

Network Analysis Finds Shifts in the History of Modern Architecture

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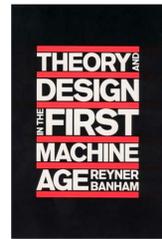
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Overview

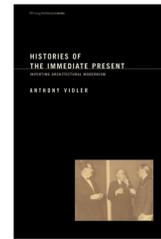
- Histories of architecture create implicit networks by mentioning objects, people, and texts in the same contexts.
- Explicitly constructing these networks lets us study the form and content of histories using network analysis.
- As a case study, we construct networks for a small sample of English-language history of European modern architecture, which examines a consistent core of entities:



Toward an Architecture
Le Corbusier, 1923.
Introduction by
Jean-Louis Cohen, 2007.



Theory and Design in the First Machine Age
Reyner Banham, 1960



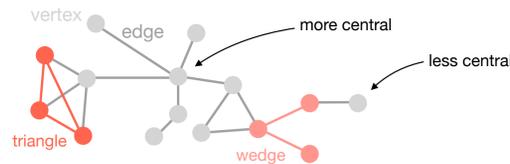
Histories of the Immediate Present
Anthony Vidler, 2008.

- We find that Corbusier mentions entities in the context of his ancient influences, but the later histories make comparisons to a canonical set of modernist architects.

Network analysis tools

Graphs

A *graph* (also called a network) consists of vertices (also called nodes) and edges. A vertex is an entity, and an edge is a link between two vertices.



Centrality

- Normalized eigenvector centrality (also called PageRank) assigns a probability between zero (not central) and one (very central) to each vertex in a graph. It solves for the stationary distribution of a Markov chain that represents a random walk through the graph.
- Vertices with large centrality values are connected with many parts of the graph.

Triangle counting

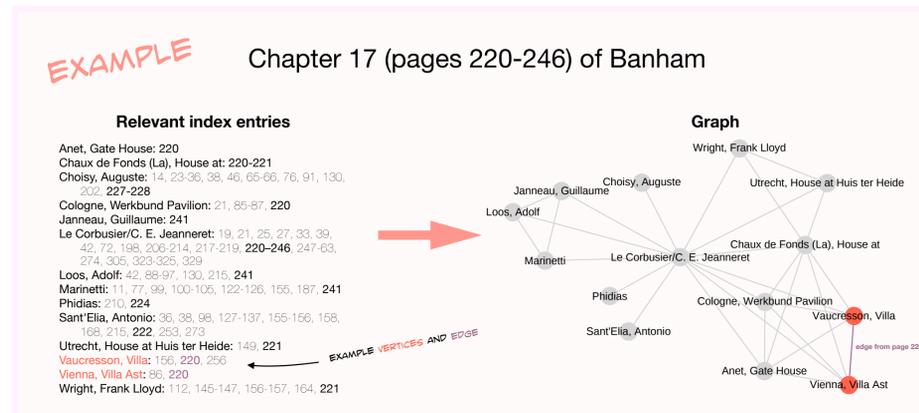
- A *triangle* is a set of three vertices with an edge between each pair. A *wedge* is a triangle missing an edge.
- The global clustering coefficient κ of a graph is a value between zero and one that measures how many triangles exist out of how many are possible:

$$\kappa = \frac{3 \cdot \# \text{ triangles}}{\# \text{ wedges}}$$

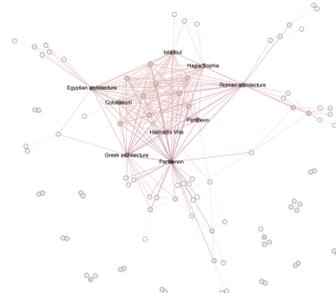
- A large clustering coefficient indicates many dense connections between vertices.

Graph construction

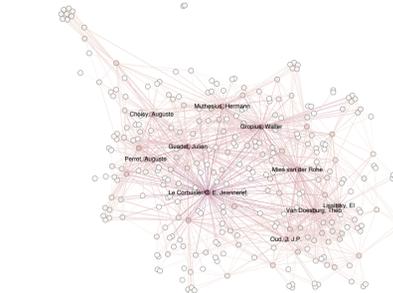
1. Digitize index
2. Create a vertex for every proper noun index entry
3. Create an edge between every pair of entries that occur on the same page



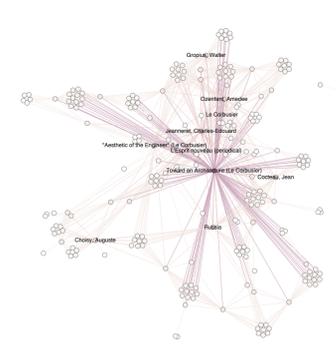
Toward an Architecture



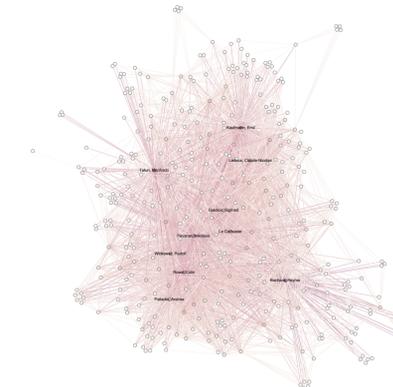
Theory and Design in the First Machine Age



Introduction to
Toward an Architecture



Histories of the Immediate Present



- Darker vertex color corresponds to greater centrality. Highest-ranked vertices are labeled.
- Edge color is just for visualization.

Centrality results

- The highest-ranked entries recover the organizational structure of the texts.
 - In Banham, sections are organized around nationality, with central entries for each.
 - In Vidler, each chapter is about a historian, each of whom is highly central.
- *Toward an Architecture*, a manifesto by an architect, ranks buildings and architectural traditions most highly, despite the network containing many architects and other people. The three other texts, which are all histories, rank architects, artists, and historians much more highly than their buildings and artworks.
- The architects from different national traditions that are highly ranked in *Theory and Design in the First Machine Age*—Le Corbusier, Walter Gropius, Ludwig Mies van der Rohe—also have among the highest ranks in *Histories of the Immediate Present*. The architects who are most central in the former are still most central in the latter, written half a century later.
- Highest-ranked entries in *Toward an Architecture* are all ancient architecture. All the later histories rank “Le Corbusier” highly but not classical architecture. This suggests a shift in the later histories to using Corbusier as a frequent point of comparison for other modern architects.

Triangle counting results

	Triangles	Triangles from different pages	Clustering coefficient κ
<i>Toward an Architecture</i>	5,674	70	0.4792
Intro to <i>Toward an Architecture</i>	899	3	0.7188
<i>Theory and Design in the First Machine Age</i>	3,344	421	0.3189
<i>Histories of the Immediate Present</i>	21,544	4,885	0.3352

- *Toward an Architecture* has the highest clustering coefficient. When one entity was mentioned on the same pages as two others, the two others were also mentioned together on the same page 71% of the time.
- Counting only triangles from different pages (where not all edges correspond to the same page) attempts to control for artifacts of the graph creation process. Almost all of the triangles in *Toward an Architecture* result from at least three entities occurring on the same page. The work densely draws connections between multiple entities, then moves on to others without drawing further connections between the multiple groups.
- In *Histories of the Immediate Present*, over 20% of the triangles are formed across different pages. This suggests that it examines connections in multiple contexts.

Takeaways

- Graphs of people, objects, and texts are implicit in history texts. We expect our approach to afford larger historiographical studies in other areas of architecture and history.
- Network centrality measures and counts of triangles often align well with traditional historical analysis and provide insight into the structures of the historical accounts.
- Page co-occurrence is an imperfect proxy for relatedness and importance.
- Centrality is an additional view of the text to supplement traditional notions of importance.

Data

<https://github.com/gyauney/modern-architectural-history-indices>