev, 2) + exp((tm2 - cluster.tm2avg) / cluster.tm2stddev, 2) + exp((tm3 - cluster.tm3avg) / cluster.tm3stddev, 2) + exp((tm4 - cluster.tm4avg) / cluster.tm4stddev, 2) + exp((tm5 - cluster.tm5avg) / cluster.tm5stddev, 2) + exp((tm7 - cluster.tm7avg) / cluster.tm7stddev, 2) + exp((texture - cluster.textureavg) / cluster.texturestddev, 2))
```
Misclassifications in areas with larger distances
Next cluster?

- GRASS/R links
- 80x80 regions chosen in GRASS, read in to R
- determine ratio between first and second cluster distances

```
args(secondcluster)
function (inputclass = classes$classes, outclass = "secondclass",
  nlayers = 4, clusclas = "clusclastbl", cluscentres = "4822",
  clustermaps = clusters, nclusters = 241, nbands = 7, tmdata = tm4822,
  nrows = 80, ncols = 80, stddist = TRUE, verbose = TRUE)
```
Potentially confused classes

Second Closest

Closest

Difference Ratio
Z-score significance

- Mixed-Open
- Mixed-Dense
- Broadleaf-Sparse
- Broadleaf-Open
- Broadleaf-Dense
- Conifer-Sparse
- Conifer-Open
- Conifer-Dense
- Herb
- Shrub-Low
- Shrub-Tall
- Water
- Exposed Land
- Shadow

Non-significant
Significant
(Last year’s) conclusions

- cluster distances enable method to evaluate per-pixel classification confidence
- for algorithm development, R, GRASS/R & friends provide a good environment to test ideas (especially for those of us with “rusting” C skills)
- some tasks challenge R’s interpreted, memory resident; R is not intended to be a GIS (even with spgrass6)
- getting the algorithm right in R allows faster development of a GRASS module (!!)
Second try at a secondclosest module.

Options

- Quiet
- standardize distances

Name of input raster map: (input: name, required)

Name of an output layer to hold closest class: (firstclassout: string, required)

Name of an output layer to hold distance to closest class: (firstdistout: string, required)

Name of an output layer to hold second closest class: (secondclassout: string, required)

Name of an output layer to hold distance to second closest class: (seconddistout: string, required)

Prefix of text file holding mapping of cluster to class IDs: (clusclas: string, required)

Prefix of file holding cluster centres, omit .clus1[0123].txt: (cluscentres: string, required)
Second try at a secondclosest module.

Options

- Quiet
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Prefix of text file holding mapping of cluster to class IDs: 

Prefix of file holding cluster centres, omit .clus1[0123].txt: 

(*To Be Continued...*)
On the other hand...

- R implementation - great for (geography) student projects
- even if student doesn’t have programming background, can read, understand, modify R code, and can run on any computer
Yes, Spearfish!

\[ d_2 - d_1 \] for unsupervised classification of LANDSAT image, Spearfish (Harding, 2007)
d₂ - d₁ for unsupervised classification of LANDSAT image, Spearfish (Harding, 2007)
Other “infiltration”

- good existing geomatics program @ Carleton
- how to best bolster curriculum, not replace?
- second year Intro to GIS: brief exposure
- fourth year classes: evolving, expanding
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Web Mapping Projects
Carleton Lab 2005

Carleton GEOG4008 Chameleon exercise, Winter 2005

This section of the Community Site was developed to help the 4th Year GIS students from Carleton University do their Chameleon project. Their project takes place between Feb 16th and March 23rd, 2005.

GEOG4008 students: this is a dynamic document and may be updated as new information becomes available - make sure you check back here each week.

The Data Portal Project -- Project Overview - "Project Contractual Requirements".

Chameleon Service Instance Lab — Lab exercise for March 2nd, 2005.

- Chameleon Lab: Glossary of Terms -- Terms used during the Lab/Project.
- Reference Listing -- Using the Tiki Directory listing, get important information about related technologies and standards.
- Chameleon Community Application Gallery -- To get ideas of different functionality found in Chameleon.
- Official Chameleon Documentation — Pay special heed to the Application Developers Guide and the "Released Widgets" Documentation.
- OGC WMS List -- List of Web Mapping Services that can be incorporated into an OGC Context file or MapServer? mapfile.
- Feb 16th Intro Slides -- Slides used by Chris Thorne for Feb 16th Intro to Web Mapping. DOWNLOAD (*.zip ~1MB)
Welcome to the Nunaliiit project

The Nunaliiit Cybertographic Atlas Framework aims to make it easy to tell stories and highlight relationships between many different forms of information from a variety of sources, using maps as a central way to connect and interact with the data.

Currently, nunaliiit consists of a schema for documenting the sources and interconnections between data, as well as software to convert that information into a highly interactive web atlas.

Did you know: The word nunaliiit means "settlement", "community", or "habitat" in Inuktitut - the name given to the dialects of the Inuit language in Canada. Written in Syllabic Inuktitut, it appears at the very top right of this site.

Search This Site

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“Advanced Topics”

- diversify student software experience
- emphasize GIScience, as opposed to software training (read manuals/find help!)
- still have lab exercises, tied to research literature & my projects, leading to class projects
- uncertainty, decision support, interpolation, pattern analysis, data standards and metadata
So what’s wrong?
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- institutional support (going it alone)
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- supporting versus “allowing”/control
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- institutional support (going it alone)
- supporting versus “allowing”/control
- system administration, security
- pace of change
Mitigation/Solution

- user’s groups
- contributions from local firms
- students
- wider support in educational community
Welcome to the Ottawa GRASS (GIS) Users Group

by zopeadmin — last modified 2006-09-05 10:38

OGUG – The Ottawa GRASS GIS Users group

We are a group of GIS Practitioners interested in GRASS and associated open source GIS technology, primarily based in the Ottawa area. The Geographic Resource Analysis Support System (GRASS) is one of the oldest and largest open source GIS applications in the GIS Free and Open Source Software (GFOSS) community. GRASS is actively developed and OGUG aims to introduce more people to it.

OGUG was created in Summer 2005, to form a network of GIS practitioners interested in incorporating or replacing their proprietary GIS workflow with Open Source GIS Solutions. OGUG aims to be a central body of knowledge and expertise for the GRASS Community in the Ottawa area. In July, 2006, reflecting exciting developments in the broader Open Source Geomatics community, and our interest in all of the geomatics tools that surround the use of GRASS, we met with the Ottawa Mapserver User's group, and any other interested participants, and decided to form a local OSGEO chapter to better serve this interest.

Visit http://cemml.carleton.ca/mailman/listinfo/ogug to see the archives of our original mailing list, but please visit ottawa.osgeo.org for the new mailing list and other resources.
Tutorials

Series of OGUG Tutorials and workshops

- Tutorial 2: Supplemental info concerning GPSMan and v.in.garmin by Dave Sampson — last modified 2006-02-14 12:01
  Old school approach to multiple external packages. This is for historical and informational use. The process outlined here does not work. It fails at importing vectors nicely. Interesting tools though

- Tutorial 3: Building a GRASS Dataset for Ottawa, Ontario by Dave Sampson — last modified 2006-02-07 19:52
  How I learned to Stop Worrying and Love Mining for Free Geospatial Data in Canada

  How I Continued My Love Affair With Free Geospatial Data in Canada

- Tutorial 2: GPS and GRASS v1.4 by Dave Sampson — last modified 2006-02-05 17:12
  Introducing v.in.GPSBabel

- Tutorial 5: Raster elevation data in GRASS workshop by Scott Mitchell — last modified 2006-03-25 14:11
  This document will structure the workshop being given in Ottawa on March 23, and will
Mitigation/Solution

- user's groups
- contributions from local firms
- students
- wider support in educational community
• FOSS4G has been an important part of research and research-teaching partnerships.

• Ottawa community, evolution of FOSS4G in broader community, have come together to facilitate richer educational experience for students.

• Focus on individual projects plus multi-purpose tutorials (as opposed to traditional courseware) worked for me; came to hear about and discuss other ideas out there, how we might work together.