

12 — Relational Data (1)

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Relational Data

Load the packages, as always

```
library(here)      # manage file paths  
library(socviz)   # data and some useful functions  
library(tidyverse) # your friend and mine
```

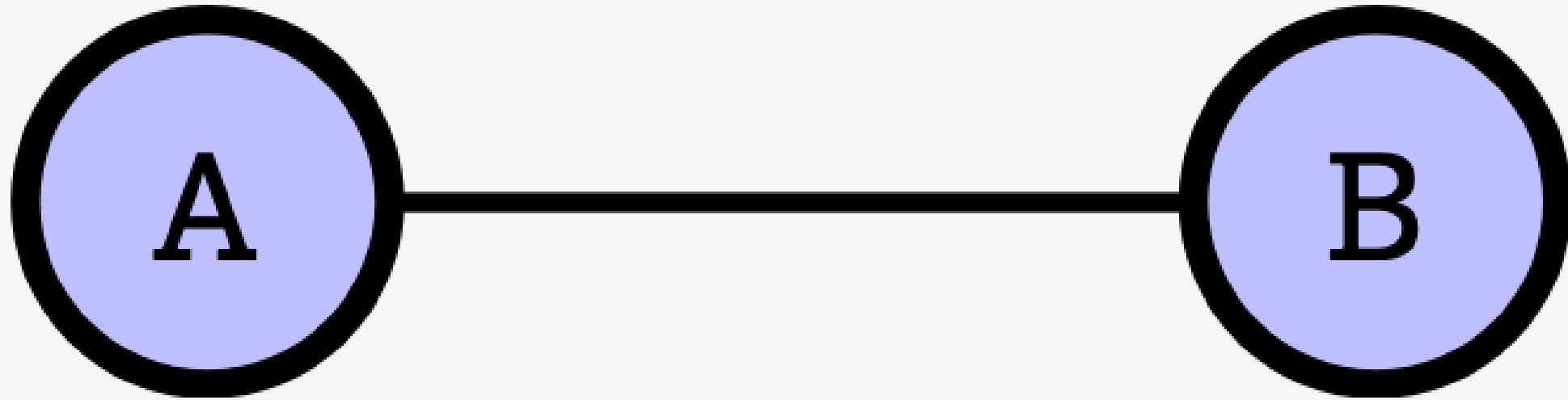
Specialty packages

```
library(tidygraph) # tidy management of relational data
library(ggraph)    # geoms for drawing graphs

#remotes::install_github("kjhealy/kjhnet")
library(kjhnet)    # some network datasets
```

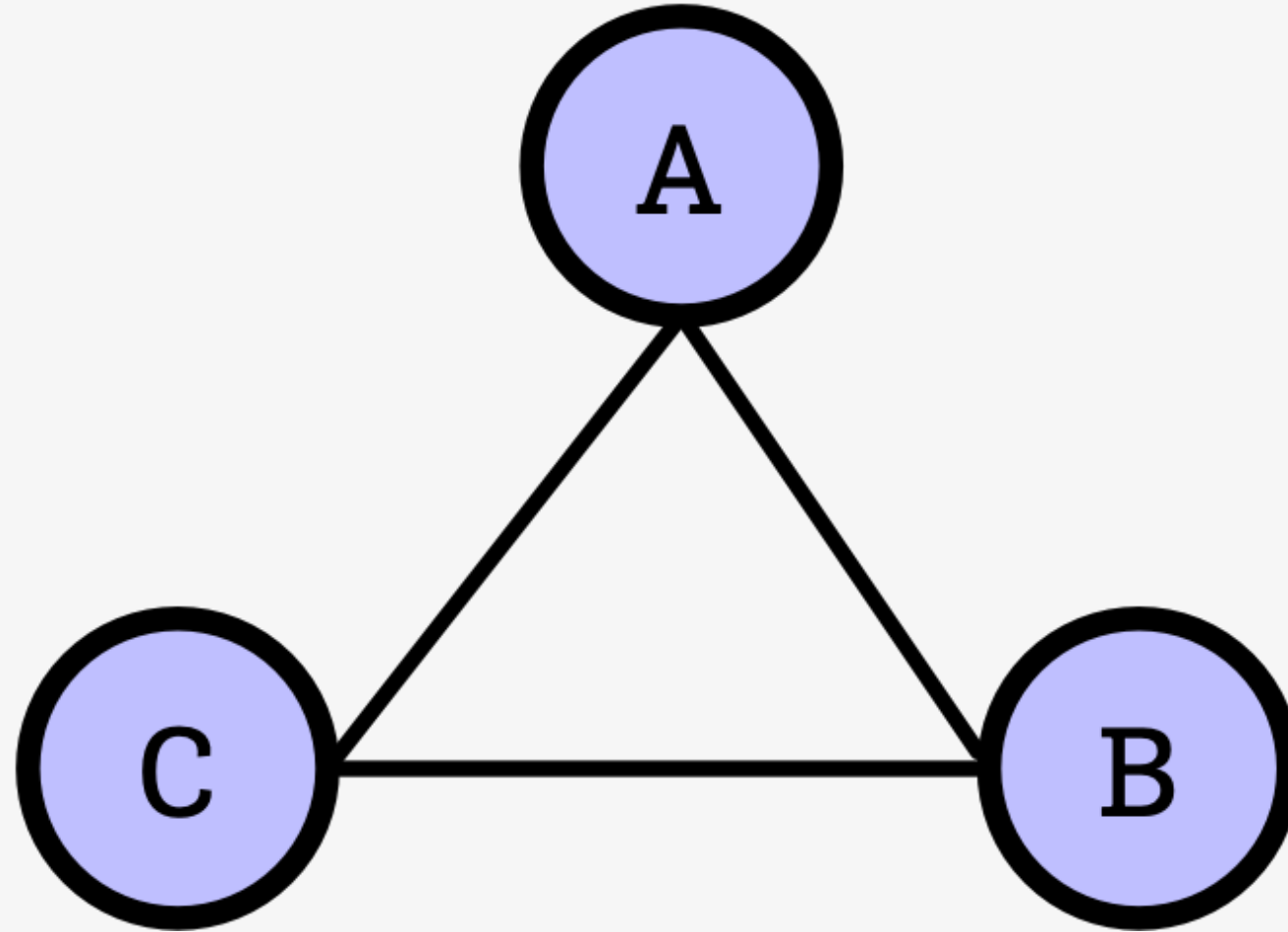
Social Relations and Ties

Social Relations and Ties



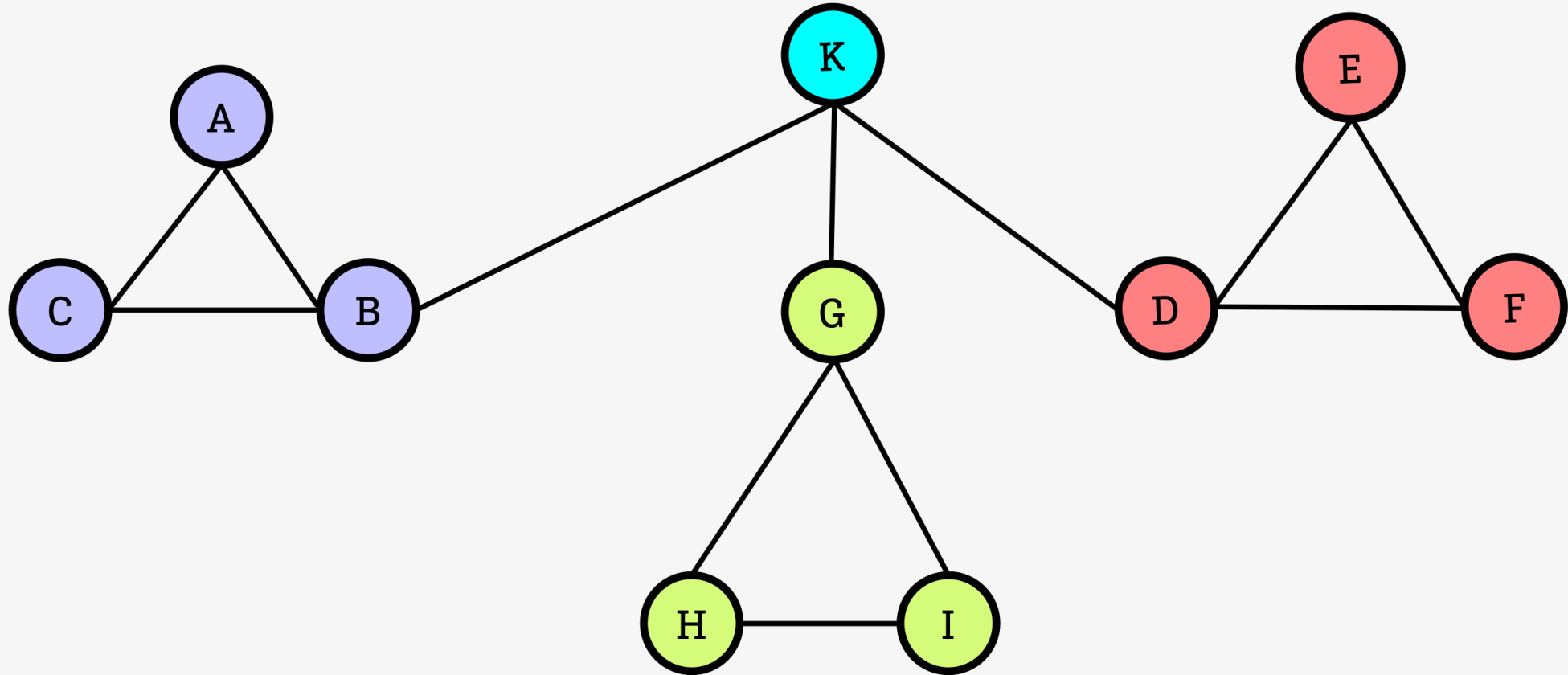
A dyad

Social Relations and Ties



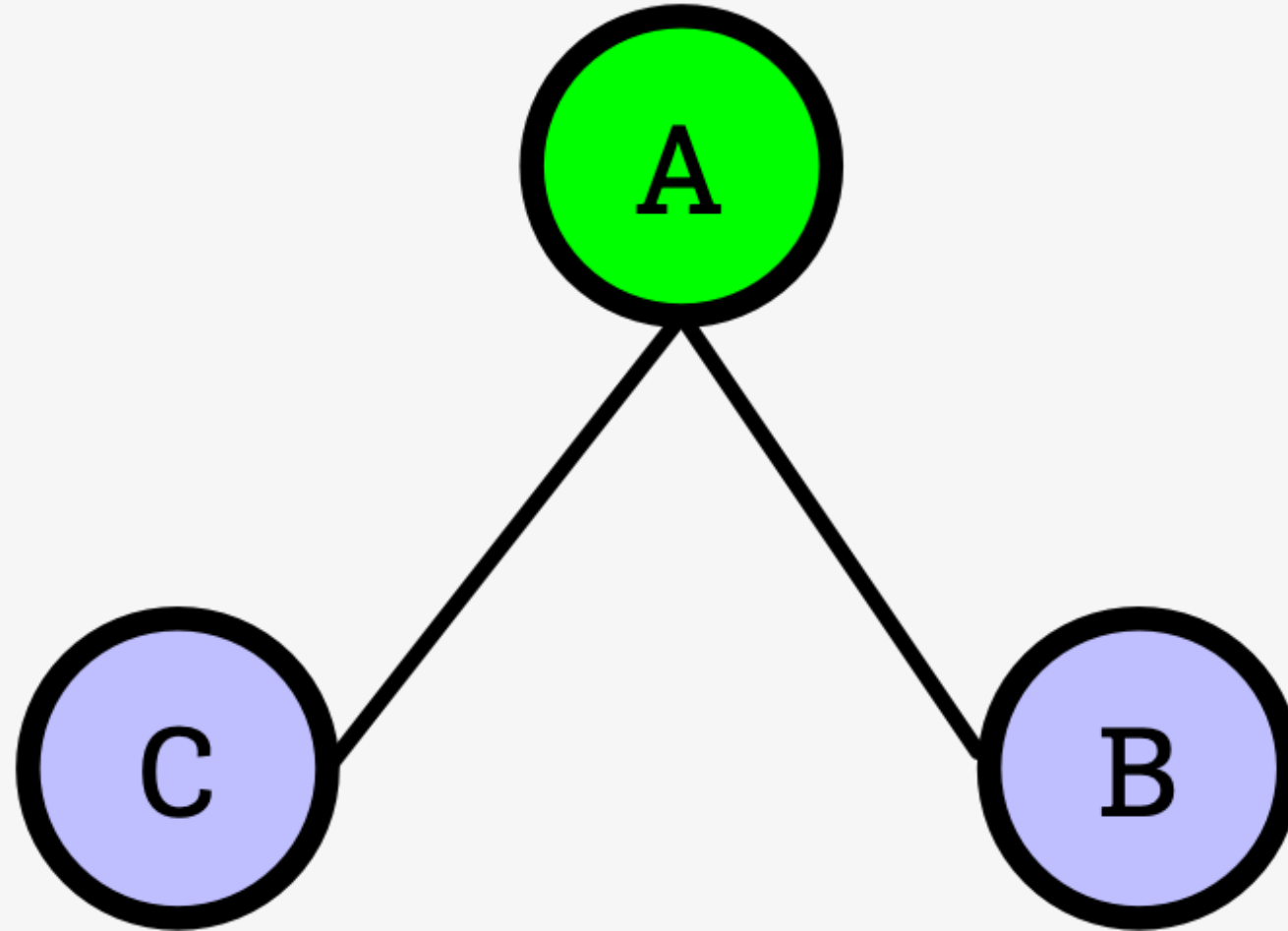
Triads

Centrality in Networks



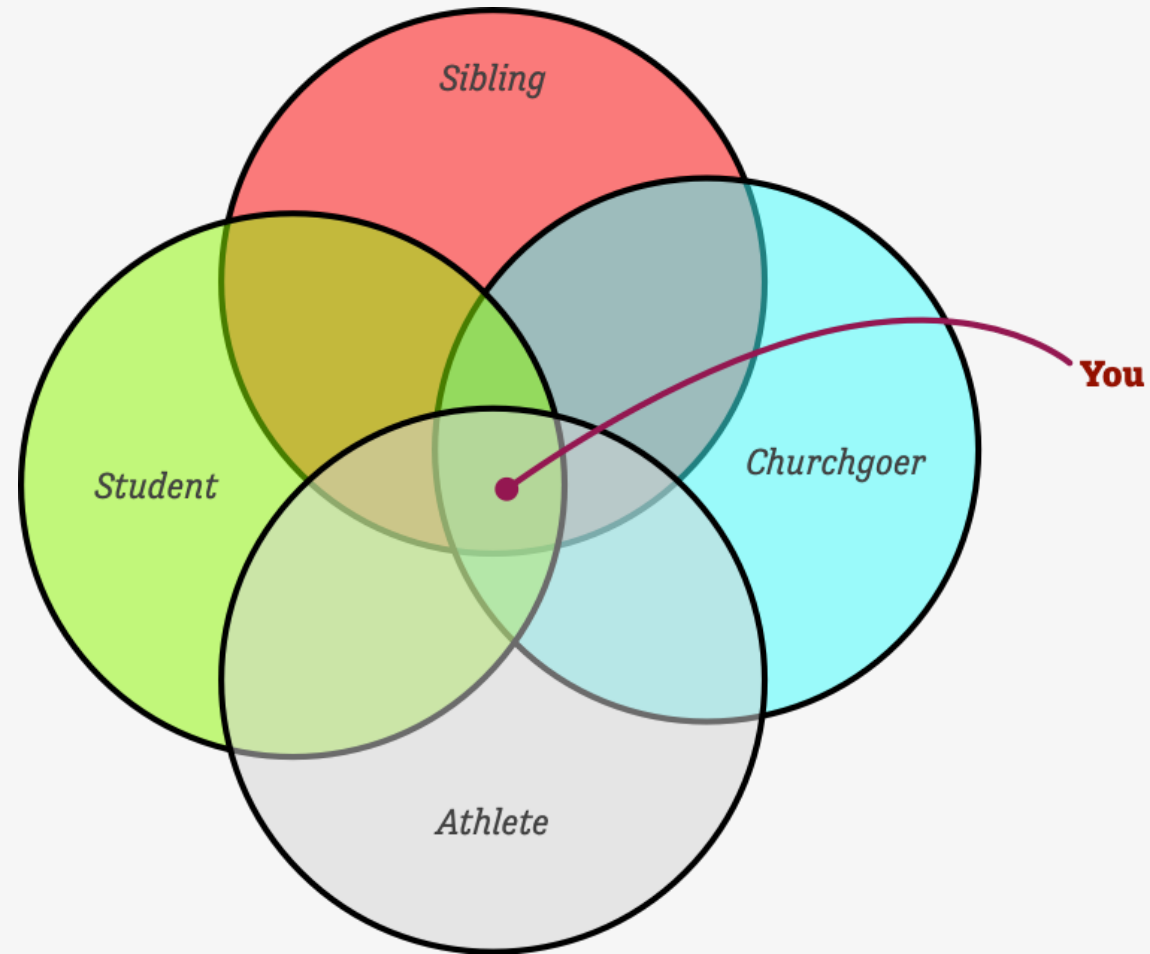
Centrality

Centrality as a kind of power



The 'tertius gaudens' or 'laughing third'

Groups and Categories



The duality of persons and groups



The Redcoats are coming

Example: Paul Revere

Paul Revere



He looks a lot like Jack Black

Paul Revere

St Andrew's Lodge

The Loyal Nine

Boston North Caucus

The Long Room Club

The Tea Party

The Boston Committee

The London Enemies List

Paul Revere

7 organizations

254 people

Membership table

	<i>- St Andrew's Lodge</i>	<i>- The Loyal Nine</i>	<i>- Boston North Caucus</i>	<i>- The Long Room Club</i>	<i>- The Tea Party</i>	<i>- The Boston Committee</i>	<i>- The London Enemies List</i>
- J. Adams	0	0	1	1	0	0	0
- S. Adams	0	0	1	0	0	0	0
- N. Appleton	0	0	1	0	0	0	0
- G. Ash	1	0	1	0	0	0	1
- B. Austin	0	0	0	0	0	0	0
- S. Austin	0	1	0	0	0	1	0
- J. Avery	0	0	1	0	0	0	1
- C. Baldwin	0	0	0	0	1	0	0
- J. Ballard	0	1	0	0	0	1	0

This is an adjacency matrix

Membership table ... transposed

- J. Adams	0	0	1	1	1	0	0	0	- St Andrew's Lodge
- S. Adams	0	0	0	1	0	0	0	0	- The Loyal Nine
- N. Appleton	0	0	1	0	0	0	0	0	- Boston North Caucus
- G. Ash	1	0	0	0	0	0	0	1	- The Long Room Club
- B. Austin	0	0	0	0	0	0	0	0	- The Tea Party
- S. Austin	0	1	0	0	0	0	0	0	- The Boston Committee
- J. Avery	0	0	1	0	0	0	0	1	- The London Enemies List
- C. Baldwin	0	0	0	0	1	0	0	0	
- J. Ballard	0	1	0	0	1	0	0	0	

Flip it on its side

The Duality of Persons and Groups

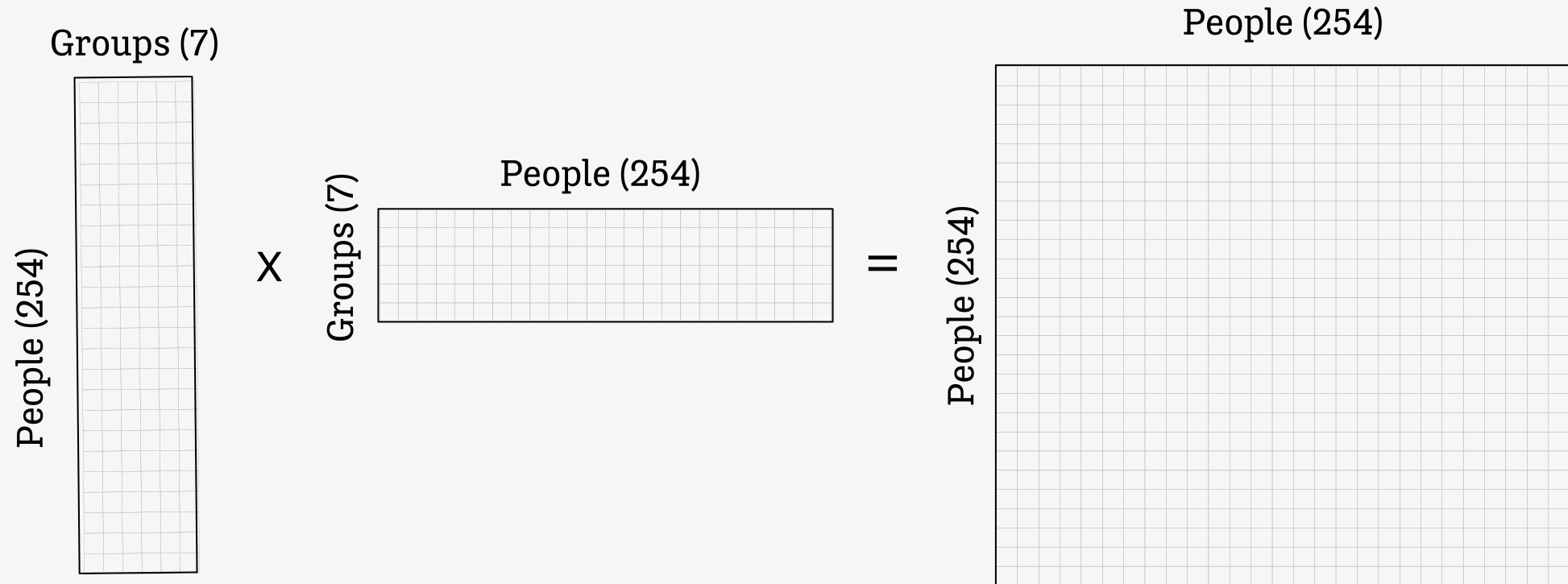
People are “connected” by their co-membership in groups

Groups are “connected” by the people they share

We can move back and forth between these representations

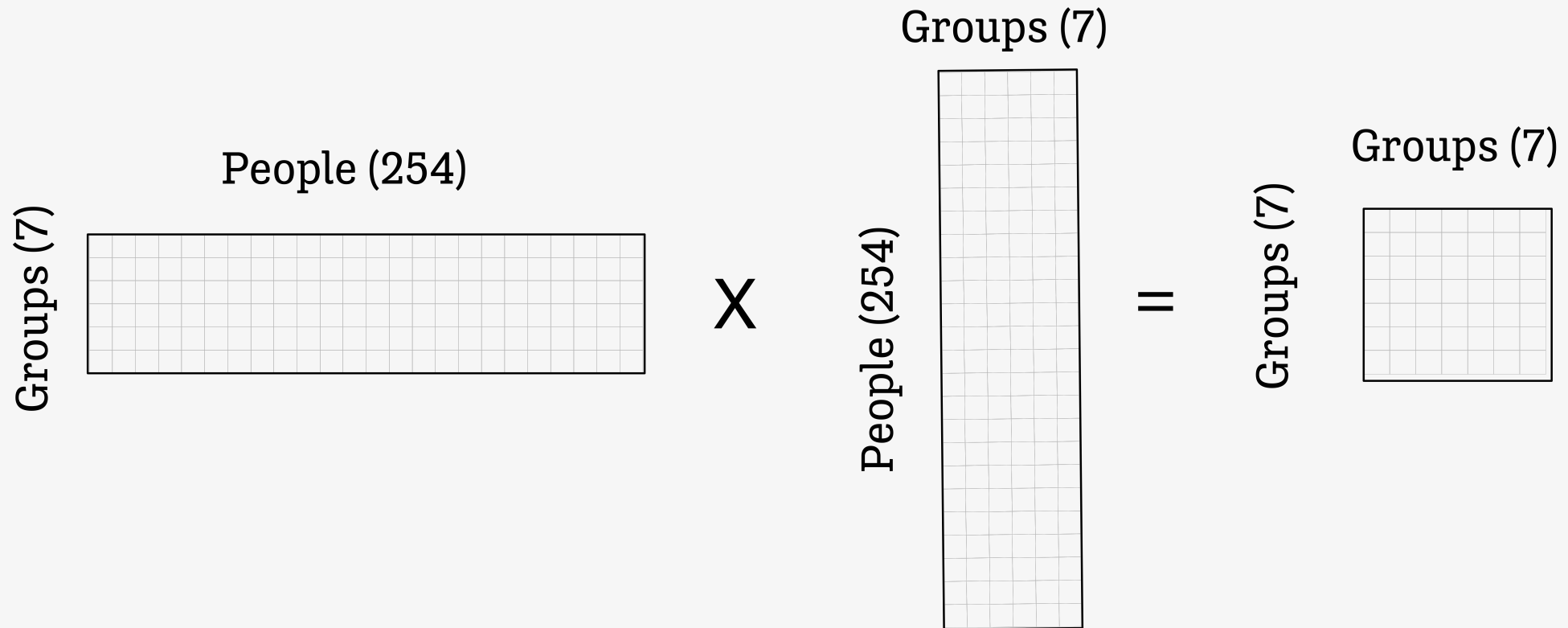
Breiger (1974)

Moving between the tables



One way to multiply the matrices

Moving between the tables



And the other way

Paul Revere: Matrix version

```
head(revere)
```

```
      person st_andrews_lodge loyal_nine north_caucus long_room_club
1     Adams.John           0           0             1             1
2     Adams.Samuel         0           0             1             1
3       Allen.Dr           0           0             1             0
4 Appleton.Nathaniel       0           0             1             0
5       Ash.Gilbert        1           0             0             0
6   Austin.Benjamin        0           0             0             0
 tea_party boston_committee london_enemies
1          0              0             0
2          0              1             1
3          0              0             0
4          0              1             0
5          0              0             0
6          0              0             1
```

```
tail(revere)
```

```
      person st_andrews_lodge loyal_nine north_caucus long_room_club
249 Willis.Nathaniel         0           0             0             0
250 Wingfield.William        1           0             0             0
251   Winslow.John           0           0             0             1
252   Winthrop.John          0           0             1             0
253   Wyeth.Joshua           0           0             0             0
254   Young.Thomas           0           0             1             0
 tea_party boston_committee london_enemies
249        1              0             0
250        0              0             0
251        0              0             0
252        0              0             1
253        1              0             0
254        1              1             0
```

Paul Revere: Matrix version

```
r_p ← as.matrix(revere[,-1]) %*% t(as.matrix(revere[,-1]))  
dim(r_p)
```

```
[1] 254 254
```

```
r_p[1:10, 1:10]
```

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]	[,10]
[1,]	2	2	1	1	0	0	0	0	0	1
[2,]	2	4	1	2	0	1	1	1	1	1
[3,]	1	1	1	1	0	0	0	0	0	1
[4,]	1	2	1	2	0	0	0	0	0	1
[5,]	0	0	0	0	1	0	0	0	0	0
[6,]	0	1	0	0	0	1	1	1	1	0
[7,]	0	1	0	0	0	1	1	1	1	0
[8,]	0	1	0	0	0	1	1	2	1	0
[9,]	0	1	0	0	0	1	1	1	1	0
[10,]	1	1	1	1	0	0	0	0	0	1

Paul Revere: Matrix version

```
r_g ← t(as.matrix(revere[,-1])) %*% as.matrix(revere[,-1])
```

```
dim(r_g)
```

```
[1] 7 7
```

```
r_g
```

	st_andrews_lodge	loyal_nine	north_caucus	long_room_club
st_andrews_lodge	53	2	3	2
loyal_nine	2	10	3	0
north_caucus	3	3	59	5
long_room_club	2	0	5	17
tea_party	3	2	13	2
boston_committee	1	0	9	5
london_enemies	3	3	16	5

	tea_party	boston_committee	london_enemies
st_andrews_lodge	3	1	3
loyal_nine	2	0	3
north_caucus	13	9	16
long_room_club	2	5	5
tea_party	97	3	8
boston_committee	3	21	11
london_enemies	8	11	62

Making this tidier

Network matrices get really large really fast

They're also usually very *sparse*

We can't store this data tidily in a *single* table

But we *can* with two tables. `tidygraph` does this for us.

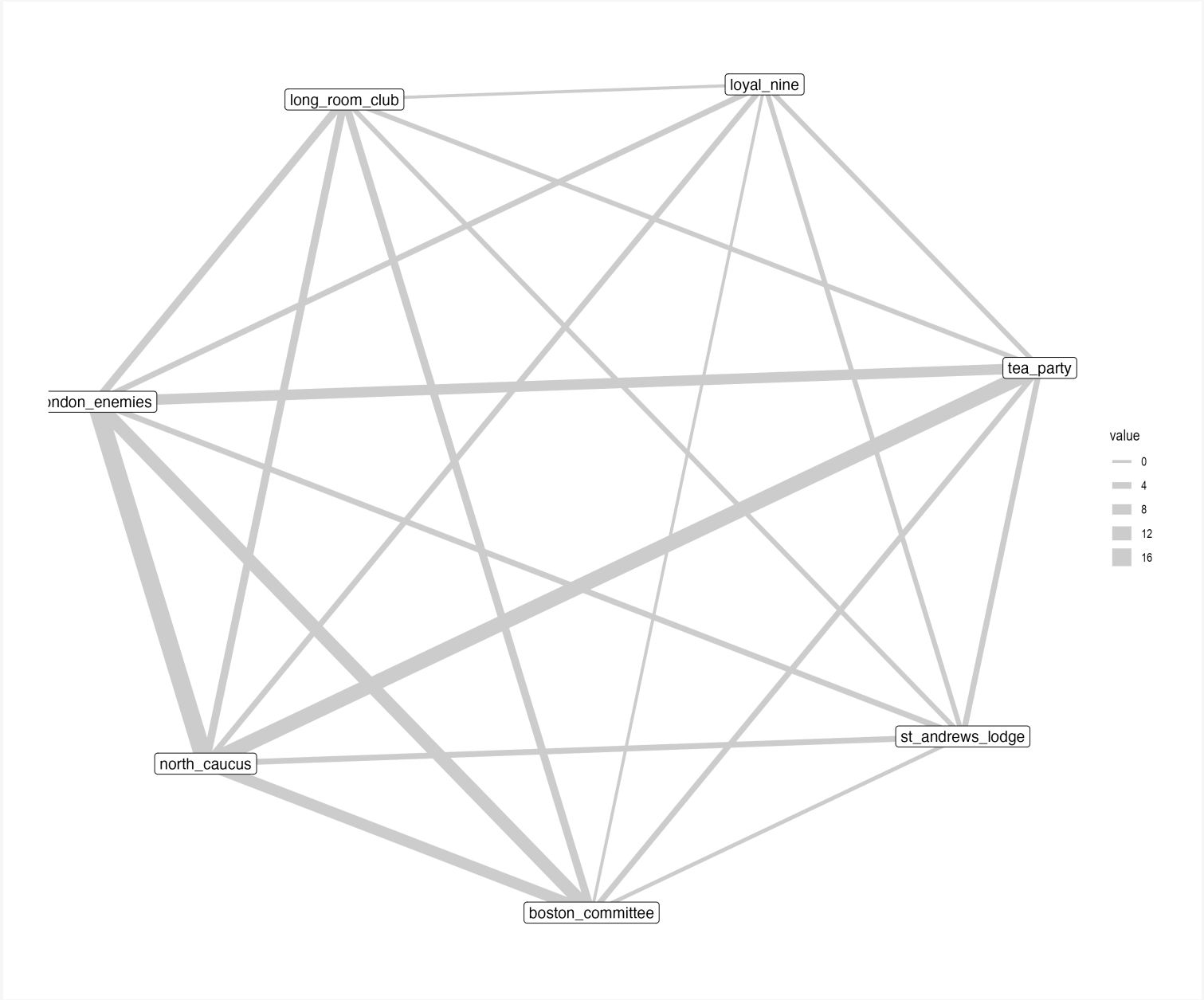
Paul Revere: Tidy version

```
revere_groups
```

```
# A tbl_graph: 7 nodes and 49 edges
#
# An undirected multigraph with 1 component
#
# Node Data: 7 × 2 (active)
  id name
<int> <chr>
1     1 st_andrews_lodge
2     2 loyal_nine
3     3 north_caucus
4     4 long_room_club
5     5 tea_party
6     6 boston_committee
7     7 london_enemies
#
# Edge Data: 49 × 3
  from to value
<int> <int> <dbl>
1     1     1    53
2     1     2     2
3     1     3     3
# i 46 more rows
```

Paul Revere: Tidy version

```
out ← revere_groups ▷  
  ggraph(layout = "kk") +  
  geom_edge_link(aes(width = value), color = "gray80") +  
  geom_node_label(aes(label = name)) + theme_graph()
```



Paul Revere: Tidy version

The person x person network

```
out ← revere_persons ▷  
  mutate(centrality = centrality_eigen()) ▷  
  ggraph(layout = "stress") +  
  geom_edge_link0(aes(edge_width = value), color = "gray60") +  
  scale_edge_width(range = c(0.02, 2))+  
  geom_node_point() +  
  geom_node_label(aes(filter = centrality > 0.9, label = name), size = rel(2.5)) +  
  theme_graph()
```

