The Invisible in Philosophy: Mapping the Stanford Encyclopedia of Philosophy's Network

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Extended Abstract

The Stanford Encyclopedia of Philosophy (SEP) serves as a key resource in the dissemination of philosophical knowledge. SEP is committed to the long-term preservation of high-quality academic knowledge and has gained a wide readership, exerting significant influence both within and beyond the humanities and social sciences [1]. Like other online encyclopedias, SEP features interconnected entries, with hyperlinks primarily concentrated in the "Related Entries" section of each article. This hyperlink structure raises concerns about visibility: users often navigate SEP by following internal citations, meaning that the discoverability of an entry is largely shaped by its position within the citation network. If structural inequalities exist in this network, certain types of entries may be less accessible to users, suggesting a form of representational bias in SEP. Such bias could reflect or even reinforce existing inequalities in philosophical scholarship. To promote a more comprehensive and inclusive representation of knowledge, this study investigates the potential factors influencing the visibility of SEP entries.

Using Python, we scraped all entries from the SEP along with the hyperlinks between them, resulting in a total of 1,814 entries and 19,368 hyperlinks. Additionally, the initial publication date of each entry and its preamble section were recorded. The dataset is stored as a directed graph, where each entry serves as a node, and hyperlinks define the edges between them. In our exploratory analysis, we first computed the in-degree distribution of the network. We then calculated the PageRank score for each node. Originally introduced as a connectivity-based measure of a website's importance on the Web, PageRank has since been widely applied in social science research involving network-structured data. Within a network, the PageRank score captures a node's global influence: a node does not necessarily need a high degree to attain a high PageRank, but a high PageRank indicates a greater probability of encountering the node during a random walk[2]. Thus, in online encyclopedic knowledge bases like the SEP, the PageRank score can serve as a proxy for the visibility or discoverability of specific entries. To further examine this, we visualized the Louvain community structure of the network and highlighted the 20 entries with the highest PageRank scores to determine whether they cluster into specific categories. Finally, we identified a group of "orphan" entries—those with an in-degree of zero—meaning that no other entries link to them, rendering their visibility to users virtually nonexistent[3].

Building on these exploratory findings, we developed two regression models to assess how different node attributes influence (1) PageRank scores (via OLS) and (2) the likelihood of being an orphan entry (via logistic regression). The node attributes included: year of first publication, whether the entry concerns a female philosopher (is_female; 0/1), whether it belongs to Analytic vs. Continental philosophy (is_continental; -1/0/1), and whether it represents Western vs. non-Western philosophy (is_nonwestern; -1/0/1). The is_female variable was determined using a combination of keyword matching ("her," "she," "women," "female") and manual annotation, while is_continental and is_nonwestern were assigned using machine learning classifiers.

To evaluate classification accuracy, we conducted a five-fold cross-validation comparing Support Vector Machines (SVM), Decision Trees, Random Forests, and Naïve Bayes, reporting both the mean and variance of their performance.

Our findings indicate that the in-degree distribution of SEP entries approximates a power-law, where most nodes have an in-degree below 20, while a small number of entries exhibit extremely high in-degree values (Figure 1)[4]. This pattern aligns with the preferential attachment model, suggesting that newer entries tend to link disproportionately to those that already have a large number of citations. Notably, the nodes with the highest PageRank and in-degree scores were Kant and Aristotle. Upon converting the network to an undirected graph, we applied Louvain community detection and identified nine distinct communities, each roughly corresponding to a philosophical domain. High-PageRank entries were predominantly concentrated in the fields of the history of philosophy and analytic philosophy, with all high-ranking philosopher entries being Western male philosophers from ancient or modern times (Figure 2). Conversely, among the identified orphan entries ($N_{orphan} = 58$), a significant proportion represented female philosophers (e.g., Rosa Luxemburg), non-Western philosophers (e.g., Ayn al-Qudat), or Continental philosophers (e.g., Michel Henry). Based on these patterns, we hypothesize that entries concerning female philosophers, non-Western philosophy, and Continental philosophy tend to have lower visibility/discoverability within the SEP network. Additionally, given that an entry's publication year is likely to influence its number of citations, we included this variable as a control in our subsequent models.

We manually annotated a training set and evaluated model performance using 5-fold cross-validation. Regardless of whether the classification task was Analytical-Continental or Western-Nonwestern, the Naïve Bayes classifier achieved the highest average accuracy and standard deviation among the four classification models (Table 1). Consequently, we used the Naïve Bayes classifier trained on the training set to generate the attributes is_continental and is_nonwestern for the entire dataset. Given that some entries did not exhibit a clear bias along these two dimensions, we defined the predicted attribute as 0 when the computed posterior probability fell within the interval $[0.1, 0.9]$. Under this criterion, 122 and 217 entries were classified as neutral in the Analytical-Continental and Western-Nonwestern dimensions, respectively. Finally, we employed OLS and Logit regression to examine the effects of these attributes on PageRank scores and the probability of being an Orphan entry. After controlling for the year of first publication, these attributes remained statistically significant at the 0.1 significance level. Among them, the effect of is_female appeared to be the strongest (Table 2 and 3).

These findings have both theoretical and practical implications. Theoretically, they highlight the role of hyperlink structures in shaping knowledge accessibility, reinforcing concerns about epistemic injustice in digital academic resources (e.g., gender bias). In practice, our results suggest that editorial interventions—such as encouraging cross-tradition citations—could help mitigate existing biases and promote a more inclusive representation of philosophical knowledge. Additionally, scholars and educators should be aware of these structural biases when using SEP as a reference, ensuring that diverse philosophical perspectives are not inadvertently marginalized. Finally, this study also makes a methodological contribution. By integrating computational methods with traditional statistical analysis, we propose a quantitative framework for analyzing the visibility of academic knowledge networks. This framework can be extended to broader studies of online knowledge networks, such as scientific citation networks or other online encyclopedias.

References

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Appendix

Table 1: Comparison of Classification Model Performance (Mean and Std.) across Two Dimensions (Analytical-Continental and Western-Nonwestern)

Model	**Analytical-Continental**		**Western-Nonwestern**	
	Mean	Std Dev	Mean	Std Dev
SVM	0.698	0.121	0.591	0.136
Decision Tree	0.784	0.060	0.726	0.120
Naïve Bayes	0.933	0.054	0.895	0.090
Random Forest	0.698	0.121	0.694	0.142

Table 2: Results of OLS Regression of Node Features on 10000*PageRank Score

	coef	**std err**	**t-statistics**	**p-value**	**95% CI**
intercept	7.7613	0.232	33.507	0.000***	[7.307, 8.216]
is_female	-2.5982	0.977	-2.658	0.008***	[-4.515, -0.681]
publish_year	-0.2570	0.018	-13.989	0.000***	[-0.293, -0.221]
is_continental	-0.7107	0.157	-4.535	0.000***	[-1.018, -0.403]
is_nonwestern	-0.2419	0.142	-1.709	0.088*	[-0.520, 0.036]

Table 3: Results of Logit Regression of Node Features on Is Orphan Entry

	coef	**std err**	**z-statistics**	**p-value**	**95% CI**
intercept	-7.2514	0.603	-12.028	0.000***	[-8.433, -6.070]
is_female	2.6253	0.533	4.924	0.000***	[1.580, 3.670]
publish_year	0.2481	0.030	8.261	0.000***	[0.189, 0.307]
is_continental	0.2830	0.157	1.801	0.072*	[-0.025, 0.591]
is_nonwestern	0.3593	0.169	2.123	0.034**	[0.028, 0.691]

Figure 1: In-degree Distribution of SEP Entries Network

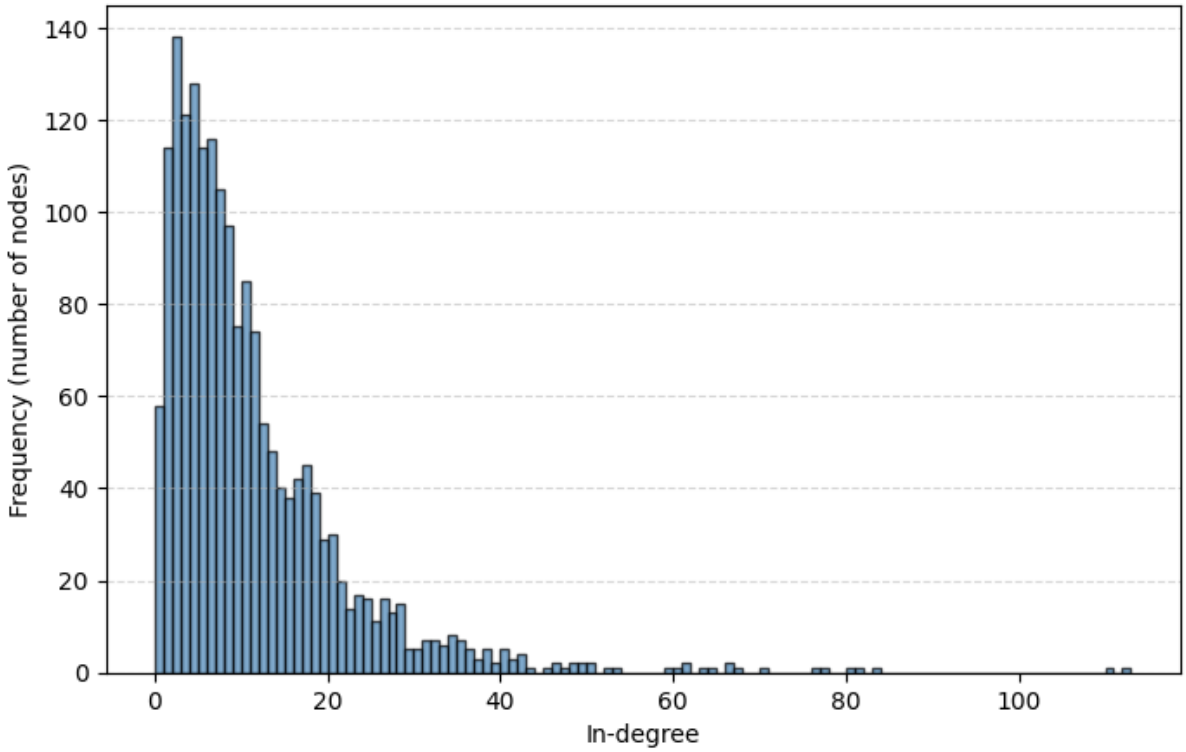

Figure 2: The SEP Entries Communities (Louvain) and the 20 Highest Ranked Nodes