

Visual Exploration of Graph Data

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Outline

- Elements of exploratory visualization of graphs
- Introductory demos
- The software environment
- Final demos

What's different about graphs?

- Three interconnected data structures (approximately)
 - data associated with nodes
 - data associated with edges
 - the graph itself
- Different communities specialize in different data structures
 - graph drawing community: graph layout
 - statisticians: multivariate data analysis, visualization
 - social network analysts: a bit of both

Goal: an integrated environment

Integration of

- data format that encompasses graphs and multivariate data
- scripting language to construct and manipulate graphs
- graph layout algorithms to generate spatial mappings
- other graph algorithms: searches, finding cliques, cycles, ...
- high-quality static graphics
- direct manipulation visualization
 - tweaking, pruning, navigating the graph
 - linking a variety of displays

Demos: simple graphs

- a corporate intranet
- the permutation graph of degree 3

Discussion of first examples

What we saw

- R: generated graph description
- Rggobi (an R package): initiated ggobi
- ggobi: laid out the graph, tuned the layout, explored the graph

Graphs with data

- multivariate data for each node
 - telephone number: usage characteristics, household demographics, ...
 - person: gender, age, ...
 - country: population, type of government, ...
- multivariate data for each edge
 - frequency, duration, type of contact ...

Demo: a graph with data

- a COI with its variables and labels masked

Software integration: the components

- R: language and environment for statistics
- ggobi: general-purpose multivariate data visualization
- Rggobi: R package for driving ggobi
- extensions to ggobi (plugins) for graphs

Visualization: ggobi

- General visualization methods
 - linked views
 - ease of manipulation: painting, scaling, rotation, ...
 - data operations: subsetting, variable transformation, ...
 - high-dimensional projections
- Visualization methods of particular interest for graphs
 - edge painting and identification
 - point motion
 - edge editing: adding nodes and edges

Layout and navigation: plugins to ggobi

- layout methods
 - radial layout
 - neato and dot (www.graphviz.org)
 - ggvis: multidimensional scaling
- pruning methods, navigation

Data formats: handing the graph to ggobi

- ggobi alone: XML

- nodes

```
<record id="Banquo"> 2.4 7.7 </record>
```

```
<record id="Macbeth"> 1.0 2.5 </record>
```

- edges

```
<record source="Macbeth" destination="Banquo">
```

```
66.3 -4 .78
```

```
</record>
```

- ggobi embedded: R data structures

Programming environment: ggobi in R

- ggobi can be embedded in R, and driven through its API
- Rggobi functionality includes:
 - construct a graph in R, hand it to ggobi
 - read results from ggobi displays back into R
 - respond to ggobi events

Aside: ggobi can of course be run independently of R, and then graphs are specified in XML.

Further work

- R packages of graph algorithms are emerging, presenting opportunities for further integration
- other graph manipulations: aggregation, working with subsets
- other scripting languages: python

Where to get it: www.ggobi.org

Paper corresponding to this talk:

www.ci.tuwien.ac.at/Conferences/DSC-2003

Does it work under Windows? Yes, but getting all the plugins to work is a bit tricky.