Network Analysis Finds Shifts in the History of Modern Architecture

Centrality
- 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:

  - 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.

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 $c$ of a graph is a value between zero and one that measures how many triangles exist out of how many are possible.
- A large clustering coefficient indicates many dense connections between vertices.
- The triangle counting result from at least three entities occurring on the same page is $\frac{3 \times \#\text{triangles}}{\#\text{wedges}}$.

Overview
- Graphs
  
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

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
<table>
<thead>
<tr>
<th>Textual Archive</th>
<th>Triangles</th>
<th>Triangles from different pages</th>
<th>Clustering coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toward an Architecture</td>
<td>3,344</td>
<td>0.3189</td>
<td></td>
</tr>
<tr>
<td>Intro to Toward an Architecture</td>
<td>220</td>
<td>0.1996</td>
<td></td>
</tr>
<tr>
<td>Theory and Design in the First Machine Age</td>
<td>220</td>
<td>0.2941</td>
<td></td>
</tr>
<tr>
<td>Histories of the Immediate Present</td>
<td>21,541</td>
<td>0.5550</td>
<td></td>
</tr>
</tbody>
</table>

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