Embrio and Wuiw
two web interfaces for WPS

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1:00 pm, September 26, 2007

Adapted from Jachym Cepický (GRASS goes web: PyWPS 0.1)
http://Les-ejk.cz
Embrio & Wuiw

**Embrio**
- Technologies: DHTML + AJAX + PHP/Mapscript
- Scope: an interface based on UMN Mapserver Mapscript to access GRASS functions (Mapserver and WPS on the same server).
- Dev state: beta

**Wuiw**
- Tecnologie: DHTML + AJAX
- Scope: an interface as man in the middle between a WPS server and other OWS servers (WCS, WFS) joining remote resources for data and processing.
- Dev state: alpha
PyWPS in action - WPS Demo

- http://pywps.ominiverdi.org/
  - Repository of demo apps created by ominiverdi.org

- Developers:
  - Lorenzo Becchi (ominoverde)
  - Luca Casagrande (doktoreas)

- All applications shown have to be considered under development. If you find a bug, please, post it to PyWPS's mailing list:
  pywps-devel@wald.intevation.org
EMBRIIO - a simple PyWPS AJAX Web Interface

This page is intended to show the development status of a Web User Interface for PyWPS

Demo applications

- **V.Buffer** - Create a buffer around features of given type (areas must contain centroid).
- **R.Los** - Generates a raster map output in which the cells that are visible from a user-specified observer location are marked with integer values that represent the vertical angle (in degrees) required to see those cells (viewshed).
- **V.Net.Path** - Find shortest path on vector network.
- **R.walk and r.drain** Find shortest path between 2 points using slope factor as cost value.

Demo applications of ka-Map tool

This applications use ka-Map API to create tiled cache and map navigation. SLD style definition is supported for the WPS output layer.

- **R.Los with Embrio interface**
- **R.Los with Winman interface**

Developers

- doktorean
- ominiverdi
GRASS Buffer module (v.buffer)

Create a buffer around features of given type (areas must contain centroid).

Usage: click on map to set coord of the centroid, manually insert the radius param. Then click on Go! button to see overlayed output.

Params

| X: | 602233 |
| Y: | 4921471 |
| Radius: | 3000 |

[Go!]
Embrio - R.Los

GRASS Buffer module

**r.los** generates a raster map output in which the cells that are visible from a user-specified observer location are marked with integer values that represent the vertical angle (in degrees) required to see those cells (viewshed).

**Usage:** click on map to set **coords**. Use selects to change **distance** and **height** params. Then click on **Go!** button to see overlayed output.

**Params**

- **X:** 592614
- **Y:** 4926515
- **Max distance where check visibility:** (range 500 - 1500)
  - 1500
- **Height of the observer:** (range 1 - 3)
  - 3

**Go!**
**Embrio - V.Net.Path**

GRASS Routing module (v.net.path)

Find shortest path on vector network.

**Usage:** click on map to set coordinates of start and end point. Then click on Go! button to see overlayed output.

**Params**

- **X1:** 591061
- **Y1:** 4926622
- **X2:** 605142
- **Y2:** 4920243
- **Cost:** 0

[Image of a map with a window showing GRASS Routing module parameters]
Embrio – R.Walk
Embrio + ka-Map - R. Los

GRASS Buffer module

r.los generates a raster map output in which the cells that are visible from a user-specified observer location are marked with integer values that represent the vertical angle (in degrees) required to see those cells (viewshed).

Usage: click on map to set coords. Use selects to change distance and height params. Then click on Go! button to see overlayed output.

Parameters:
- X: 603179
- Y: 4925198
- Max distance where check visibility: (range 2000 -> 7500)
  - 5666
- Height of the observer: (range 1 -> 50)
  - 50
- Go!

Style:
- Choose a color scheme:
  - Red color table
- link to old file
Embrio + ka-Map + Winman - R.Los

GRASS Buffer module

r.los generates a raster map output in which the cells that are visible from a user-specified observer location are marked with integer values that represent the vertical angle (in degrees) required to see those cells (viewshed).
Embrio – last prototype
PyWPS in action - WUIW Demo

- [link](http://www.les-ejk.cz/english/pywps-and-openlayers)
  - Code status: Alpha
  - Developers:
    - Jachym Cepicky (ominoverde)
  - Based on OpenLayers API
PyWPS in action - WUIW Demo
Open Geospatial Consortium, Inc (OGC)

- International voluntarily consensus standards organization
- Development and implementation of standards for geospatial content and services
- http://www.opengeospatial.org/
Web service

- Software system designed to support interoperable machine-to-machine interaction over a network (Wikipedia)
- In OGC terminology, "Service" refers to a processing task that is invoked by a client and executed by a server, usually across a network.
- The OpenGIS Specifications that make this possible are referred to as "OGC Web Services".
- OpenGIS Web Service (OWS):
  - OpenGIS Catalog Service (CAT)
  - OpenGIS Web Coverage Service (WCS)
  - OpenGIS Web Feature Service (WFS)
  - OpenGIS Web Map Service (WMS)
  - . . .
  - Web Processing Service (WPS) (draft)
OpenGIS Web Processing Service

- Document OGC 05-007r4, version 0.4.0
- Not yet OGC standard, "Discussion Paper", Draft
- To offer any sort of GIS functionality to clients across a network
- XML-based communication protocol

Es: http://pywps.ominiverdi.org/cgi-bin/wps?service=WPS&version=0.4.0&request=...
WPS request=GetCapabilities

http://www.bnhelp.cz/cgi-bin/wps?service=WPS&version=0.4.0&request=GetCapabilities

<?xml version="1.0" ?>
    <Capabilities version="0.4.0" ... >
        <ows:ServiceIdentification>
            <ows:Title>Sample WPS server</ows:Title>
            <ows:Abstract>WPS for Lausanne</ows:Abstract>
            <ows:ServiceType>WPS</ows:ServiceType>
            <ows:Fees>free</ows:Fees>
        </ows:ServiceIdentification>
        <ows:ServiceProvider>
            <ows:ProviderName>GDF</ows:ProviderName>
            <ows:ServiceContact>
                <ows:IndividualName>Jachym Cepicky</ows:IndividualName>
                <ows:PositionName>Student</ows:PositionName>
            </ows:ServiceContact>
        </ows:ServiceProvider>
    </Capabilities>
...<ProcessOfferings>
  <Process processVersion="0.1">
    <ows:Identifier>addvalue</ows:Identifier>
    <ows:Title>Add some value to raster map</ows:Title>
  </Process>
  <Process processVersion="0.1">
    <ows:Identifier>classify</ows:Identifier>
    <ows:Title>Image classification</ows:Title>
    <ows:Abstract>
      GRASS processed imagery classification. Only unsupervised is supported at the moment.
    </ows:Abstract>
  </Process>
  <Process processVersion="0.1">
    <ows:Identifier>shortestpath</ows:Identifier>
    <ows:Title>Shortest path</ows:Title>
  </Process>
</ProcessOfferings>
http://www.bnhelp.cz/cgi-bin/wps.py?service=WPS&version=0.4.0&request=DescribeProcess&identifier=addvalue

<?xml version="1.0" ?>
<ProcessDescriptions ...
  <ProcessDescription ...
    <ows:Identifier>addvalue</ows:Identifier>
    <ows:Title>Add value</ows:Title>
    <ows:Abstract>Adds some value to each cell of input raster map</ows:Abstract>
    <DataInputs>
      <Input>
        <ows:Identifier>value</ows:Identifier>
        <ows:Title>Value to be added</ows:Title>
        <LiteralData>
          <AllowedValues>
            <Value>1</Value>
            ...
          </AllowedValues>
          <ows:DefaultValue>10</ows:DefaultValue>
        </LiteralData>
      </Input>
    </DataInputs>
  </ProcessDescription>
...</xml>
WPS request=DescribeProcess

<Input>
  <ows:Identifier>map</ows:Identifier>
  <ows:Title>Input raster map</ows:Title>
  <ComplexData defaultFormat="image/tiff">
  </ComplexData>
</input>
</DataInputs>

<ProcessOutputs>
  <Output>
    <ows:Identifier>value</ows:Identifier>
    <ows:Title>literal value + 1</ows:Title>
    <LiteralOutput>... </LiteralOutput>
  </Output>
  <Output>
    <ows:Identifier>map</ows:Identifier>
    <ows:Title>Resulting output map</ows:Title>
    <ComplexOutput defaultFormat="image/tiff">
      ...
    </ComplexOutput>
    </Output>
<br>  <Output>
  </ProcessOutputs>
</ProcessDescriptions>
WPS request=Execute

http://www.bnhelp.cz/cgi-bin/wps.py?service=WPS&version=0.4.0&request=Execute&identifier=addvalue&DataInputs=value,5,map,http://localhost/data/soils.tif

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<Execute service="wps" version="0.4.0" store="true" status="false"
   xmlns="http://www.opengeospatial.net/wps"
   xmlns:ows="http://www.opengeospatial.net/ows">
  <ows:Identifier>addvalue</ows:Identifier>
  <DataInputs>
    <Input>
      <ows:Identifier>value</ows:Identifier>
      <LiteralValue>5</LiteralValue>
    </Input>
    <Input>
      <ows:Identifier>map</ows:Identifier>
      <ComplexValueReference reference="http://localhost/data/soils.tif"/>
    </Input>
    ...
  </DataInputs>
</Execute>
<?xml version="1.0" ?>
<ExecuteResponse ...>
  <ows:Identifier>addvalue</ows:Identifier>
  <Status>
    <ProcessSucceeded/>
  </Status>
  <ProcessOutputs>
    <Output>
      <ows:Identifier>value</ows:Identifier>
      <ows:Title>literal value + 1</ows:Title>
      <LiteralValue>6</LiteralValue>
    </Output>
    <Output>
      <ows:Identifier>value</ows:Identifier>
      <ows:Title>Resulting output map</ows:Title>
      <ComplexValueReference format="image/tiff"
    </Output>
  </ProcessOutputs>
</ExecuteResponse>
PyWPS 2.0

- Implementation OGC's WPS standard (90-95 %)
- CGI Application
- Python programming language
PyWPS 2.0

- PyWPS starts as dedicated connector to GRASS
  - CLI
  - More than 300 modules for raster and vector analysis
  - GNU/GPL
  - GRASS Functionality can be via PyWPS offered in Internet
- User does not need Desktop-GIS (GRASS, ESRI, Idrisi, ... ) – Web browser becomes GIS
- One can use other CLI-oriented programs (PROJ.4, GDAL, R, ... )
PyWPS 2.0 – Execute – how it works

- Controlling input data, if all necessary parameters have arrived (Identifier, DataInputs, . . . )
- Loading process, for each input:
  - LiteralValue: Controlling, if input fits AllowedValues array
  - ComplexValue: Embed input files will be extruded from input XML request into separate files
  - ComplexValueReference: Tries to download the data from external source and stores it to new file
  - BoundingBoxValue
- If some DataInput is missing, it looks for the default value value
PyWPS 2.0 – Execute – how it works

- Creates temporarily GRASS Location or just temporarily Mapset within existing location, which will be deleted, after the work is done
- Calls function execute() of the process
- Formulates output XML file
- Deletes temporarily files (location, mapset, pid file)
- Returns output XML or resulting map file (TIFF, GML) to the client
- Process can be run asynchronously: After the request is accepted, XML response is immediately returned with <ProcessAccepted /> element and the calculation is forked to background.
PyWPS 2.0 - Addvalue – Sample process

**Inputs**
- Literal input: il valore da aggiungere
- ComplexValueReference input: una mappa raster

**Outputs**
- Literal output: Input+1
- ComplexValueReference: la mappa risultante (GeoTIFF)
class Process:
    def __init__(self):
        self.Identifier = "addvalue"
        self.Title = "Sample process for demonstration purposes"
        self.Inputs = [
            {'Identifier': 'value',
             'Title': 'Value to added',
             'LiteralValue': {'values': [0, 1, 2, 3, 4, 5]},
             'dataType': type(0),
             'value': 0, # default},
            {'Identifier': 'map',
             'Title': 'The raster map',
             'ComplexValueReference': {'Formats': ['image/tiff'}...
            }
        ]
        self.Outputs = [
            {'Identifier': 'value',
             'Title': 'Input value + 1',
             'LiteralValue': {},
             'value': 1 }... ]
```python
def execute(self):
    self.status = ['The start', 5]
    self.Outputs[0]['value'] = self.Inputs[0]['value'] + 1
    self.status = ['LiteralValue set', 20]

    self.status = ['Data import', 25]
    os.system("r.in.gdal in=%s out=map" % (self.Inputs[1]['value']

    self.status = ['Creating output map', 50]
    os.system("r.mapcalc map=map+%d" % (self.Inputs[0]['value']))

    self.status = ['Exporting map', 75]
    if os.system("r.out.gdal in=map out=output.tif type=UInt16 >
    return "Could not export map"
else: # ok
    return
```
Conclusions

- WPS Standard implemented to usable degree
- Making GRASS scripts run via web-interface was never easier
- It is relatively simple to connect UMN MapServer (or ARC IMS) with GRASS via PyWPS. Further GRASS development will make this even easier
Sviluppi futuri

- PyWPS
- Process definition (data inputs and outputs) is primitive – build set of classes for process definition
- GRASS
  - Implementation of new GRASS-python interface (Alessandro Frigeri aka ’geoalf ’)
  - 3D views via VTK (Sören Gebbert aka ’huhabla’)
- Embrio & Wuiw
  - Road to stable versions
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