A SIMPLE INSTALLATION and USER's GUIDE

for the plugins and scripts developed to conduct space syntax analysis (SSA) in FOSS4GIS:

OpenJUMP, gvSIG, OrbisGIS,
Quantum GIS, OpenEV, Thuban,
MapWindow GIS, SAGA,
and
R Project

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About SSA Plugin

The user of this plugin is assumed to know fundamental knowledge about the space syntax analysis (SSA) and geographic information systems (GIS). The plugin basically calculates the basic space syntax parameters particularly for line networks (axial lines, named streets or segment based) and makes it possible for the user to export the produced adjusted graph and geodesics to a social network analysis (SNA) software program file format (dl or net file) for further analysis of the spatial configuration concerned in the respective SNA software programs. SSA Plugins have been particularly designed for FOSS4GIS and released under the GNU GPL v2 license as it is also stated in the explanations given at beginning of the scripts for this purpose.

How to Install SSA Plugin

The procedure to install SSA plugin in FOSS4GIS is quite simple. Once you copy the files or folder listed in Table 1 and Table 2 to the directory where the plugins are located, you can directly begin to use SSA plugin without any difficulty. Nevertheless the user will suddenly notice that in some FOSS4GIS, SSA plugin could not be run or activated without loading or selecting a vector layer covering information about a spatial configuration for which an adjusted graph will be produced and subsequently space syntax parameters will be calculated.

After copying the files or folder to the location provided in Table 1 and Table 2, you should (re-)start FOSS4GIS you use. For OpenJUMP Jython SSA Plugin, existing startup.py and mystartup.py are modified to work with the plugin. Thus, if you are familiar with these files, instead of copying them directly to the plugin folder you can modify the respective files by analyzing the files attached to the plugin. In a similar fashion in Thuban, a thubanstart.py file is created in order to load SSA Plugin when the program starts. If you already have a thubanstart.py file, you should actually modify it by placing "import spacesyntax.py" inside it instead of copying thubanstart.py associated with the plugin to Thuban directory.

SSA plugin can be run in different FOSS4GIS via different menu options (see Table 3 for the menu system and toolbar through which you can activate and run SSA Plugin in different FOSS4GIS). In some FOSS4GIS (gvSIG, Quantum GIS, MapWindow GIS and OpenJUMP Jython) the plugin can also be run via a toolbar. The tool image for the plugin is as following;

SSA tool icon:

In gvSIG there are two options for the plugin: (1) using Jython-Java GUI or (2) using xml GUI (see the images of GUIs given at the end of guide). It is up to you which one to choose. The only difference is between GUIs. In a different fashion, there are three options to install SSA plugin in OpenJUMP: (1) BeanShell script version, (2) Jython plugin version and (3) Java (jar) version. Although BeanShell version is very slow compared with Jython and Java version, you may prefer to use the respective version in order to see and test how the scripts work. Jython version is again slow compared with Java version but it is easier and faster to produce scripts and plugins in Jython compared with Java for which you need a development platform and compiler such as Eclipse.

Users may also experience some problems in installing and running the plugin for SAGA GIS. SSA Plugin works fine on the platform where I compile ".dll" file for SAGA, but I noticed that it may not work in other computers lacking the development environment. Lastly for OrbisGIS and R Statistical Package I only provide you with SSA scripts that should be manually loaded to the software each time you employ it.

Table 1. SSA Plugin files or folder to copy and the location of plugin directory for different FOSS4GIS (Windows):

FOSS4GIS	Files or folder to copy	Where to paste the files or folder (plugin directory)
OpenJUMP – BeanShell	Space Syntax Analysis.bsh	C:\Program Files\OpenJUMP\lib\ext\BeanTools
OpenJUMP – Jython	startup.py, mystartup.py, SpaceSyntax.py	C:\Program Files\OpenJUMP\lib\ext\jython
OpenJUMP – Java	spacesyntax.jar	C:\Program Files\OpenJUMP\lib\ext
gvSIG – Jython GUI	SSA folder	C:\Program Files\gvSIG_1.9\bin\gvSIG\extensiones
gvSIG – xml GUI	SpaceSyntax folder	C:\Program Files\gvSIG_1.9\bin\gvSIG\extensiones
Thuban – Python	thubanstart.py, spacesyntax.py	C:\Program Files\Thuban
OpenEV – Python	spacesyntax.py	C:\Program Files\FWTools2.4.7\tools
Quantum GIS – Python	spacesyntax folder	C:\Program Files\Quantum GIS Wroclaw\apps\qgis\python\plugins
MapWindow GIS – VB.Net	SpaceSyntax folder	C:\Program Files\MapWindow\Plugins
SAGA GIS – C++	SpaceSyntax.dll	C:\Program Files\SAGA-GIS\modules
OrbisGIS – BeanShell	Space Syntax Analysis.bsh	anywhere you like (you need to load the script)
R Project	Space Syntax Analysis.r	anywhere you like (you need to load the script)

Table 2. SSA Plugin files or folder to copy and the location of plugin directory for different FOSS4GIS (Ubuntu):

FOSS4GIS	Files or folder to copy	Where to paste the files or folder (plugin directory)
OpenJUMP – BeanShell	Space Syntax Analysis.bsh	/usr/share/openjump/ext /BeanTools
OpenJUMP – Jython	startup.py, mystartup.py, SpaceSyntax.py	/usr/share/openjump/ext /jython
OpenJUMP – Java	spacesyntax.jar	/usr/share/openjump/ext
gvSIG – Jython GUI	SSA folder	…/gvSIG/extensiones
gvSIG – xml GUI	SpaceSyntax folder	…/gvSIG/extensiones
Thuban – Python	thubanstart.py, spacesyntax.py	…/thuban
OpenEV – Python	spacesyntax.py	…/tools
Quantum GIS – Python	spacesyntax folder	/usr/share/qgis/python/plugins/
OrbisGIS – BeanShell	Space Syntax Analysis.bsh	any where you like (you need to load the script)
R Project	Space Syntax Analysis.r	any where you like (you need to load the script)

Table 3. Menu items and toolbar through which SSA Plugin can be activated and run in different FOSS4GIS:

FOSS4GIS	Menu path to run SSA plugin
OJ – BeanShell	Customize → BeanTools → Space Syntax Analysis
OJ – Jython	Customize → Python Console and Tools... (activate Jython menu-tool) Tools → Space Syntax Analysis
OJ – Java	Graph Theoretic → Space Syntax Analysis
gvSIG	File → Scripting → Space Syntax Analysis
Thuban	Space Syntax Analysis → Space Syntax Analysis
OpenEV	Tools → Space Syntax Analysis
Quantum GIS	Plugins → Space Syntax Analysis → Space Syntax Analysis
MapWindow GIS	by clicking SSA Plugin icon on "SpaceSyntax" toolbar
SAGA GIS	Modules → Shapes → Space Syntax Analysis (or) Module Libraries → Space Syntax Analysis Module → Space Syntax Analysis
OrbisGIS	View → Beanshell Console (activate BeanShell Console) bsh script can be loaded and run via BeanShell Console
R Project	File → Open Script… (you can load and run R script)

Before running SSA Plugin, in some FOSS4GIS you are required to activate or load it. In this respect both in Quantum GIS and MapWindow GIS, you should first activate the plugin via the proper menu. In QGIS you can enable SSA Plugin via "Plugins → Manage Plugins…". Once you active the plugin it can be run via both Menu bar and Plugin toolbar. In MapWindow GIS, you can activate SSA Plugin icon via directly selecting "Plug-ins → Space Syntax Analysis" or "Plug-ins → Edit Plug-ins" where you can get some extra information about the plugin (such as author and version number). In some FOSS4GIS, plugin can be run after activating another tool. For example in OpenJUMP in order to run Jython SSA plugin you are first required to activate Jython menu and tool bar, and then you can select SSA via either "Tools - Space Syntax Analysis" or SSA text icon placed on the Jython toolbar.

How to Use SSA Plugin

Once you select the menu item or click the toolbar icon provided for SSA Plugin, a dialog box appears in the window as a Graphical User Interface (GUI) in order to make it possible for you to activate the options in relation to the outcomes of space syntax analysis in addition to the calculation of basic space syntax parameters. If no option is selected via GUI, plugin assigns a sequential number to each feature (currently lines or regions) and calculates the following parameters for a given spatial configuration (see Hillier and Hanson (2003) for the elaboration of the respective parameters, and see Beyhan (2011 and 2012) for the operationalization of them as a SSA plugin for FOSS4GIS):

Parameters calculated by SSA Plugin: **Graphical User Interface of the plugin:**

For each feature in a vector layer;

- Connectivity,
- Total Depth,
- Mean Depth,
- Global Integration,
- Local Depth,
- Local Integration,
- Control Value.

For the whole spatial configuration;

- Intelligibility value
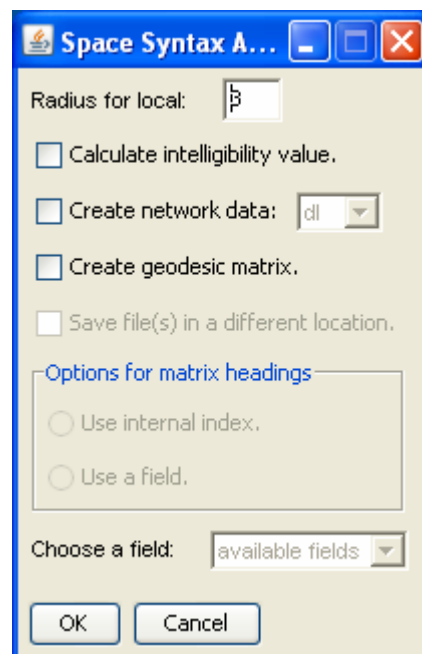
If user checks the option "Calculate intelligibility value", in addition to the above parameters plugin also calculates the Pearson Correlation (i.e. intelligibility value)

between connectivity and global integration. For those who are willing to calculate graph theoretic parameters other than the ones available in a standard SSA software including the ones offered in this plugin, extra option is available to transfer the adjusted graph created by the plugin to an external file (Ucinet's ".dl" or Pajek's ".net" format) that can be further processed in the software programs specifically designed for social network analysis (SNA) (such as ORA (Organizational Risk Analyzer), Pajek, Ucinet, visone, and socnetv). For this purpose, you should mark "Create network data:" option that makes it possible for you to choose a file format to save the resulting adjusted graph.

Once you save the adjusted graph in a SNA file format, you can easily open the respective network data, for example, in ORA and conduct further analysis (such as calculation of other measures of centrality including closeness, betweenness, authority, hub and information centrality). The new parameters calculated in ORA can later be transferred to FOSS4GIS by saving the results to a ".csv" or ".txt" file that can easily be linked to the original spatial data in GIS via the proper procedure available to connect an external tabular data to the existing attribute table.

You can also write the geodesic matrix to a text (".txt") file if you mark the option for "Create geodesic matrix." Once the user chooses any of the options available for the creation of an external file that can be used in other software programs particularly developed for social network analysis, plugin also asks for the matrix headings that will appear in the output files. In this respect, two options are available for the matrix headings;

(1) employment of the internal index that range between 1 and the number of features involved in the network,

(2) employment of a field in the attribute table as the matrix headings.

What is particularly important for the second option is the fact that the field chosen for the matrix heading should not include duplicate IDs (identity numbers) for (line or polygon) features. If you choose to use a field from the attribute table, you are asked to provide the respective field. Irrespective of the users' choice, the internal IDs of the

features (Lineno) are also added to the new attribute table in addition to the space syntax parameters in order to make it possible for the users to re-integrate the parameters calculated outside FOSS4GIS to the attribute table.

If the option available to "Save the file(s) in a different location" is checked, you are asked to provide location and name of the file that will store the adjusted graph or geodesic distance. Otherwise, the files created for adjusted graph and geodesic distance are saved in the directory where the source layer is located by using the name of the source layer if the respective options are marked to produce output files.

The GUI given above in the sixth page is almost standard for all FOSS4GIS for which a SSA plugin or script is developed by the author except for Thuban and R Project where user is additionally asked for to provide a file name to which the output GIS file (".shp") will be written. Except for Thuban and R Project it was possible for the author to write the results of the analysis to either the attribute table of the layer selected to be analyzed or to a new layer (gvSIG only). However, in other FOSS4GIS users should also save the results of the analysis before they close FOSS4GIS they prefer to use. Otherwise, all the new information can be lost. In R, when the script is run, it first asks for the location of ".shp" file to be processed. After selecting ".shp" file, script constructs the adjusted graph and calculates geodesics by using sna package written by Butts (2010). After these calculations an option is also offered to the user via SSA GUI to calculate intelligibility value and to enter the radius for local value. And when you press OK, you are prompted to provide the location and name of the file to which the results of the analysis (parameters) will be written. Considering the existence of a social network analysis library (sna) in R Project, no option is created to export the adjusted graph to an external file in the respective software program. After running the script, user will already have the adjusted graph stored in a two dimensional array named as 'sna'. By using sna library you can easily calculate, for example, betweenness and closeness centralities (just type betweenness(sna) or closeness(sna) in the console and press enter). You can also calculate other graph theoretic parameters available in sna library for the spatial configuration concerned.

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You can import any spatial data produced by employing computer assisted drawing (CAD) software programs to FOSS4GIS by converting the respective data first into a ".dxf" (drawing exchange format) file and then importing the resulting file to FOSS4GIS that you prefer to use via the module or option available for the respective task. SSA plugin for FOSS4GIS are particularly designed to be operational for the exchange of data between GIS and SNA software programs in which a wide range of network parameters can easily be calculated thanks to their specific focus on graph theoretical analysis.

Although users of the plugin are assumed to know the basic knowledge about GIS, it would be helpful to describe how they can produce thematic maps (see Figure 1 – 9 for some examples from Siteler, an industrial cluster in Ankara) in GIS by using the parameters calculated by SSA Plugin in each FOSS4GIS. In this respect, Table 4 shows the menu items or mouse button through which you can produce thematic maps for different fields (parameters) available in an attribute table:

Table 4. Menu and mouse button path to produce thematic maps in different FOSS4GIS:

FOSS4GIS	Menu and mouse button path to produce thematic maps
OpenJUMP	Press the right button of the mouse while the cursor is on the name of the layer, and then select "Change Styles → Colour Theming". Check "Enable colour theming" and choose among the options available for both "Classification Method" and "Attribute" (i.e. parameters).
gvSIG	Press the right button of the mouse while the cursor is on the name of the layer, and then select "Properties… → Symbology → Quantities → Intervals". Choose among the options available for both "Interval type" and "Classification field" (i.e. parameters).
Thuban	"Layer → Properties", and then select a "Field" (parameter) and press "Generate Class"
OpenEV	On the toolbar click "Classify Layer" tool, and then you can select the field (parameter) for thematic map. Press "reclassify…" in order to choose among the options available for classification "Type".
Quantum GIS	"Layer → Properties…", and then select "Style" tab and "Graduated" option for the classification. Select the parameters from the available "Column"s.

Table 4. Menu and mouse button path to produce thematic maps in different FOSS4GIS (continued from above):

FOSS4GIS	Menu and mouse button path to produce thematic maps
MapWindow GIS	"Layer → Properties", and then select "Categories" tab and uncheck "Unique values". Select the parameters from the available "Fields" and press "Generate" in order to classify the values.
SAGA GIS	Activate "Show Object Properties" via "Window" menu. And then select "Colors → Type → Graduated Color" and define the parameter via "Colors → Type → Graduated Color → Attribute".
OrbisGIS	Press the right button of the mouse while the cursor is on the name of the layer, and then select "Edit Legend". And then press "Add" tool and select "Interval classification". Define "Classification field:" (parameter) and "Type of interval:".
R Project	Script automatically produces a thematic for the global integration values. Please refer to R manuals and also analyze the script to see how to produce alternative thematic maps.

Lastly, as this user's guide is not intended to provide users with some knowledge about how to use a GIS software program, if you are unfamiliar with GIS programs, you will need to search for a simple user's guide for FOSS4GIS you prefer to use in order to, at least, to open or load a vector layer into FOSS4GIS. Nevertheless, most of the time the respective procedure is very simple for the majority of FOSS4GIS and you can easily explore how to add a vector layer to the program. You may obtain information about a general user guide for FOSS4GIS you prefer to use via the following links;

Table 5. Links for FOSS4GIS

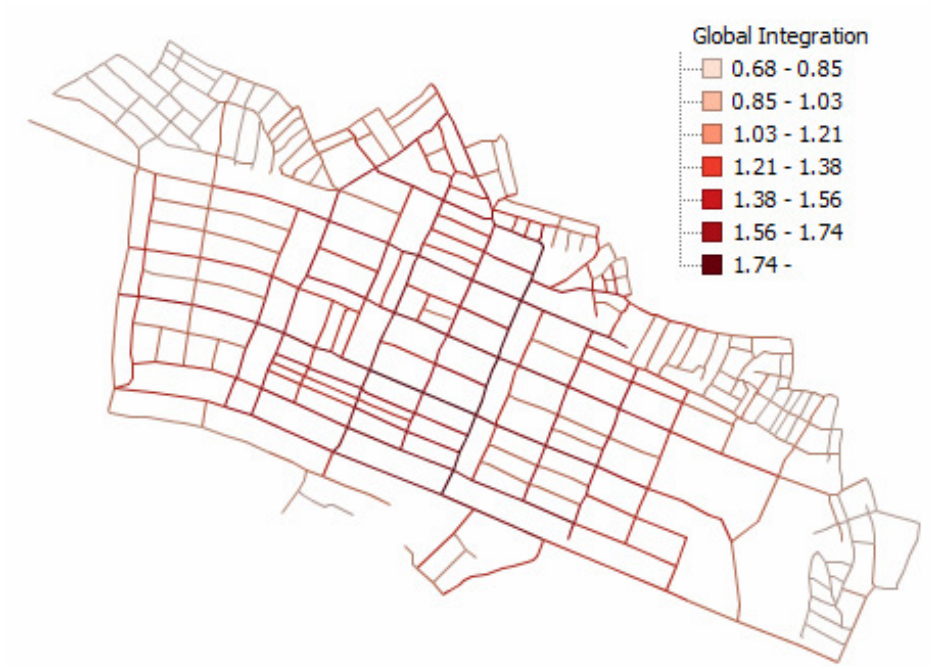| FOSS4GIS	link	FOSS4GIS	link
OpenJUMP	http://www.openjump.org/	MapWindow	http://www.mapwindow.org/
gvSIG	http://www.gvsig.org/web/	OrbisGIS	http://www.orbisgis.org/
Thuban	http://thuban.intevation.org/	R Project	http://www.r-project.org/
OpenEV	http://openev.sourceforge.net/	SAGA GIS	http://www.saga-gis.org/en/index.html
Quantum GIS	http://www.qgis.org/		

Figure 1. A thematic map produced in OpenJUMP for Global Integration values.

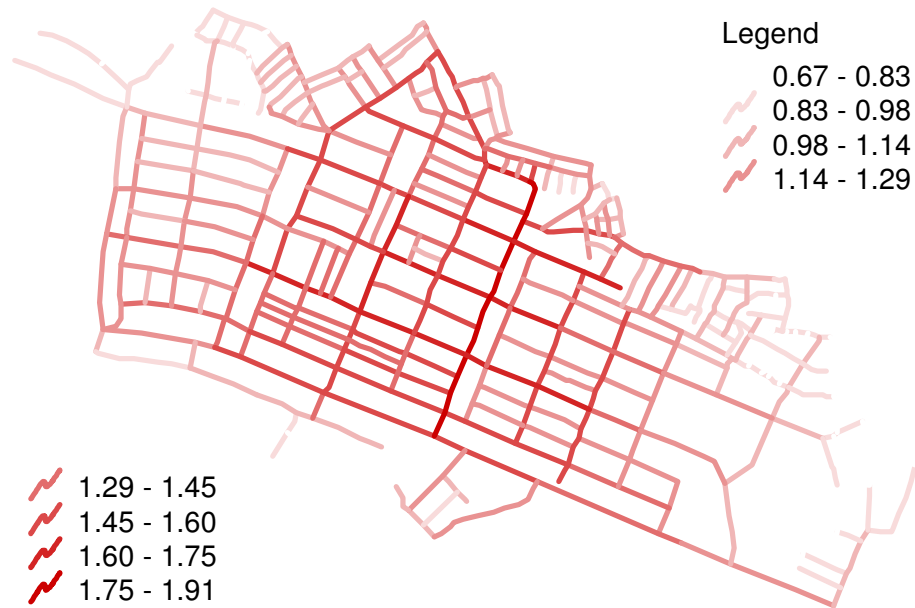Figure 2. A thematic map produced in Quantum GIS for Global Integration values.

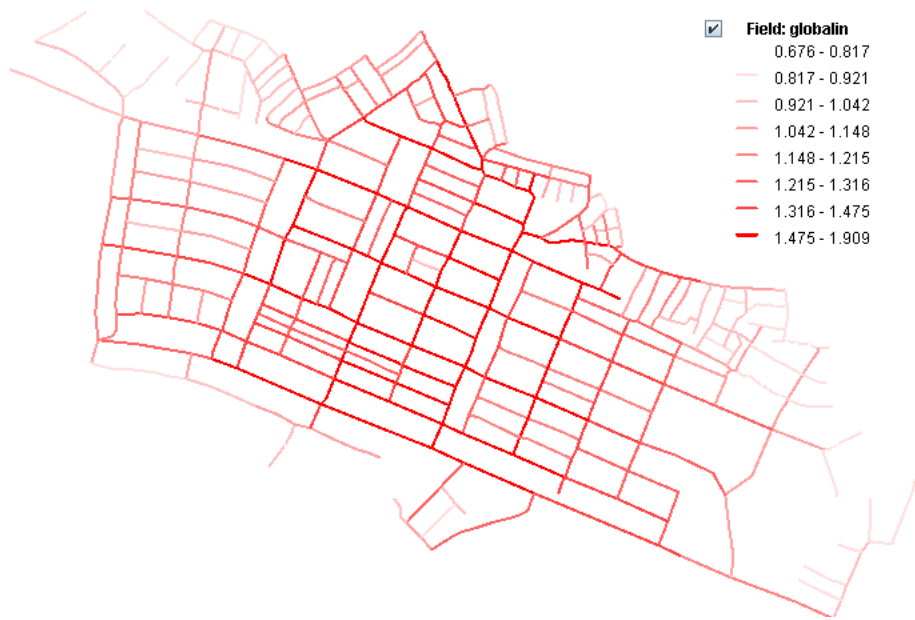Figure 3. A thematic map produced in Thuban for Global Integration values.

Figure 4. A thematic map produced in OpenEV for Global Integration values.

Figure 5. A thematic map produced in gvSIG for Global Integration values.

Figure 6. A thematic map produced in SAGA GIS for Global Integration values.

Figure 7. A thematic map produced in MapWindow GIS for Global Integration values.

Figure 8. A thematic map produced in OrbisGIS for Global Integration values.

Figure 9. A thematic map produced in R Project for Global Integration values.

References

Hillier, B. and Hanson, J. (2003) The social logic of space, Cambridge: Cambridge University Press.

Beyhan, B. (2011) "Developing Space Syntax Tools for Free and Open Source Software for GIS", in Proceedings of the 19th International Conference on Geoinformatics (Geoinformatics 2011), Shanghai, China.

Beyhan, B. (2012) "Developing Graph Theoretic Analysis Tools in FOSS4GIS: An Experiment in OpenJUMP with a Specific Focus on Space Syntax", FOSS4G-CEE and Geoinformatics, Prague 2012.

Butts, C.T. (2010) The sna Package: Tools for Social Network Analysis, available on the internet, URL http://erzuli.ss.uci.edu/R.stuff (last accessed at 18.06.2012).

download link for this guide: http://mekandizim.mersin.edu.tr/belgeler/SSA-IUG.pdf

download link for SSA Plugins:: http://mekandizim.mersin.edu.tr/

GUIs of the plugin in different FOSS4GIS are presented below;

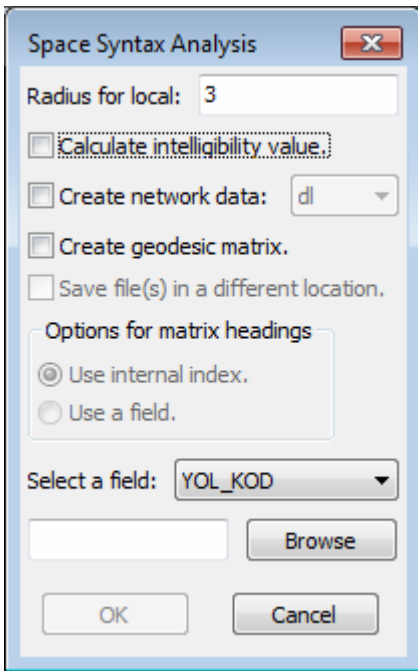OpenJUMP BeanShell and Jython plugin
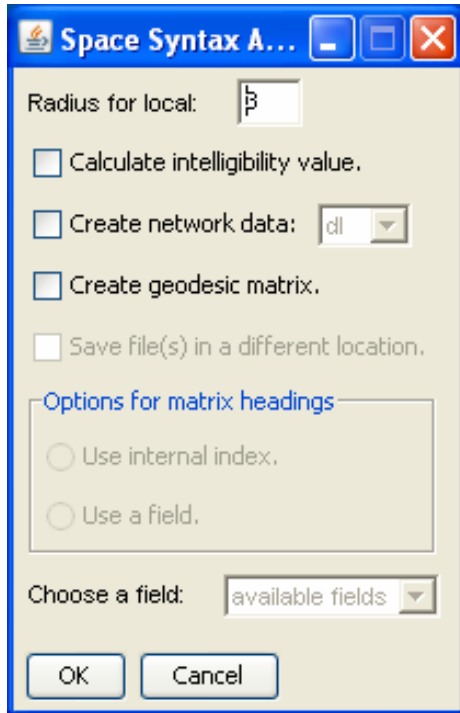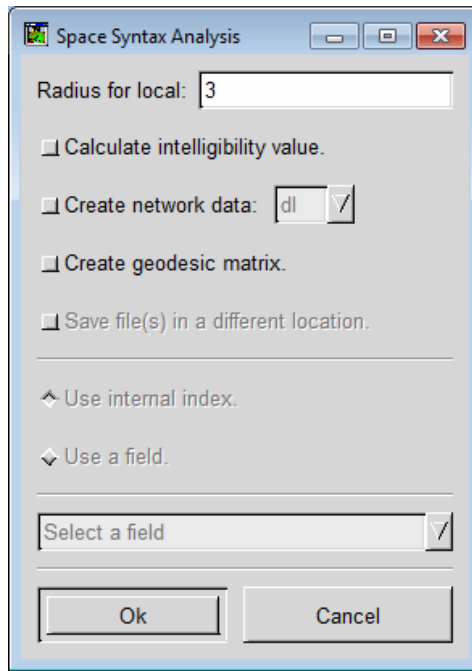
OpenJUMP Java (jar) plugin
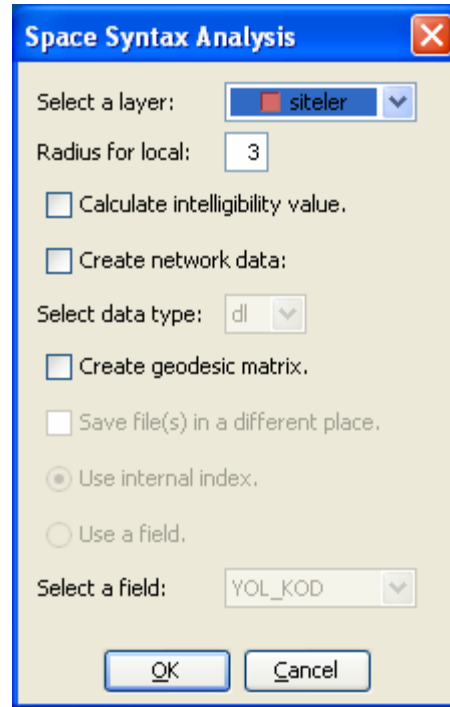
gvSIG Jython GUI and plugin
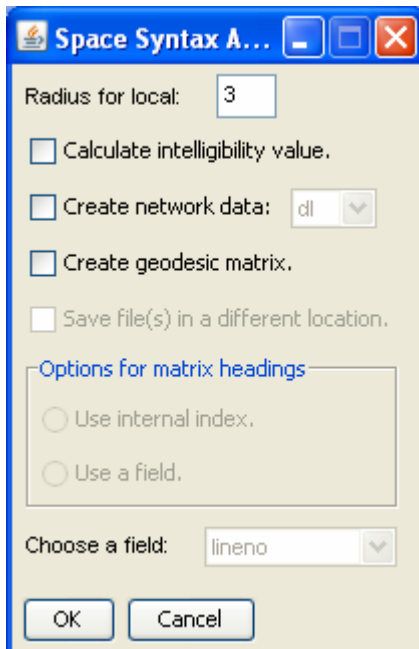
gvSIG xml GUI and Jython plugin
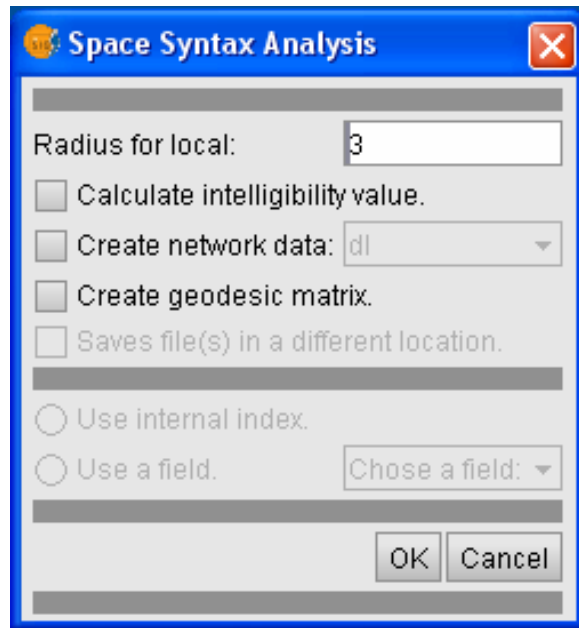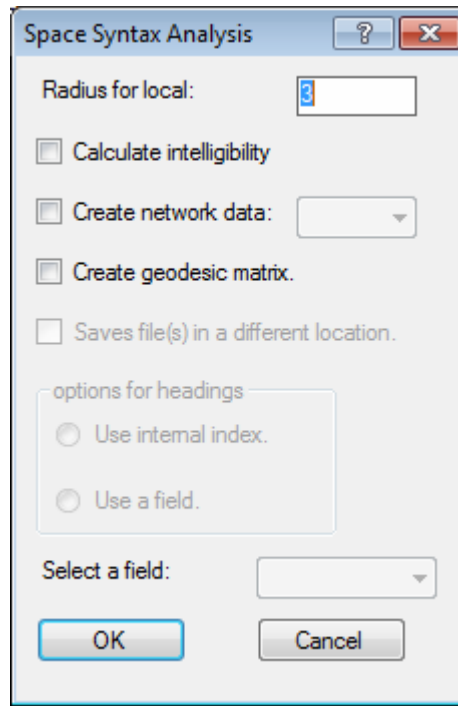
Thuban Python plugin
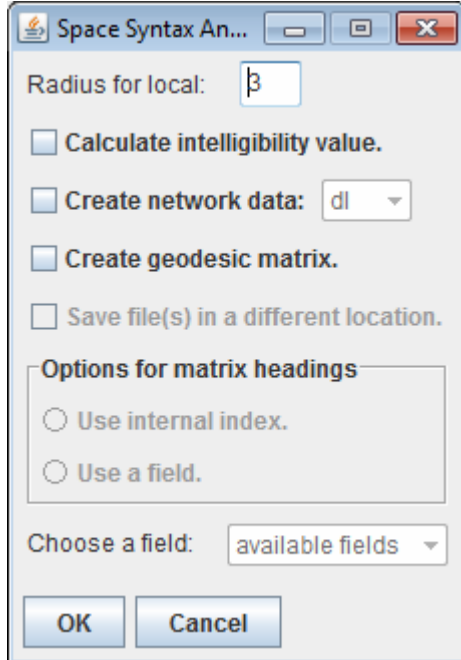

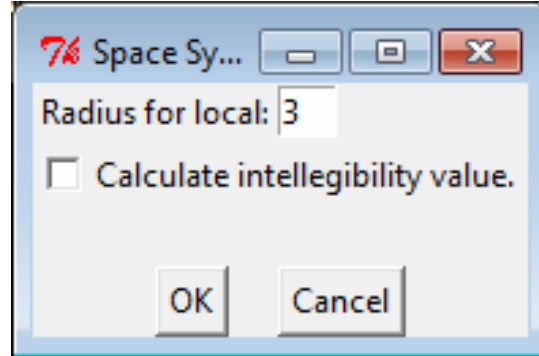OpenEV Python plugin

Quantum GIS Python plugin
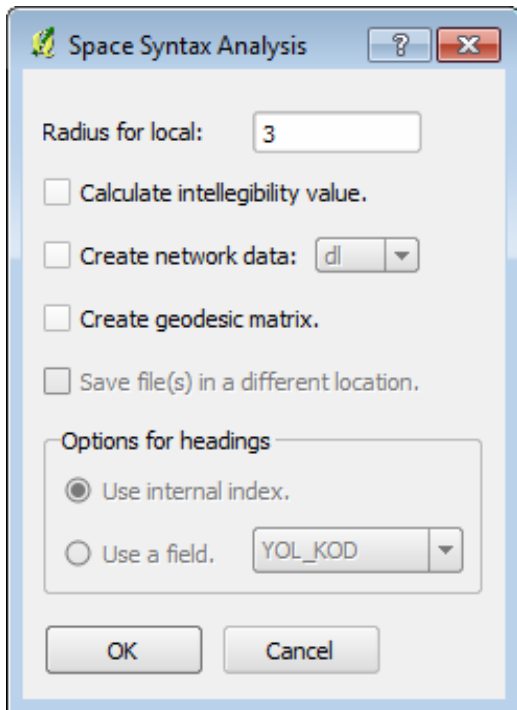
MapWindow GIS VB.Net plugin

OrbisGIS BeanShell Script plugin

R Project R Script plugin

In R Project, no option is actually needed for the creation of an external network data and geodesic matrix as in R you can conduct social network analysis using sna package and calculate many other graph theoretic parameters thanks to the availability of a wide range of packages.

SAGA GIS C++ plugin