GRASS GIS 7 User interface

What you think it is...
GRASS GIS 7 User interface

What you think it is...

What it really is...
GRASS 7: Map histogram tool

Additionally: Histogram in legend
GRASS 7: Adding a grid to the map view

- Grids
- Labels
- Geodesic lines
- Rhumblines
GRASS 7: New Geospatial Modeller

Extra bonus:
Export it as a Python script
Vector data processing
GRASS 7: Topological Vector Digitizer
GRASS 7: Topological Vector Digitizer in PostGIS 2 (under development)

Programmer: Martin Landa

http://grass.osgeo.org/grass70/manuals/v.out.postgis.html

http://grasswiki.osgeo.org/wiki/PostGIS_Topology

Cofunded by Municipality of Trento, Italy
News in GRASS 7's Vector Topology

**Spatial query example**

Query of vector point maps

GUI: click on vector map, what is there?

CLI: v.what east_north=east,north

![Graph showing performance comparison between GRASS 6.4.2 and GRASS 7 for spatial query processing with increasing number of million points. The x-axis represents the number of million points, and the y-axis represents the time in seconds. The graph shows a linear increase in time with an increase in the number of points, with GRASS 7 performing better than GRASS 6.4.2.]
Vector network analysis in GRASS
Vector network analysis in GRASS

Example travelling salesman problem, 4 points to visit with optimal path
Support for massive spatial datasets in GRASS GIS
GRASS 7: Support for massive datasets

What is massive?

Massive is relative to

- Hardware resources
- Software capabilities
- Operating system capabilities

Limiting factors

- RAM
- Processing time
- Disk space
- Largest supported file size
GRASS 7: Support for massive datasets

Cost surfaces: $r.cost$

Other speed figure:
PCA of 30 million pixels in 6 seconds on this small presentation laptop...
New tools for hydrological modelling

Fig. 2. The structure of the r.stream toolset and data flow between particular modules and external software.

A new GRASS GIS toolkit for Hortonian analysis of drainage networks

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ABSTRACT

The aim of this paper is to present a new GRASS GIS toolkit designed for Hortonian analysis of drainage networks. The toolkit consists of a multistage flow direction algorithm for stream network extraction as well as for calculating other hydrogeomorphological indices in the catchment area. For all GRASS GIS modules, existing consists of several separate modules that can extract stream networks from a spectrum of accumulation maps, order the catchment networks using several ordering methods, do advanced modelling of catchment boundaries, perform Hortonian simulations, compute additional parameters such as flow path distances to watershed outlets, partition ordered and unmodelled networks to reach-streamflow time series, and calculate some directions. The package is free and open-source software, available for GRASS version 6 and later.
Programming own applications with GRASS GIS 7
New GRASS 7 Python API

http://grass.osgeo.org/wiki/GRASS_and_Python

GRASS and Python

Introduction to Vector classes

Details about the architecture can be found in the GRASS GIS 7 Programmer’s Manual: GRASS Vector Library

Instantiation and basic interaction.

```python
>>> from pygrass.vector import VectTopo
>>> municip = VectTopo('boundary_municip_sqlite')
>>> municip.is_open()
False
>>> municip.mapset
''
>>> municip.exist()  # check if exist, and if True set mapset
True
>>> municip.mapset
'user1'
```

Open the map with topology:

```python
>>> municip.open()
```

get the number of primitive:
Pygrass: An Object Oriented Python Application Programming Interface (API) for Geographic Resources Analysis Support System (GRASS) Geographic Information System (GIS)

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Abstract: PyGRASS is an object-oriented Python Application Programming Interface (API) for Geographic Resources Analysis Support System (GRASS) Geographic Information System (GIS), a powerful open source GIS widely used in academia, commercial settings and governmental agencies. We present the architecture of the PyGRASS library, covering interfaces to GRASS modules, vector and raster data, with a focus on the new capabilities that it provides to GRASS users and developers. Our

All former shell scripts have been rewritten to Python in GRASS GIS 7: → re-use as example!
GRASS 7 Programmer's Manual

GRASS GIS (Geographic Resources Analysis Support System) is an open source, free software Geographic Information System (GIS) with raster, topological vector, image processing, and graphics production functionality that operates on various platforms through a graphical user interface (GUI) or command line interface (CLI). It is released under GNU General Public License (GPL).

This manual introduces the reader to the Geographic Resources Analysis Support System from the programming perspective. Design theory, system support libraries, system maintenance, and system enhancement are all presented. This work is part of ongoing research being performed by the GRASS Development Team, an international team of programmers, GRASS module authors are cited within their module’s source code and the contributed manual pages.

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This manual is published under GNU Free Documentation License (GFDL), and comes with ABSOLUTELY NO WARRANTY. The development of GRASS software and this manual is kindly supported by the Open Source Geospatial Foundation, who provides the GRASS main infrastructure.

Main web site: http://grass.osgeo.org
GRASS GIS as Open Source GIS backbone:
Connecting to other software packages
GRASS and QGIS Integration: Processing

Dissolving geometry by string column attributes: **Processing** calls GRASS GIS in a virtual session which delivers the result back (here: SHAPE file)
Integration of GRASS GIS with QGIS, PostGIS, OGC

Geoprocessing of an external wildfire point layer: PostGIS or WFS -> QGIS → Processing → GRASS GIS
GRASS and R Integration

GRASS 7.0.svn (nc_spm_08_grass7):~ > R

R version 3.0.1 (2013-05-16) -- "Good Sport"
Copyright (C) 2013 The R Foundation for Statistical Computing
Platform: x86_64-redhat-linux-gnu (64-bit)

> library(spgrass6)
Loading required package: sp
Loading required package: XML
GRASS GIS interface loaded with GRASS version: GRASS 7.0.svn (2013)
and location: nc_spm_08_grass7
>
> myrast <- readRAST6(c("geology", "elevation"), cat=c(TRUE, FALSE))
> myvect <- readVECT6("roads")
...
> writeRAST6(myrast, "elev_filt", zcol="elev")
...

http://grass.osgeo.org/wiki/R_statistics
GRASS 7: Native WPS Support

```
<?xml version="1.0" encoding="UTF-8"?>
<ows:ProcessDescriptions xmlns:ows="http://www.opengis.net/ows/1.0.0"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://www.opengis.net/ows/1.0.0" http://schemas.opengis.net/ows/1.0.0/wpsDescribeProcess_response.xsd"
 service="WPS" version="1.0.0" xml:lang="en-US">

  <ProcessDescription processVersion="1" storeSupported="true" statusSupported="true">
    <ows:Identifier>r.grow</ows:Identifier>
    <ows:Title>Generates a raster map layer with contiguous areas grown by one cell.</ows:Title>
    <ows:Abstract>The manual page of this module is available here: http://grass.osgeo.org/grass70/manuals/html70_user
    <ows:Metadata xlink:title="raster" />
    <DataInputs>
      <Input minOccurs="1" maxOccurs="1">
        <ows:Identifier>input</ows:Identifier>
        <ows:Title>Name of input raster map</ows:Title>
        <ComplexData maximumMegabytes="2048">
          <Default>
            <Format>
              <MimeType>image/tiff</MimeType>
            </Format>
          </Default>
          <Supported>
            <Format>
              <MimeType>image/tiff</MimeType>
            </Format>
            <Format>
              <MimeType>image/gtiff</MimeType>
            </Format>
          </Supported>
        </ComplexData>
      </Input>
    </DataInputs>
  </ProcessDescription>
```

http://grasswiki.osgeo.org/wiki/WPS
Image processing

*Improved modules:*

Georectification
Orthorectification
Atmospheric correction
Terrain correction
Landsat cloud detection
GRASS 7: New geocoding tool

Image/Map rectifier

For raster (imagery, historic scans) and vector maps
GRASS 7: New bivariate Scatterplots

LANDSAT 7 2002 channels 1 and 3 of Wake county, NC
Tool for supervised classification of imagery data.

Generates spectral signatures for an image by allowing the user to outline regions of interest.
GRASS 7: Unsupervised image classification

i.segment - Identifies segments (objects) from imagery data.

Pietro Zambelli
GRASS 7: New cool stuff: massive data processing

- Since **2005** GRASS GIS is running *natively* on 64bit CPUs
- GRASS GIS 7 also offers Large File Support on 32bit Windows

- Installed on Grids and TOP500 supercomputers (AKKA Umeå, ENEA Frascati, Aurel Bratislava, ...)
- Runs on Linux, AIX, Solaris, freeBSD, netBSD, ...
- Various ways of parallelization
GRASS GIS 7 Temporal Framework: Time-series support
New Space-Time functionality in GRASS 7

Temporal data processing in GRASS GIS

The temporal GIS framework in GRASS introduces three new datatypes that are designed to handle time series data:

- **Space time raster datasets** (strds) are designed to manage raster map time series. Modules that process strds have the naming prefix `t.rast`.
- **Space time 3D raster datasets** (str3ds) are designed to manage 3D raster map time series. Modules that process str3ds have the naming prefix `t.rast3d`.
- **Space time vector datasets** (stvds) are designed to manage vector map time series. Modules that process stvds have the naming prefix `t.vect`.

Temporal data management in general

List of general management modules:

- `t.connect`
- `t.create`
- `t.remove`
- `t.register`
- `t.unregister`
- `t.info`
- `t.list`
- `t.rast3d.list`
- `t.vect.list`
- `t.vect.db.select`
- `t.sample`
- `t.support`
- `t.topology`

**Export/import conversion**

- `t.rast.export`
- `t.rast.import`
- `t.rast.out.vtk`
- `t.rast.to.rast3`
- `r3.out.netcdf`
- `t.vect.export`

**Querying and map calculation**

- `t.rast.list`
- `t.rast.extract`
- `t.rast.gapfill`
- `t.rast.mapcalc`
- `t.rast3d.extract`
- `t.rast3d.mapcalc`
- `t.rast3d.univar`
- `t.vect.extract`
- `t.vect.import`
- `t.vect.observe.strds`
- `t.vect.univar`
- `t.vect.what.strds`

**Aggregation**

- `t.rast.aggregate.ds`
- `t.rast.aggregate`
- `t.rast.series`

**Statistics and gap filling**

- `t.rast.gapfill`
- `t.rast.univar`

Space time datasets are stored in a temporal database. SQLite3 or PostgreSQL are supported as SQL database back end. Connection settings are performed with `t.connect`. As default a sqlite3 database will be created in the PERMANENT mapset that stores all space time datasets and registered time series maps from all mapsets in the location.

New Space-Time functionality in GRASS 7

Time series plot (Chlorophyll vs Time) for a certain coordinate pair (V. Andreo)

Monthly avg LST: 01/2002
Visualization
GRASS 7: New animation tool for time series

The Animation Tool is a wxGUI component for animating a series of GRASS raster maps or a space time raster dataset (created by t* modules).

Animation Tool allows you to:

- display up to 4 synchronized animations
- control the animation speed
- interactively change active frame using a slider
- visualize space time datasets with unequally spaced intervals
- animate 3D view (partially implemented)

3D view animation enables to animate raster (as an elevation map or a color map) or vector. m.nviz.image is used. To display 3D view animation follow these steps:

- open GRASS GUI, load maps and start 3D view
- set view, light and other parameters as you like
- save workspace file
- add new animation in Animation Tool, choose 3D view mode
- choose data (series of maps or space time dataset) used for animation
- set workspace file
- choose parameter (parameter of m.nviz.image) to animate (e.g. color_map)

http://grass.osgeo.org/grass70/manuals/g.gui.animation.html
New Map swiping tool for multitemporal maps

Pre and post disaster images of the tsunami in Japan in 2011 (MODIS images taken on February 26 and March 13, 2011)
GRASS 7: New visualization tool: wxNVIZ

http://grasswiki.osgeo.org/wiki/WxNVIZ

Programming/screenshot: Anna Petrasova
New visualization methods (NC state university)

LiDAR derived DSM: 100k x 50k pixels
GRASS GIS as a platform for sustainable Open Science

GRASS GIS software offers to you:

- **Reproducibility**: Open source is the natural habitat for science and research

- **Return of Investment**: Example `r.mapcalc`: available since 1985, continuously developed, user can still run old scripts in latest GRASS GIS 7

- **Auto-documentation**: map and command history preserved “forever”

- **Reliability**: Testing and quality control system (in progress) integrated into the software itself

- **Longevity for Open Science**: code integrated into GRASS “survives” even if original authors would not continue

In a Nutshell, GRASS GIS...

- has had 50,946 commits made by 71 contributors representing 1,344,395 lines of code

- is mostly written in C with an average number of source code comments

- has a well established, mature codebase maintained by a large development team with stable Y-O-Y commits

- took an estimated 378 years of effort (COCOMO model) starting with its first commit in December, 1999 ending with its most recent commit 2 months ago

https://www.openhub.net/p/grass_gis
Where is the stuff?

**GRASS GIS 7 Software:**
*Free download for MS Windows, MacOSX, Linux and source code:*
http://grass.osgeo.org/download/

*Addons (user contributed extensions):*
http://grasswiki.osgeo.org/wiki/GRASS_AddOns

**Free sample data:**
*Rich data set of North Carolina (NC)*
... available as GRASS GIS location and in common GIS formats
http://grass.osgeo.org/download/sample-data/

**User Help:**
*Mailing lists* (also in different languages):
http://grass.osgeo.org/support/

*Wiki:*
http://grasswiki.osgeo.org/wiki/

*Manuals:*
http://grass.osgeo.org/documentation/manuals/
Coming soon: GRASS GIS 7!

THANKS