

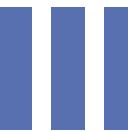


The implementation of temporal graph management system

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E-commerce Engineering with Law



Current Systems

- display basic statistical information
- do not provide user-friendly service

Temporal graph management system

- Interact with the system freely
- Have an intuitive sense of network architecture
- Explore the properties of community structure, etc.

Temporal networks

Name	Type	Nodes	Temporal Edges	Static Edges
soc-RedditHyperlinks	Directed, Signed, Temporal, Attributed	55,863	858,490	858,490
sx-stackoverflow	Directed, Temporal	2,601,977	63,497,050	36,233,450
sx-mathoverflow	Directed, Temporal	24,818	506,550	239,978
sx-superuser	Directed, Temporal	194,085	1,443,339	924,886

Figure 1 Stanford Large Network Dataset Collection

Achievement

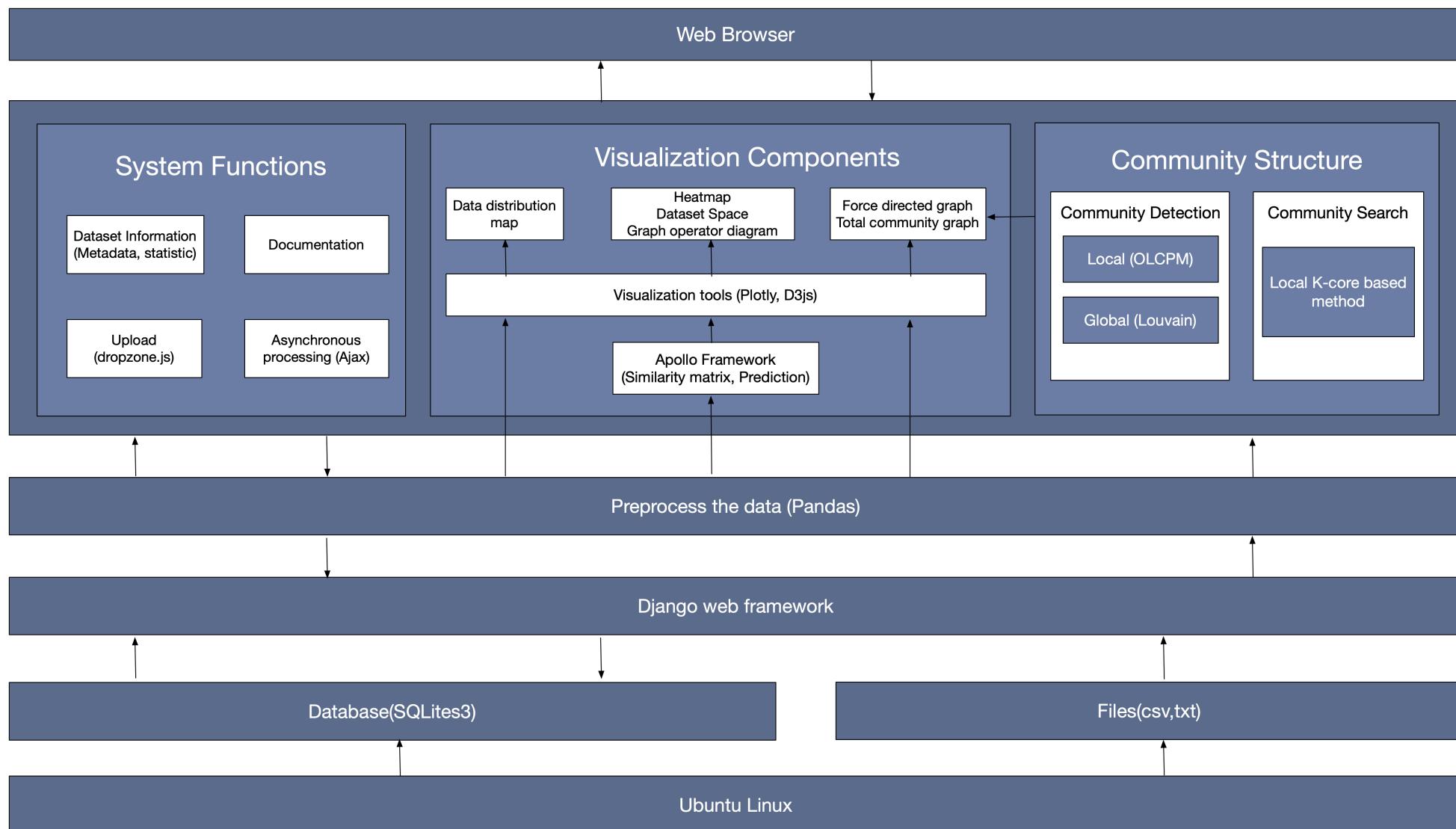


Figure 2 Web-based temporal graph management system



Degree Distribution

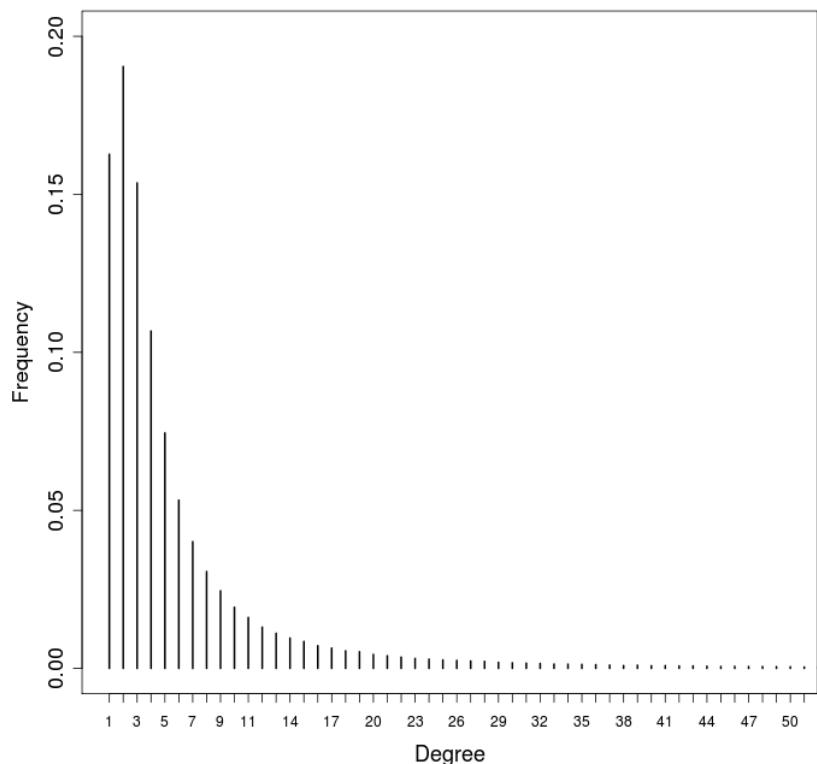


Figure 3 Degree Distribution

Compare the similarity of degree distribution

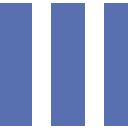
- Jensen–Shannon divergence

$$JSD(P||Q) = \frac{1}{2} D(P||M) + \frac{1}{2} D(Q||M)$$

$$\text{Where } M = \frac{1}{2}(P + Q)$$

- Bhattacharyya coefficient

$$BC(p, q) = \sum_{x \in X} \sqrt{p(x)q(x)}$$



Community Definitions

- a collection of nodes
- densely connected to each other

Local Community

- subgraph cohesiveness and mutuality
- k-cliques and k-cores

Global Community

- a property of the whole network
- Modularity

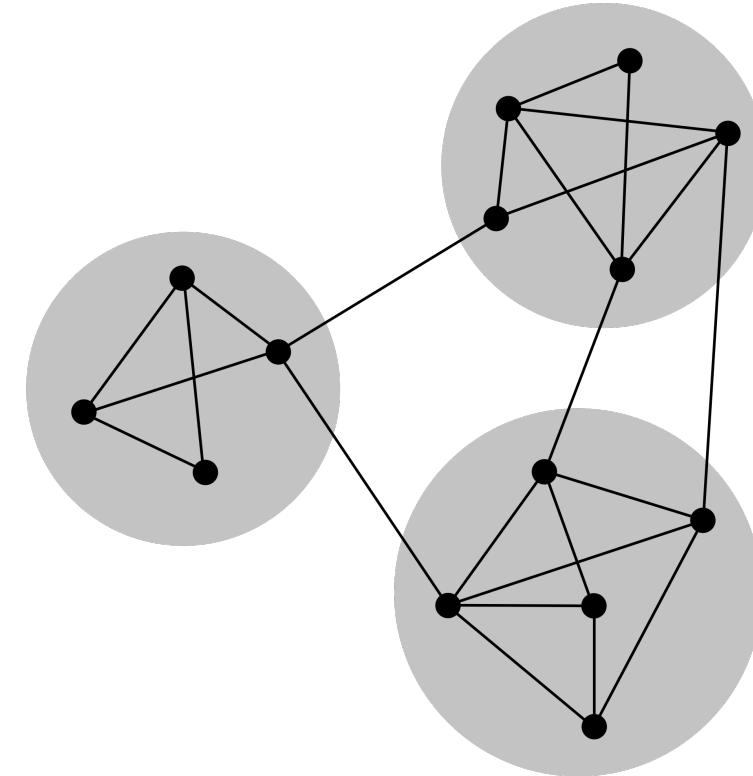


Figure 4 Community

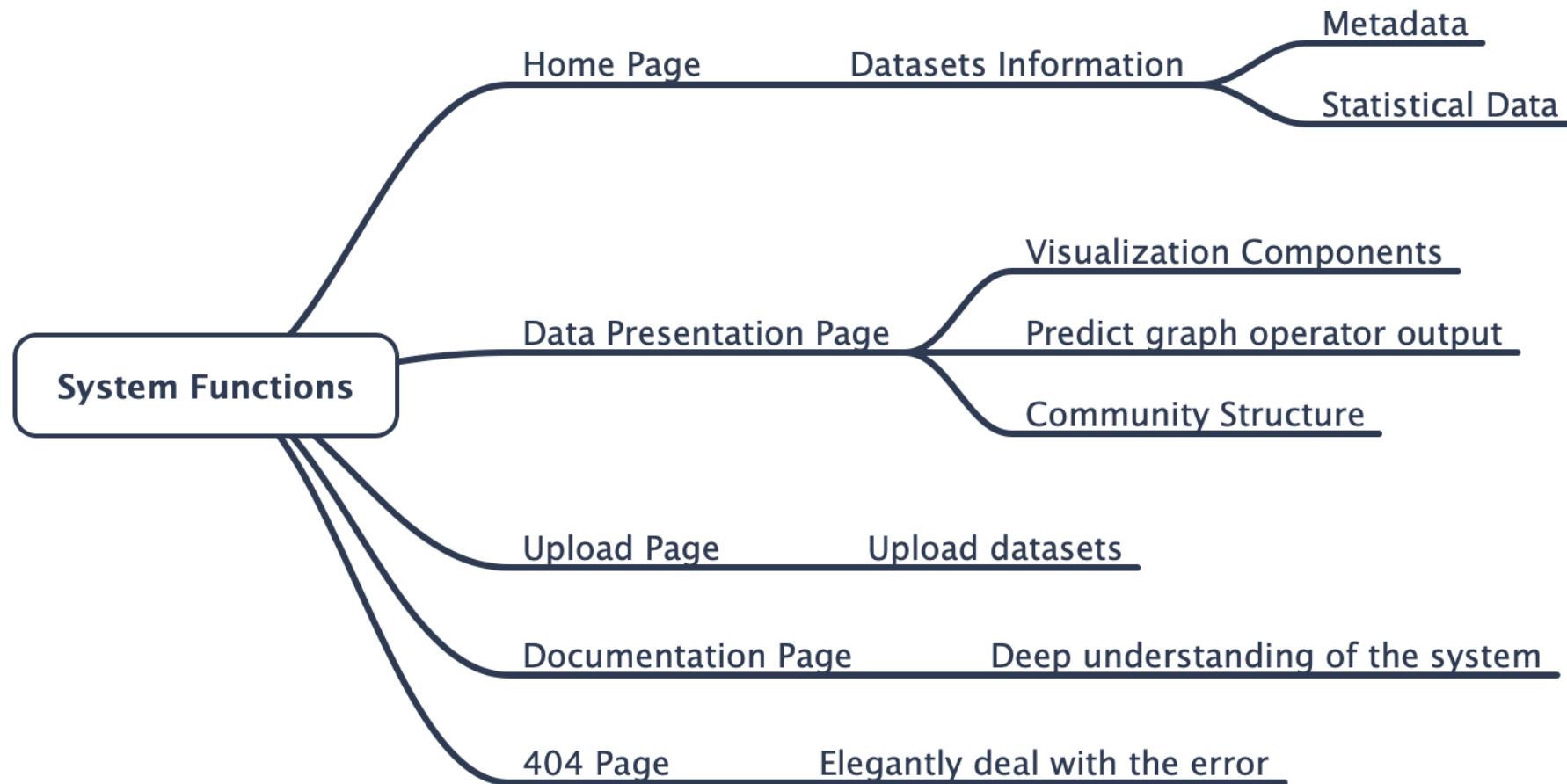


Figure 5 System Functions



Asynchronous processing

- Ajax
- Dropzone.js

Store Graph data into Database

- Calculate the data in advance
- Save HTML of Graph into database
- Retrieve the data without computational effort

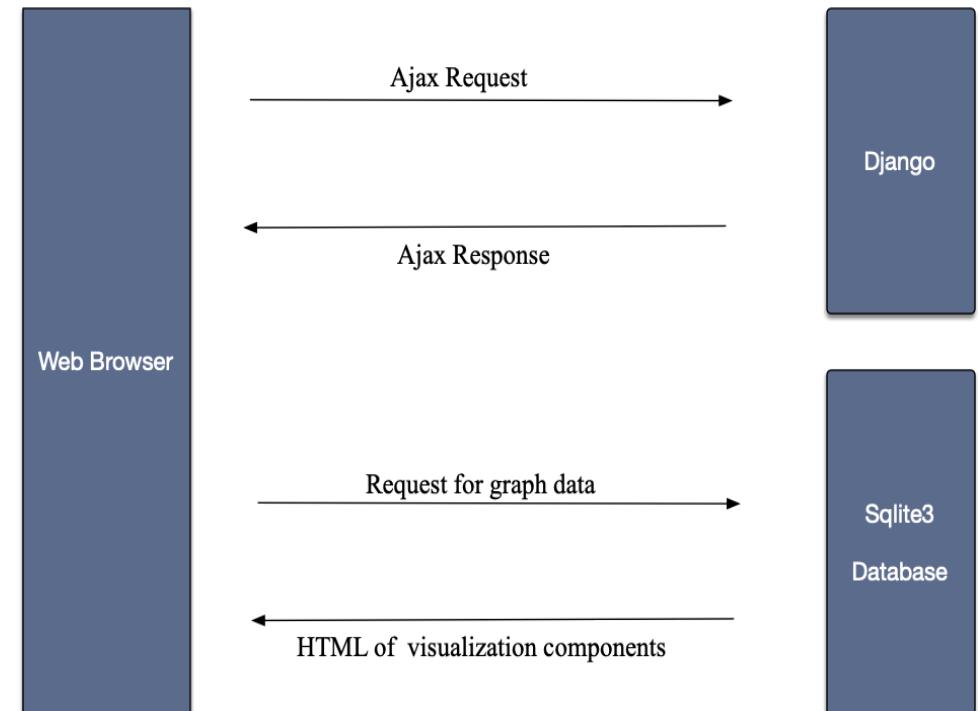


Figure 6 Performance Optimization

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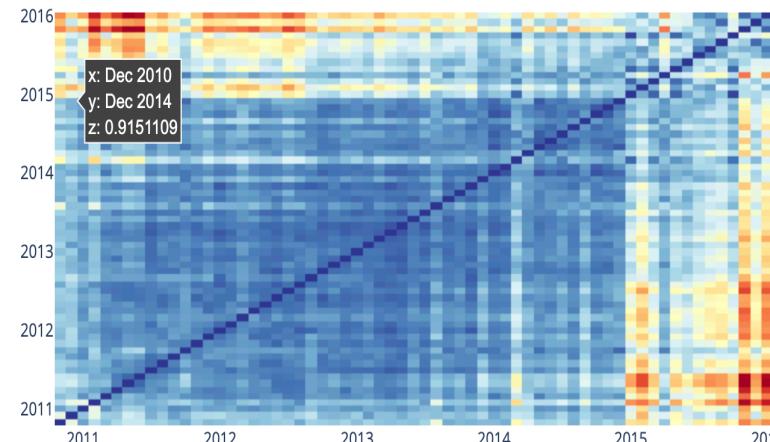
Visualization Components

Data distribution map

sx-mathoverflow

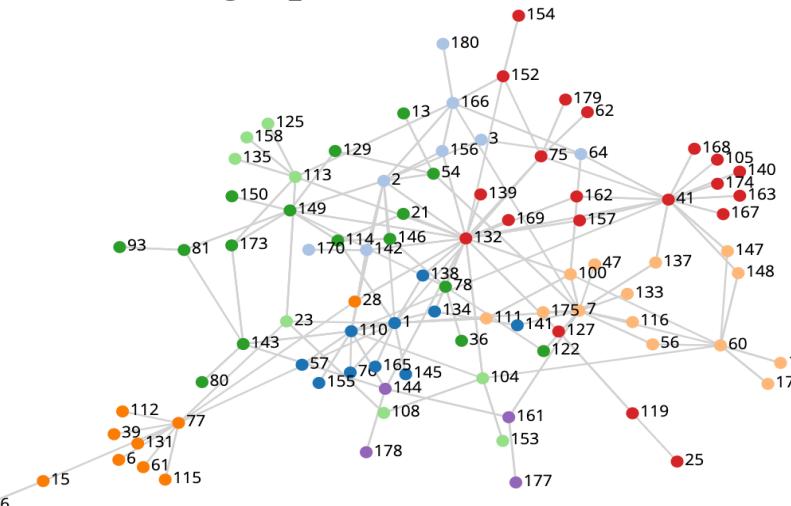


Heatmap

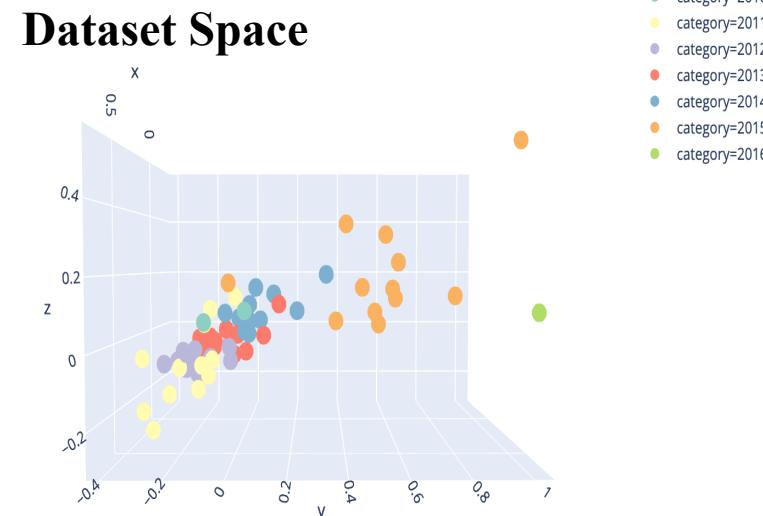


Force-directed graph

- None
- C1
- C2
- C3
- C4
- C5
- C6
- C7
- C8

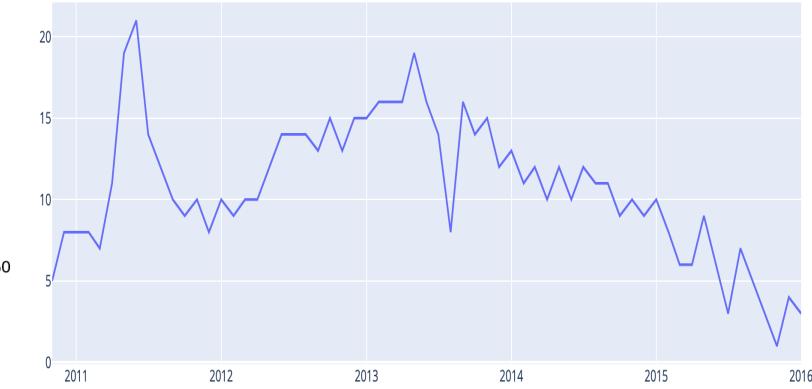


Dataset Space



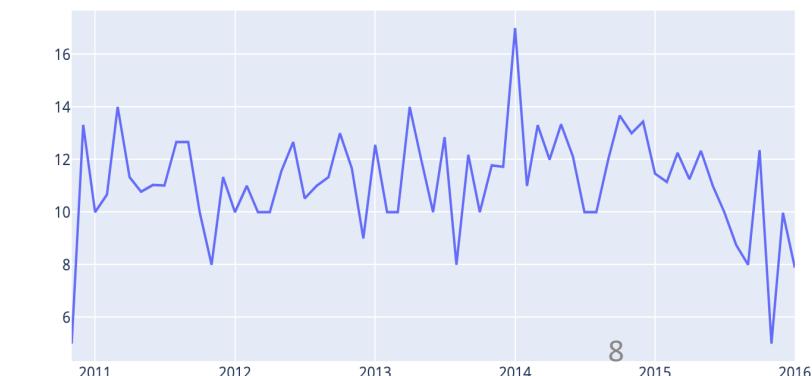
Total community graph

soc-sign-bitcoin-otc



Graph operator diagram

Diameter



Apollo Framework

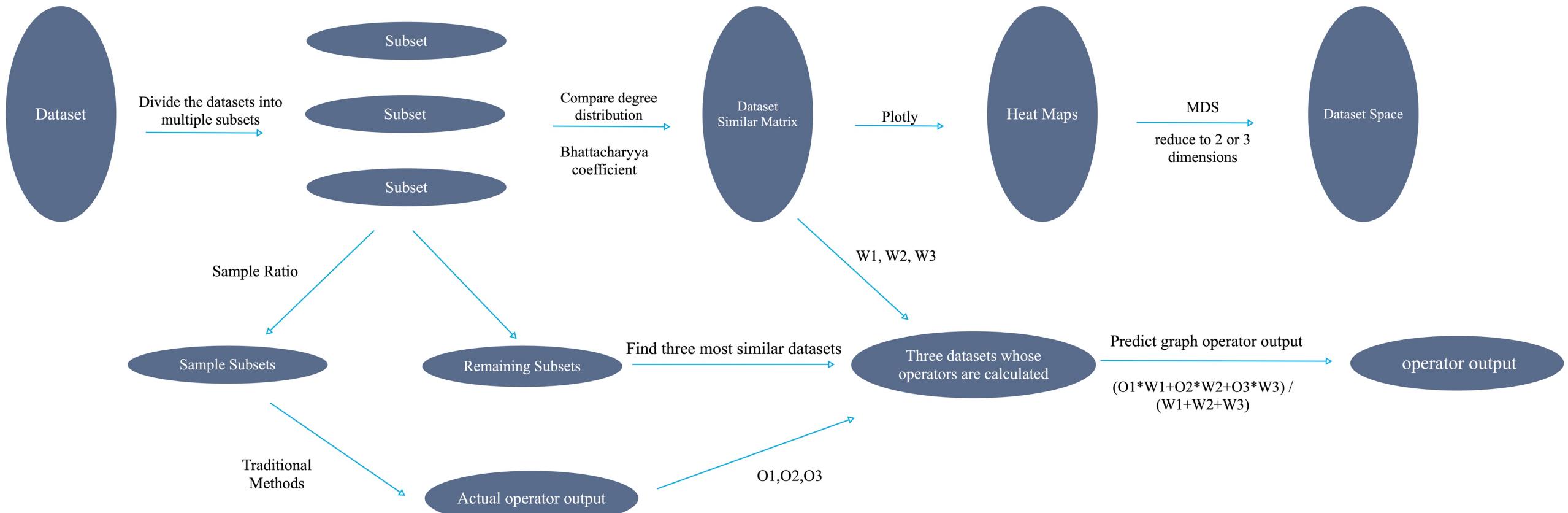
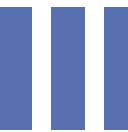


Figure 7 Apollo Framework



Community Detection

- identify highly connected groups of objects inside networks

Community Search

- aim to find communities that contain a given set of nodes

Algorithm	Community	Feature
OLCPM community detection	Local: K-clique	Overlapping communities
Louvain community detection	Global: Modularity	Extract communities efficiently
local community search	Local: K-core	Search community in the network with query node

Result and Discussion

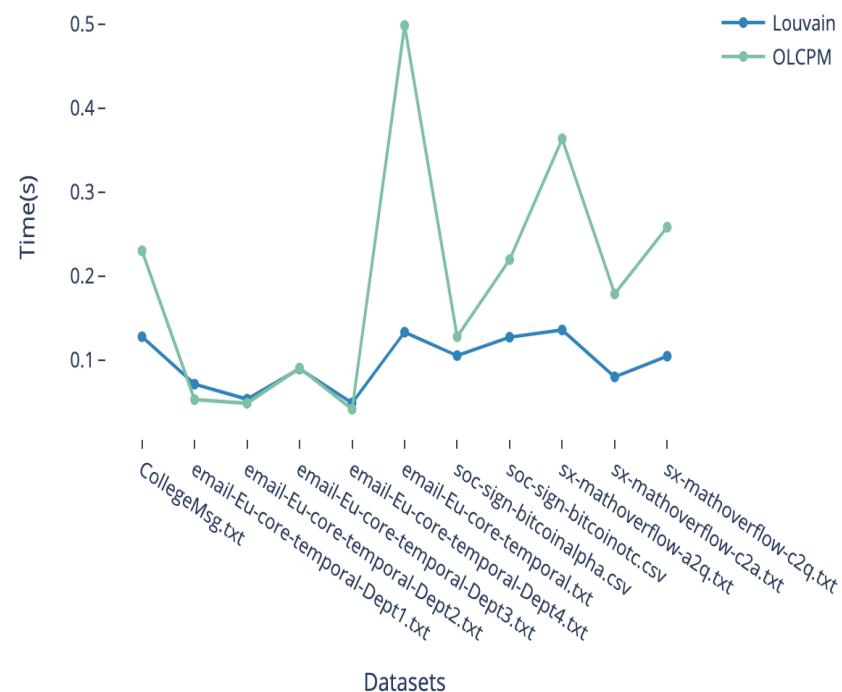


Figure 8 Community detection time consumption

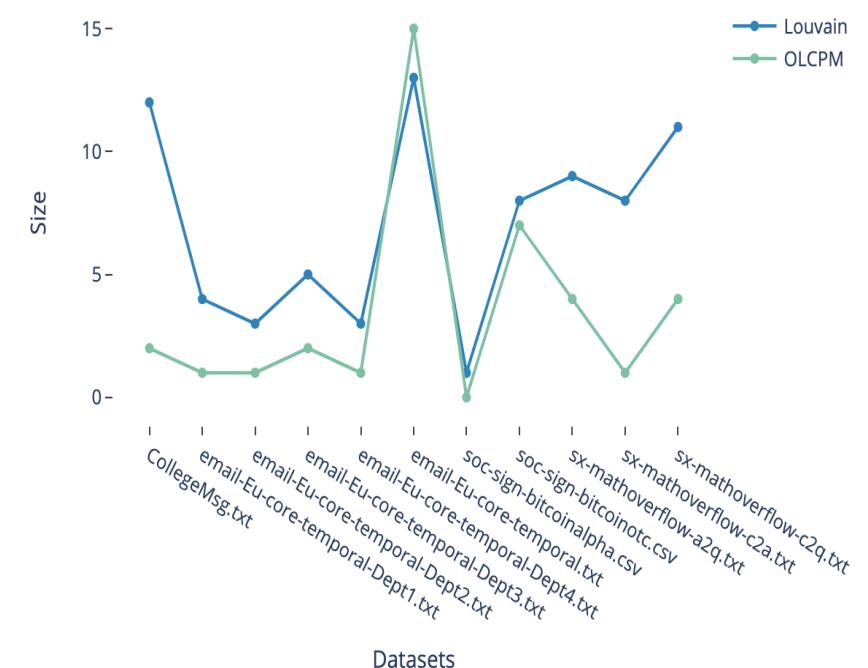


Figure 9 the number of communities

Result and Discussion

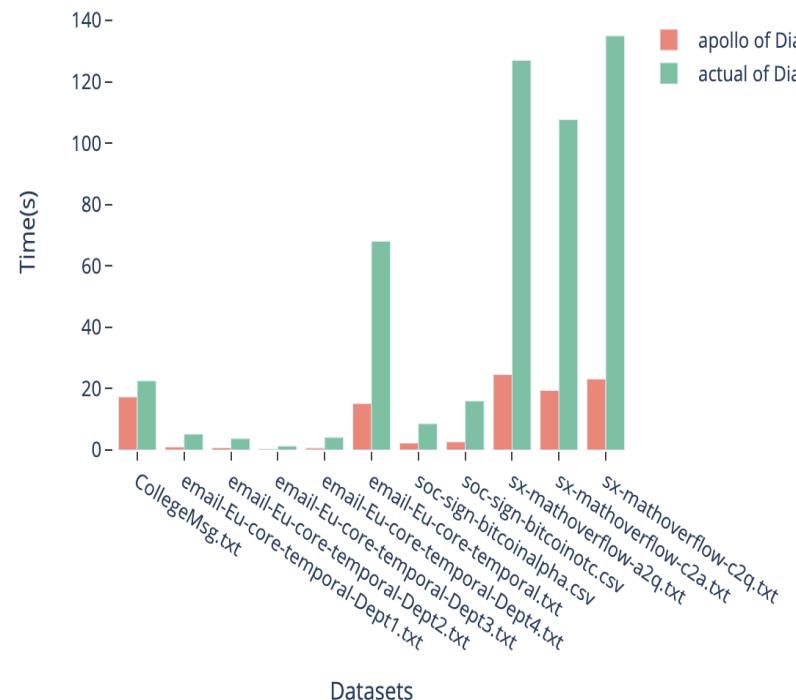


Figure 10 Graph operator output time cost

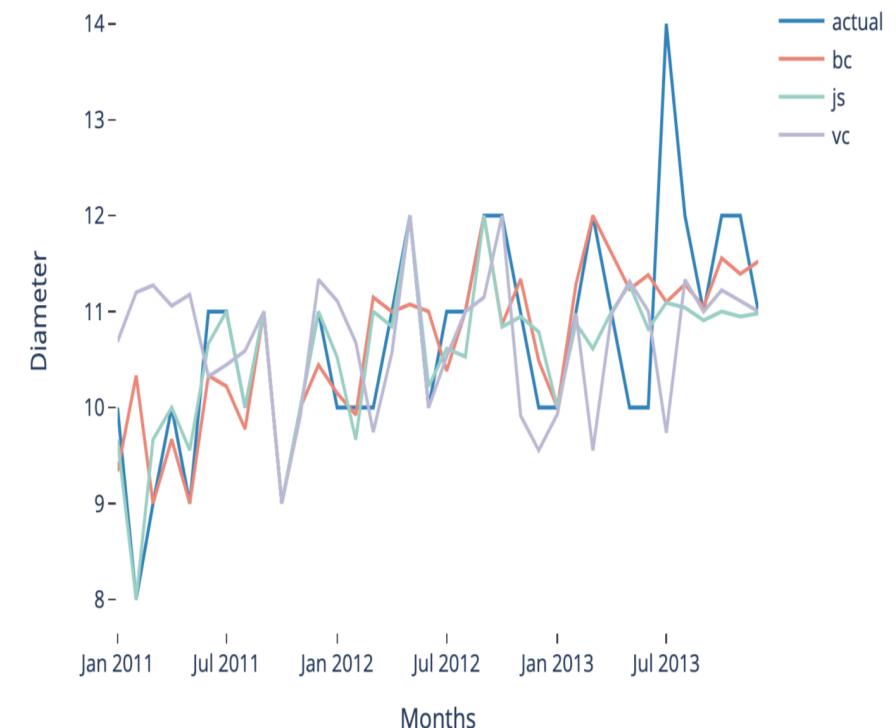


Figure 11 Graph operator output value



Conclusion

1

A web-based temporal graph management system

2

Datasets information

3

Visualization components

4

Community Structure

Further work

Focus on other graph attributes

- Directed, Signed network

Improve system functions

- OLCPM, Community Search

Support login and register functions

- Save dataset into collection
- Upload private datasets

05

Display of the temporal graph management system

[Website Address: 152.136.59.62:8080](http://152.136.59.62:8080)

[Project Github Link](#)

The screenshot displays the 'Temporal Graph Management System' interface. On the left, a sidebar menu includes 'Home', 'Datasets' (selected), 'Upload', 'Extra Datasets', and 'Documentation'. The main content area shows 'DATASETS INFORMATION' with a table listing seven datasets. The right side shows 'DOCUMENT FILES' with download links for various temporal datasets.

ID No.	Datasets	Type	Nodes	Temporal Edges	Static Edges	Description
1	CollegeMsg	Directed, Temporal	1899	59835	20296	Messages on a Facebook-like platform at UC-Irvine
2	email-Eu-core-temporal	Directed, Temporal	986	332334	24929	E-mails between users at a research institution
3	soc-sign-bitcoinalpha	Weighted, Signed, Directed, Temporal	3783	24186	24186	Bitcoin Alpha web of trust network
4	soc-sign-bitcoinotc	Weighted, Signed, Directed, Temporal	5881	35592	35592	Bitcoin OTC web of trust network
5	sx-askubuntu	Directed, Temporal	159316	964437	596933	Comments, questions, and answers on Ask Ubuntu
6	sx-mathoverflow	Directed, Temporal	24818	506550	239978	Comments, questions, and answers on Math Overflow
7	sx-superuser	Directed, Temporal	194085	1443339	924886	Comments, questions, and answers on Super User

DOCUMENT FILES

- CollegeMsg.txt
- email-Eu-core-temporal-Dept1.txt
- email-Eu-core-temporal-Dept2.txt
- email-Eu-core-temporal-Dept3.txt
- email-Eu-core-temporal-Dept4.txt
- email-Eu-core-temporal.txt



Thank You