

# Temporal Analysis of Inter-Community User Flows in Online Knowledge-Sharing Networks

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August 10, 2015

# Communities in Knowledge-Sharing Networks

- Online Knowledge-Sharing Networks
  - Wikis, Q&A sites, discussion forums
  - User-created and maintained discussions
  - Wealth of knowledge!

The image shows two overlapping screenshots of online knowledge-sharing networks. The top screenshot is a Wikipedia article for "Java (programming language)". It features the Wikipedia logo, a "Talk" tab, and the text "From Wikipedia, the free encyclopedia". The bottom screenshot is a Stack Overflow page for a question titled "New To Java". It includes the Stack Overflow logo, a "Questions" tab, and the text "Java (not to be confused with JavaScript) is a general-purpose programming language designed to be used in conjunction with the Java Virtual Machine (JVM). 'Java platform' is the name for a computing system that has installed tools for developing and running Java programs. Use this tag for questions ...".

WIKIPEDIA  
The Free Encyclopedia

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## Java (programming language)

From Wikipedia, the free encyclopedia

**Java Programming Forum - Learn Java Programming**  
Welcome to the Java Programming Forum - Learn Java Programming.

Java Programming Threads / Posts Last Post

Java programming forums for both new and experienced Java developers.

**New To Java** (111 Viewing)  
New to Java technology and you want to learn Java? Do you have a Java

Threads: 36,307  
by jim829  
02:20 AM

Touch event  
Printing PDF with...

02:47 PM

see Java  
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stackoverflow

Tagged Questions info newest 43 featured frequent votes active unanswered

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[learn more...](#) [top users](#) [synonyms \(7\)](#) [java jobs](#)

# Communities in Knowledge-Sharing Networks

- More than repositories for knowledge
  - Community structure surrounding discussions
  - Multiple topics, multiple communities

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- This study:
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# Communities in Knowledge-Sharing Networks

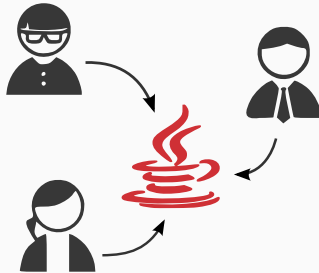
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# Communities in Knowledge-Sharing Networks

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  - Inter-community relationships according to user dynamics
  - Temporal evolution of inter-community relationships

# Communities in Knowledge-Sharing Networks

- Communities centered around topics
  - Topics are explicitly defined
  - Independent from social interaction graph
- Non-exclusive membership to multiple communities



# Topic-Based Communities in Stack Overflow

[Questions](#)[Tags](#)[Users](#)[All Questions](#)[newest](#)[406](#)[featured](#)[frequent](#)[votes](#)[active](#)[unanswered](#)

20

votes

6

answers

31k views

## redirect stderr to stdout in c shell

When I run the following command in csh, I got nothing, but it works in bash, is there any equivalent in csh which can redirect the standard error to standard out? xxx 2>&1 Note: xxx is a ...

[shell](#)[csh](#)[io-redirection](#)

modified 1 min ago

[mdiehl13](#)

134 ● 3 ● 10

1

vote

0

answers

5 views

## Is it possible to run a python command within a shell script?

I'm learning some basic scripting and I thought I would try my hand at "automating" a small task at work and make things a littler easier for users not so comfortable working inside their terminal. ...

[python](#)[shell](#)

asked 1 min ago

[Jacktheyeti](#)

8 ● 3



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Tags

# Stack Overflow Dataset

- User activity
  - User ID, Tag ID, Time stamp
- Data covering a six-year period
  - 2008–2014

Dataset	Tags	Posts	Users
Top-100	100	15.4 million	1.2 million
Top-400	400	19.8 million	1.7 million

# Inter-Community User Flows

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- How to measure the relationship between two communities?
  - Tag hierarchy
  - Semantic similarity of keywords
  - **User dynamics**
- Flow of users between communities:

$$flow_{c_1, c_2}(t) = \frac{|C_2(t) \cap C_1(t-1)|}{|C_1(t-1)|}$$

# Inter-Community User Flows: Findings

- Prevalence of lower flow values
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- Increasing number of low flow values over time
  - $flow_{c1,c2}(2014) > 0.14$  for 22% and 10% of all community pairs

Mean Flow Value

Dataset	2008	2014
Top-100	0.21	0.08
Top-400	0.14	0.05

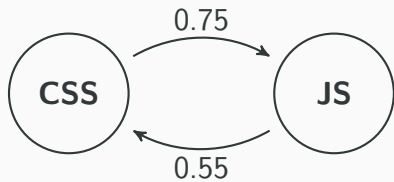
# Inter-Community User Flows: Findings

- Prevalence of lower flow values
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- Increasing number of low flow values over time
  - $flow_{c1,c2}(2014) > 0.14$  for 22% and 10% of all community pairs
- Greater variability of flow values over time

## Mean Coefficient of Variation

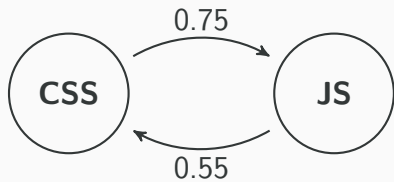
Dataset	2008	2014
Top-100	0.73	1.23
Top-400	0.87	1.27

# Flow Evolution: CSS to Javascript

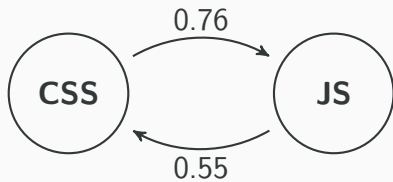


2008

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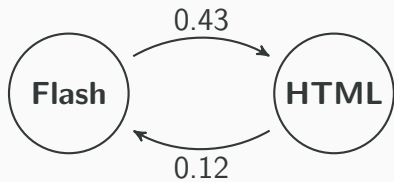


2008



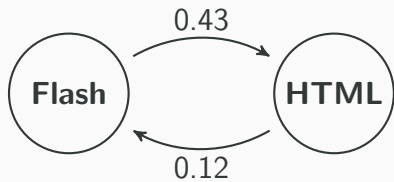
2014

# Flow Evolution: Flash to HTML

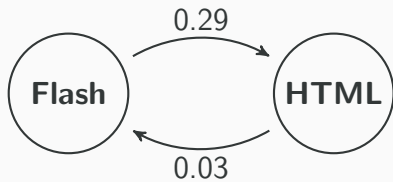


2009

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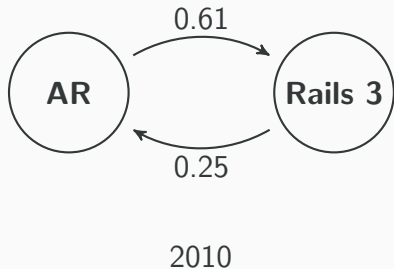


2009

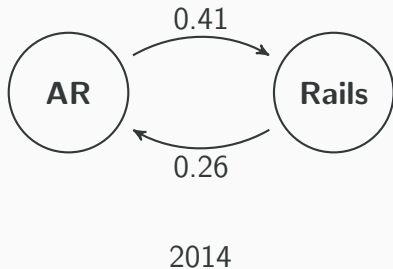
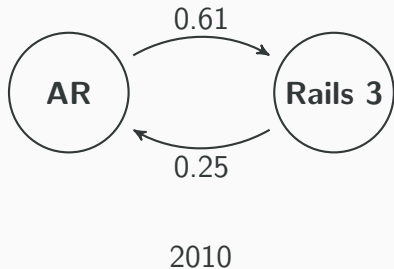


2014

# Flow Evolution: Active Record to Ruby on Rails

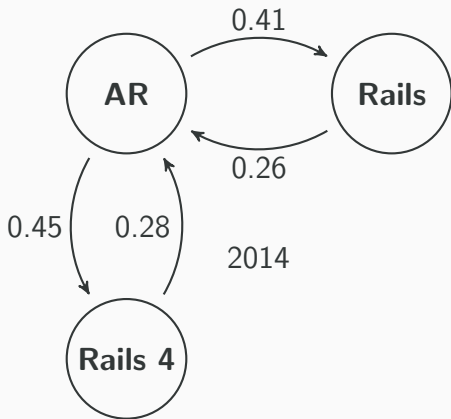
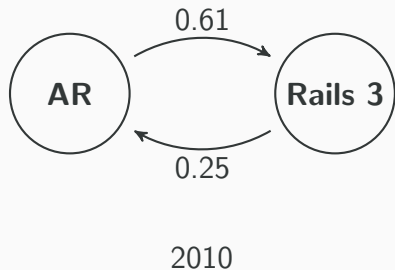


# Flow Evolution: Active Record to Ruby on Rails





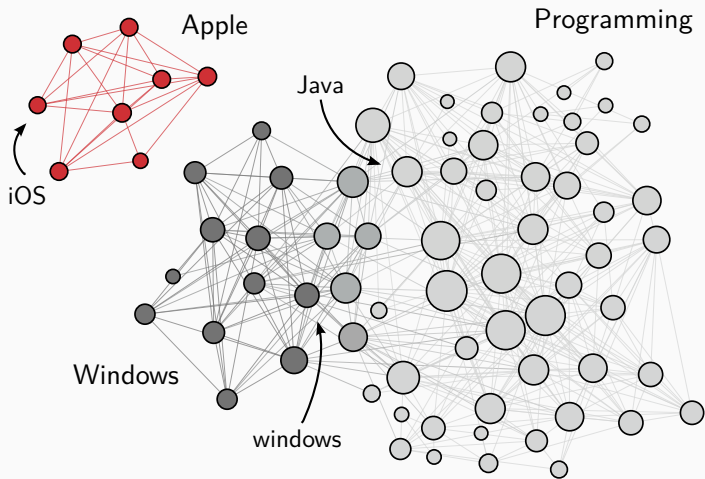
# Flow Evolution: Active Record to Ruby on Rails



# Macro-Communities

- Increasingly well-defined inter-community relationships
- Groups of communities with high inter-community flows
  - Determined by user dynamics instead of semantic analysis
- Clique Percolation Method applied over community graph
  - Communities as nodes and user flows as edge weights
  - Top 10% edges with highest flow values
  - Community overlap

# Macro-Communities



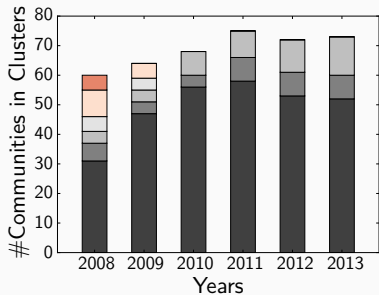
# Macro-Communities

- Small number of macro-communities
  - Popular communities connected to several satellite communities
  - e.g., Java connected to 88 communities in the Top-100 set
- Topical cohesion
  - General programming, Windows-related technologies, Apple-related technologies, Ruby on Rails technologies, programming IDEs and extensions

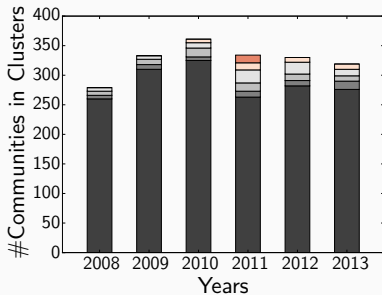
# Evolution of Macro-Communities

- Changes to macro-community structure over time:

Top-100



Top-400



# Evolution of Macro-Communities

- Single, dominant macro-community
  - Present at every time window
  - Covers a majority of the communities
  - General, more popular topics
- Fragmented macro-communities converge over time
- Recurring core of communities
- Variable community composition
  - Macro-communities may feature a different subset of communities in each time period

# Conclusions

- Knowledge-sharing networks as a dynamics multi-community network
- Inter-community relationships as a function of their members
  - Different evolution patterns for community relationships
- Discovery of macro-communities
  - User flows

Thank you!

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