

Reading Network Diagrams by Using Contour Lines and Word Clouds

Mapping the SPT 2021 Technological Imaginaries Conference

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1 Introduction

Network diagrams have met frequent improvements in terms of computing time (Sapio et al., 2017) and layout algorithms (Jacomy et al., 2014), but the same cannot be said for the graphic design and aesthetics. In fact, the traditional network visualization style dates back about 85 years, and is attributed to Jacob L. Moreno’s influential book *Who Shall Survive?* (Moreno, 1934). Developed in order to make readable social relations, observed during his fieldwork, Moreno introduced simple diagrammatic representations called sociograms. The sociogram’s visual grammar was indeed composed of circles, lines, and labels, which still represent the graphic elements employed to draw networks almost one century later.

Although the computational turn transformed network diagrams into objects capable of presenting incredibly complex structures and high levels of connectivity (Lima, 2011), the network’s visual grammar is still based on circles, lines, and labels in their simplest, immediately recognizable form. The research lab led by Albert-László Barabási at Northeastern University is a prime example of visualizing complex networks, especially for its capacity to bring designers within the research environment. In a recent solo exhibition at the ZKM Center for Art and Media in Karlsruhe (?), the lab’s production perfectly illustrates the marriage between graphic design and network science, along with a historical evolution that covers approximately two decades. Barabási’s intuition to bring design expertise within the lab was a winning strategy, which demonstrated the importance of involving talented designers in the scientific production of visuals by the significant number of citations and by the several covers of scientific magazines. The designers working with Albert-László Barabási molded network aesthetics out of colors, transparencies, and space. They brought networks to their upper levels by drawing edges with different intensity (Coutinho et al., 2016), by elaborating visual organization and style (Albrecht and Yucesoy, 2016; Kosack et al., 2018), and by exploring three-dimensional representations (Gates et al., 2019; Schich et al., 2014). These network diagrams demonstrated that we can stray from the traditional representation of network diagrams, by omitting links and amplifying nodes’ positions and weights, without compromising insights.

2 Removing Links

Although simplicity is a great quality to properly address messages through visuals, the incredible work of Albert-László Barabási and his peers at Northeastern University supports alternative paths led to exploring innovative ways to present network diagrams (Rodighiero et al., 2018). This text aims to discuss the problem of scalability that severely affects networks that are characterized by millions or even billions of nodes and edges, producing what is commonly known as the spaghetti effect (Börner, 2015; Venturini, 2011). The idea hereby presented is simple and can be summarized by the question, “do we really need to visualize links to make network diagrams meaningful?”

The answer to the question of whether links are needed is equally simple, working by subtraction. No doubt removing links implies a loss of information, but circles, and eventually their labels, remain. Getting rid of the spaghetti effect created by high connectivity allows us to remove background noise and increase the visual readability, and then to focus with more attention on circles and their characteristics. Circles, indeed, usually come with additional information that can be differently amplified such as position and weight. The position is the result of the arrangement produced by balancing the whole set of forces that attracts or keeps apart a given network element, while the weight is an arbitrary value that corresponds to the relevance of the same element.

It is also worth noticing that an increasing group of scholars (Crockett, 2019; Lee et al., 2021; Noichl, 2019; Schmidt, 2018) prefer techniques of dimensionality reduction such as UMAP (McInnes et al., 2018), rather than force-directed algorithms such as D3.js (Bostock et al., 2011). Dimensionality reduction is a machine-learning method used in statistics to reduce many variables to smaller numbers, while force-directed algorithms work with relational datasets in which two elements are connected by a weighted tie. The famous sociologist Pierre Bourdieu used the former method for mapping a large set of interviews on two dimensions (Blasius and Schmitz, 2014), while Bruno Latour’s laboratory widely invested in the latter that is often associated with the software Gephi (Bastian et al., 2009). The reason for choosing dimensionality reduction is related to the use of large datasets or by the programming language employed for the analysis. In relation to the aesthetical change, and one of the major visual results of using techniques of dimensionality reduction is the loss of link drawing also caused by the interchangeability of the two techniques. As stated by Venturini, Jensen, and Jacomy, “dimensionality reduction algorithms [...] are implicitly building networks and spatializing them” (Venturini, 2011). Consequently, scientific visuals are facing a technology-driven aesthetical turn (Romele and Rodighiero, 2020).

3 Adding Contour Lines and Word Clouds

Innovative visual tools, such as the Cartography of SPT2021 (see Figure 1), can be used as a case study for alternative network diagram visualizations. This tool was developed during the pandemic to orientate attendees in the annual conference organized at the Catholic University of Lille by the Society for Philosophy and Technology (SPT) in 2021. The conference proved an ideal occasion to showcase a tool for conference mapping already developed for the Italian community of digital humanities the previous year (Moon and Rodighiero, 2020) because on this occasion the program map was published a week before the start of the conference. By analyzing the speak-

unifies the speaker’s relevance, and on the other hand, it helps to identify clusters of speakers at a glance.

In addition, the speakers’ terms associated with each cluster were collected and visualized through a word cloud, also called weighted list, a visualization technique that shows the most relevant keywords by composing a sort of textual collage. The idea was to summarize the clusters to give the viewers a preview of the content.

All of these graphical elements are finally organized through two layers of zooming, revealing detail according to Ben Shneiderman’s renowned mantra, “overview first, zoom and filter, then details on demand” (Shneiderman, 1996). In the beginning, the viewer sees contour lines and a word cloud. One potential scenario is that the viewer notices a familiar word that encourages them to zoom into a specific cluster. After zooming in, contour lines and word clouds fade out to leave room for speakers’ names and their contextual lexicon. At this point, the viewer might click on a specific author for further details associated with them, such as their own terms, or the number of publications.

4 A Way of Seeing

For those who are familiar with the field of philosophy of technology, it is interesting to observe how the SPT2021 map provides three insights: 1) Overcoming the divide between humanities-oriented and engineering-oriented approaches, which seem to share contours except for the “engineering” cluster at the bottom of the map. 2) The emergence of new trends such as “energy and politics” and “data and bias” as respectively illustrated at the middle right and the upper right, while a common topic such as “posthuman” disappears probably due to its popularization 3) The propensity of philosophy of technology for other disciplines and objects, as is the case with the “media” cluster in the middle and the “image” cluster a bit higher up. These insights are helpful in understanding emerging and disappearing subjects in the field of philosophy and technology, revealing the orientation of the scientific community.

The SPT2021 conference was dedicated to the theme of “technological imaginaries.” As is often the case for large conferences, finding a topic wide enough to gather different trends in the same discipline is always challenging. The concept of “technological imaginary” responds well to this need, capable of designating many things at the same time as a vague notion, which represents a risk of dispersion. The scholar who attends this type of event, especially online, might feel lost before such a multiplicity of presentations and panels that seem similar, but far different from each other. During conferences, scholars put considerable effort into designing their program with pertinent sessions. This activity is not easy if we consider that the sessions are manually organized following not only thematic requirements but also timing, availability, and other factors. While planning can be particularly time-consuming if the attendee chooses to read all the abstracts, the SPT 2021 map, on the other hand, made the identification of emerging themes easier, offering an orientation tool to attendees (Moon and Rodighiero, 2020). Furthermore, it is interesting to notice how the map also helped the organizers to build the SPT 2021 program, as panels were inferred from clustering, while the proximity between speakers helped complete panels. Nevertheless, the SPT 2021 map invites us to do this in the last instance: the personal affinities that lead us to attend certain sessions and panels, are secondary to thematic affinities so that new relationships between researchers can be fostered, as it happens in university faculties (Rodighiero, 2021).

Compared to traditional network visualizations, the visual method that has been called lexical cartography, offers a clearer way to identify the most interesting conference clusters to the reader. The intermediary level of reading composed of contour lines allows for a better identification of clusters, while word clouds present a lexical information that belongs neither to the whole structure nor to a single speaker. Introducing an intermediary information layer, such as word clouds, is one technique of making complex networks more readable and therefore accessible by manipulating its traditional design.

5 Conclusions

This visual model based on contour lines and word clouds is not intended to be a replacement for a more standard visual network graph with links and nodes, but as an alternative to it. In particular, this linkless network design seems particularly suitable for social structures with high connectivity, as in the case of word-frequency-based networks. The idea of focusing on clusters rather than nodes or the entire structure is valuable and moreover easy to implement. In the context of conferences such as SPT 2021, for example, attendees are more interested in identifying the most trends with a secondary interest in the speakers, which is achieved by zooming in on the interface.

In conclusion, the approach to relational data has always been critical for the digital humanist. Their study is heavily driven by how data is presented, and a critical approach to data visualization is needed to avoid being stuck in the same visual models, which can narrow down how we look at corpora. By using a novel design, such as in this case study, we can see how an intermediary level of data interpretation can be achieved by reorienting the focus onto clusters, rather than the overall network. As clearly stated in *Digital Humanities* (Burdick et al., 2012), scholars of digital humanities must think like the designers of their tools, including visualization, to get more understanding of the information they are working with. While computational improvements are indeed important for furthering novel ways of manipulating and working with data, it is fundamental to bring design into scientific structures and think of how viewers experience data. By doing this, designers do not simply assume the role of collaborators, but they have to be employed as scientists, and professors. The digital renaissance of digital humanities will come only when humanists, designers, and computer scientists have interchangeable roles, moving from one domain to another naturally. This change of paradigm can and should be instigated by universities who, equipped with education programs and research facilities, can pave the way for innovations that naturally come about with interdisciplinary teams .

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