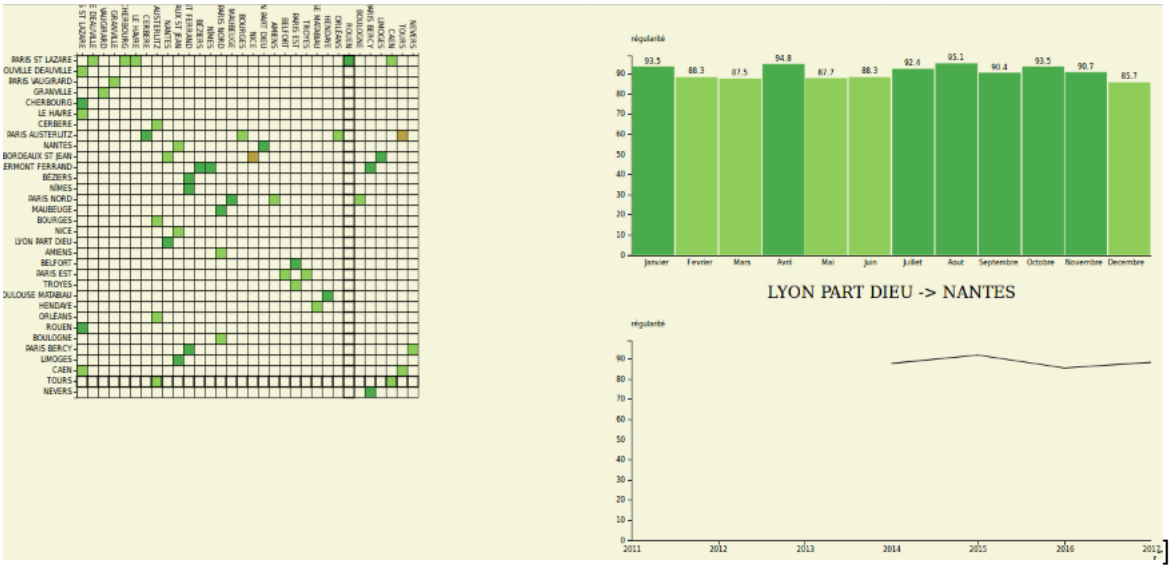
Are SNCF's TGV trains always late?

Isabelle Flores
Univ Claude Bernard Lyon 1

Enzo Lebrun
Univ Claude Bernard Lyon 1

Romain Candy
Univ Claude Bernard Lyon 1



1 Introduction

A graph is a way to represent dependencies between entities, each dependencies is represented by an edge between two (or more) vertices. It is a very convenient way to represent many problems in computer science because most of the time we get rid of any combinatorics issues such as exponential complexity and so on. It is also a way to represent real things such as traffic and evolution of things. The main issue with graph is that they are mainly adapted for computers than for human especially when they are very heavy. The visualisation of network problematic is now a hot topic in many fields of research such as traffic, cloud computing, scheduling and so on. The Big issue with networks visualisation is that we do not visualise a big network the way we visualise a small one, we do not visualise a thick network the way we visualise a light one, or a directed one. There is such a high variety of graphs and there is no ready to wear only made-to-measure. But this article will expose some good methods that we can use for graph representation in order to solve a problematic. In this article we will lean on a question to solve, and try to use the best graph representation methods in order to answer this question. The question is "Are SNCF trains always late?". This problematic is very relevant because it concerns everyone and then we will be able to see if the representation we will use is adapt to a non-computer-scientist public. The SNCF train networks is a very thick graph so the representation will be adapted to this problematic, this article will show you why the adjacency matrix fits our problematic, why it is very interesting on directed graphs, and how we will deduce some other informations from it. Then we will use some barchart representation in order to show the evolution of a specific node in the graph. The user graphical interface will be very user friendly, the user will have to click on any box of the matrix in order to see some informations about the traffic of this specific line.

2 Related Work

2.1 Adjacency Matrix and Matrix de Co-occurence: Les Misérables

About how we could visualise our data, we thought about adjacency matrix and the Mike Bostock work with co-occurence Matrix, les Misérable [1], see Figure 1. There is some studies that talk about how visualising networks. There is essentially two ways of doing so: adjacency matrix or node-link diagram. Node-link diagram wouldn't be adapted to our problem because we want to see all the links at the same time and it won't be as readable as desired but with adjacency matrix, we'll lose some information so we searched how to resolve this issue.

2.2 Juxtaposition

As Jean-Daniel Fekete [2] wrote, one drawback of adjacency matrix is that some informations about the topological properties of graphs are lost, as instance, there is no way to represent where Marseille is located to Paris or Lyon or other cities. The juxtaposition of a graph in order to represent the topological aspect of those data must be done if some geographical aspects are correlated. It is also important to notice that adjacency matrix does not provide a way to represent path between multiple nodes as instance the path between Paris, Lyon and Marseille, there will be visualize in a convenient way. As a consequence, if there is no direct path between two cities, there will be no way to represent it. Again, adding a graph or a map of the subject will provide some good support for the visualisation of the problem. Now the point is what can we juxtapose next to the adjacency matrix and what additional information this juxtaposed visualisation provides?

- Barcharts and linecharts: this representation can be a good way to decompose the data over time and then show some evolution

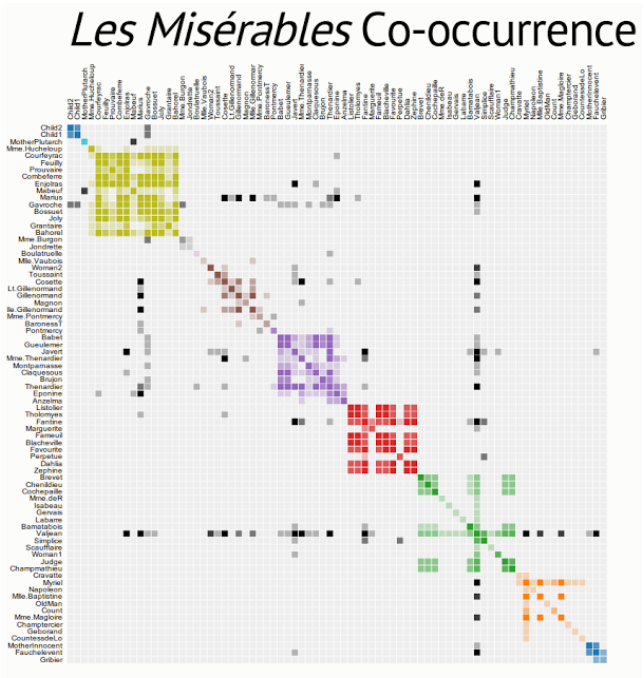


Figure 1: co-occurence matrix

of trends.

- Trendalyzer, if we can correlate different populations of data in order to show a trend, we can use this well known representation.

- Graph and maps: in order to introduce data in a geographical context graph and maps are required.

3 Projet Description

3.1 Data acquisition

We choose to work on the delayed train and how to visualize the fact that people thinks that trains are always late. For this project we are using an open dataset from the SNCF website. The dataset is composed of the train station, with traffic regularity rate and the date of the measures. Those data will provide some geographical informations that we must keep in the visualisation of the problem in order to give to the audience concrete results. The exact template of the dataset is: the date, the name of the main axis where the train is running, the departure station, the arrival station, the number of trains scheduled, the number of train that runs on this line over the month, the number of train cancelled the number of train delayed, the regularity rate, the number of train on time against the number of train delayed. For our visualisation we have only selected a few of them, which are, the date that we divided on the year and the month, the departure station named source, the arrival station named target and the regularity rate, which is saved as a weight between two stations. We could have added many more that but we wanted to keep our datas simple in order to use the adjacency matrix and the others chart in an effective and simpler way. We lose some accuracy on the datas with only the regularity rate but we think the first and global answer must be simple. We always can add some datas to develop further possibilities in the future.

Every regularity we saw on the matrix (for each square), is precalculated on a python code before (for the sake of performances) file and added two our cvs, then a year is composed of 12 months numbered form one to twelve, and we also got the month zero which is actually not a month but the mean of each month of the respective year. For the multiple matrix, on a python code, we created the graph between the stations, and then for each station on the graph we compute the shortest path thanks to dijkstra's algorithm from this station to all the targets. Thus we created the complete graph of each station this representation is much more heavier and is not very relevant of any situation, because when we compute the regularity of a path between two stations, we assume that the delayed train are independants, which is a very naïve assumption. But it's a first step on the vast world of improvements of adjacency matrix.

3.2 Implementation

As explained before, for the sake of performances the main part of the computation are done with python scripts, and save as csv. Then we give the hand to javascript and d3.js module, **RAJOUTER DES CHOSES!!!!!!!!!!!!!!!!!!** In terms of implementation we also worked on the matrix ordering in order to extract some clusters or some patterns. The main plan was to order the matrix by regularity rate of stations, thus we create an algorithm that sort the matrix in function of the mean of the regularity of each station, but this ordering methods was not very relevant, because most of the line are Paris centered, so there is no real cluster possible, it is more due to the data type than the ideas that sats within. Moreover there must be some better methodes to cluster the matrix with some datamining algorithm but this is way beyond the limits of the possible for this specific project.

3.3 Scenario

The visualisation is available on our webpage, first of all the user have to chose the type of train he wants to visualise and if he wants to include non-direct paths, those options are made for the sake of simplicity, the multiple stations variation is more like an experiment of the limits of our visualisation model, so if the user wants to have a cristal clear representation of the data which goes to the essentials it is better to chose the simple representation. We could have gathered the TGV and the intercité matrix together but because they are not connected by any station, it is better to keep them separated. For the sake of our scenario he has chosen TGV and simple paths, at this stage the chosen visualisation will appear as a matrix, now the user can chose on the left the departure station and the arrival one on the top, he will have to click on the corresponding square on the matrix. For example our user as chose the line: MARSEILLE ST CHARLES ->LILLE, now on the top, the regularity barchart will appear for this specific line, each bar represents a month, the color variates from green to red regarding the quality of traffic during this specific months for this specific year. When the user pass over a bar with his mouse, two things will be noticed: A comment of the mains reasons for those delayed train, and on the bottom right corner a line of the variation of this specific month all over the years.

4 Discussion

5 Conclusion

The adjacency matrix representation: In order to solve the problematic, the main idea is to visualise the network train station by train station. With the adjacency matrix, each station will be represented in a line and in a column and for every existing train line between two stations, the corresponding square will be colored regarding the quality of the traffic, see next paragraph. As instance, where the line Marseille collide with the line Lille, we color the square with the right color. Thus, when all this representation is done, every line between station will be color regarding the quality of traffic. Now it is quite important to notice that an A to B line is different than a B to A line we will have some differences in the quality of traffic, and those differences will jump right to the eyes of the public. (show matrix picture) The choice of colors: The color choice is very simple, good is represented by the green color and the worst it gets,

darker the red will be. As instance, the line Marseille Lille is getting worst all over the years, so you can see in the representation that each month the green is becoming more and more red. This choice of color is due to the fact that red means bad for everyone and green means good, it also remind traffic lights so it's a good choice of color for this kind of problematic. (article des premiers à être passés) The barchart representation: When we click on a specific square, one which represent a line between two stations, some additional data are gathered. Thus we are able to represent the evolution of traffic quality month by month all over the year. this representation is very user friendly because it's simple to use, the user will have to click on the lines he is interested on, Moreover, the informations is hidden until the user wants to learn more about a specific line. And we have some additional we the user puts his cursor on a specific month, there is a feedback on the reason why traffic was delayed during this specific month. Many way to sort the matrix, many way to visualise:

REFERENCES

[1] Les misérables co-occurrence. `https://bost.ocks.org/mike/miserables/`. Accessed: 2017-11-25.

[2] Jean-Daniel Fekete. Visualizing networks using adjacency matrices: Progresses and challenges. pages 636 – 638, 09 2009.