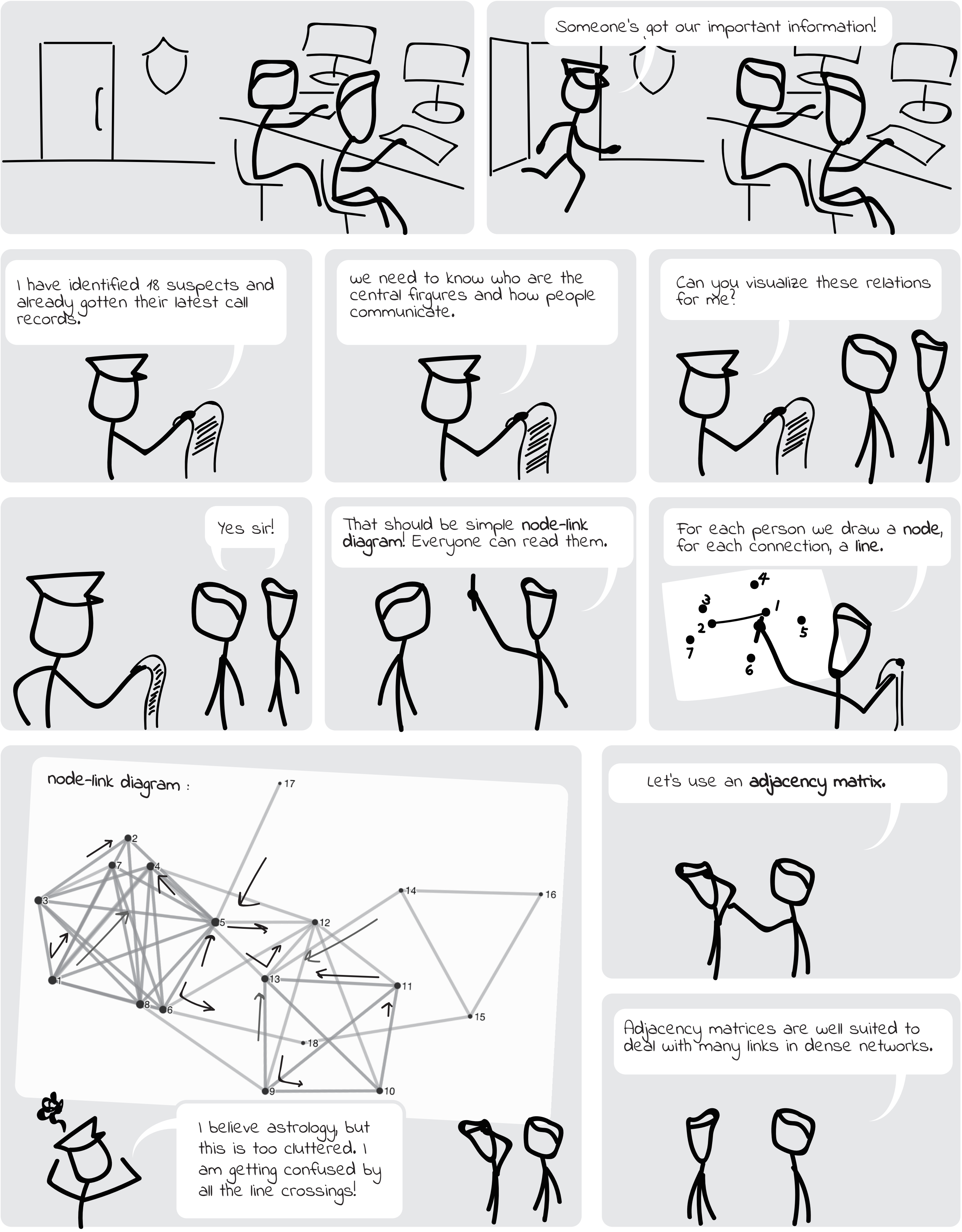
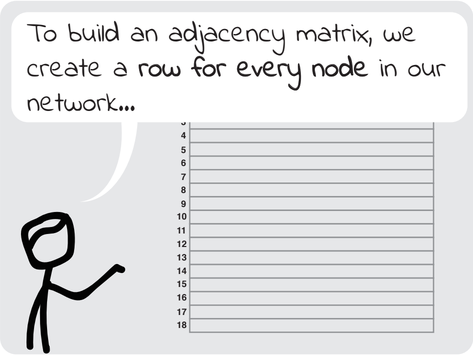
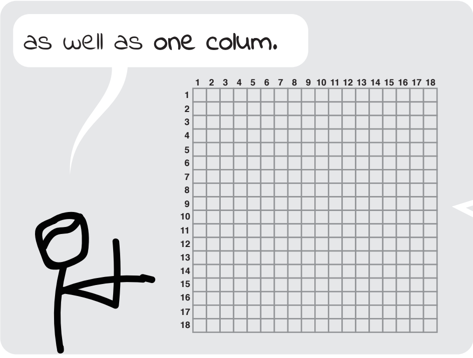
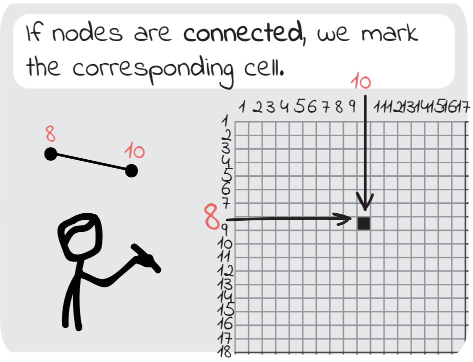
Adjacency Matrix

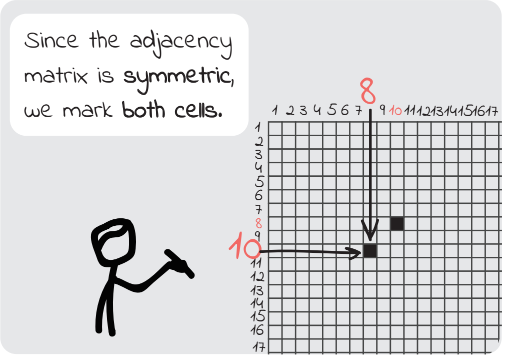
Introduction

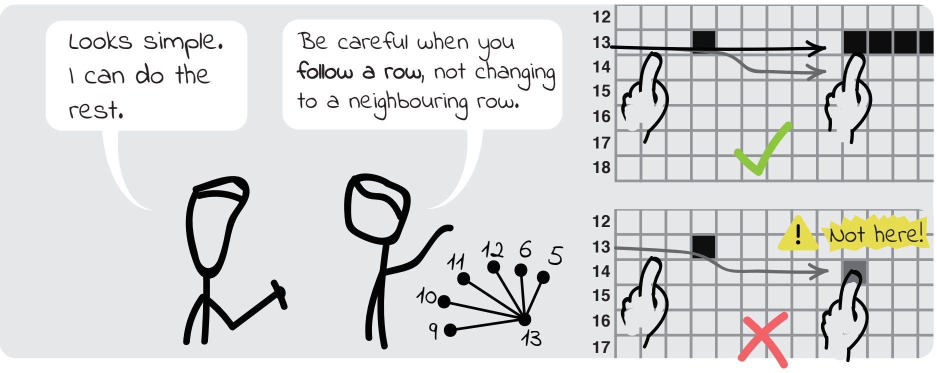

Someone's got our important information!
I have identified 18 suspects and already gotten their latest call records.
we need to know who are the central firgures and how people communicate.
Can you visualize these relations for me?
Yes sir!
That should be simple **node-link diagram**! Everyone can read them.
For each person we draw a **node**, for each connection, a **line**.
4
3
1
2
5
7
6
node-link diagram :
17
2
7
4
3
14
16
5
12
1
13
11
8
6
15
18
9
10
I believe astrology, but this is too cluttered. I am getting confused by all the line crossings!
Let's use an **adjacency matrix**.
Adjacency matrices are well suited to deal with many links in dense networks.

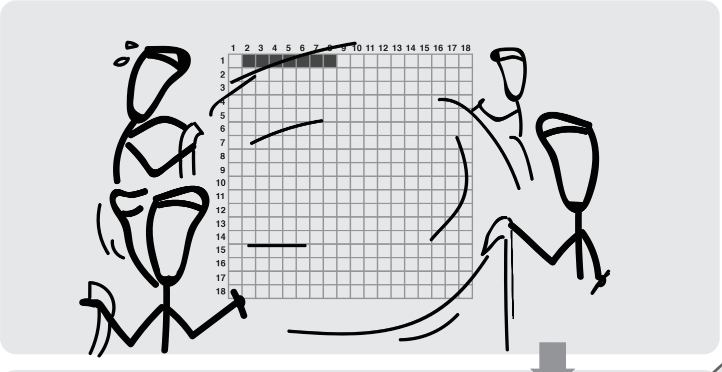

To build an adjacency matrix, we create a **row for every node** in our network...
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

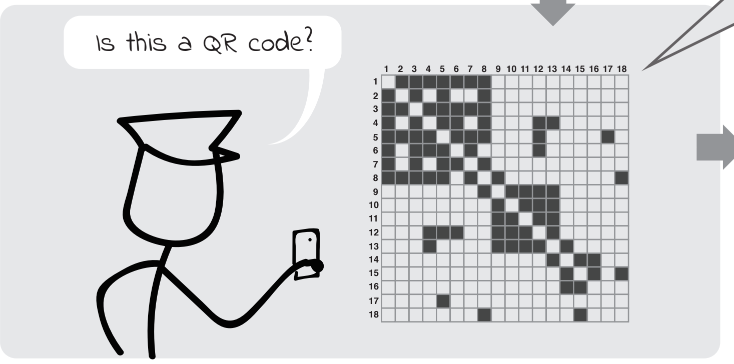

as well as **one colum.**
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

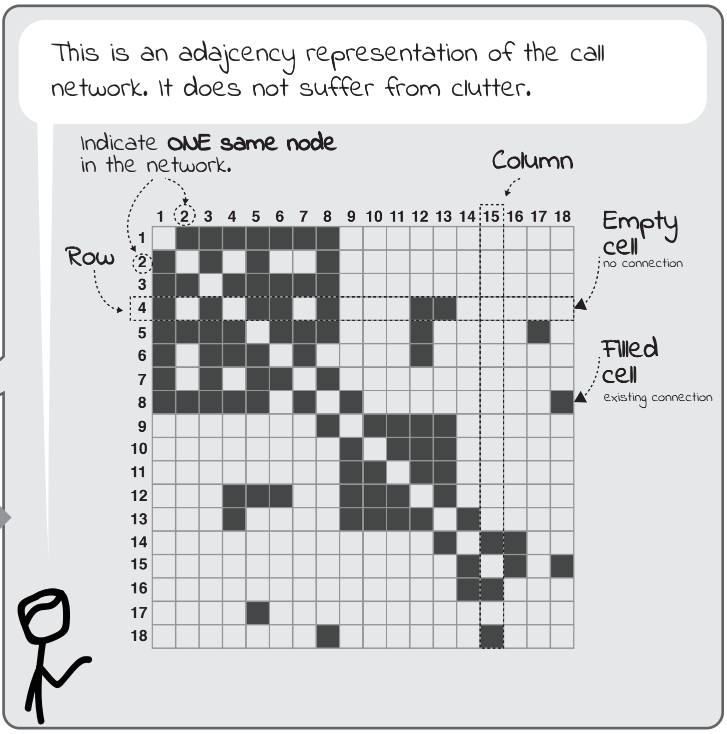

If nodes are **connected**, we mark the corresponding cell.
8
10
10
8

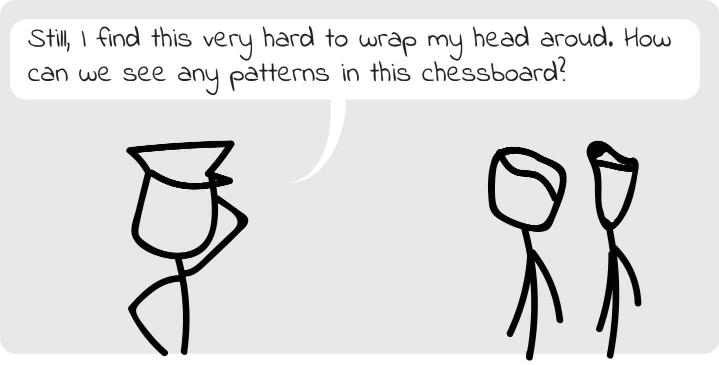

Since the adjacency matrix is **symmetric**, we mark **both cells.**
8
10

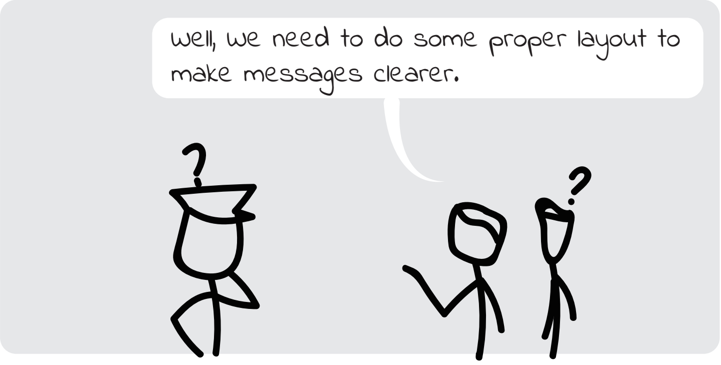

Looks simple. I can do the rest.
Be careful when you **follow a row**, not changing to a neighbouring row.
11 12 6 5
10 9 13
12 13 14 15 16 17 18
12 13 14 15 16 17
Not here!

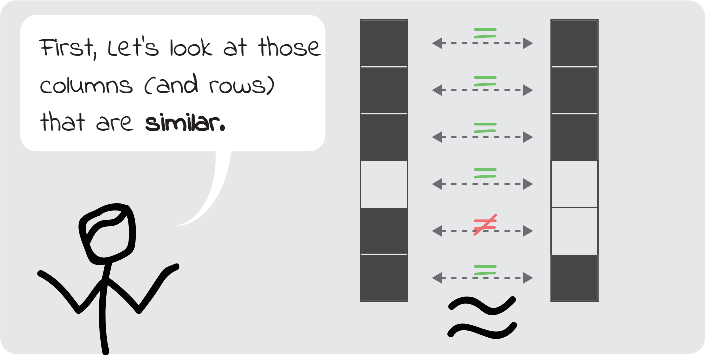


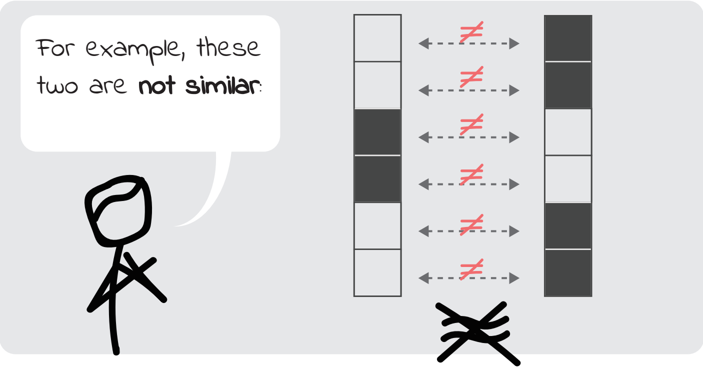

Is this a QR code?


This is an adajcency representation of the call network. It does not suffer from clutter.
Indicate **ONE same node** in the network.
Column
Row
Empty cell
no connection
Filled cell
existing connection

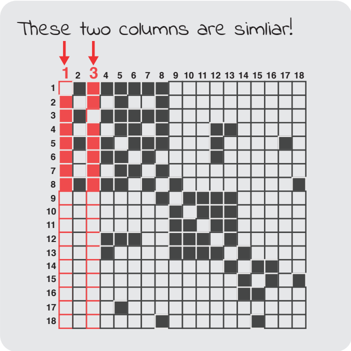

Still, I find this very hard to wrap my head aroud. How can we see any patterns in this chessboard?

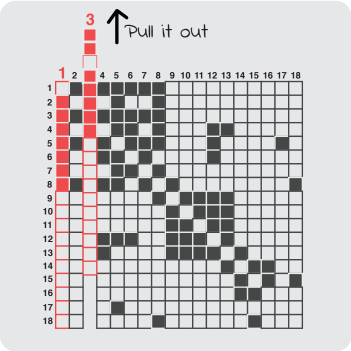

Well, we need to do some proper layout to make messages clearer.

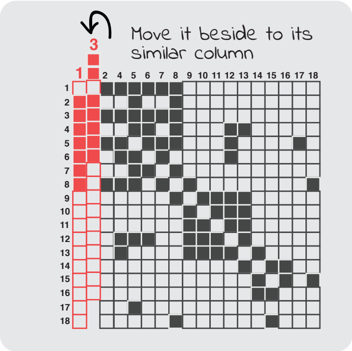

First, Let's look at those columns (and rows) that are **similar.**
=
=
=
=
≠
=
≈

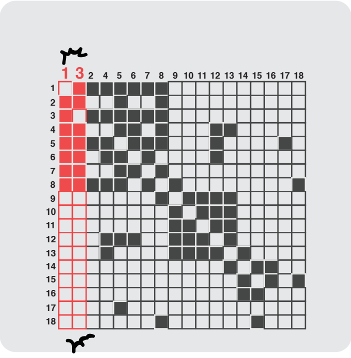

For example, these two are **not similar.**
≠
≠
≠
≠
≠
≠

Now we will move simliar columns nearby...

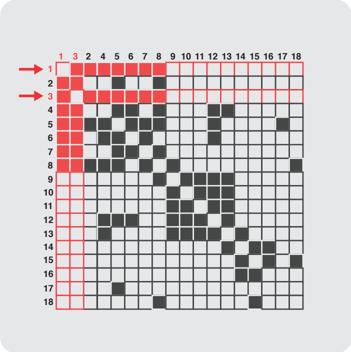

These two columns are simliar!
1
3

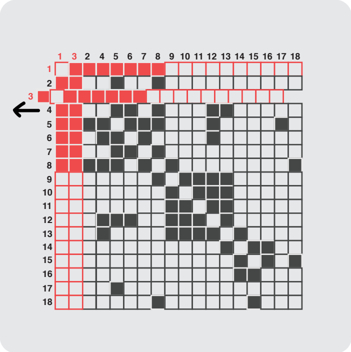

3
Pull it out
1

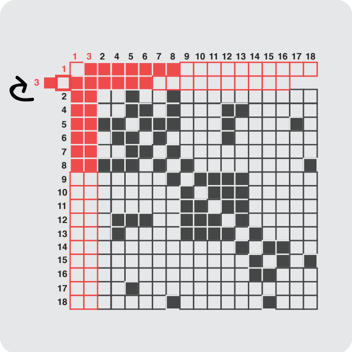

3
Move it beside to its similar column
1

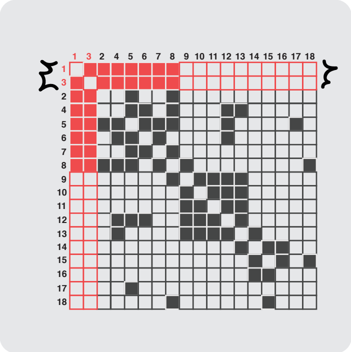


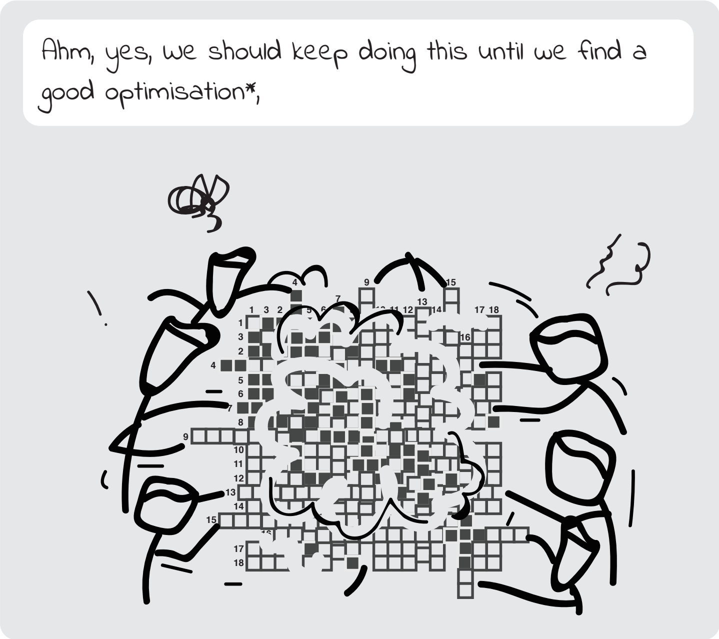
... and will repeat the same for the respective rows.

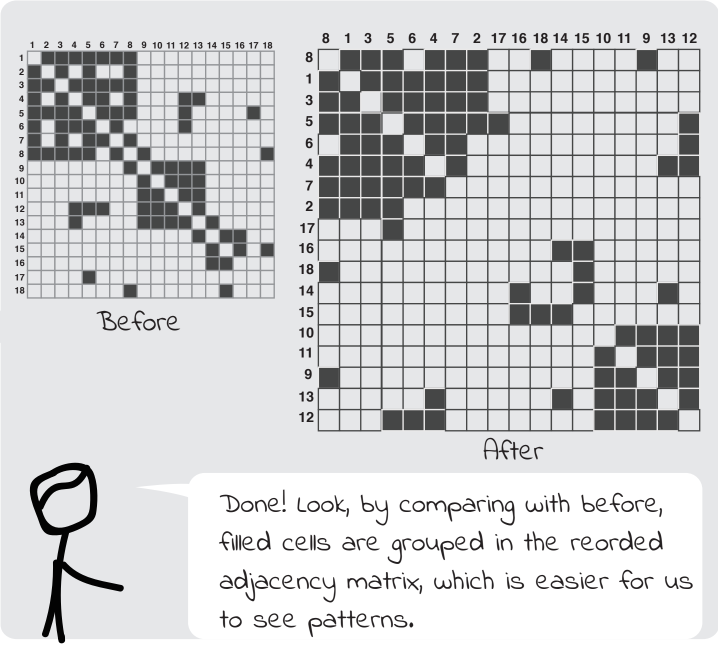

1 3 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


1 3 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
3


1 3 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
3


1 3 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
1
3
2


Ahm, yes, we should keep doing this until we find a good optimisation*,


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Before
8 1 3 5 6 4 7 2 17 16 18 14 15 10 11 9 13 12
After
Done! Look, by comparing with before, filled cells are grouped in the reorded adjacency matrix, which is easier for us to see patterns.

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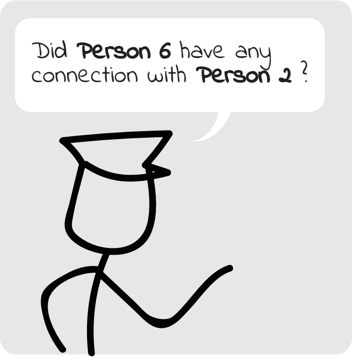
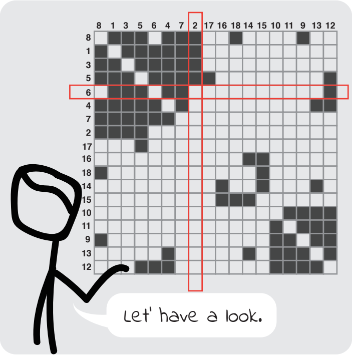
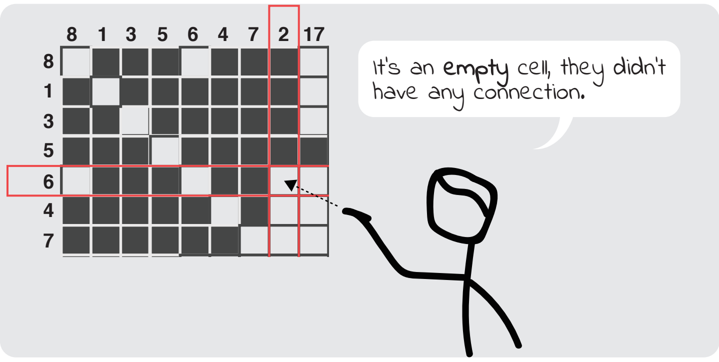
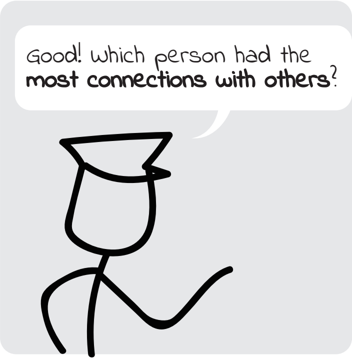
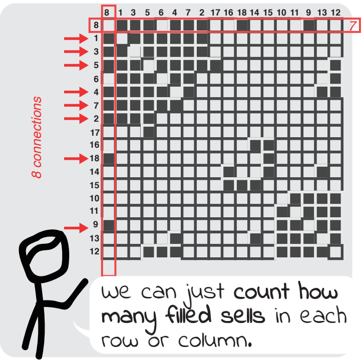
* *Learn more about the algorithm:*
Behrisch, M., Bach, B., Henry Riche, N., Schreck, T., & Fekete, J. D. (2016, June). Matrix reordering methods for table and network visualization. In Computer Graphics Forum (Vol. 35, No. 3, pp. 693-716).

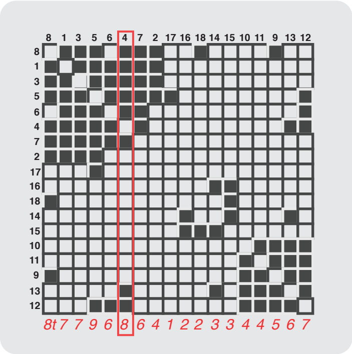

Did **Person 6** have any connection with **Person 2** ?

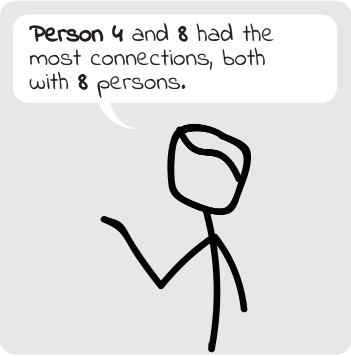

8 1 3 5 6 4 7 2 17 16 18 14 15 10 11 9 13 12
Let' have a look.

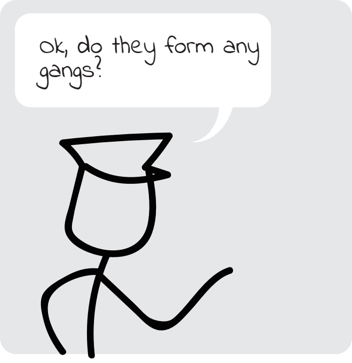

8 1 3 5 6 4 7 2 17
8
1
3
5
6
4
7
It's an **empty** cell, they didn't have any connection.

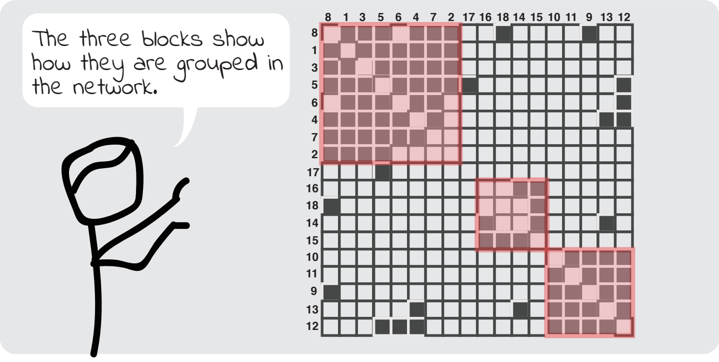

Good! Which person had the **most connections with others**?

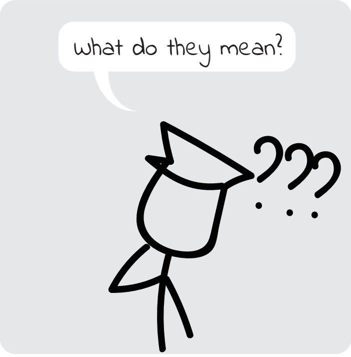

8 connections
7
We can just **count how many filled sells** in each row or column.

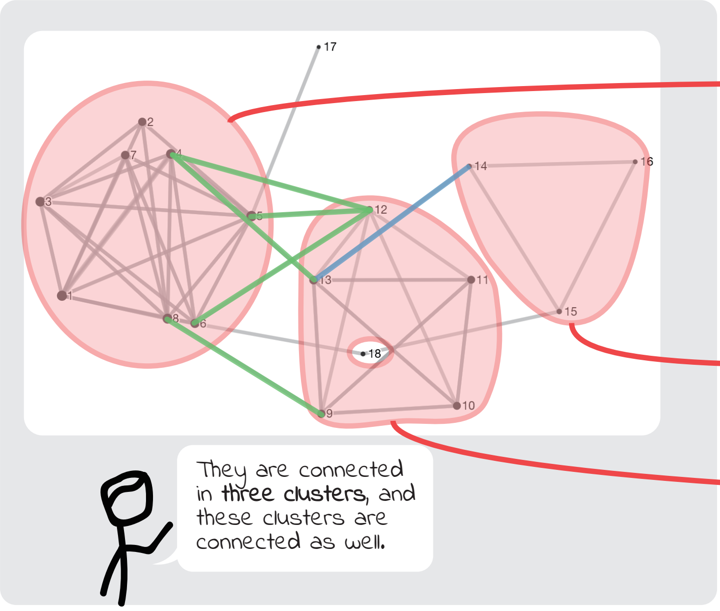

8 1 3 5 6 4 7 2 17 16 18 14 15 10 11 9 13 12
8t 7 7 9 6 8 6 4 1 2 2 3 3 4 4 5 6 7

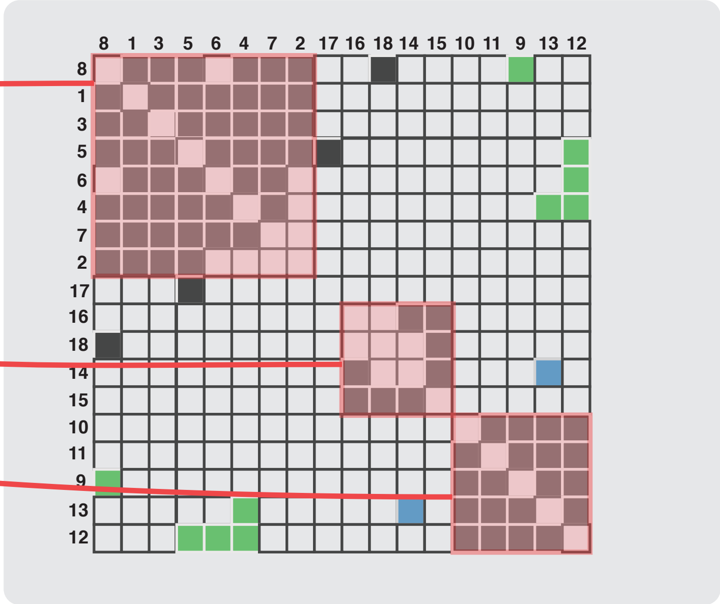

Person 4 and **8** had the most connections, both with **8** persons.


Ok, do they form any gangs?


The three blocks show how they are grouped in the network.
8 1 3 5 6 4 7 2 17 16 18 14 15 10 11 9 13 12


What do they mean?
???


17
2
7
4
3
5
12
14
16
13
11
1
8
6
18
15
9
10
They are connected in **three clusters**, and these clusters are connected as well.


8 1 3 5 6 4 7 2 17 16 18 14 15 10 11 9 13 12
8
1
3
5
6
4
7
2
17
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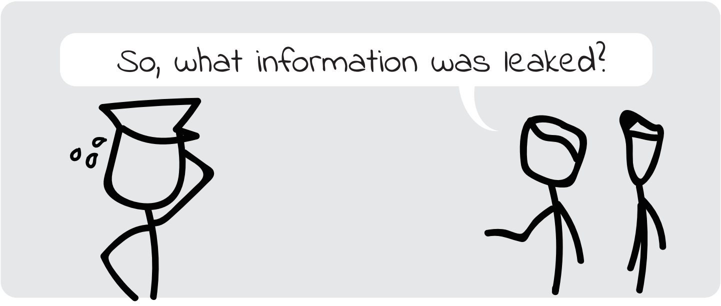
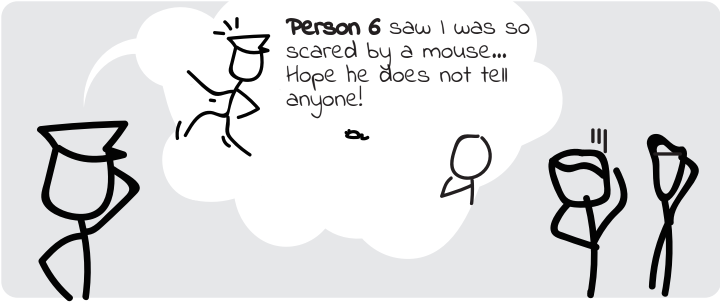
11
9
13
12


So, what information was leaked?


Person 6 saw I was so scared by a mouse... Hope he does not tell anyone!