Two-mode networks

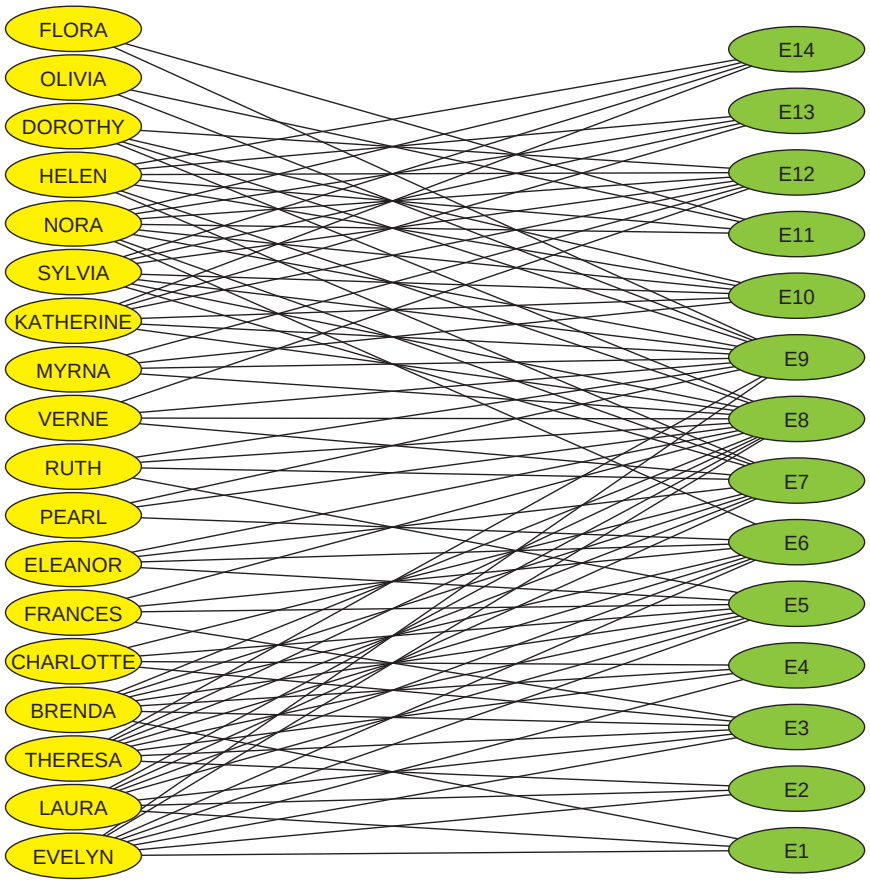
A two-mode network consists of two sets of units (e. g. people and events), relation connects the two sets, e. g. participation of people in social events.

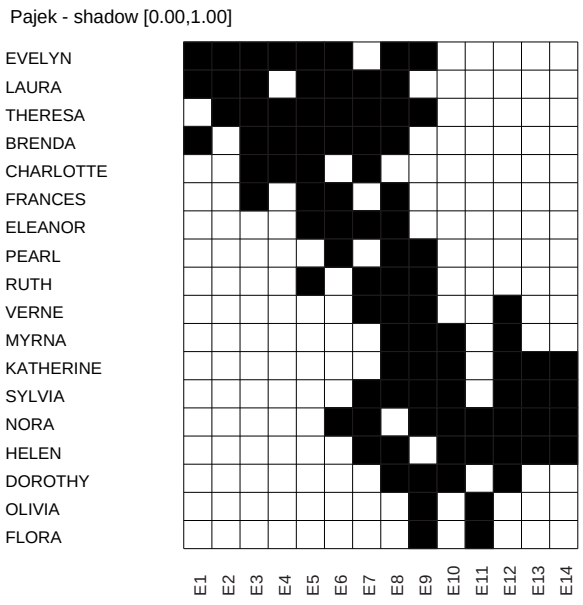
There exist several two-mode networks:

- *Membership in institutions* - people, institutions, *is a member*, e.g. directors and commissioners on the boards of corporations.
- *Voting for suggestions* - polititians, suggestions, *votes for*.
- *'Buying articles in the shop'*, where first set consists of consumers, the second of articles, the connection tells which *article was bought by a consumer*.
- *Readers and magazines*.
- *Citation network*, where first set consists of authors, the second set consists of articles/papers, connection is a relation *author cites a paper*.
- *Co-autorship networks* - authors, papers, *is a (co)author*.

A corresponding graph is called *bipartite graph* – lines connect only vertices from one to vertices from another set – inside sets there are no connections.

Example: participation of women in social events: davis.net – example from UCINET dataset:





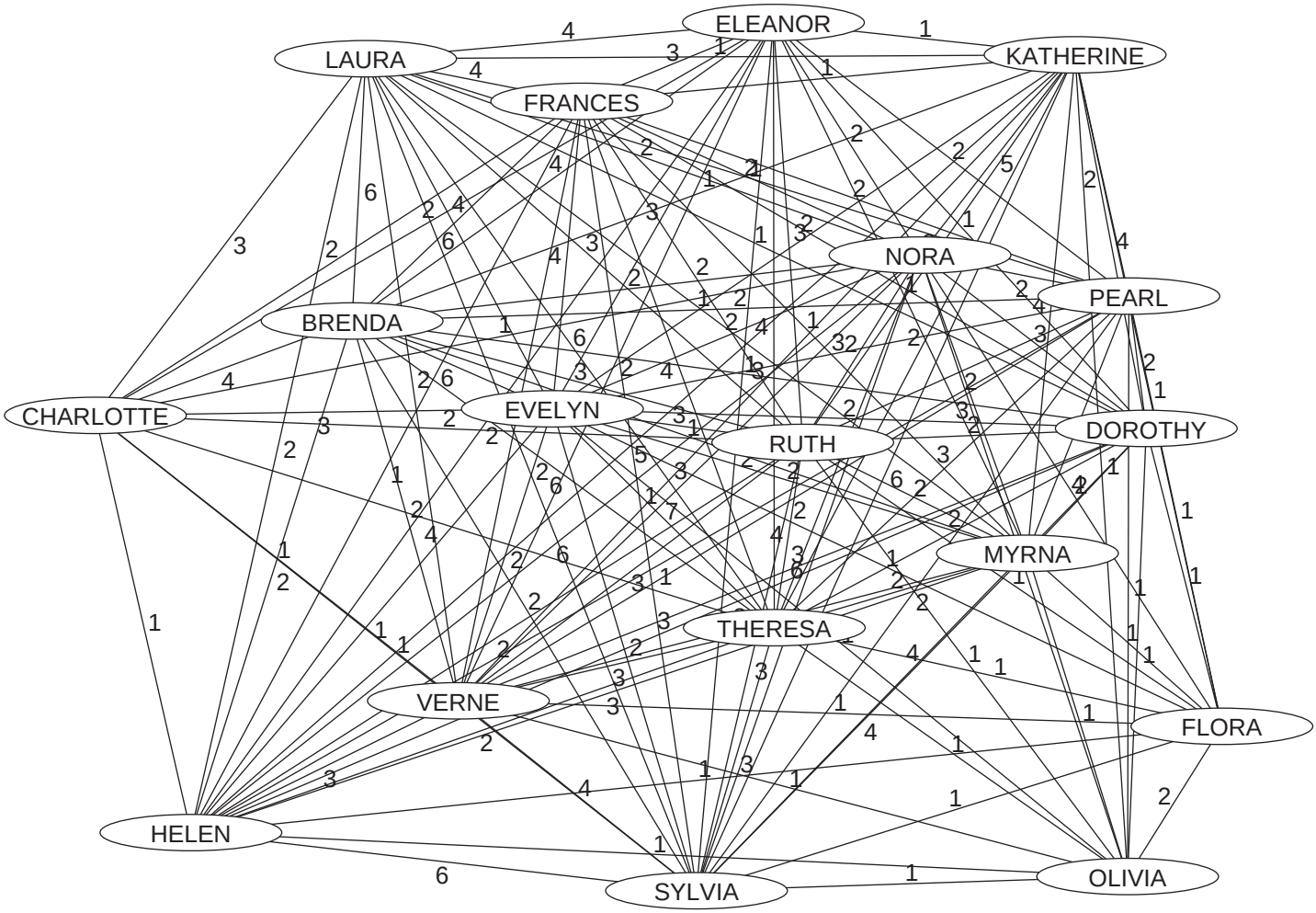
Transforming two-mode networks to ordinary valued networks

Two-mode network can be transformed to 'ordinary' network, where units are only units from first or only units from the second set.

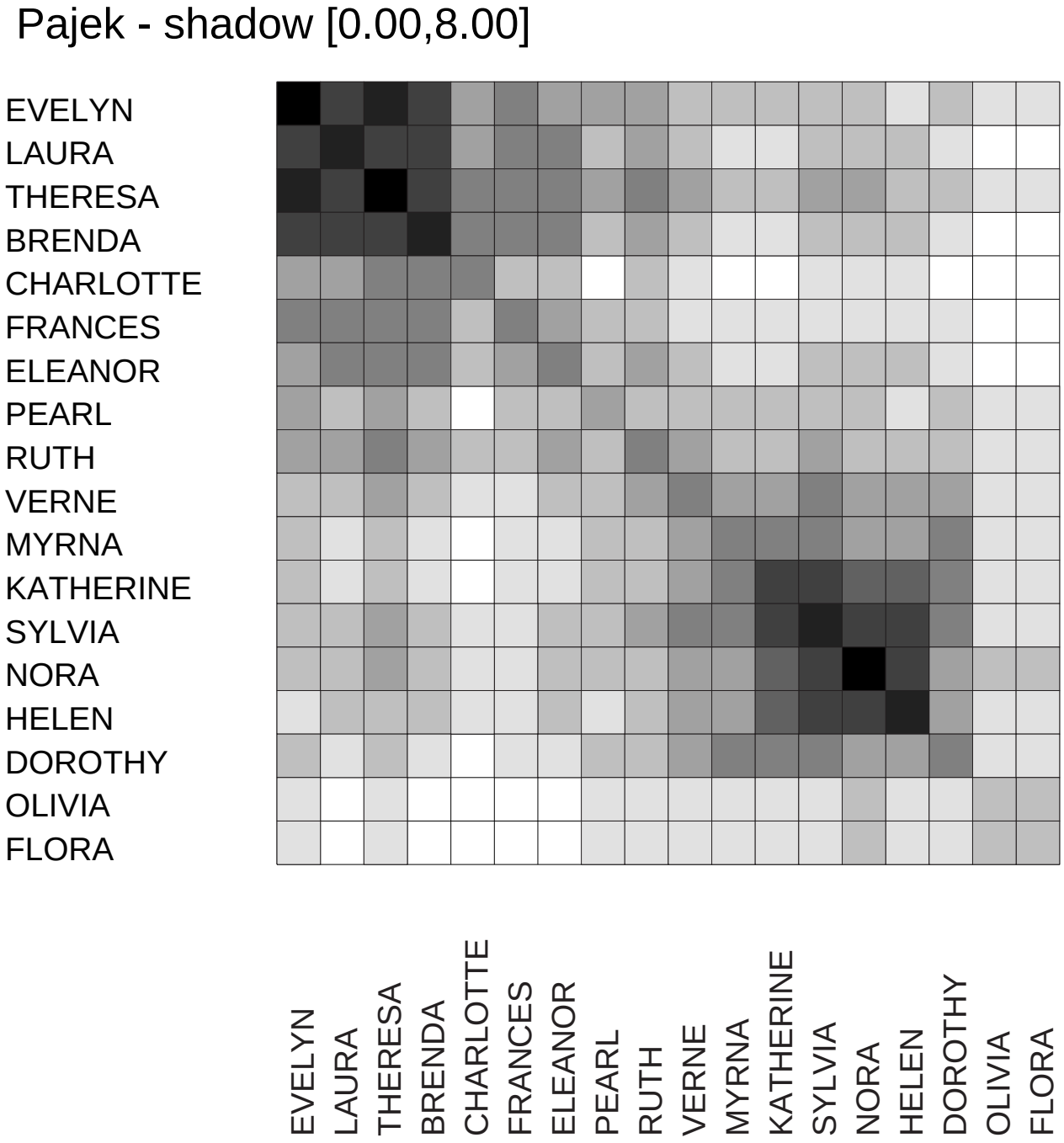
The previous two-mode network (women-events) can be transformed to ordinary network, where units are women. Two women are in relation (in the corresponding graph there exists an undirected line) if they took part in at least one common event. The line value tells the number of events where both of them took place. Loop values represent total number of events for each woman.

But if we transform network to ordinary network where units are events, the two events are in relation (in the corresponding graph there exists an undirected line) if there exists at least one woman who took part in both events. The line value between two events tells the number of women who took place in both events. Loop values represent total number of women present at each event.

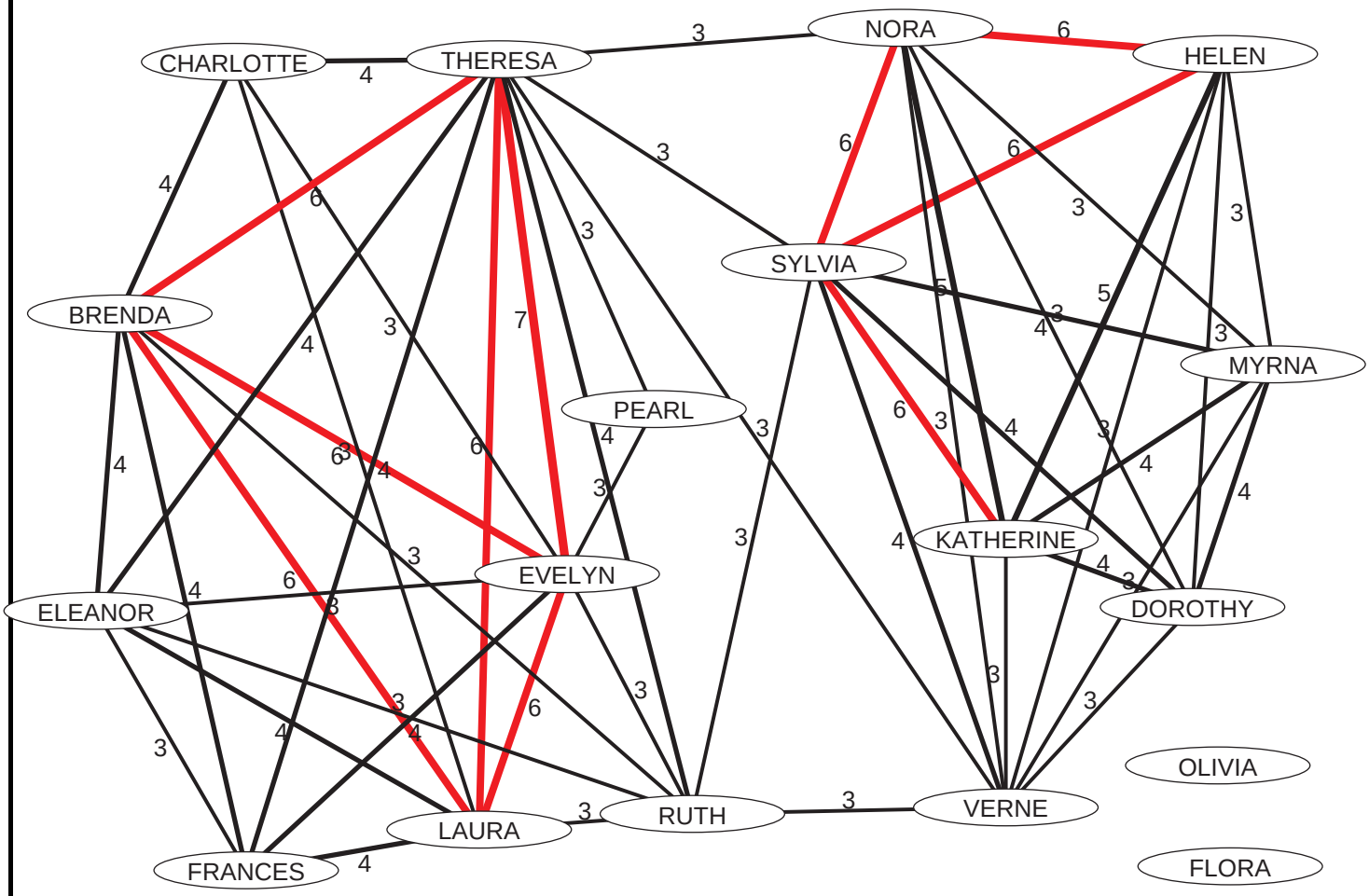
Network of women and number of common events (without loops)



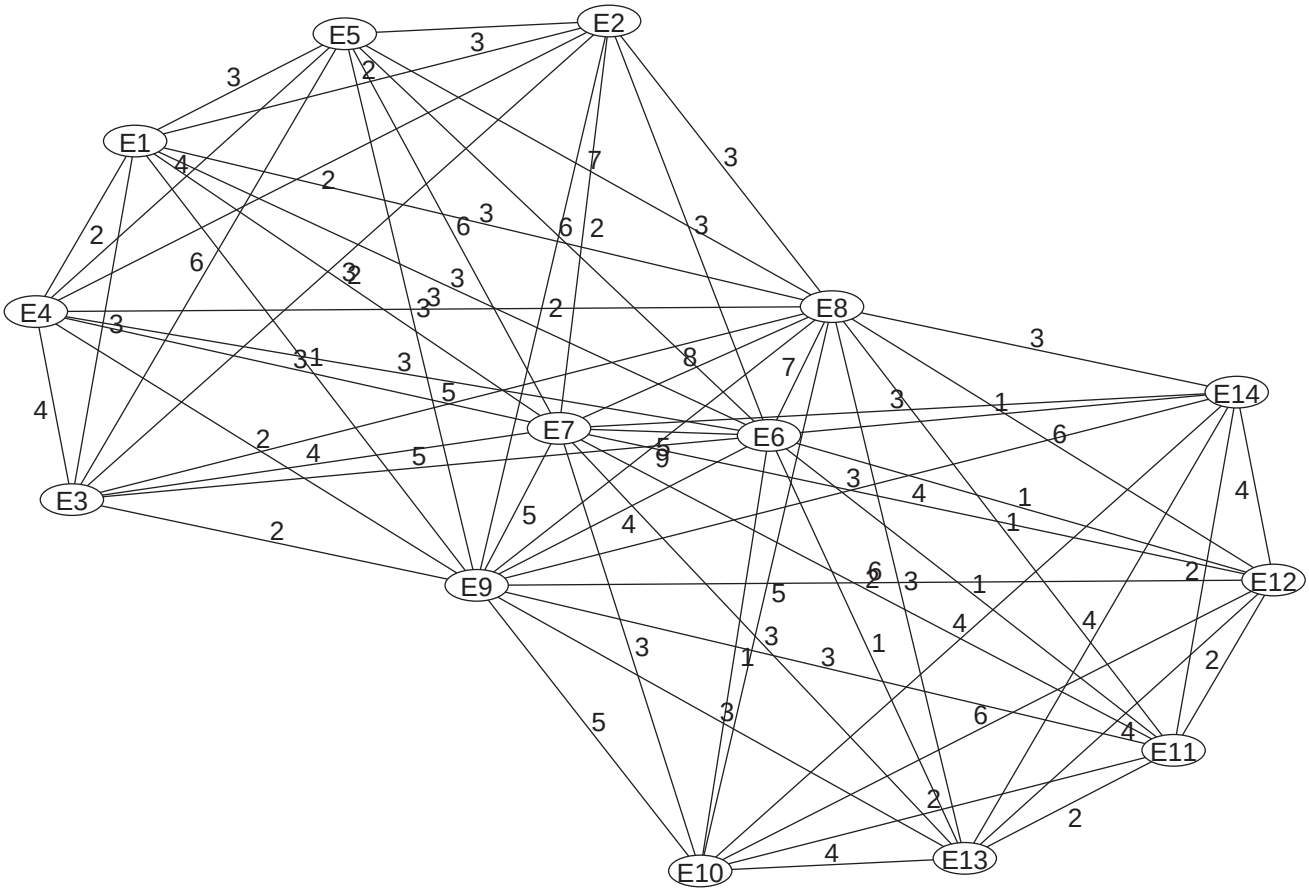
Matrix representation



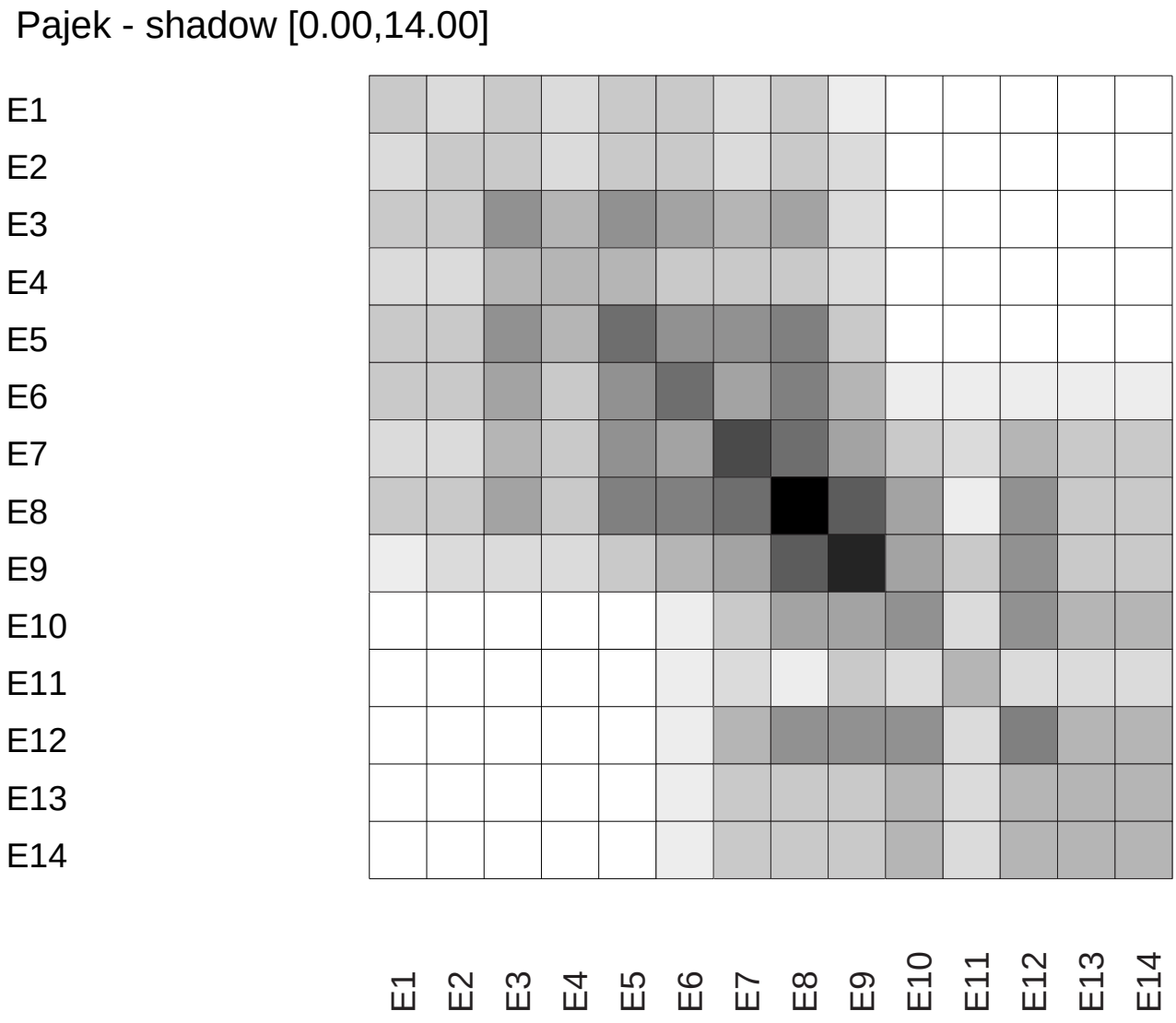
Number of common events at least 3



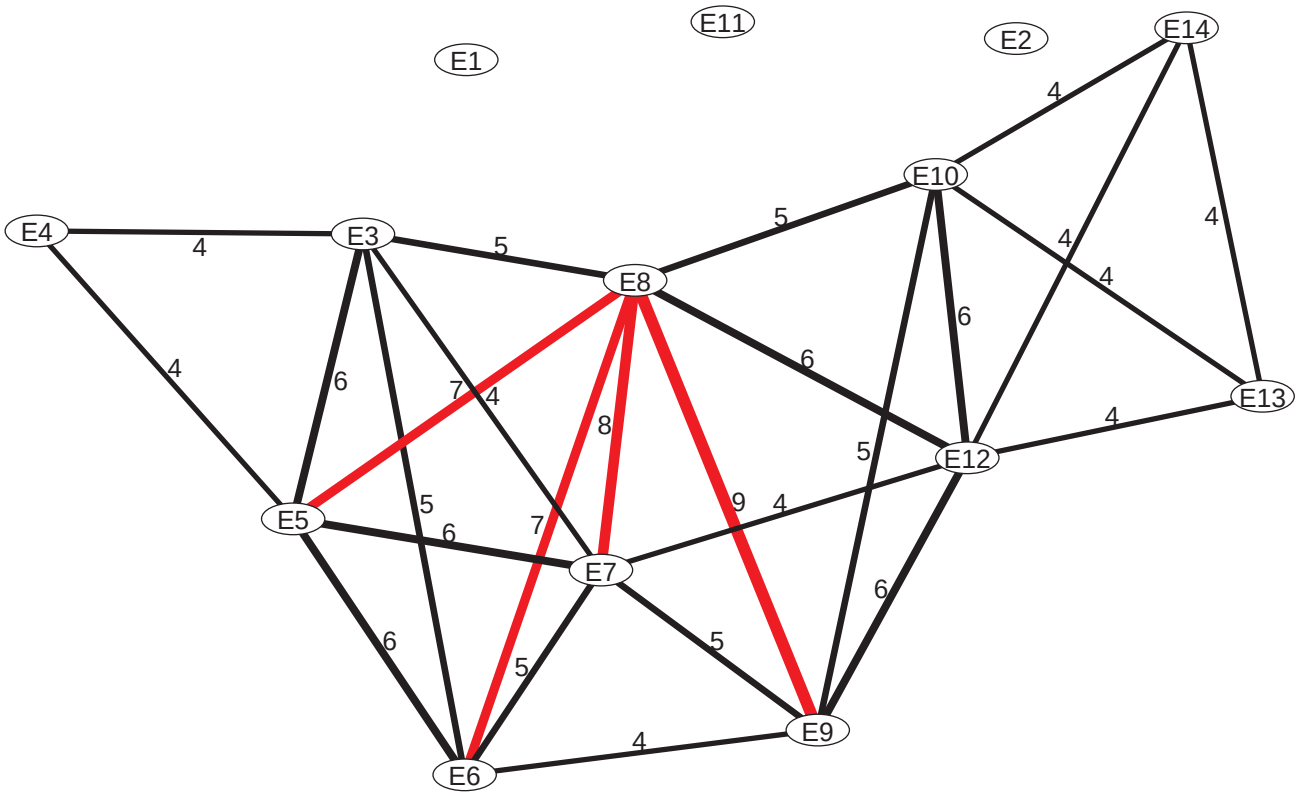
Network of events and number of women taking part in connected events (without loops)



Matrix representation



Number of common women at least 4



Transforming two-mode networks to ordinary networks in Pajek

A two-mode network is defined on an input file in the following way (Davis.net):

```
*Vertices 32 18
 1 EVELYN           27 E9
 2 LAURA            28 E10
 3 THERESA          29 E11
 4 BRENDA           30 E12
 5 CHARLOTTE        31 E13
 6 FRANCES          32 E14
 7 ELEANOR          *Edgeslist
 8 PEARL            1 19 20 21 22 23 24 26 27
 9 RUTH             2 19 20 21 23 24 25 26
10 VERNE            3 20 21 22 23 24 25 26 27
11 MYRNA            4 19 21 22 23 24 25 26
12 KATHERINE        5 21 22 23 25
13 SYLVIA           6 21 23 24 26
14 NORA             7 23 24 25 26
15 HELEN            8 24 26 27
16 DOROTHY          9 23 25 26 27
17 OLIVIA           10 25 26 27 30
18 FLORA            11 26 27 28 30
19 E1               12 26 27 28 30 31 32
20 E2               13 25 26 27 28 30 31 32
21 E3               14 24 25 27 28 29 30 31 32
22 E4               15 25 26 28 29 30 31 32
23 E5               16 26 27 28 30
24 E6               17 27 29
25 E7               18 27 29
26 E8
```

Explanation

The only difference comparing to ordinary networks is that we have to specify the total number of vertices (in our case 32) and number of vertices that belong to the first subset (in our case 18 women). First, all vertices from the first subset must be listed (women) and afterwards all vertices from the second subset (events). Partition into the two subsets is obtained using Network/2-Mode Network/Partition into 2 Modes, where value 1 is given to vertices from the first subset (women), and value 2 to vertices from the second subset (events).

Transforming to valued networks

The network is transformed into an ordinary network, where the vertices are elements from the first subset (women), using Network/2-Mode Network/2-Mode to 1-Mode/Rows.
If we want to get a network with elements from the second subset Network/2-Mode Network/2-Mode to 1-Mode/Cols.
Network with or without loops can be generated:
Network/2-Mode Network/2-Mode to 1-Mode/Include Loops.

We can generate network with values on lines (in our case number of common events) or network with multiple lines – for each common event a line between corresponding two women:

Network/2-Mode Network/2-Mode to 1-Mode/Multiple Lines

For our purposes we will always generate a valued network, sometime the loops will be useful sometimes not.

Obtaining picture of valued network

We store values of loops (e.g. total number of events for each women) into vector using Network/Create Vector/Get Loops and use later this vector to determine sizes of vertices (Draw/Network + Vector).
After network with values on lines is generated we can visualize it in different ways:

- picture of complete network: First we draw network using Energy drawing, providing that option Options/Values of Lines/Similarities is selected (vertices connected with higher values will be drawn closer).

  Values of lines can be shown using different widths of lines (Options/Lines/Different Widths) and/or greyscale (Options/Lines/GreyScale).

  After that we export picture to SVG, where we can interactively add lines according to their values: Export/SVG/LineValues/Nested Classes.
- picture of the most important part of the network: only

lines with values which are large enough are kept.

Distribution of line values can obtained using
Network/Info/Line Values.

According to the distribution, we remove lines with low vaues from the network using
Network/Create New Network/Transform/Remove/...
...lines with value/lower than
and entering the limit value.

Islands

In a network where some properties (values) of vertices or lines are known we can find *islands*. Islands are called *vertex islands* if values of vertices are given, and they are called *line islands* if values of lines are given.

Lets take the network obtained from two mode network. As we know, in such network values of lines are given, therefore we can find line islands – clusters of vertices, connected with lines having higher values than values of lines going out (inside islands line values are higher than between islands).

We must also select the smallest and the largest size of island allowed. In Pajek line islands are computed using

Network/Create Partition/Islands/Line Weights

Examples

- Analyse and draw two-mode network Davis.net.
- Compute line islands for networks Davis.net.