Aj Cooke
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Information Visualizations

In the current "Age of Images"[1] (Zeeuw 2014), where Post-Modern thought emphasizes individuality and diversity in regards to the creation of meaning and structures in our world, the similarity of humanity as a species can often be disregarded and overlooked in reference to shared meaning. This defining biological connection explains how the majority of humans can function within similar sensory frameworks, but is also conflicting to the notion of difference in meaning, or perception. Vision for instance, is the biological sense of sight that is part of our body's central nervous system, allowing us to process the world through optical representation based off light. However, the way we individually interpret the environment we perceive is not only unique to every human being from these sensory physical aspects, but also because of the countless number of daily decisions and experiences we have in our memory bank of knowledge that defines our individuality; we will never have a universal perception. Allowing for both our shared biology and individual realities creates a paradox for our species: How can we possibly structure and function within a world of such varied difference? Yet our need to compulsively find pattern and organize information – even in our own ways, is a link that can be exploited and epistemologically portrayed by visualizing data. These graphic representations can transcend the initial taxonomy of statistical information and create new meaning to a viewer based on the language of the image as well as the participatory mental function of categorization.

[1] Barbara Stafford

We are all different. This statement is easy to assert in a Western philosophy of Heidegger's individual realities and Derrida's theoretical complex web of knowledge that promotes the deconstructionist framework of personal meaning. Yet with all this contrast, where do we find the link of community? Our biological makeup can account for a certain level of systematic processing, in which George Lakoff and Mark Johnson write: "Because we all have pretty much the same embodied basic-level and spatial relations concepts, there will be an enormous range of shared 'truths'" (Lakoff 1999), but this connection is also the cognitive source of the discrepancy since the information we use to perceive and make sense of our world is formulated by the personal environments we belong to or engage with. In *Visual Analogy*, Barbara Stafford contends that it is difficult to bridge the gap among disputing groups, calling Post-Modernism a "conundrum" in its wealth of difference.

> Without a sophisticated theory of analogy, there is only the negative dialectics of difference, ending in the unbreachable impasse of pretending assimilation or the self-enclosed insistence on absolute identity with no possibility for meaningful communication. (Stafford 1999)

The "negative dialects of difference" that Stafford mentions are created by only focusing on (and finding a hierarchal value in) the individual realities and unique viewpoints of a single person, as promoted by Post-Structuralism. To combat this division made possible by highlighting difference, Stafford argues for a demonstrative relationship in her concept of visual analogy, referring to a "likeness in diversity"[2], by connecting "originality with continuity, what comes after with what comes before, ensuring parts with evolving whole…a mutual sharing in, or partaking of, certain determinable quantitative and qualitative attributes through a mediating image" (Stafford 1999). It is important to

[2] Helena Cronin. *The Art and the Peacock: Altruism and Sexual Selection from Darwin to Today*. (Cambridge: Cambridge University Press, 1991), p8.

note that Stafford is not recommending a complete denial of difference, nor refuting the importance of acknowledging the value found in varied meaning. Rather, there also needs to be a link that unites our species, since by definition, we are so similar. By promoting the analogy – the comparison of two separates, Stafford contends that we might be able to find likeness in our variances.

Can we then, turn to the mediated image and the cognitive processing of representations as a template to navigate Post-Modern diversity?

> Like verbal languages, visual languages have many dialects and registers, which their respective discourse communities define and shape. We inhabit only a limited number of these communities, which circumscribe our domain of conventional practices. Some of these communities are quite amorphous and large, including whole cultures or even people around the globe who use public information symbols, such as the circle and the slash" (Kostelnick 2003).

Though visual images can provide a conventional code for perceptual experience that can be culturally learned, the notion of a universal meaning is unrealistic due to the unique reality of both author and reader; Any individual will belong to a series of communities that can be categorized by culture, organization and discipline (Figure 1) (Kostelnick 2003), and therefore already have embedded knowledge of signs from their own predetermined world. However, Stafford affirms that we may learn new meanings by immersing ourselves in a greater context of humanity, and therefore not only expand on our personal web of knowledge, but connect our experience and meaning to others.

> The capacity to generalize to new objects from those already encountered is based on perceiving common traits and matching them according to a shared category[3]. Information theory is particularly interested in the role played by inferencing in problem solving and how analogy not only compares mental representation

[3] Keith J. Holyoak and Paul Thagard. *Mental Leaps: Analogy in Creative Thought.* (Cambridge, Mass.: MIT Press, 1995), p53.

> but inductively regroups them into new coordinations[4] (Stafford 1999).

An example of grouping both pre-determined perception and shared convention together can be seen with the use of information design, which pairs the epistemological function of categorization with another organization tool – art design. To define Information Design is to engulf on a conundrum of its own, for the term blends many subjects that include (and not limited to) typography, illustration, communication, ergonomics, psychology, sociology, linguistics, and computer science (O'Grady 2008).

> Information visualization is widely used as a tool for understanding data – i.e., discovering pattern, connections, and structure. Since science is the area of human activity targeting the discovery of new knowledge about the world through systematic methods – such as experimentation, mathematical modeling, simulation – visualization now functions as another of these methods. What distinguishes this new method is that it also firmly belongs to design – it involves the *visual* presentation of data in a way that facilitates the perception of patterns" (Lima 2011).

The Information Designer is fully employed in the visual arts; though their work considered a non-art image, they are still creating an image within visual culture and doing so with reference to the language of art. Armin Akhavan, an Information Designer at Northeastern University[5], personally believes that "visualizing data and visual art are different to the extent it represents designer's thoughts over what information implies". Furthermore, Akhavan states "For me it starts with a project. In my works, I visualize civic data for urban planning projects so I start with what might going [sic] to be the argument and try to represent the data in a way that makes it easier to understand." (Akhavan 2014) Visualization then, creates an image both taxonomic and polymathic by classifying specific collected data into an image organized by the visual sensory properties

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[4] Marie-Dominique Gineste. *Analogie et Cognition. Etude experimentale et simulation informatique*. (Paris: Presses Universitaires de France, 1997), p83-84.
[5] Northeastern University, Boston, Massachusetts, USA.

of design. In visualizing information, the individual parts are just as important as the systematic whole because both are needed for the visualization to be successful – the points of data supply the information to be read, and the overall structure allows for accessibility to the viewer.

> Functional visualizations are more than innovative statistical analyses and computational algorithms. They must make sense to the user and require a visual language system that uses colour, shape, line, hierarchy and composition to communicate clearly and appropriate, much like the alphabetic and character-based languages used world-wide between humans (Woolman 2011).

Furthermore, to allow this accessibility among more than a select few, the pictorial representation of information has shifted from the absolute hierarchy of a tree to a more interconnected arrangement of a network – which includes every node to make up the systematic whole. This then, is a visual demonstration of Post-Modern individualism grouped together to create a systematic whole.

> In contrast to centered systems with hierarchal modes of communication and pre-established paths, the rhizome is an accentered, nonhierarchical, nonsignifying system without a General and without an organizing memory or central automaton, defined solely by a circulation of states"[6]. (Guatteri 2011)

Since there is not a hierarchal ladder of power to determine importance, each node of data is just as vital as the next and furthermore, there are many ways to read the overall visualization, as opposed to a top down view (or vice versa) in the tree format. When asked about the possibility of multiple meanings in visualizing data, Armin Akhavan responded: "It is not only possible, but somewhat inevitable. "We understand things in relation to what we already know" and any viewer/reader will interpret the visualization different than others…" (Akhavan 2014). Lima also views the network-based lens of the

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[6] Lecointre and Le Guyaden. *The Tree of Life,* p21.
[7] Richard Saul Wurman

world as one that includes and does not omit, but is "based on diversity, decentralization, and non-linearity" (Lima 2011). This method of visualizing data fits nicely in Stafford's theory of visual analogy by allowing the viewer to compare data to data both inductively and deductively, letting the invisible become visible, and making connections where the viewer sees them as opposed to being told how to read the information displayed.

Unlike the static list of data that can be displayed in a text-based system, a network visualization depicts the content in multiple ways and therefore can also be interpreted in various means based on how the visual information is mapped for the viewer, as well as how the viewer chooses to categorize the information shown.

> Networks have multiple interpretations and definitions, usually depending on the particular discipline responsible for studying the network…This series of queries can lead to the identification of a taxonomy, or topological truth, of the analyzed network. …Network visualization can…translate structural complexity into perceptible visual insights aimed at a clearer understanding. It is through this pictorial representation and interactive analysis that modern network visualization gives life to many structures hidden from human perception, providing us with an original "map" of the territory" (Lima 2011).

Due to its accessibility and readability of data, the network visualization could be classified within the contemporary genre of Universal Design, which focuses on clarity in design for a wide audience of readers (O'Grady 2008). Information Designers can achieve this goal by working within the broad aesthetics of visual art, and the subjectivity therein, in reference to basic principles of design. In *Visual Complexity: Mapping Patterns of Information*, Lima outlines a variety of trends in the compositions of visualizations, such as arc diagrams, centralized bursts, flow charts, organic rhizome, ramifications, and scaling circles, etc., that are chosen by the designer to best relay the data, much like how a visual artist chooses material that best suits the concept of their work. These organizational choices can be seen in Augusto Becciu's network visualization *TweetWheel* (Figure 2),

created in 2008, where the viewer is given an image that shows a single person's Twitter account followers connecting to one another (Lima 2011). Becciu chooses to compose the data in a radial convergence, which allows each user to be equally vital as another, while also turning the composition inward to the associations, highlighting the interconnectivity rather than the difference of the followers themselves (such as username and avatar image). Basic art elements are used to create an aesthetically pleasing image; the colors chosen to represent each Twitter account are within a similar value scale – no color is more significant than the other, despite the individuality they represent with their singular color classification. The lines themselves are graphically created to achieve a seamless trajectory that arches from the source and curves effortlessly towards the corresponding connection, allowing the viewer to follow the lines easily while also creating a visually pleasing linear composition within the circle. Even the background color choice of stark black allows the colors and lines to pop in contrast and therefore, the visual network is the focus for the viewer. This analytical language of viewing an image based on standard design principles is one way that people may connect and promote the notion of shared meaning within visualizations – by objectively labelling a convention. However, another way network visualizations engage our species in a shared activity is the act of looking all onto itself – which we do without even thinking about doing it. *TweetWheel*, because it is a network, allows the viewer to subjectively navigate the data, since all nodes are equally important, and there is no absolute way to begin looking at the image. For example, one viewer may try to find the user with the most connections, and another viewer might start interpreting the data by finding the follower with the least relationships; both ways of looking are dismantling the same data, but from different means. The overall point is that each viewer is reading the data, reorganizing it, and trying to make sense from the image.

Another example – *European Academic Network*, a centralized burst by Jose Luis Ortega and Isidro Agrillo created in 2004, visualizes the exchange of hyperlinks between 535 European universities in fourteen different countries (Figure 3) (Lima 2011). Again, design principles are shown; color is used to identify universities within a specific country, size and space of the nodes are used to convey how active a specific university is with shared hyperlinks, and the placement of the nodes in a centralized burst formation is based on the universities that attract the most visits (Ortega 2004). Likewise, the thin black lines used to connect the nodes are perhaps less aesthetically pleasing than the previously mentioned example, but for a purposeful compositional reason: the overlapping of the network shows the most activity and therefore visualizes another level of interpretation different than the proportion of the nodes or the trajectories of the individual lines that connect universities together. The multiple layers of information and interpretation of this one visualization is credited to the visual arrangement conducted by the designers; Ortega and Aguillo created an image that is successful because it is accessible to the viewer as an organization of what otherwise look like chaos.

It is easy to see dissimilarities among every single person we meet; humanity as a whole might sometimes look a lot like a chaotic mess without a common thread. As a collective species, we are aware that our lives are lived separately and independently, and are defined by the experiences we have and the choices we make in the communities we choose to belong to. We are constantly comparing ourselves to others and trying to understand (or perhaps not willing to understand) another's meaning and way of thinking. Our own realities define our unique spheres, yet we function as a structured population regardless of all of this difference. By concentrating on the basic connection of biology, and more specifically, the cognitive and bodily function of perception, we are able to

construct both a Post-Modern sense of variance, as well as a Pre-Modern notion of unity. Through the conventions of art and design language, data collection and pattern recognition, visualizations are a demonstrative example of a visual analogy – the mediated image that allows individual and shared meaning by comparing one thing to another. This example is by no means a solution to any form of a big question paradox, but it does offer an illustrative instance of contrast in community, likeness in difference, and the human connection – however corporeal it might be.

Figure 1

Figure 2

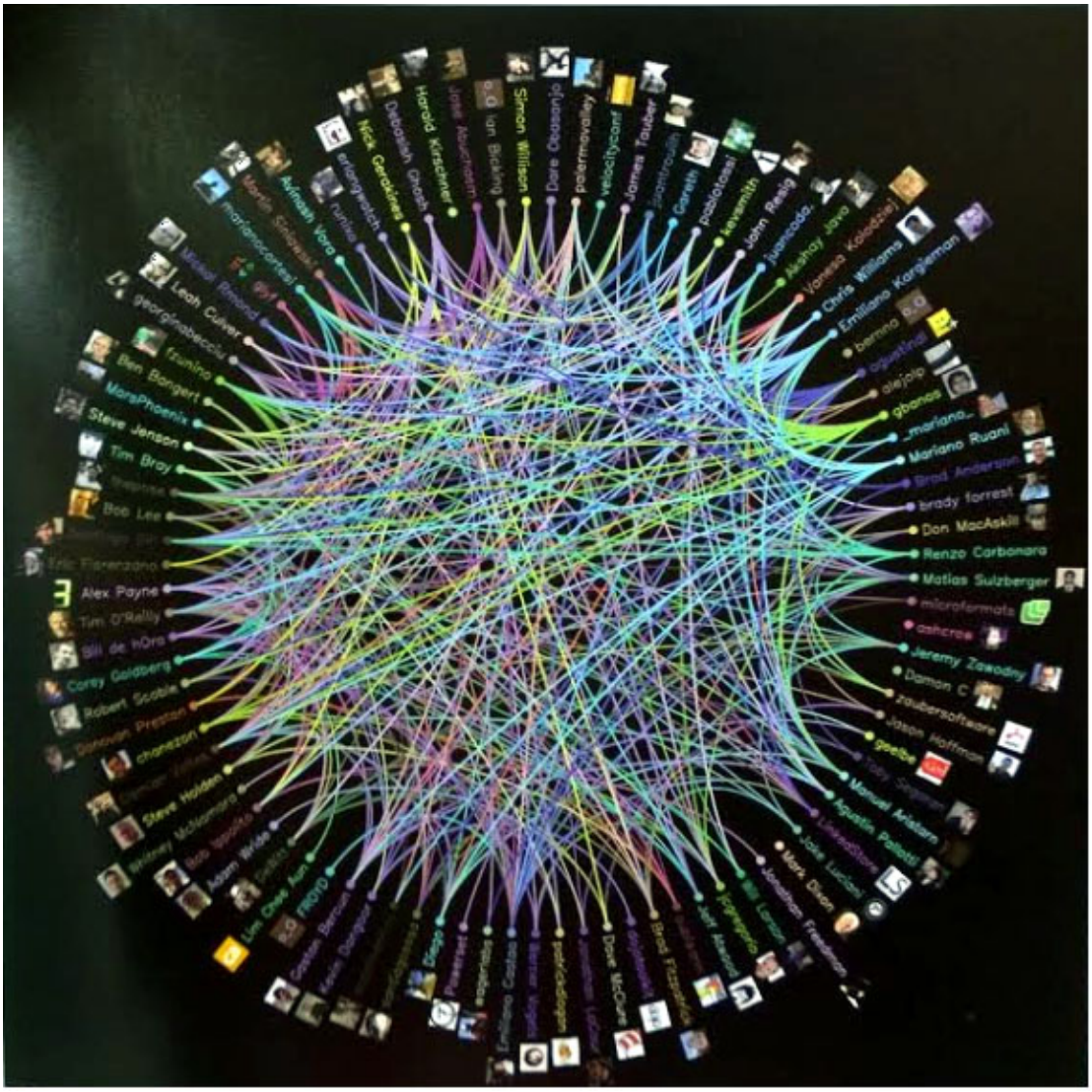


Figure 3

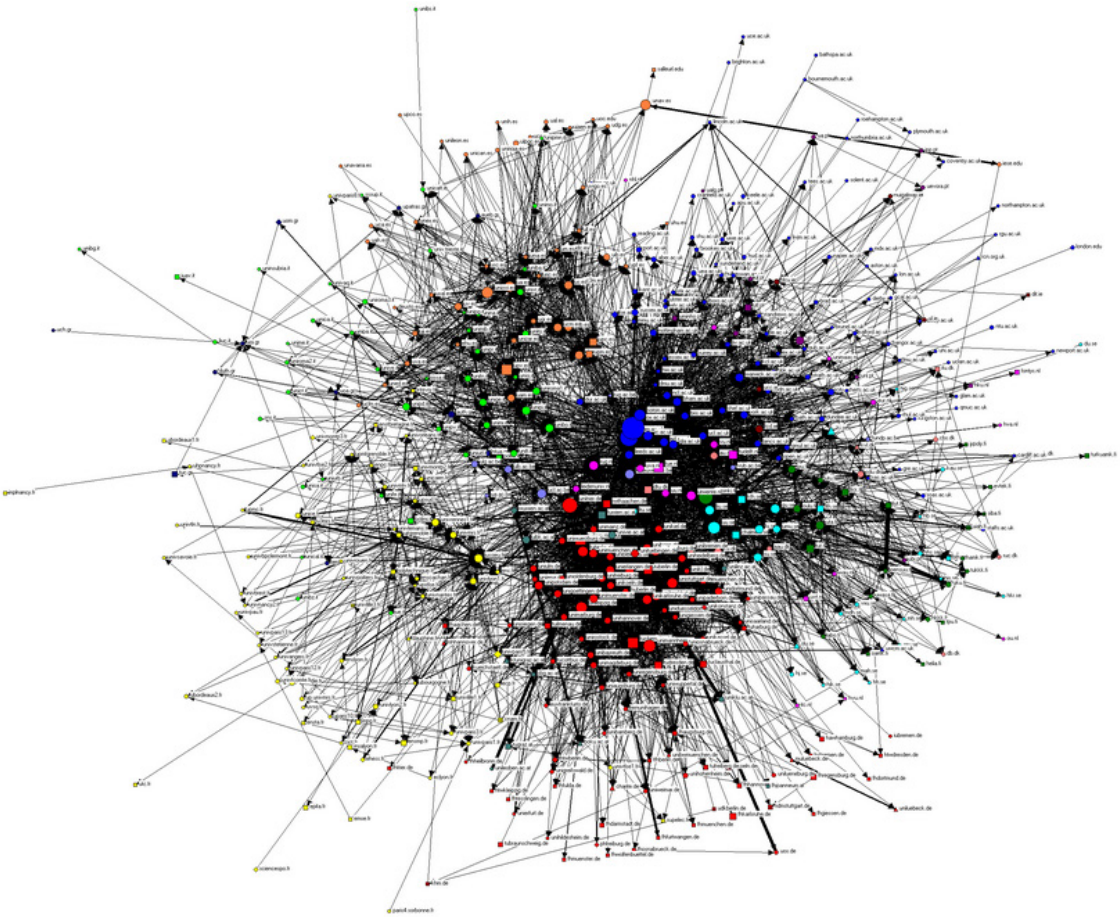
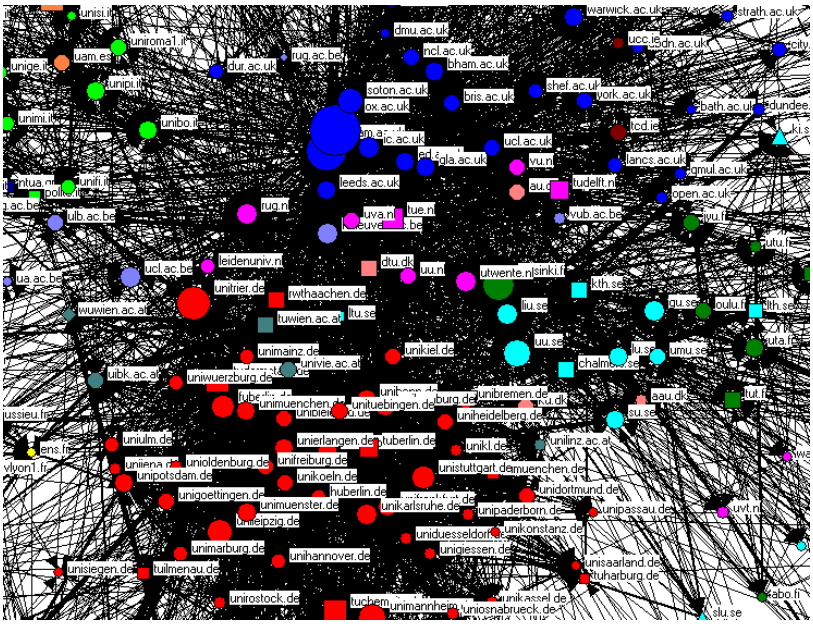


Figure 3 – detail



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Information Visualizations

The Mediated Image

How do we maintain individual meaning while functioning in a world structured by shared conventions?

Information Design

- Typography
- Illustration
- Communication Studies
- Ergonomics
- Psychology
- Sociology
- Linguistics
- Computer Science, etc.

Taxonomic & Polymathic

<u>Taxonomy</u>

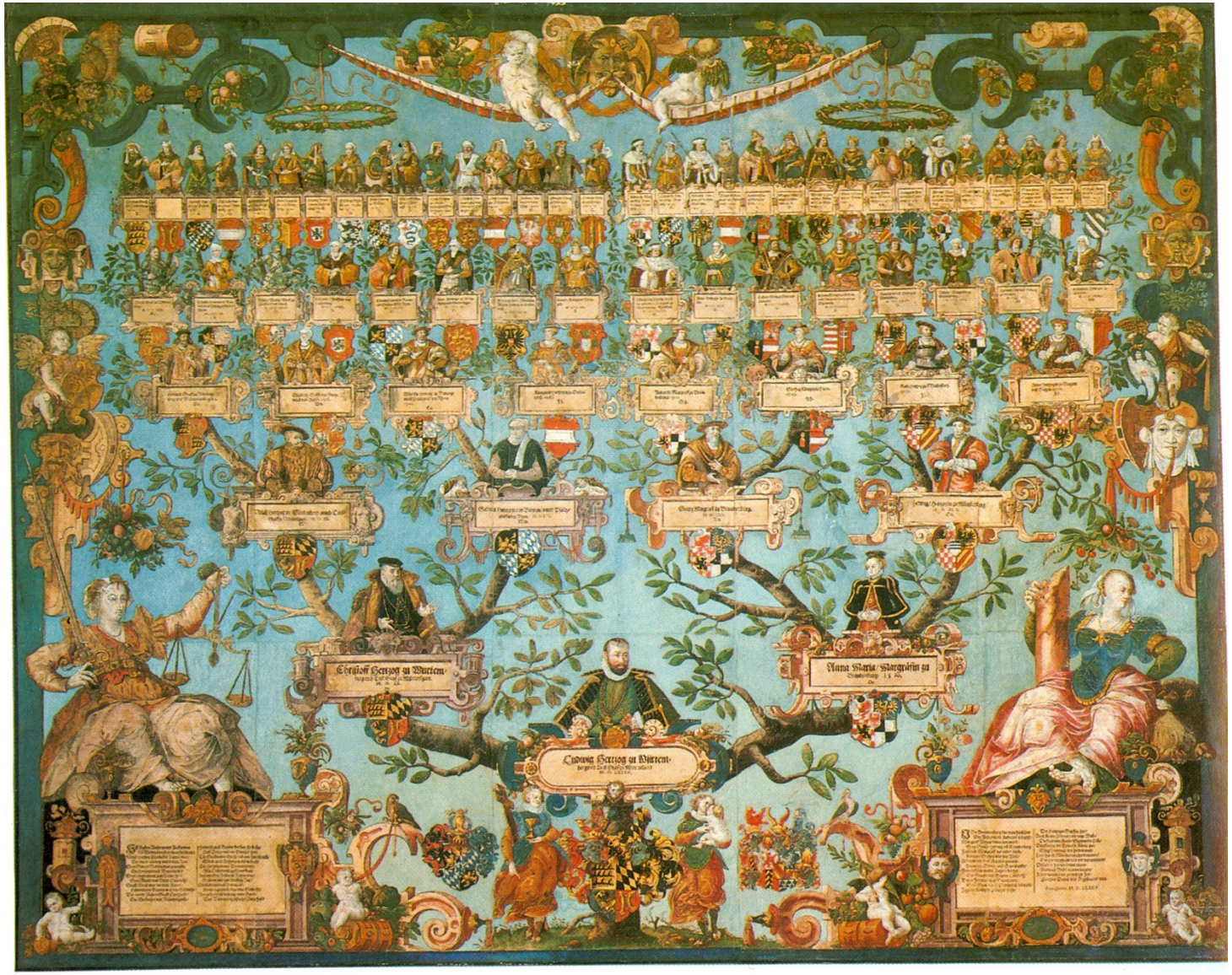
- Classification
- System is important = Visualization

<u>Polymath</u>

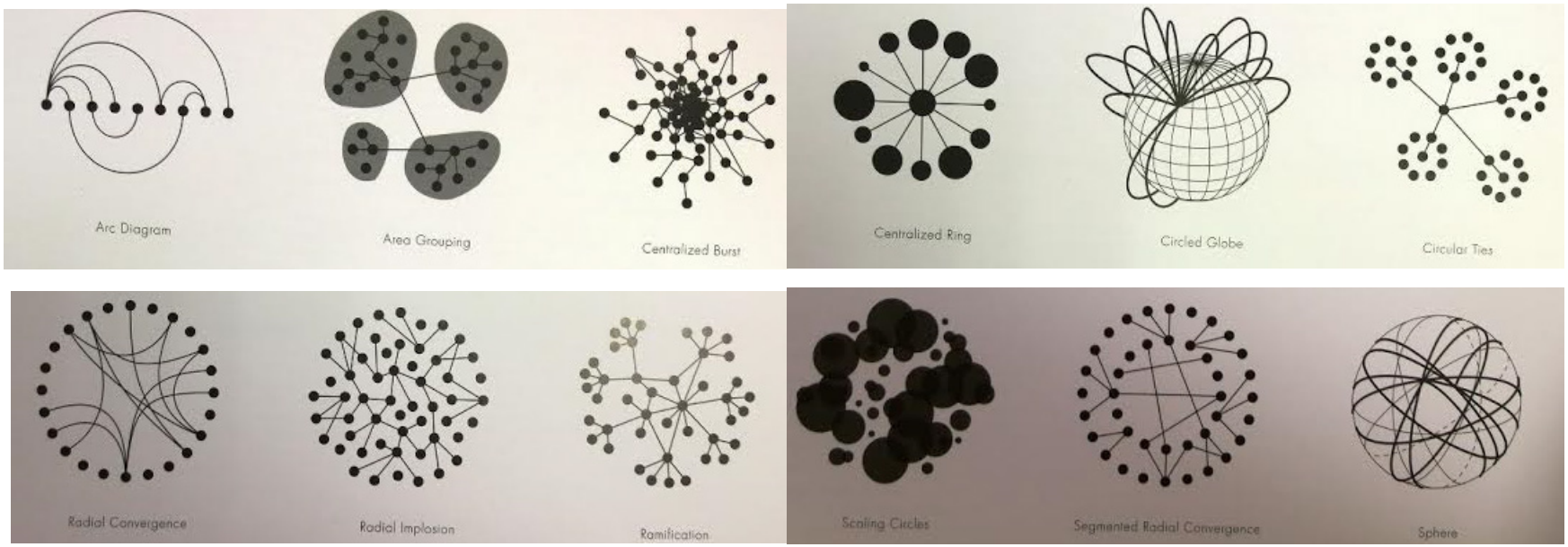
- Wide-ranging knowledge
- Parts are important = Data

Deductive and Inductive ways of reading the network.

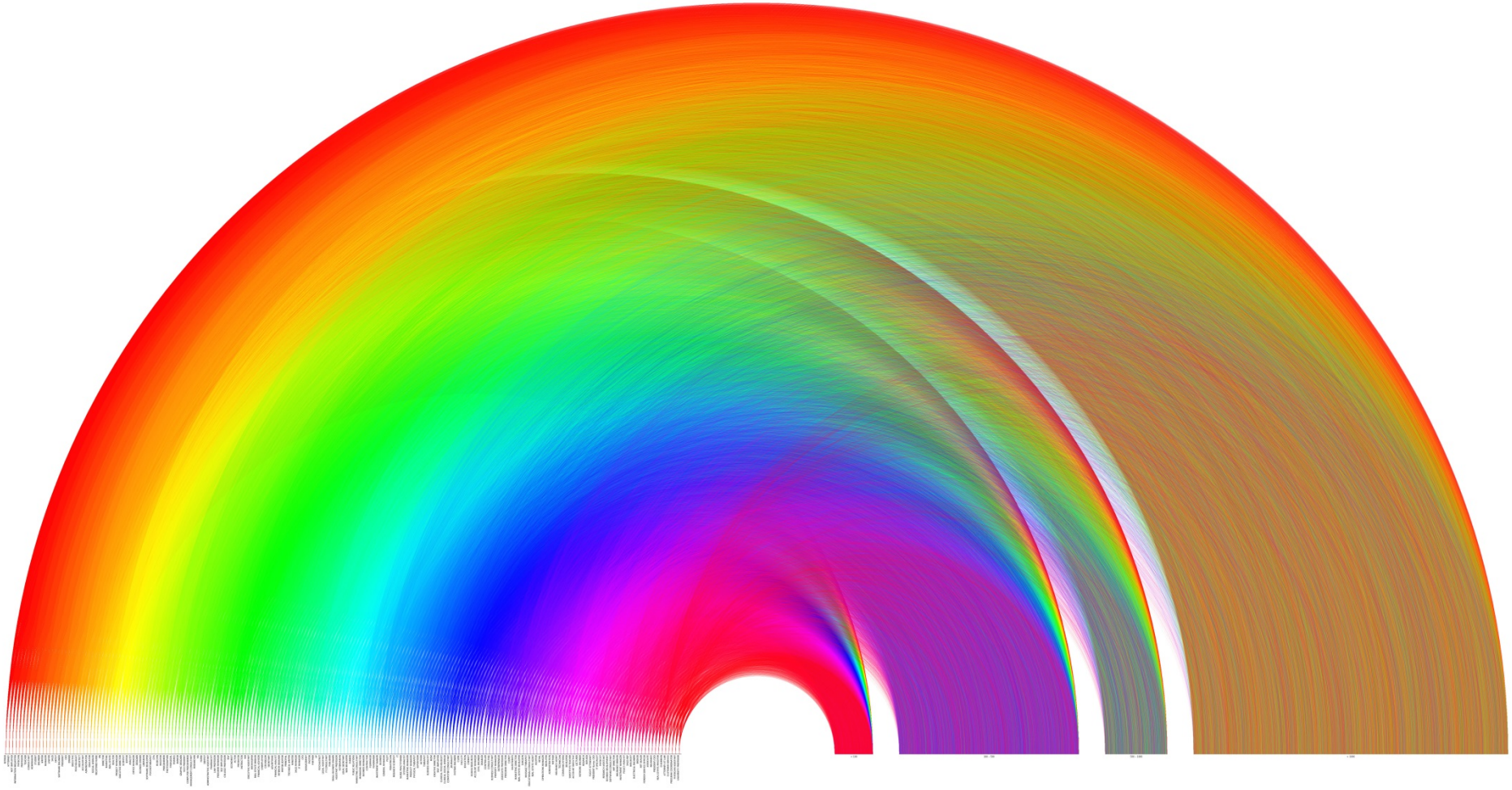
Visualizing Data

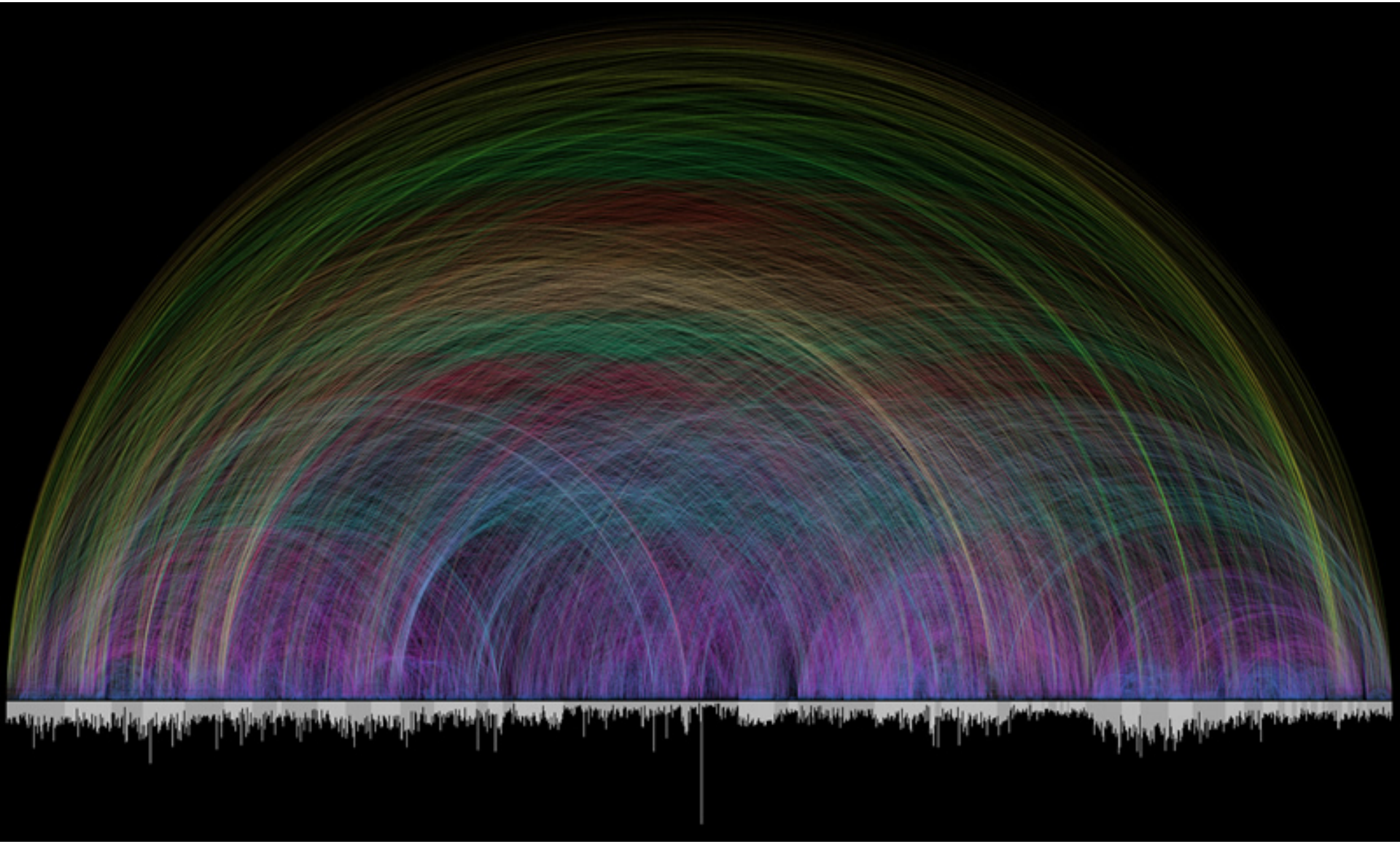


The Network Visualization

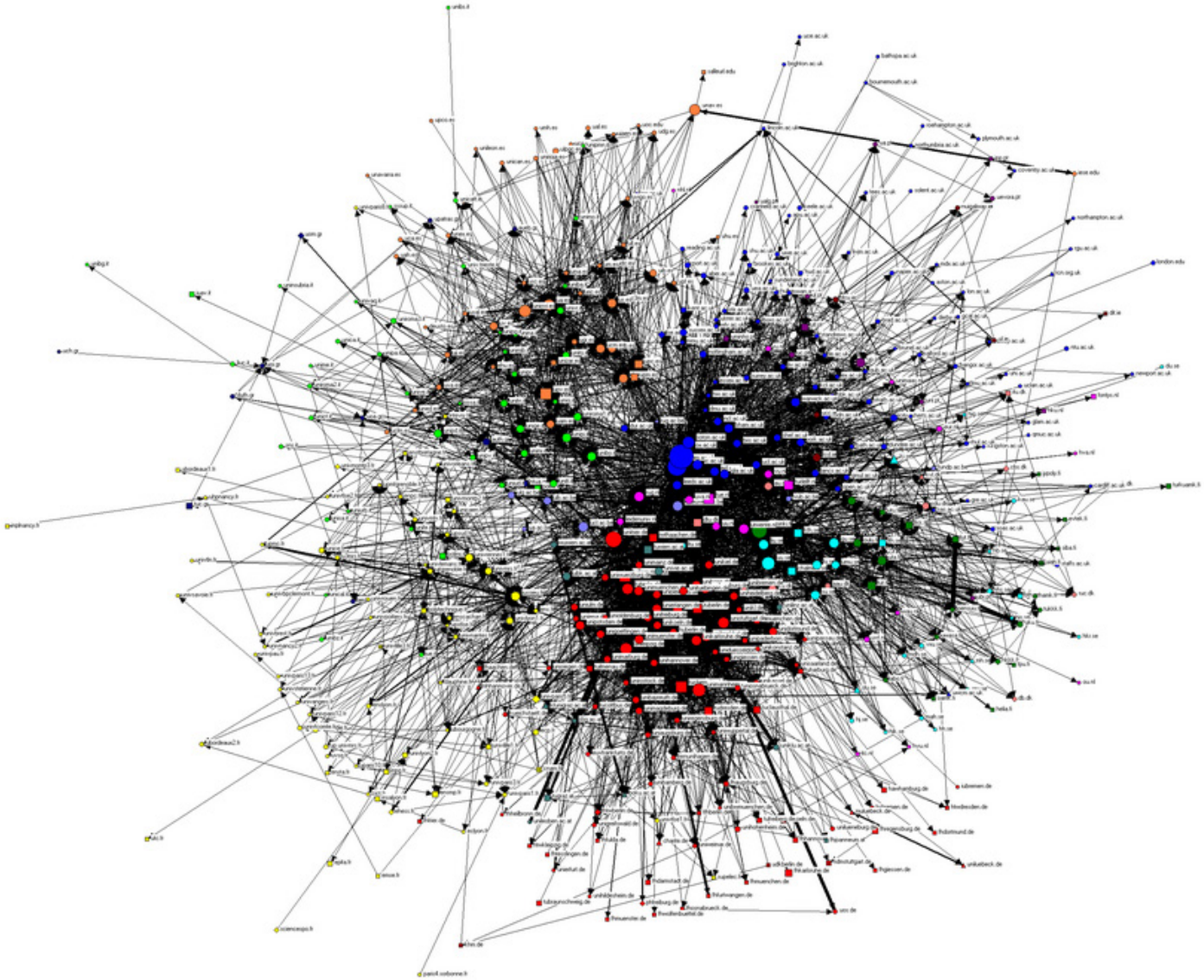


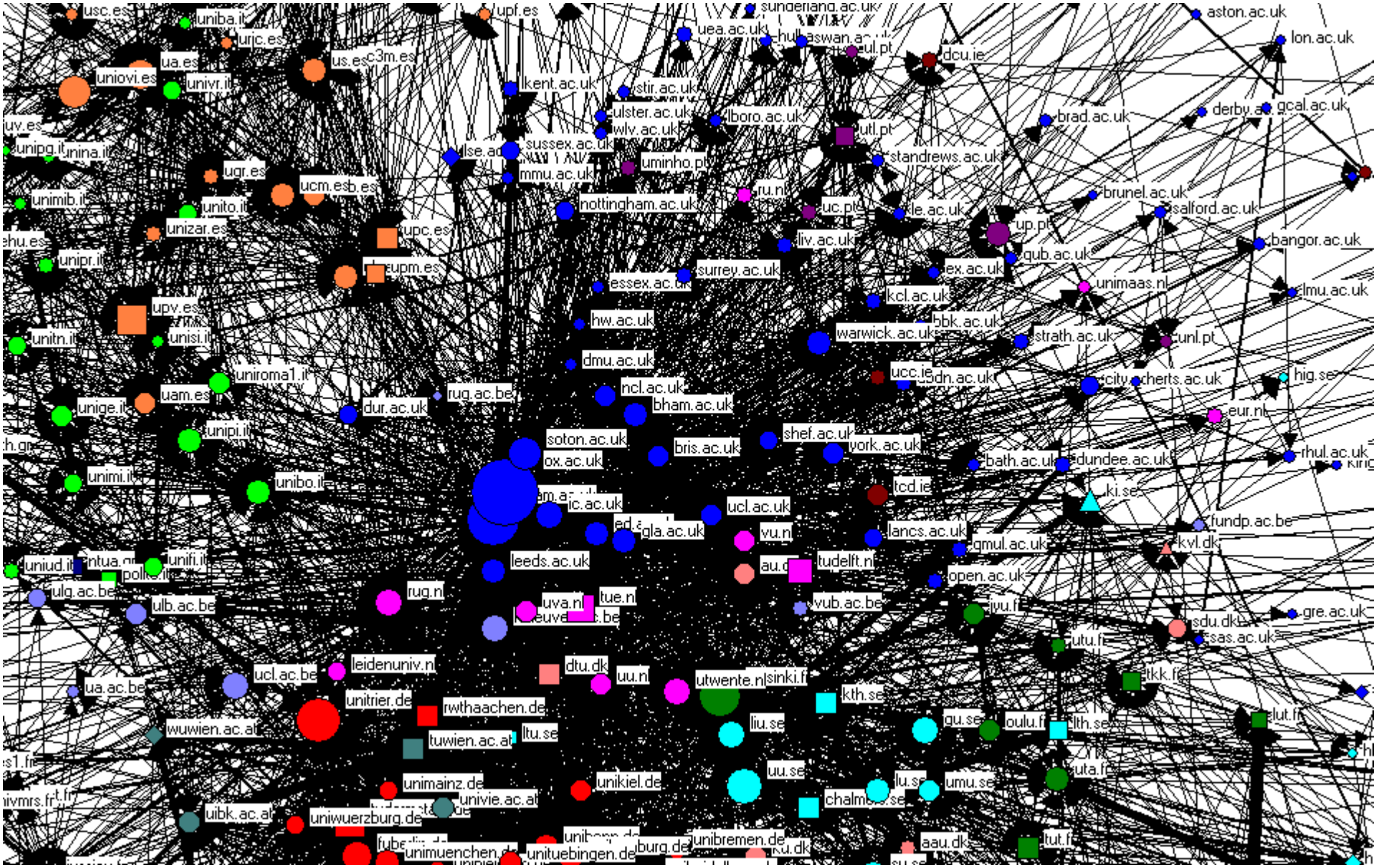
Arc Diagram





Centralized Bursts

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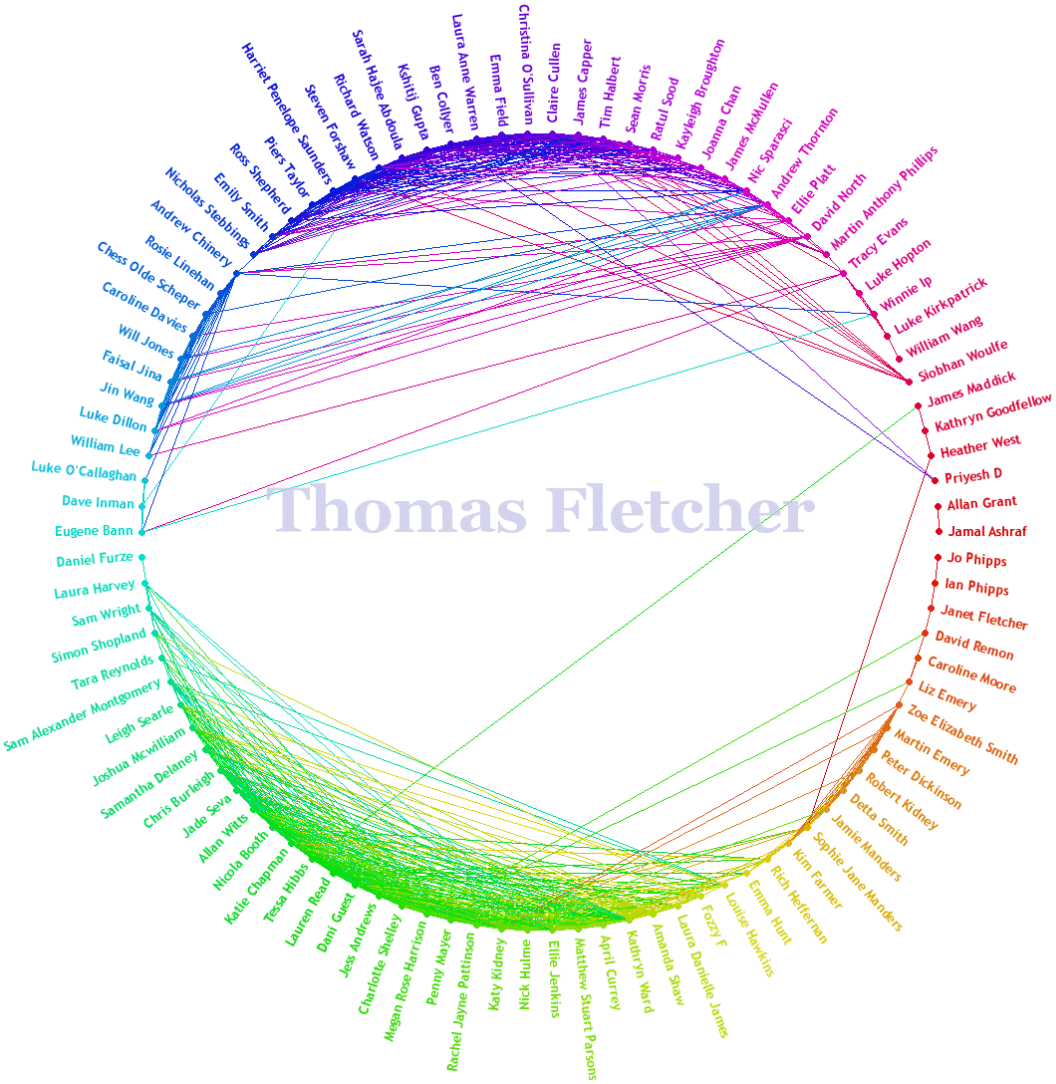
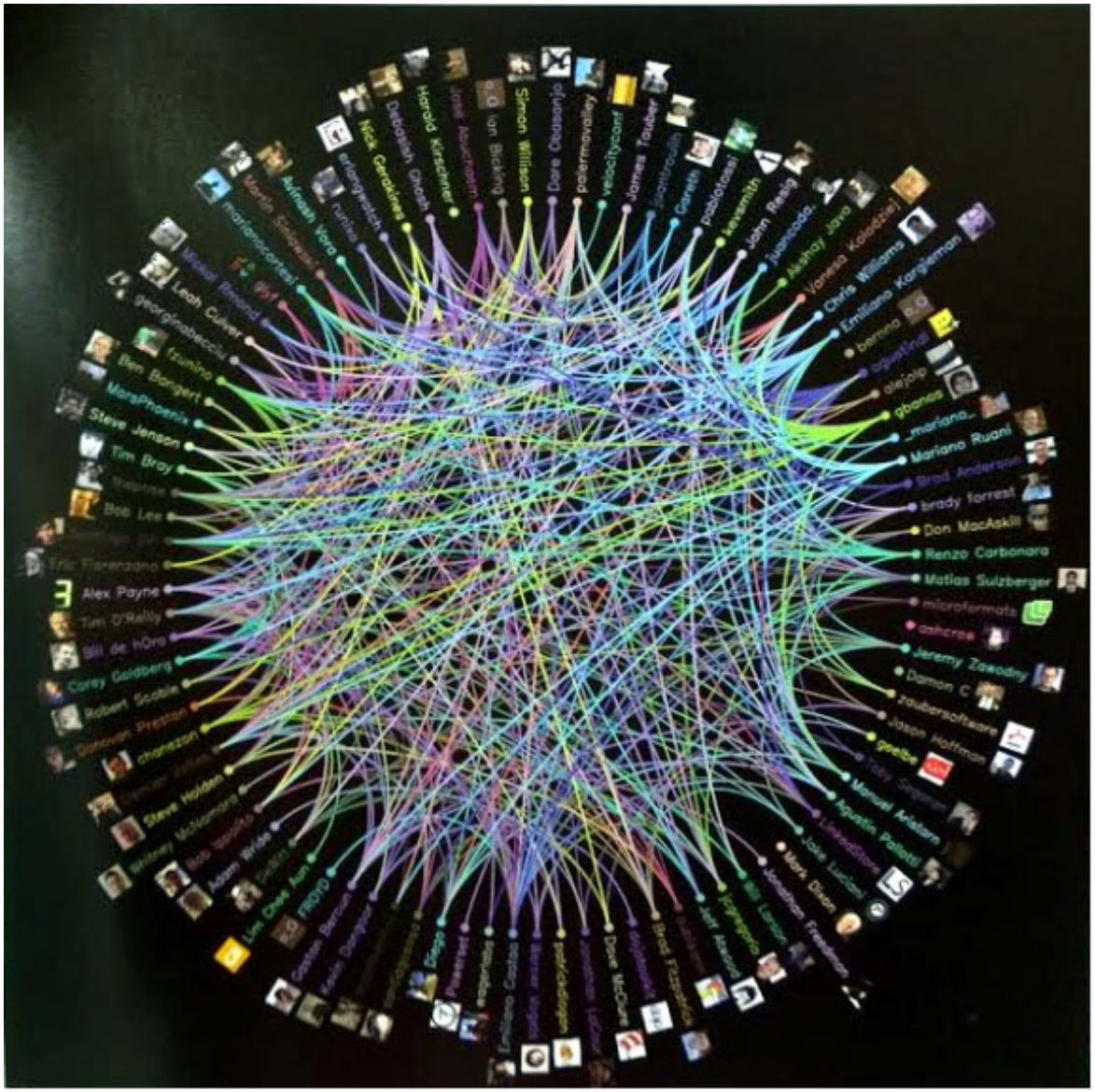
Radial Convergence

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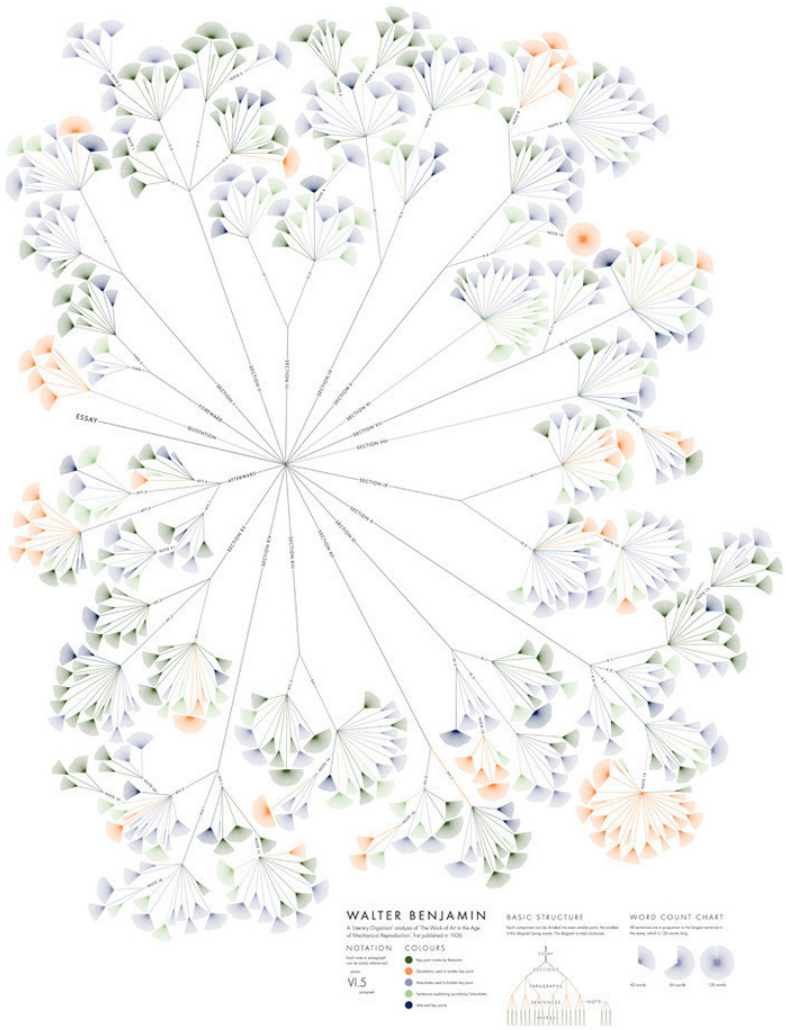
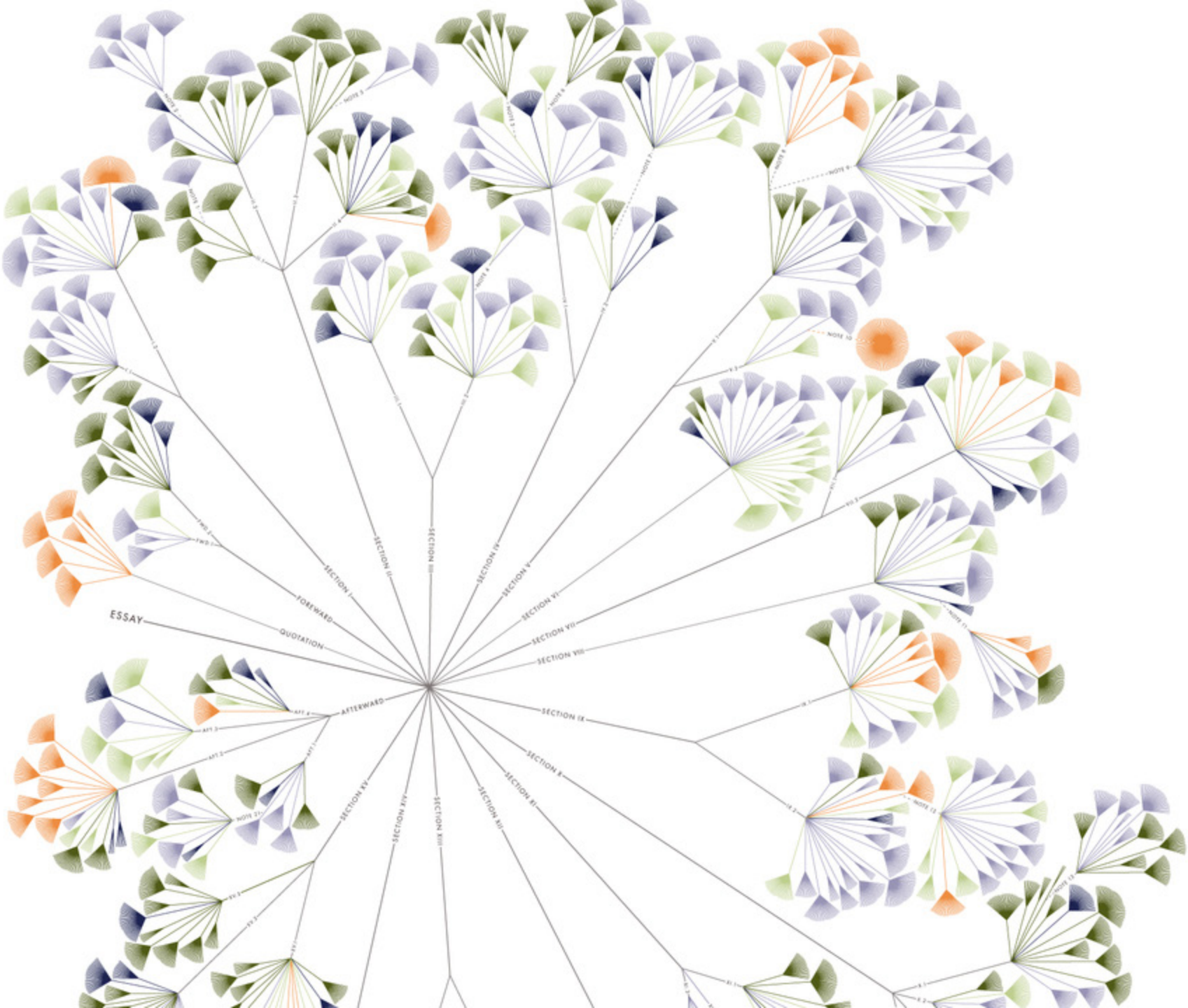
Ramifications

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