



First Steps to Network Visualization with Pajek

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Pajek



Pajek (Slovene word for Spider) is a program, for Windows (32 bit), for analysis of *large networks*. With Andrej Mrvar, we started to develop **Pajek** in November 1996. Some procedures were contributed by Matjaž Zaveršnik.

Pajek is freely available, for noncommercial use, at its homepage:

<http://vlado.fmf.uni-lj.si/pub/networks/pajek/>

When you download its installation program you simply run it and it will install **Pajek** in the selected directory.

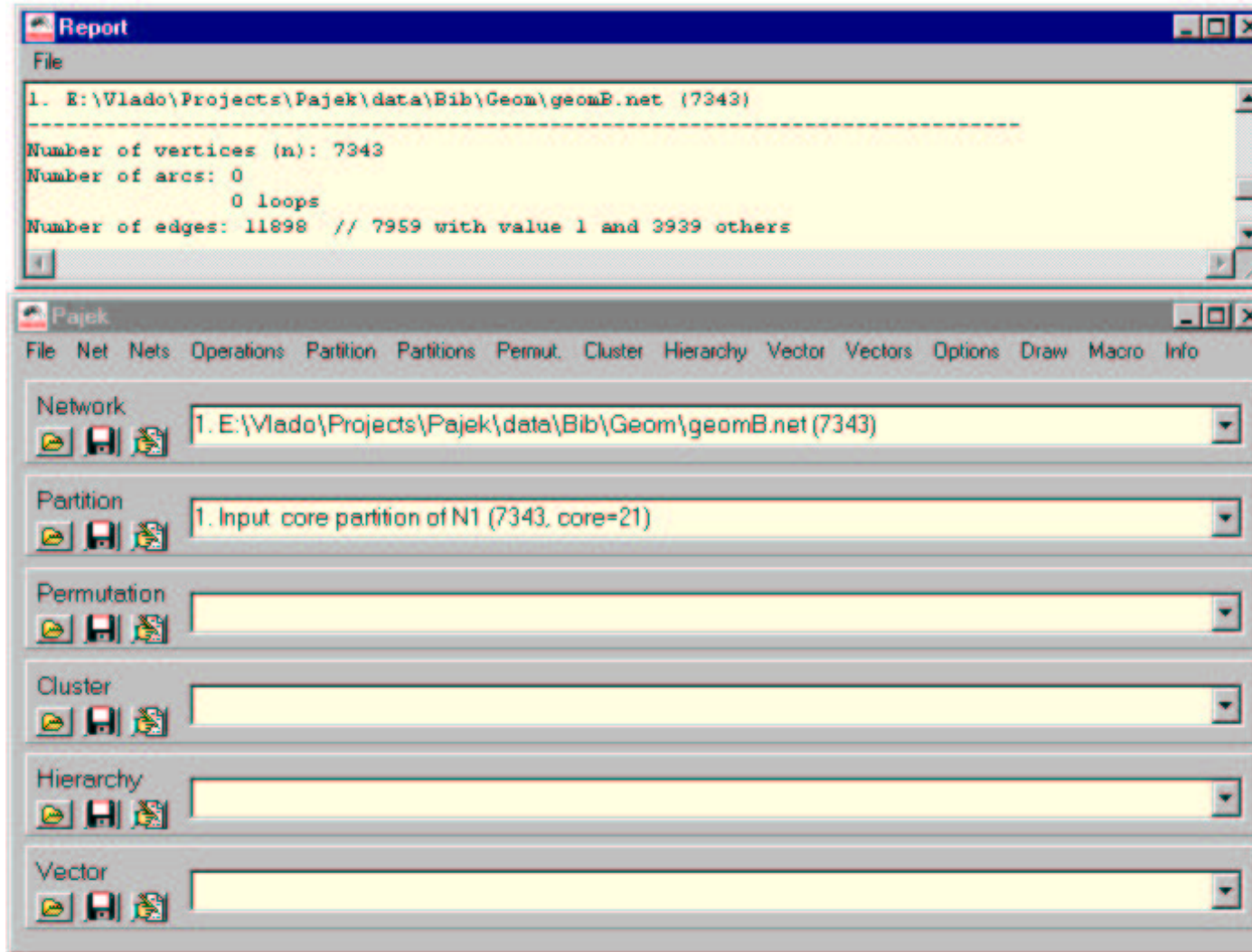
Input Data

Besides its own input formats, **Pajek** supports several other formats: UCINET DL, genealogical GED, and some molecular formats: BS (Ball and Stick), MAC (Mac Molecule) and MOL (MDL MOLfile).

Run **Pajek**. You will get the *main window* – see next slide. **Pajek** is organized as a '*calculator*' for network data:

- *network* – main object (vertices and lines);
- *partition* – to which cluster a vertex belongs;
- *vector* – values of vertices;
- *permutation* – reordering of vertices;
- *cluster* – subset of vertices (e.g. a cluster from partition);
- *hierarchy* – hierarchically ordered clusters and vertices.

Pajek's Main and Report Windows



Reading Data from a File

The power of **Pajek** is based on several transformations which support different transitions among these data types.

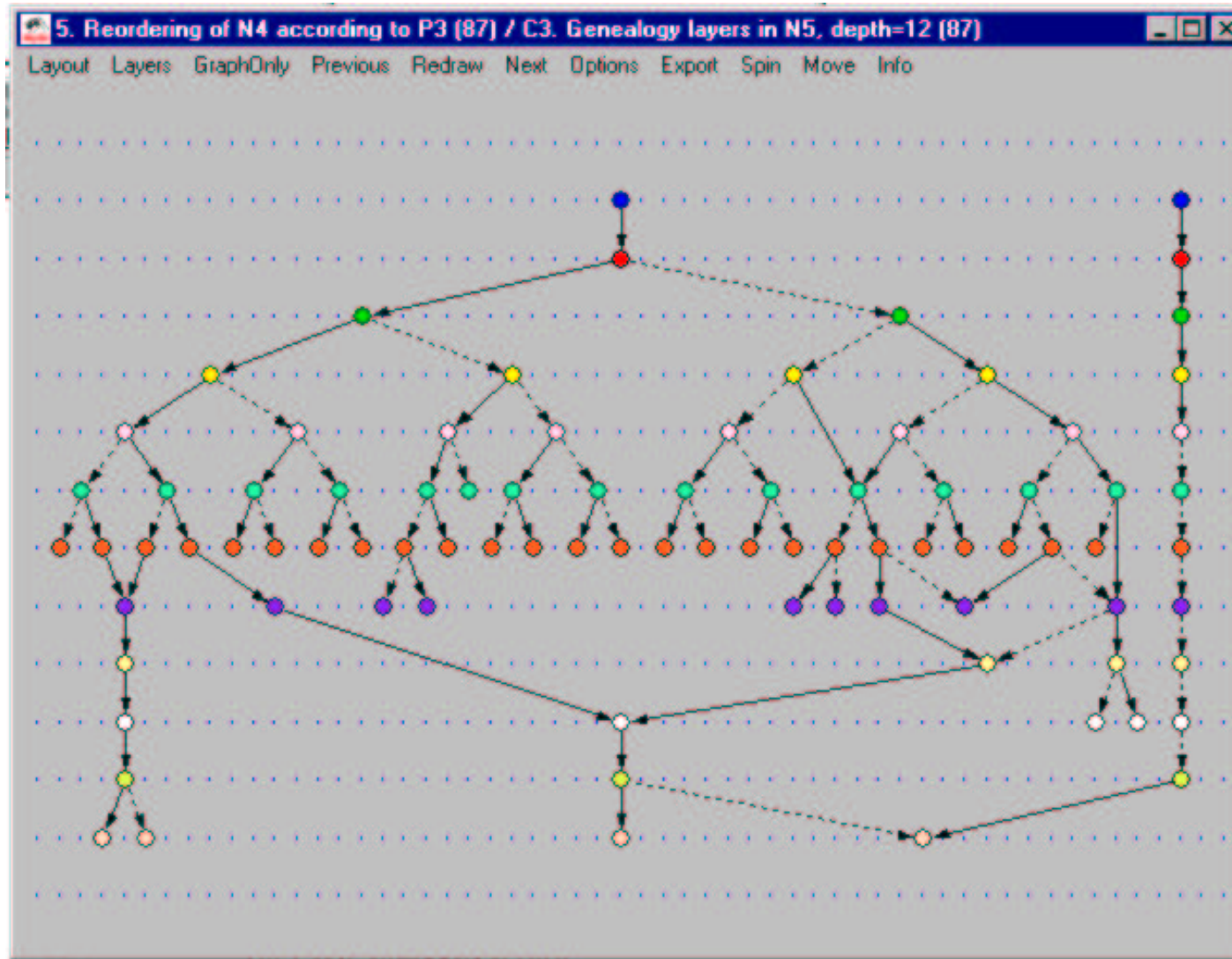
Click on the first icon of the '*Network register*' and in the dialog box select the right file type. For example, for Ucinet data, the type

UCINET DL files (*.dat)

find your file on the disk, and request its reading by click on Open. If everything is OK, you will get a new network in the Network register and report about the reading in the *report window*.

Now, you can draw the network using the Draw/Draw option in the main window. The *draw window* appears with a picture of the current network.

Pajek's Draw Window



Pajek's Data / NET

The network is described on the file *file.net* that has the following basic structure:

```
*vertices  $n$             $n$  is the number of vertices
  1 "name1"          the label of vertex 1 is  $name_1$ 
...
   $n$  "name $n$ "
*arcs
   $i$   $j$   $v_{ij}$        the arc from  $i$  to  $j$  has value  $v_{ij}$ 
...
*edges
   $p$   $q$   $v_{pq}$       the edge from  $p$  to  $q$  has value  $v_{pq}$ 
...
```

The file can contain several additional elements – see *Draweps.htm*.

Pajek's Data / CLU, VEC, PER

All three types of files have the same structure:

*vertices n	n is the number of vertices
v_1	vertex 1 has value v_1
...	
v_n	

CLUstering – partition of vertices – *nominal* or *ordinal* data about vertices

$v_i \in \mathbb{N}$: vertex i belongs to the cluster v_i ;

VECtor – *numeric* data about vertices

$v_i \in \mathbb{R}$: the property has value v_i on vertex i ;

PERmutation – *ordering* of vertices

$v_i \in \mathbb{N}$: vertex i is at the v_i -th position.

Example: Wolfe Monkey Data

inter.net	inter.net	sex.clu	age.vec	rank.per
*Vertices 20		*vertices 20	*vertices 20	*vertices 20
1 "m01"	1 6 5	1	15	1
2 "m02"	1 7 9	1	10	2
3 "m03"	1 8 7	1	10	3
4 "m04"	1 9 4	1	8	4
5 "m05"	1 10 3	1	7	5
6 "f06"	1 11 3	2	15	10
7 "f07"	1 12 7	2	5	11
8 "f08"	1 13 3	2	11	6
9 "f09"	1 14 2	2	8	12
10 "f10"	1 15 5	2	9	9
11 "f11"	1 16 1	2	16	7
12 "f12"	1 17 4	2	10	8
13 "f13"	1 18 1	2	14	18
14 "f14"	2 3 5	2	5	19
15 "f15"	2 4 1	2	7	20
16 "f16"	2 5 3	2	11	13
17 "f17"	2 6 1	2	7	14
18 "f18"	2 7 4	2	5	15
19 "f19"	2 8 2	2	15	16
20 "f20"	2 9 6	2	4	17
*Edges	2 10 2			
1 2 2	2 11 5			
1 3 10	2 12 4			
1 4 4	2 13 3			
- - -	2 14 2			
	...			

Pajek's Data / PAJ

All types of data can be combined into a single file – Pajek's *project file* .paj.

The easiest way to do this is:

read all data files in Pajek,

compute some additional data,

delete (dispose) some data,

save all as a project file with File/Project file/Save.

Next time you can restore everything with a single

File/Project file/Read.

Pajek supports also two-mode and temporal networks.

Visualization of Network Data

You enter the draw window selecting some of the options in the Draw menu in the main window.

If the vertices have no positions yet, they are displayed on the circle.

You can try to get better picture using automatic layout methods from the Layout menu.

You can further improve the picture manually by moving vertices with the mouse. The options Move/Fix, Move/Grid, Options/Transform/* can be useful.

Use also Options/* to determine what and how is displayed.

Pajek supports 2D and 3D layouts. Use x, y, z keys to rotate the picture in 3D.

Visualization of Partitions and Vectors

Partitions can be visualized by colors of vertices.

Draw/Draw Partition.

Vectors by the size of vertices or by their position.

Draw/Draw Vector,

Operations/Vector/Put Coordinate/*.

Transformations on and between partitions and vectors are available.

The value of lines can be displayed as number

Options/Lines/Mark lines/with Values

or as the width of lines

Options/Lines/Different Widths.

Sources

The spider (*Gartenkreuzspinne / Araneus diadematus*) photo from the title page was made by Stefan Ernst

<http://www.naturfoto-online.de>