Christopher G. Brinton and Mung Chiang (2017) The Power of Networks: Six principles that connect our lives. Princeton and Oxford: Princeton University Press. 328 pages. ISBN: 9780691170718

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What are the crucial engineering principles of networks? How is data traffic routed, how are search results ranked and how do video clips become viral? These are some of the fundamental questions Christopher G. Brinton and Mung Chiang address in their book "The Power of Networks". In particular, they explore the following six principles behind networking: (1) "sharing is hard", (2) "ranking is hard", (3) "crowds are wise", (4) "crowds are not so wise", (5) "divide and conquer" and (6) "end to end". Four of these principles are supplemented with compelling interview material from Internet pioneers such as Eric Schmidt, former CEO of Google, and Vinton Cerf, who co-invented the TCP-IP protocol. With this book the authors have set themselves the task to break down complex network knowledge into easy-to-understand principles, which are in the understanding of the authors "simple phrases that summarize a whole lot about the way networks are designed, built, and managed" (p. x). Throughout the whole book the authors use illustrative analogies and historical anecdotes such as the postal system, traffic jams or cocktail parties and therewith succeed to make the inner workings of networks available for a wide readership. In order to give a greater insight into the book, I will summarize and elaborate on two of the principles: (1) "ranking is hard" and (2) "crowds are not so wise".

The first principle I have chosen to describe further – "ranking is hard" – engages with the fundamental question of how to rank and categorize large amounts of information effectively. From an engineering perspective this is a challenging task, especially because the meaning of information is often ambiguous and today the number of available webpages has risen enormously; according to current statistics the number of unique website are around 60 trillion (p. 86). To illustrate the engineering task associated with how to categorize and rank information effectively, the authors start by outlining the original ideas of the two founders of Google, Sergey Brin and Larry Page. Unique to their approach of data management was the combination of the two factors "relevance score" and "importance score". While the "relevance score" is related to the content itself, the "importance score" determines the popularity of a website. According to the authors, it is especially the "importance score" that made Google so incredibly successful and hence, they explain how the "importance score" draws on graph theory in more detail. In addition to this explanation of the so-called graph theory, a short description of the random surfer concept is offered to illustrate how importance gets quantified. An interesting side note in this regard is, that ranking is not only employed for search queries, but build the fundament of Google Ads and other Internet auctions as well. Thus, for those readers interested in the economics behind such spaces, Brinton and Chiang explain methods such as "pay-

per-click" and "click-through rate" in very comprehensible mathematical terms.

The second principle I have chosen to treat in more detail is "crowds are not so wise". This principle opposes another principle "crowds are wise" also described in the book. Both principles engage the analysis of group behavior, shedding light on why crowds sometimes may take better decision and other times not. The principle "crowds are not so wise" examines group behavior associated with the phenomenon of videos going viral. Drawing on the example of "Gangnam style", the most watched video on YouTube at the time of the book publication, the authors analyze what factors made especially this video so incredibly famous. They start by defining "viral" as "1. a high total view count, 2. a rapid increase of sufficient duration, and 3. (sometimes) a short time before the rapid increase begins" (p. 173) and end by stating that there may be no "golden formula (…) to guarantee your video will become viral" (p. 173). In the meantime, the authors walk their reader through models and concepts that aim at predicting how information spreads online. It is a strength of this chapter, that the authors recognize, that the models they describe, are highly idealized. Hence, readers come to understand that while the models introduced in the book aim to predict, they cannot identify when a particular effect might occur. The chapter's intelligible introduction to sequential decision making and the mathematics behind information cascades, is thus very helpful as it makes no false promises. At the end of the chapter the authors draw a bridge to Hans Christian Andersen's tale of *The Emperor's New Clothes* (p. 185) in order to show how fragile information cascades are. Basically, it only needs very few individuals in a crowd to disturb positive network effects.

In sum, the book provides an in-depth overview of engineering models and principles employed in the digital realm. All explanations are easy-to-follow and make those principles accessible to a wide audience. What remains unclear is why exactly the mentioned six principles became ennobled as network maxims. This can give the impression that such principles are neutral without broader social implications. Hence, this book is especially recommendable for those interested in explanations of digital networks from an engineering perspective. It is not recommendable for those interested a critical analysis of networks. In this regard, however, the authors contributes with their easy-to-understand concepts towards a demystification of some underlying engineering principles of digital networks.

In this regard, a user study by Eslami et al. (2016) has shown that some users have "far-out" explanations of digital mechanisms such as algorithmic ranking. In their study, Eslami et al. examine Facebook's Newsfeed via the notion of "folk theories", which are "non-authoritative conceptions of the world that develop among non-professionals and circulate informally" (Eslami et al., 2016: 2). While some of such folk theories are unsurprising and expected, such as the "global popularity theory", which relates to the principle of "popularity ranking", other are rather surprising. One folk theory is for example that the personal similarities between friends "would affect the number of stories [a user] would see from those friends" (Eslami et al., 2016: 6). According to the explained principles in "The Power of Networks" this "magical" folk theory can be undermined from an engineering perspective. Even though this very folk theory might continue to guide everyday user behavior, it is not factual.

That user's folk theories are not always for the best shows another study by Eslami et al. (2015). Examining user's ideas of Facebook principles the authors conclude: "In the extreme case, it may be that whenever a software developer in Menlo Park adjusts a parameter, someone somewhere wrongly starts to believe themselves to be unloved" (Eslami et al., 2015: 8). To reiterate in this context Brinton and Chiang's work sheds light on the actual engineering mechanisms and so can help users to avoid such beliefs. It is clearly a good idea for undergraduates and interested citizens, especially those with a non-technical background, to engage in networks from an engineering perspective, so they can distinguish between their own folk theories and actual engineering principles.

References

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Eslami M, Karahalios K, Sandvig C, et al. (2016) *First I "Like" it, then I Hide it: Folk Theories of Social Feeds.* Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, pp. 2371-2382.