

Analysis and Visualization of Dynamic Social Networks



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Context

- Nowadays, it is hard to find something that is not organized as a network.
- OSN (Online Social Networks).

Problem

- The point is that OSN users do not have a mean to visualize and analyze their network structure.
- Users are not able to visualize their social network from a macroscopic perspective.

Motivation

- A software tool may be designed and implemented, to actually *improve the analysis of social phenomena*, allowing everyone *to explore in detail the connections of individuals* based on the **analysis of (online) Social Networks**.

Presentation structure

- Social Networks
- Online Social Networks
- Social Network Analysis
- Socii: our proposal
- Socii overview
- Implementation details
- Case study
- Conclusion

A brief overview on Social Networks (SN)

"(...) many people attribute the first use of the term "social network" to Barnes (1954). The notion of linking social entities, or of webs or ties among social units emanating through society, has found wide expression throughout the social sciences. (...)" Wasserman and Faust (1994)

Online Social Networks (OSN)

Although the first platform possessing some of the main characteristics that define OSNs, (...), the first recognizable OSN SixDegrees.com launched in 1997, allowed users to create personal profiles, connect with friends and consult friends of friends lists.

Online Social Networks (OSN)

Web-based services that allow individuals to:

- construct a profile within a bounded system,
- articulate a list of other users with whom they share a connection,
- and view and traverse their list of connections and those made by others within the system.

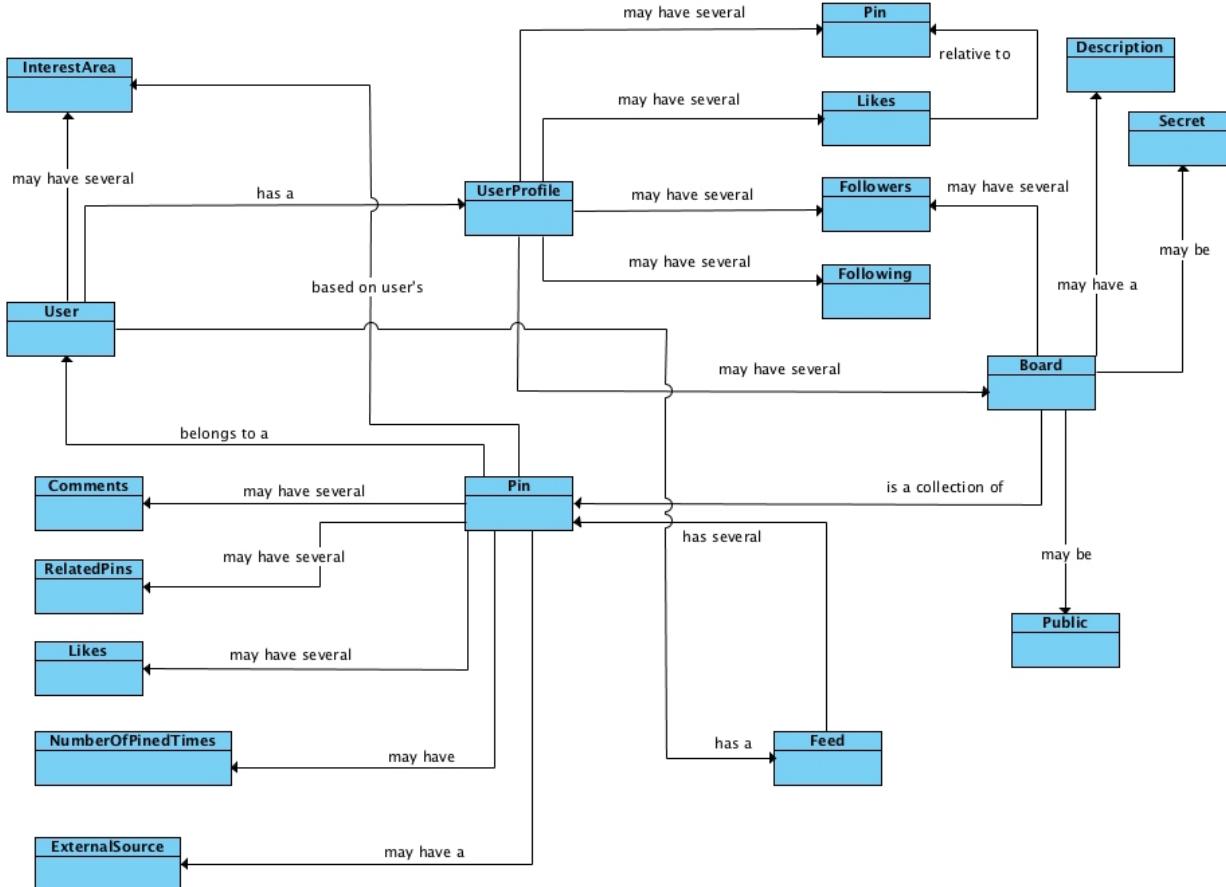
Online Social Networks (OSN)

Examples of Online Social Networks:

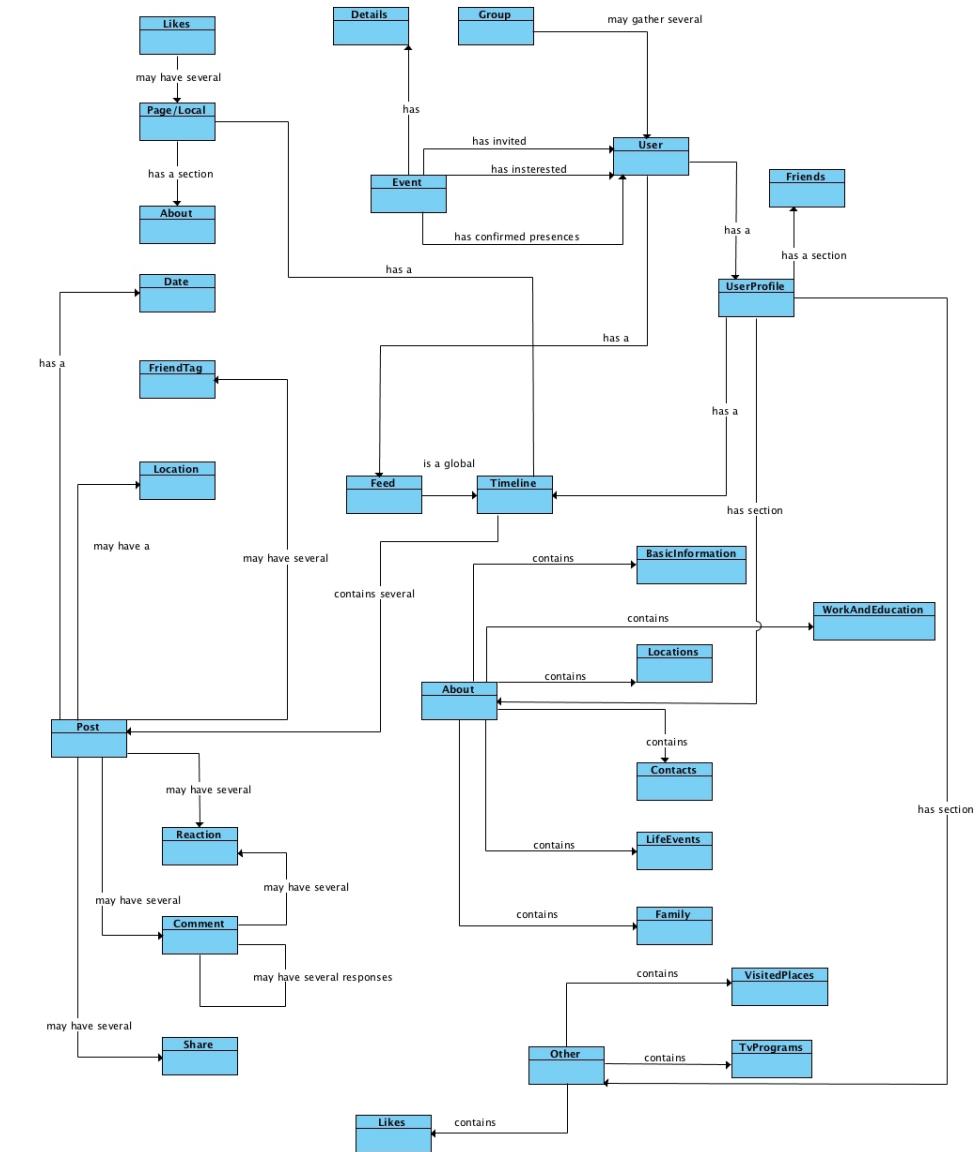
- Facebook: 2004 ; 1 712 000 000*
- Youtube: 2005 ; 1 000 000 000
- Twitter: 2006 ; 313 000 000
- Google+: 2011 ; 300 000 000
- Instagram: 2010 ; 500 000 000
- LinkedIn: 2003 ; 106 000 000
- ResearchGate: 2008 ; 11 000 000
- (17 have been referenced)

*osn: creation year ; number of registered users

Online Social Networks (OSN)



Pinterest domain model diagram



Facebook domain model diagram

Social Network Analysis (SNA)

- SNA is the study of how people are connected to each other.
- Common analysis procedure creates metrics to characterize the network.
- This analysis looks at the individuals inside the network and where are those individuals located.

Social Network Analysis (SNA)

- **Centrality Measures** (Degree, Closeness, Betweenness)
- **Clustering**
- **Link Analysis**
- **Community Detection**
- Spread of Information
- Social Learning
- Power Laws

Social Network Analysis (SNA)

- SNA Software

Tool	Availability	Complexity	Performance	Network Edition	OSNs Integration	Contextual Analysis
Structure	Desktop	Moderate	Medium	Yes	No	No
Gephi	Desktop	Moderate	Good	Yes	No	No
UCINET	Desktop	High	Very Good	Yes	No	No
SocNetV	Desktop	Low	Medium	Yes	No ¹	No
Our system projections	Web	Low	Low	No	Yes	Yes

Software tools comparison and our system positioning

(1) SocNetV has the ability to launch web crawlers, but not on OSN

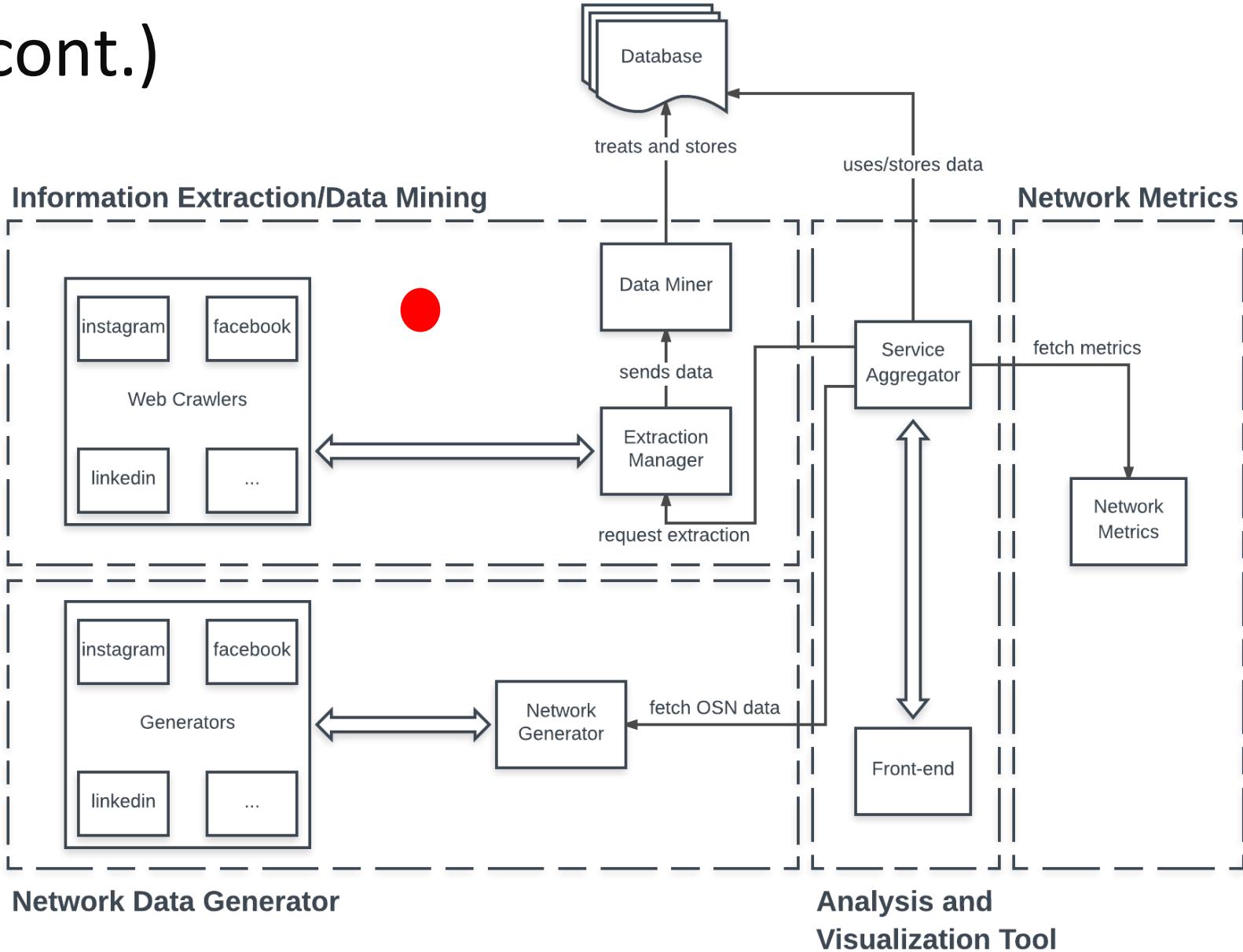
Socii: our proposal

- Socci Principles:
 - Simplicity
 - Accessibility
 - OSN integration
 - Drawing accurate conclusions

Socii: our proposal (cont.)

Architecture

- A service oriented architecture
- Architectural Components:
 - Information Extraction/Data Mining
 - Network Data Generator
 - Network Metrics
 - Analysis and Visualization Tool



Socii: our proposal (cont.)

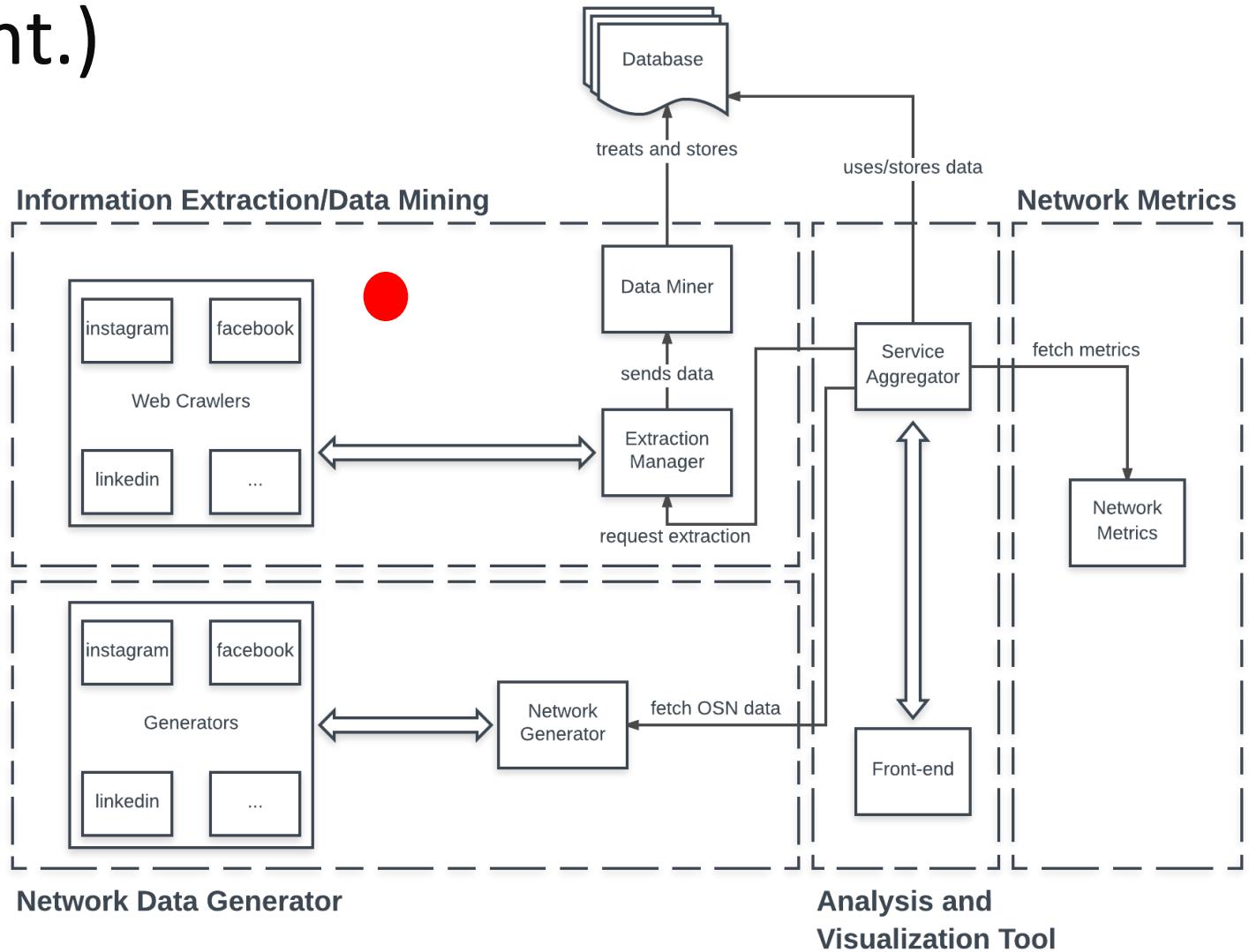
Proof of Concept



Socii: our proposal (cont.)

Technologies

- Information extraction
 - Python, XPath, Selenium, PhantomJS, Flask
- Network Data Generator
 - NodeJS, faker.js
- Network Metrics
 - Python, Flask, NetworkX
- Analysis and Visualization Tool
 - HTML, JS, SCSS (Facebook React Library)
 - D3.js
 - react-d3-graph*



*open source react component <https://github.com/danielcaldas/react-d3-graph>

Socii from the end user perspective – Network Configuration

Socii

LOGOUT

DC



Facebook

Generate network with 115 nodes (does not affect real networks)



REAL NETWORK

GENERATE NETWORK



OSN

Facebook is an OSN, created by Mark Zuckerberg in 2004, which started out by being an exclusive social network for Harvard students, but came later to spread across the country and the globe, having today more than one billion users.

Metrics

Please choose the metrics you want to compute for your network. By default all metrics are selected but you may choose not to compute metrics, use 'Select All' option to select/unselect all metrics at the same time. If none metrics are selected you will only see degree metric as placeholder.

Basic

Select All

Degree



This node number of 1st degree connections.

Average Node Degree



Mean of all nodes degree value.

Node Connectivity



Represents the minimum number of nodes that need to be removed to disconnect the remaining nodes from each other.

Centrality

Betweenness Centrality

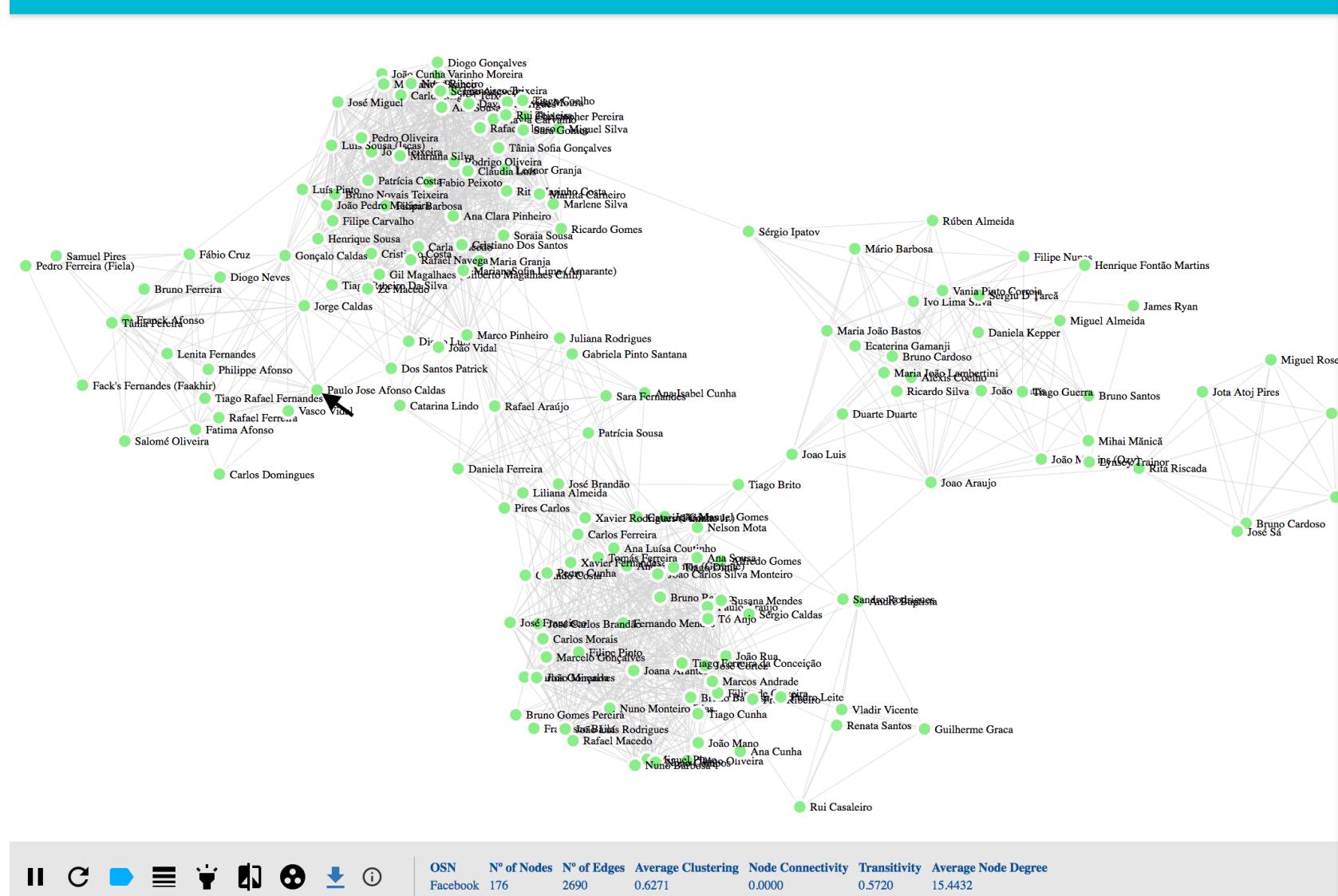


Reflects the number number of shortest paths going through a particular node. Nodes that occur in many shortest paths

Socii from the end user perspective – Tool Overview

Socii

Paulo Jose Afonso Caldas (1...



Node metrics

Basic

Degree

13.0000

Centrality

Betweenness Centrality

0.0313

Degree centrality

0.0743

Clustering

Clustering Coefficient

0.4231

Rank

Page Rank

0.0071

Closeness Centrality

0.3148

Eigenvector Centrality

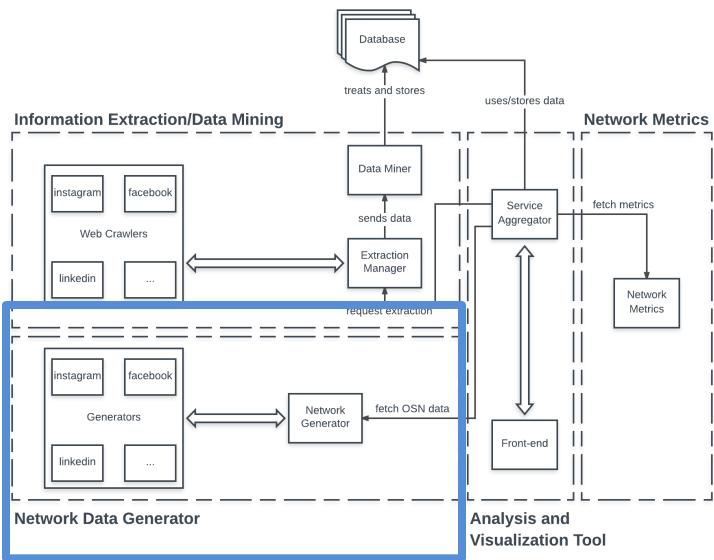
0.0115

Rich-Club Coefficient

N/A

	INFO	POSTS
From	Monção	
Lives in	Monção	
Was born in	1969/09/29 (has 47 years old)	
Gender	male	
Has liked	9 pages	
Has recently posted	10 times	
Average comments per post is:	0.00	
Average likes per post:	4.70	
Average reactions per post:	5.20	

Implementation details – Generate fake data



```
1 var schema = {  
2   'uid': 'number',  
3   'livesIn': 'city',  
4   'lifeEvents': 'lifeEvents',  
5   'birthDate': 'restrictedDate',  
6   'likes': 'facebookLikes',
```



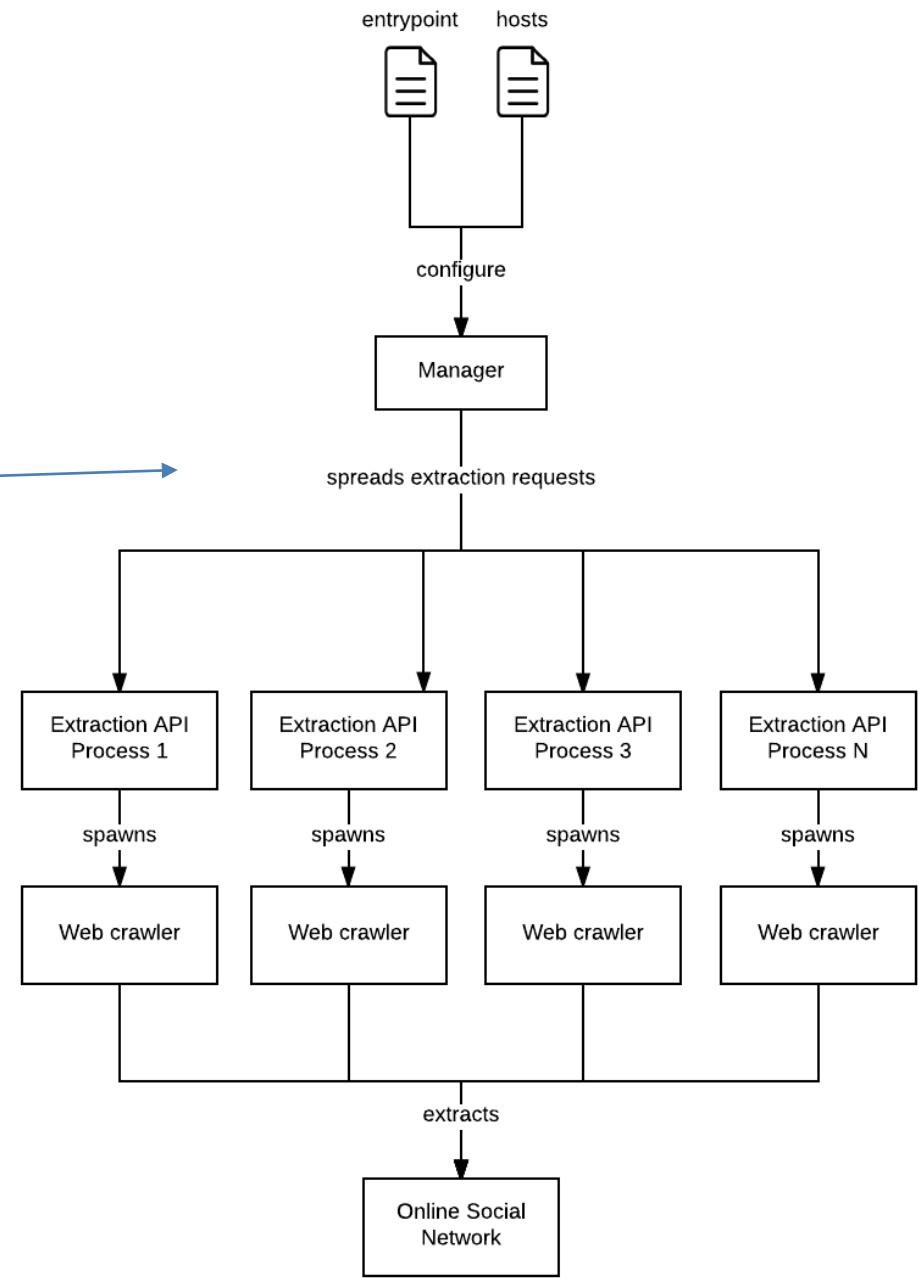
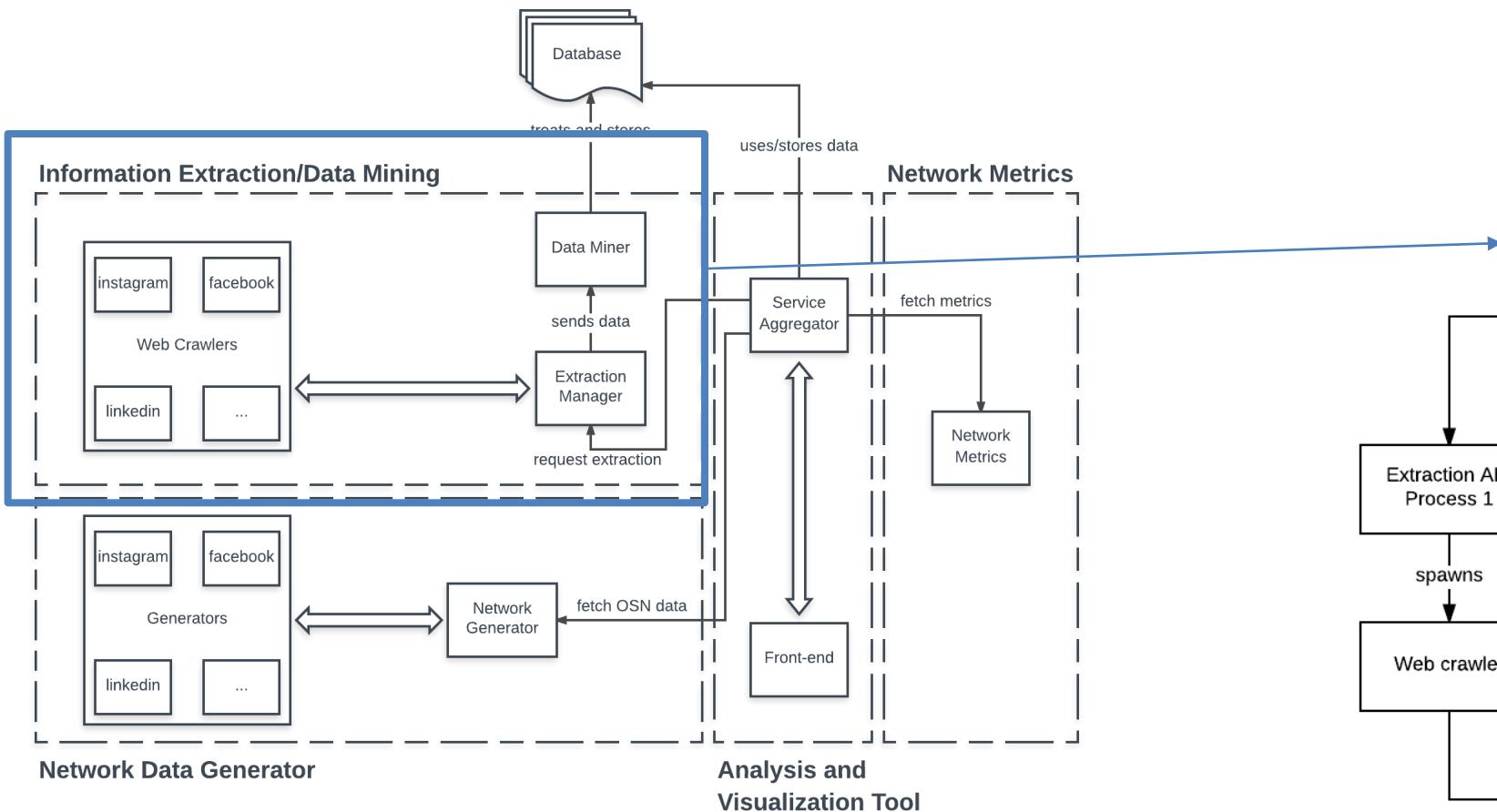
Data Schema

```
1 var facebookThreshold = {  
2   MAX_FB_LIKES: 20,  
3   MAX_FB_POSTS: 10,  
4   MAX_FB_REACTION_VALUE: 1000,  
5   MAX_FB_POST_COMMENTS: 1000,  
6   MAX_FB_POST_SHARED: 1000,  
7   // There is a 30% changes of no reactions for a given post  
8   NOREACTION_PROB: 30,
```

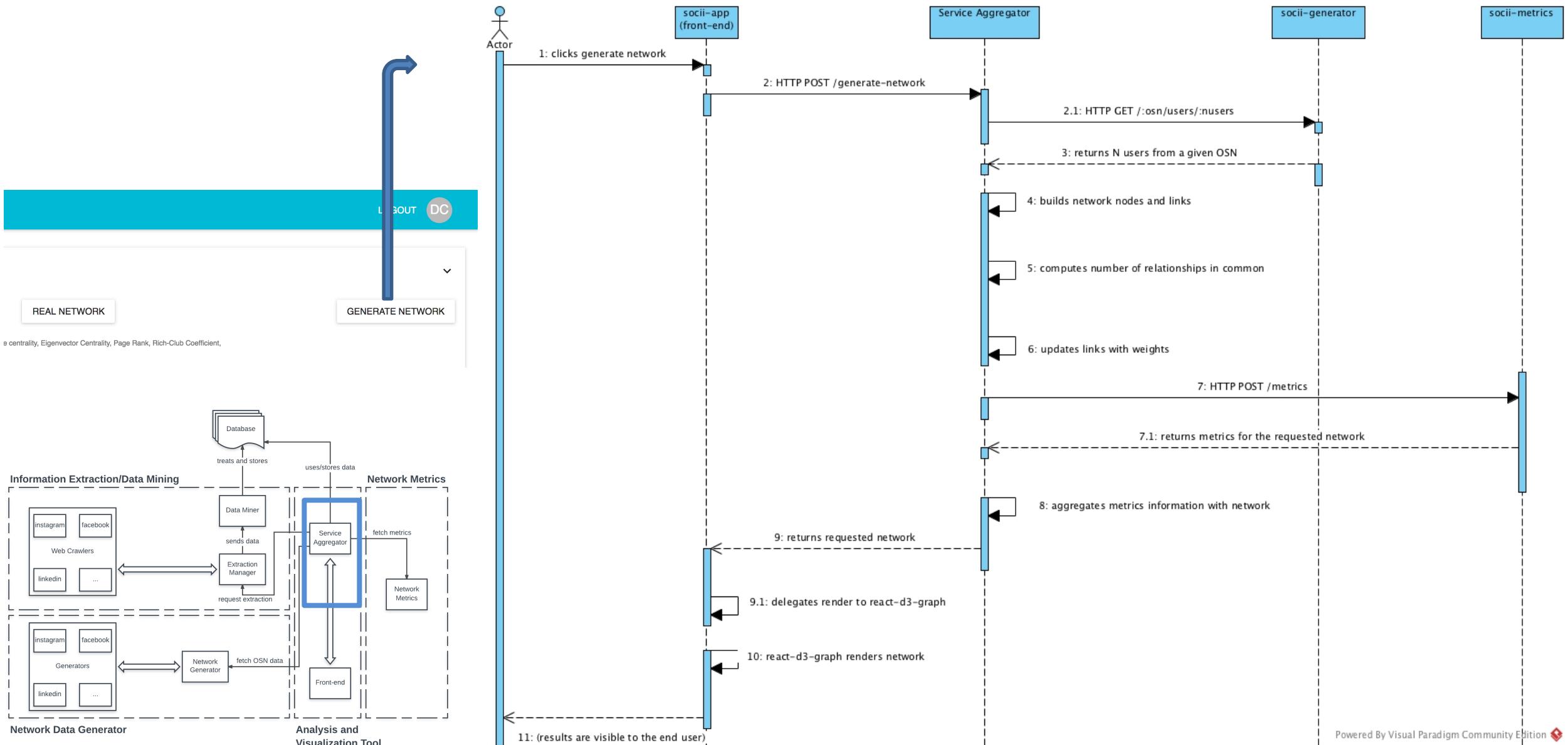
Data Restrictions

```
{  
  "uid": {string},  
  "livesIn": {  
    "id": {string},  
    "description": {string}  
  },  
  "life_events": {  
    [string]: [{string}]  
  },  
  "birthDate": {string},  
  "likes": {  
    [string]: {string}  
  },  
  "friends": [{string}],  
  "relationships": {  
    [string]: {string}  
  }
```

Implementation details – Get real data



Implementation details – Building a network



Case Study – Marketing with community detection in Facebook

Socii

LOGOUT



OSN	Nº of Nodes	Nº of Edges	Average Clustering	Node Connectivity	Transitivity	Average Node Degree
Facebook	176	2690	0.6271	0.0000	0.5720	15.4432



Conclusions

- **Socii results**
 - Socii architecture is interoperable.
 - Socii is simple, highly interactive and configurable.
 - Socii allows configurable/parameterized analysis.
 - Socii provides clear and intuitive social graph visualization and interaction.
 - Socii provides an organized overview upon SNAs and OSNs data.

Conclusions

- **Socii applications**
 - Sociology general studies, social analysis.
 - Society happiness studies.
 - Depression detection among youngsters.
 - Marketing analytics.
 - Cyber warfare.

Conclusions

- **Socii future work**
 - All the requirements that we defined as non proprietary could now be implemented.
 - Improve network extraction process (integration with official OSNs APIs).
 - Analyze different networks (e.g. build network of terms/keywords within restricted domains).

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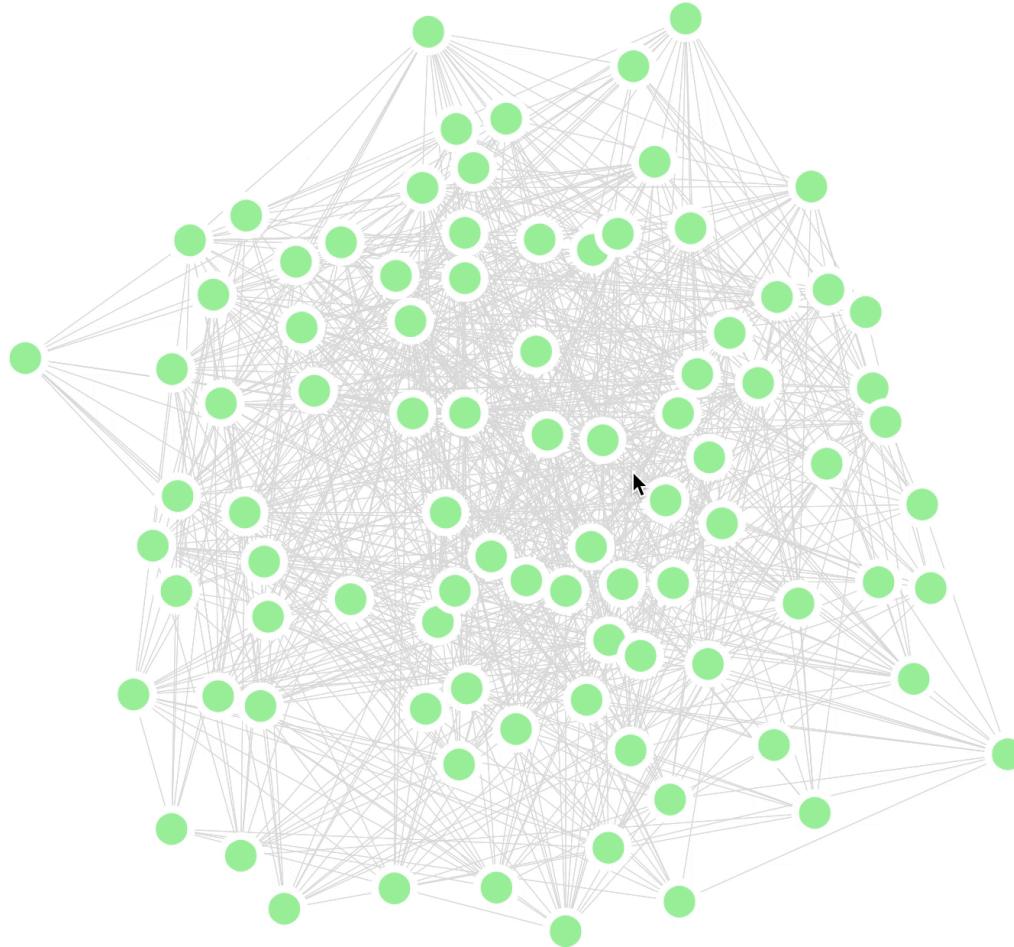
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Case Study -Professional discovery with LinkedIn Network

Socii

LOGOUT



OSN	Nº of Nodes	Nº of Edges	Average Clustering	Node Connectivity	Transitivity	Average Node Degree
LinkedIn	90	763	0.1798	8.000	0.1840	16.9556

