The YouTube™ Social Network

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Google™

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

In 2011, >1 trillion views (140/person on Earth)

>60 hours of video is uploaded every minute

…thousands of full-length movies

>4 billion videos are viewed everyday

Every week, 100 million people take social actions on YouTube

Millions of subscriptions happen each day…

>800 million unique visitors on YouTube every month

>50% of videos have been rated/commented on

Source: www.youtube.com/t/press_statistics

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Questions…

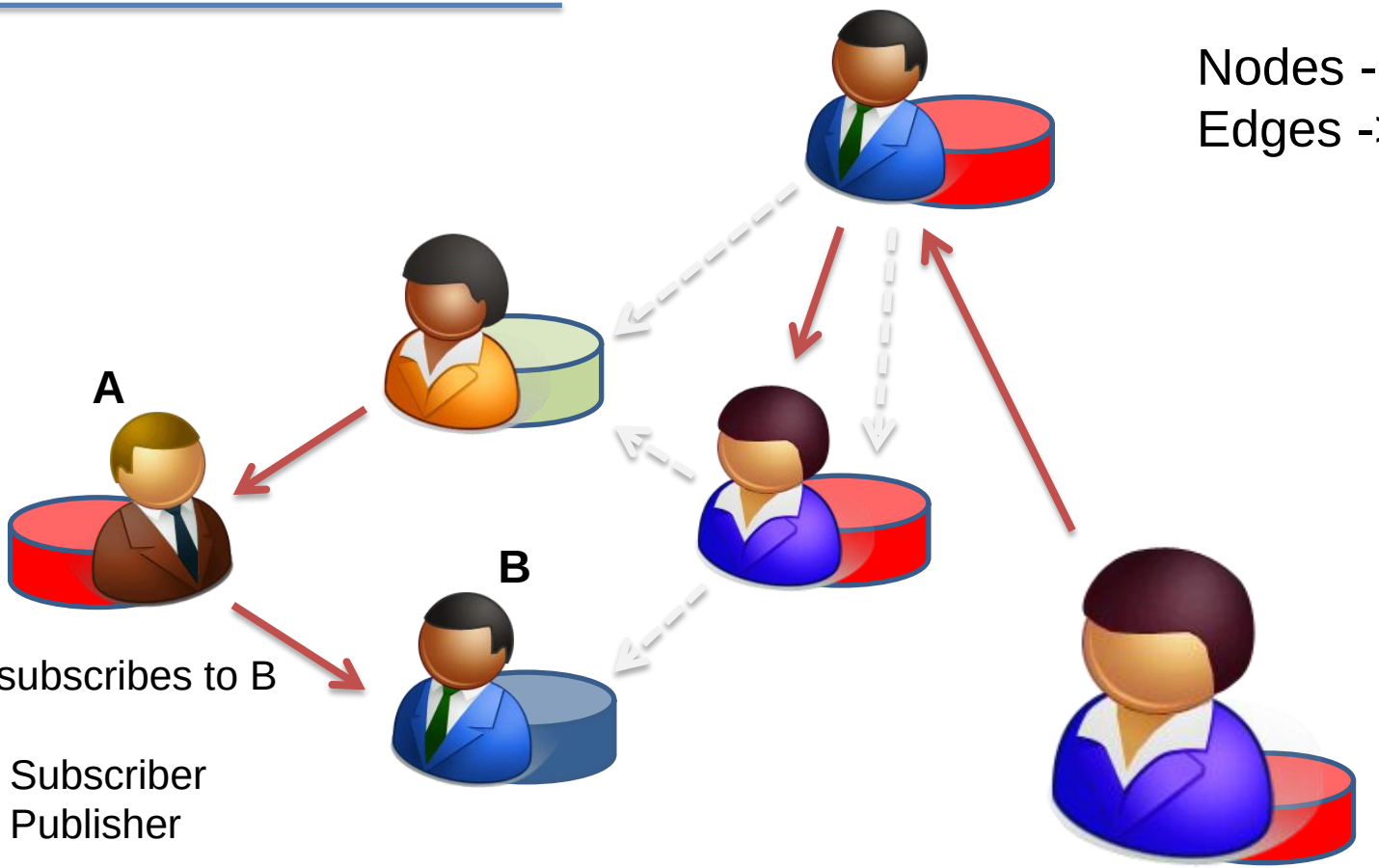
1. Are YouTube users behaving similarly to users of traditional social networks?
   - How do users interact and connect?

2. How are members of the YouTube Partner Program selected?
   - What is the interplay between content popularity and social popularity?
   - Which measures of popularity are indicative of potential partners?

YouTube &
Traditional Social Networks

Popularity &
YouTube Partners

Measurements

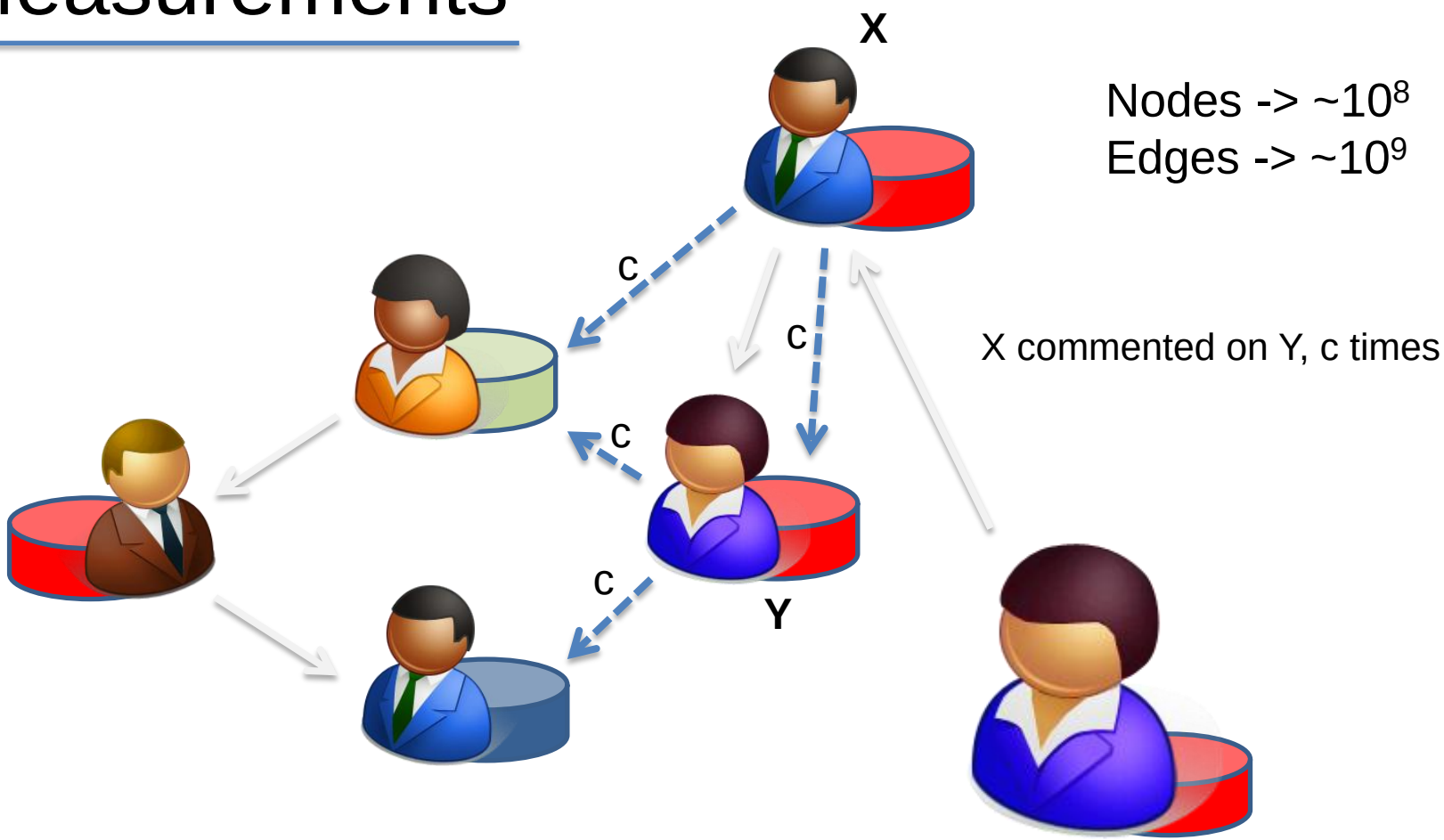


Nodes -> ~10^8
Edges -> ~10^9

A subscribes to B

A: Subscriber
B: Publisher

Measurements



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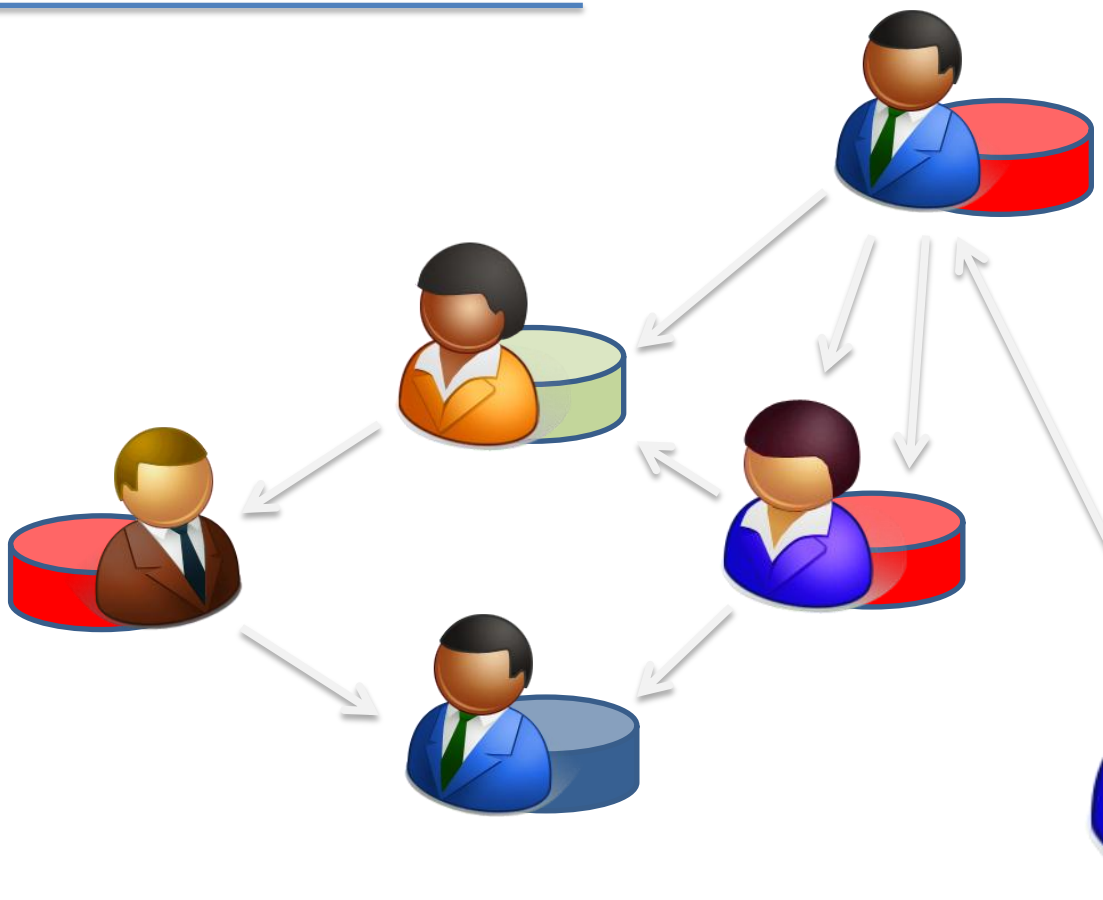

Social Features
Deg. on sub-graph
Deg. on com-graph
PageRanks
Reciprocal Links
.
.
.

Content features

.

Max/med/min video views
Mode upload category
Max/med/min avg. rating
Max/med/min rating quantity
Upload quantity

.
.
.

$\mathfrak{R}^{1\times 28}$

We measure the complete **subscription graph**, **comment graph** and **video metrics** aggregated to the user level. This snapshot was compiled in August 2011.

Connecting & Interacting

Given user μ, we compare sets

$$C_\mu \in \{c_1, c_2, \dots, c_n\}$$
$$S_\mu \in \{s_1, s_2, \dots, s_n\}$$

for the overlap proportion

$$\rho_\mu = \frac{S_\mu \cap C_\mu}{S_\mu \cup C_\mu}$$

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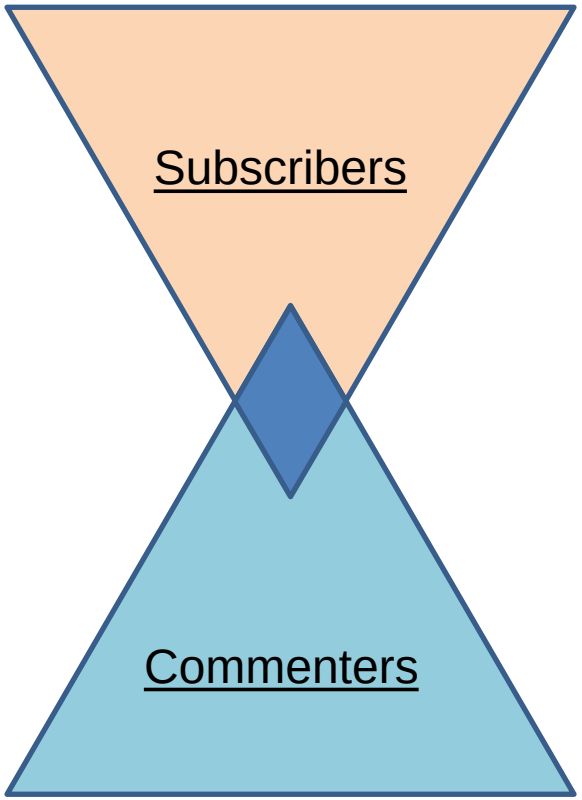

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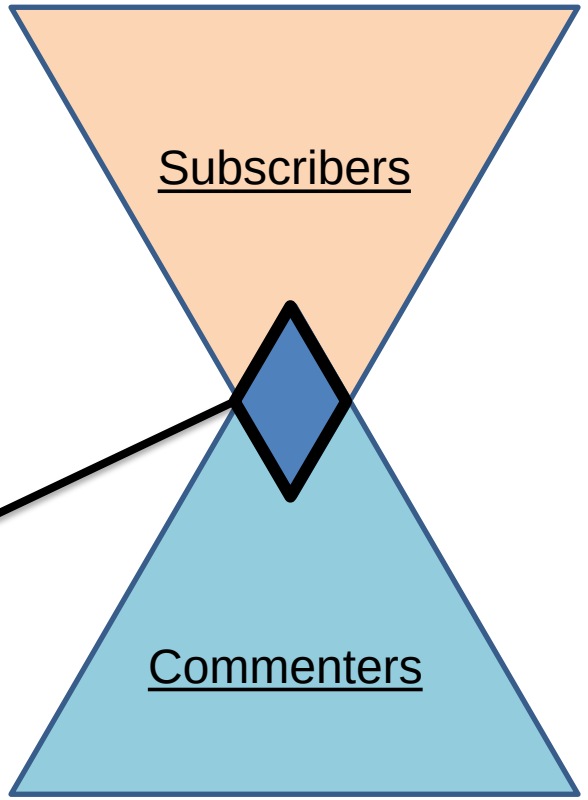

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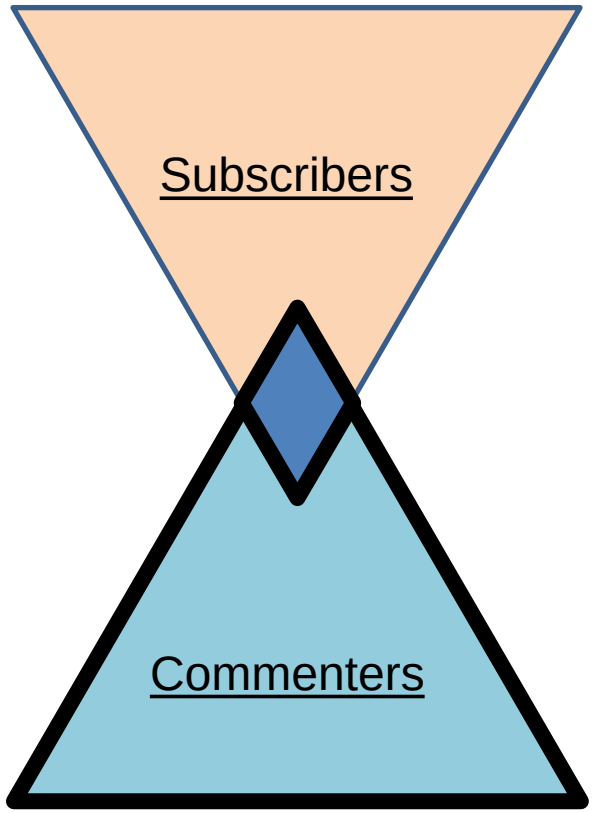

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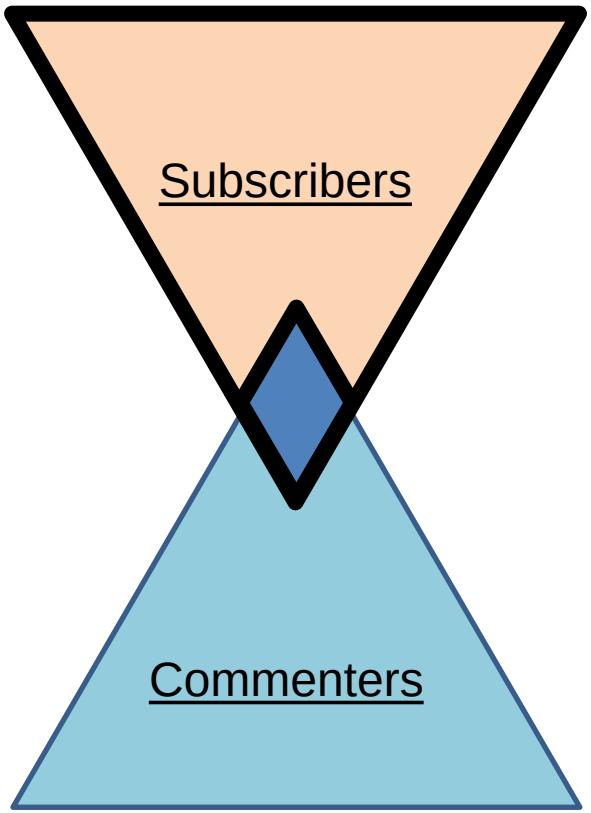

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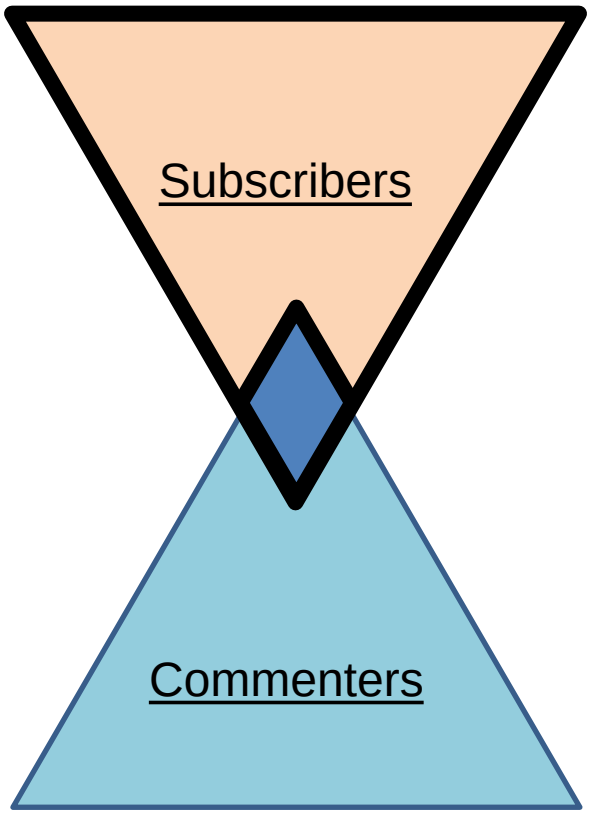

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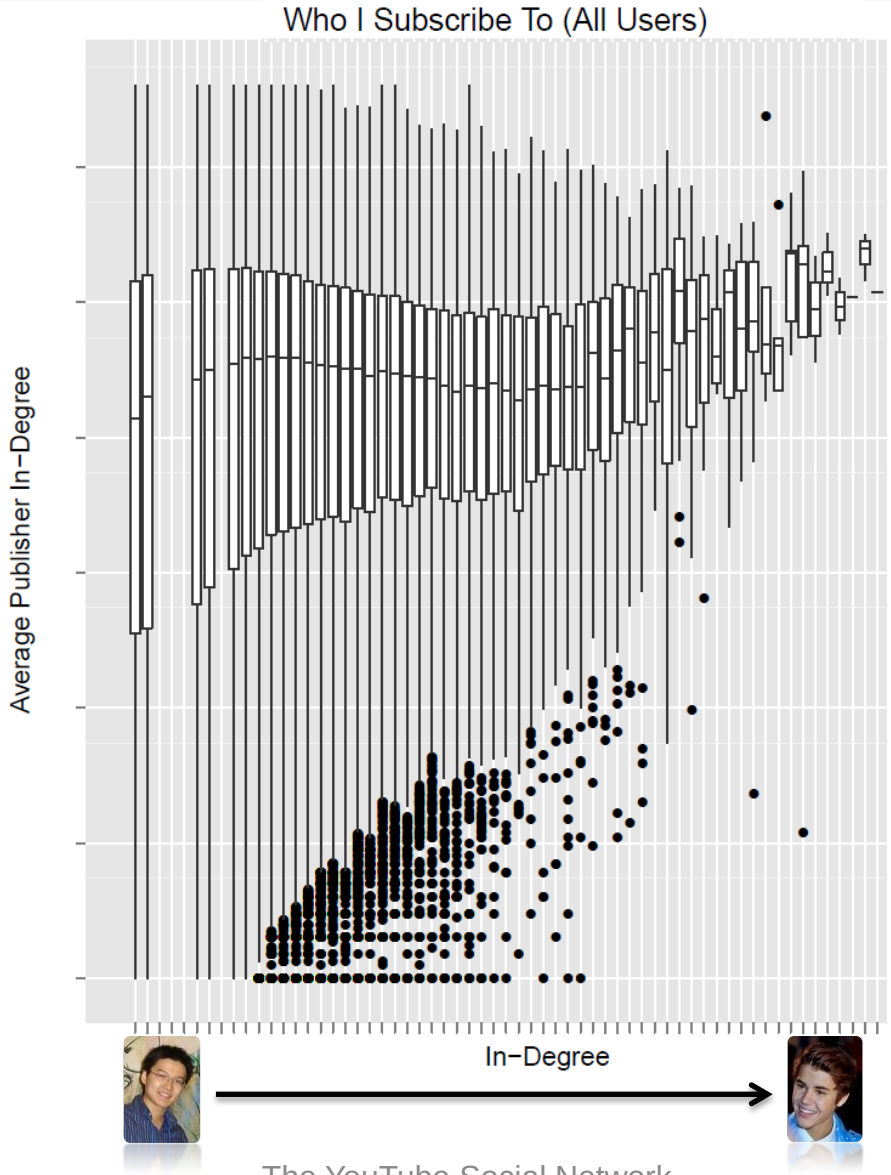
Only a small portion of a user's subscribers are also commenters and vice-versa. The set of commenters and subscribers are **highly disparate populations**

Assortative Linking



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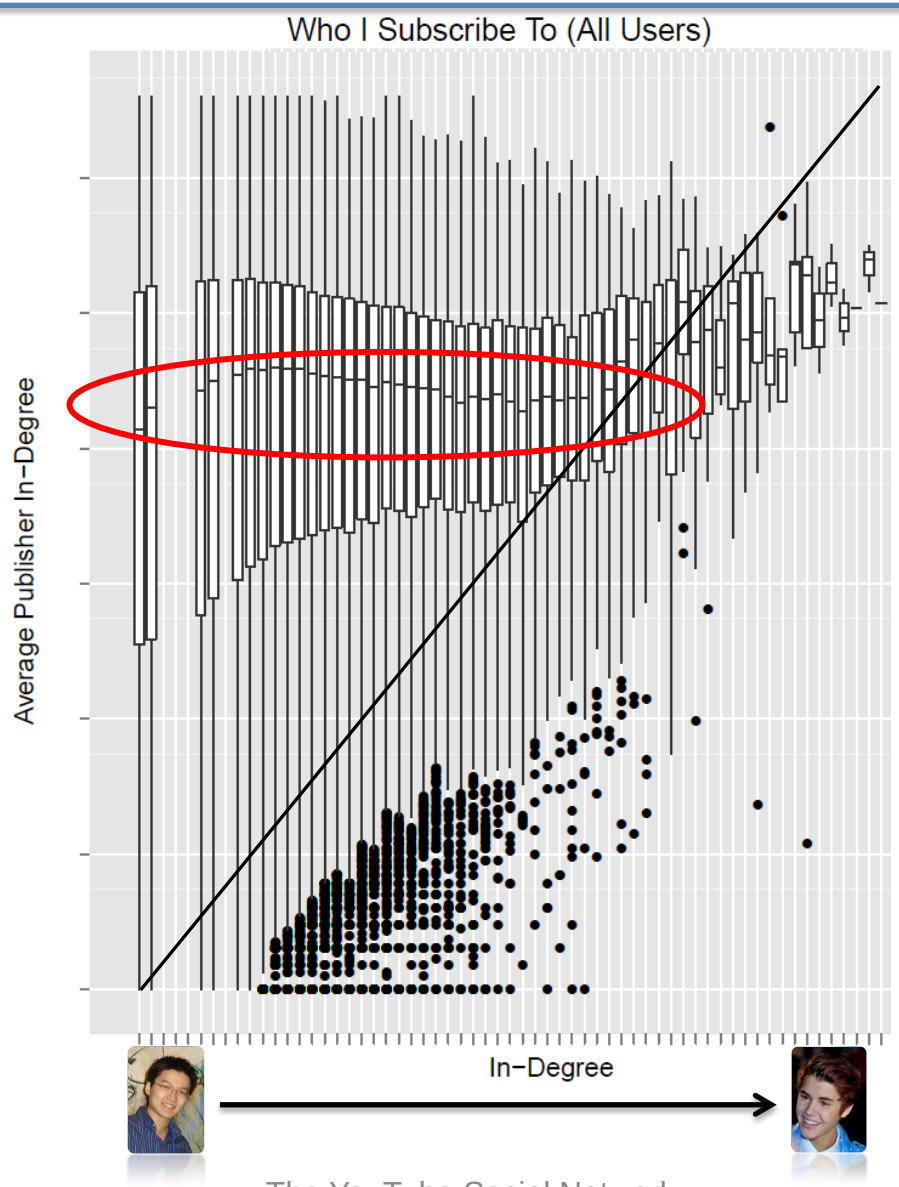

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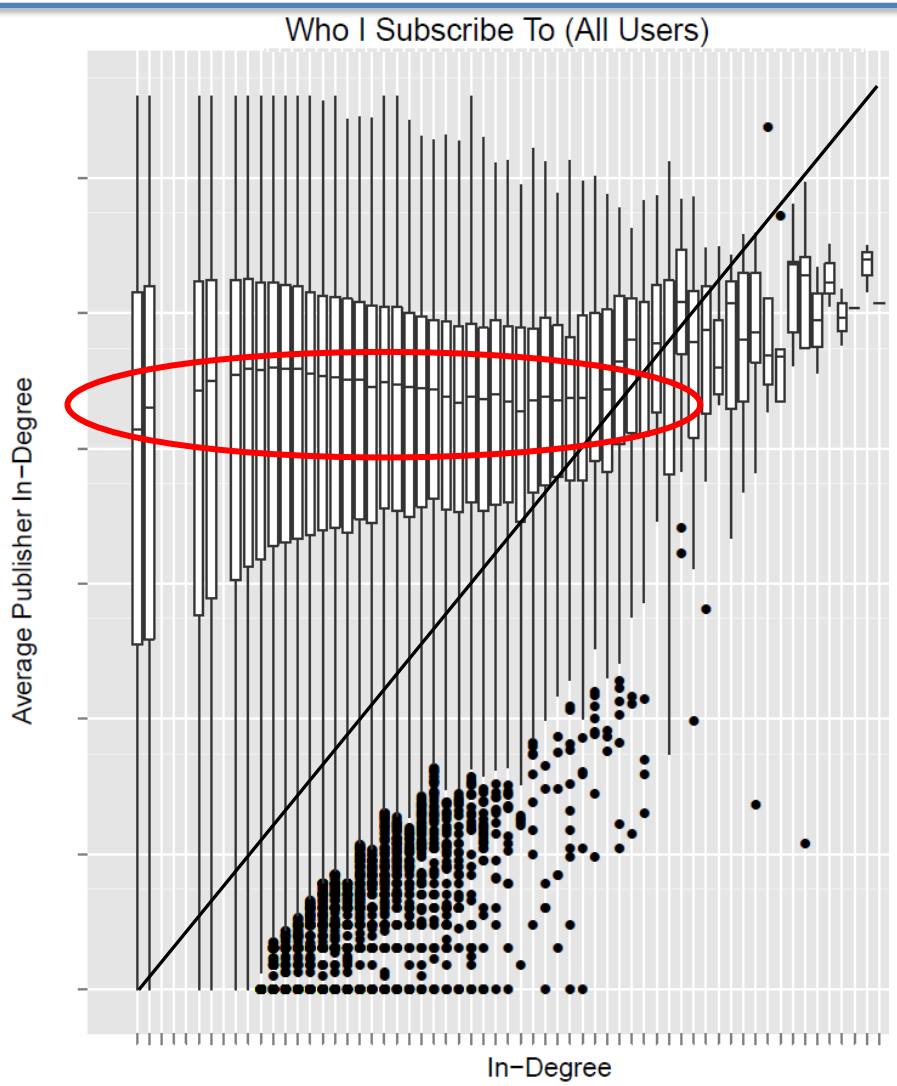
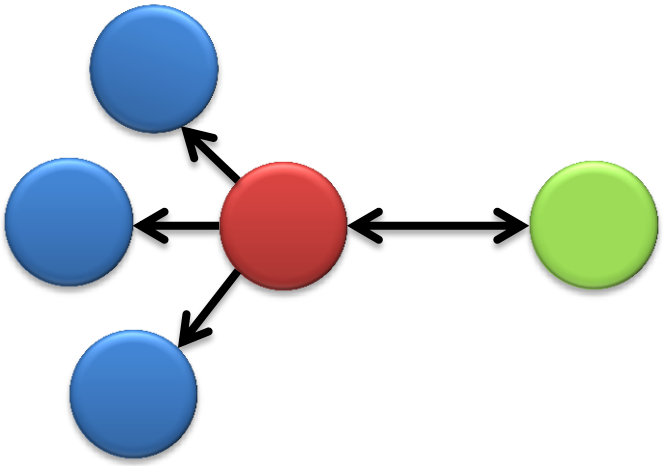


YouTube users **link disassortatively**, such that most subscribe to power-users.

Reciprocity

- Measurements of flickr and YAHOO! 360° BETA illustrate the presence of reciprocal linking amongst users *[Kumar et. al. 2006, Cha et. al. 2009]*

- We measure % of users with ≥ 1 reciprocal link:



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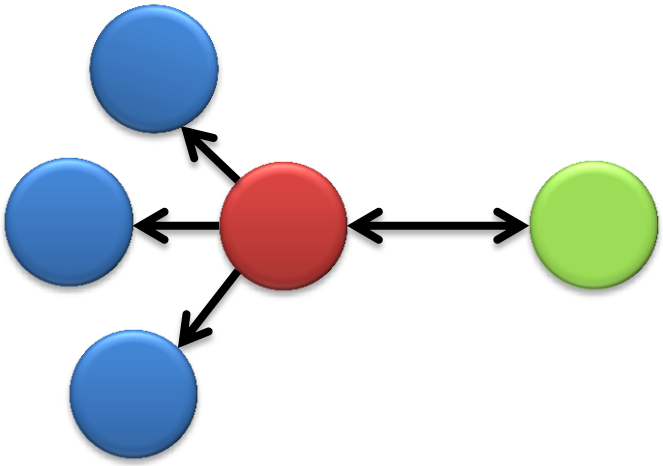

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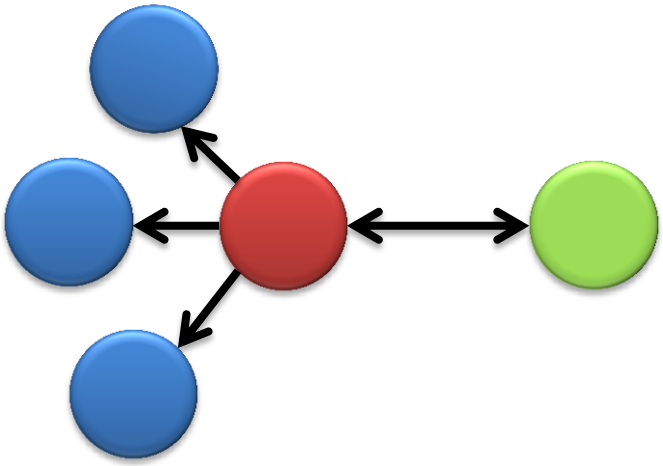

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twitter

77.9% pairs are not linked reciprocally *[Kwak. et. al. 2010]*

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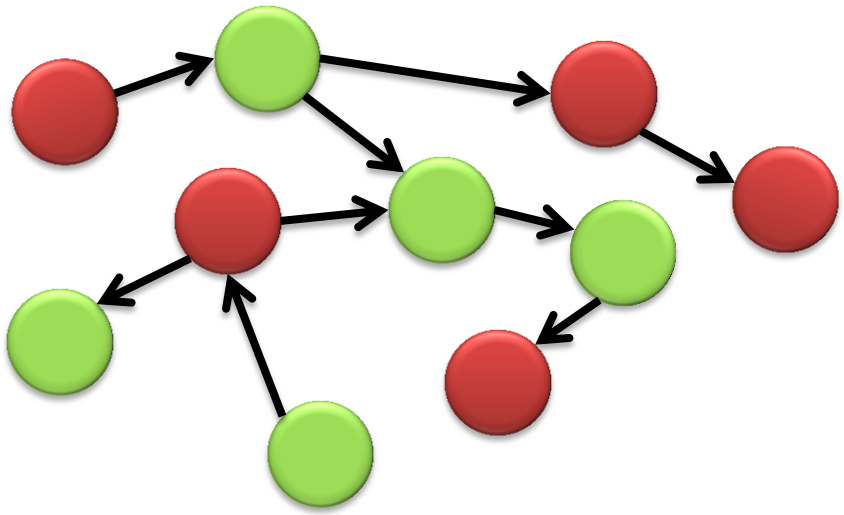
Homophily



- Established by *[McPherson et. al., 2001]*
- Measure homophily via upload category
  - Hard assignment of all videos to 1 of 12 categories
  - Capture a **mode** upload category for each user
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- Compare whether a pair of linked users have the same mode category

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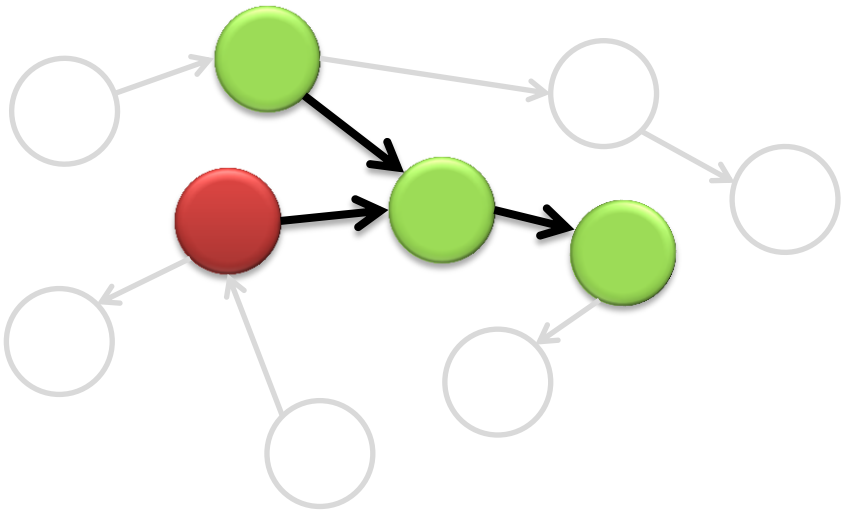

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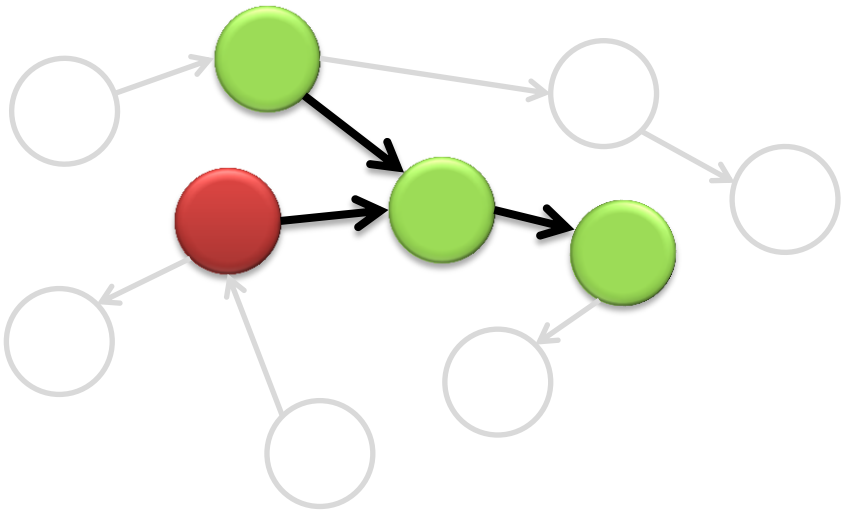

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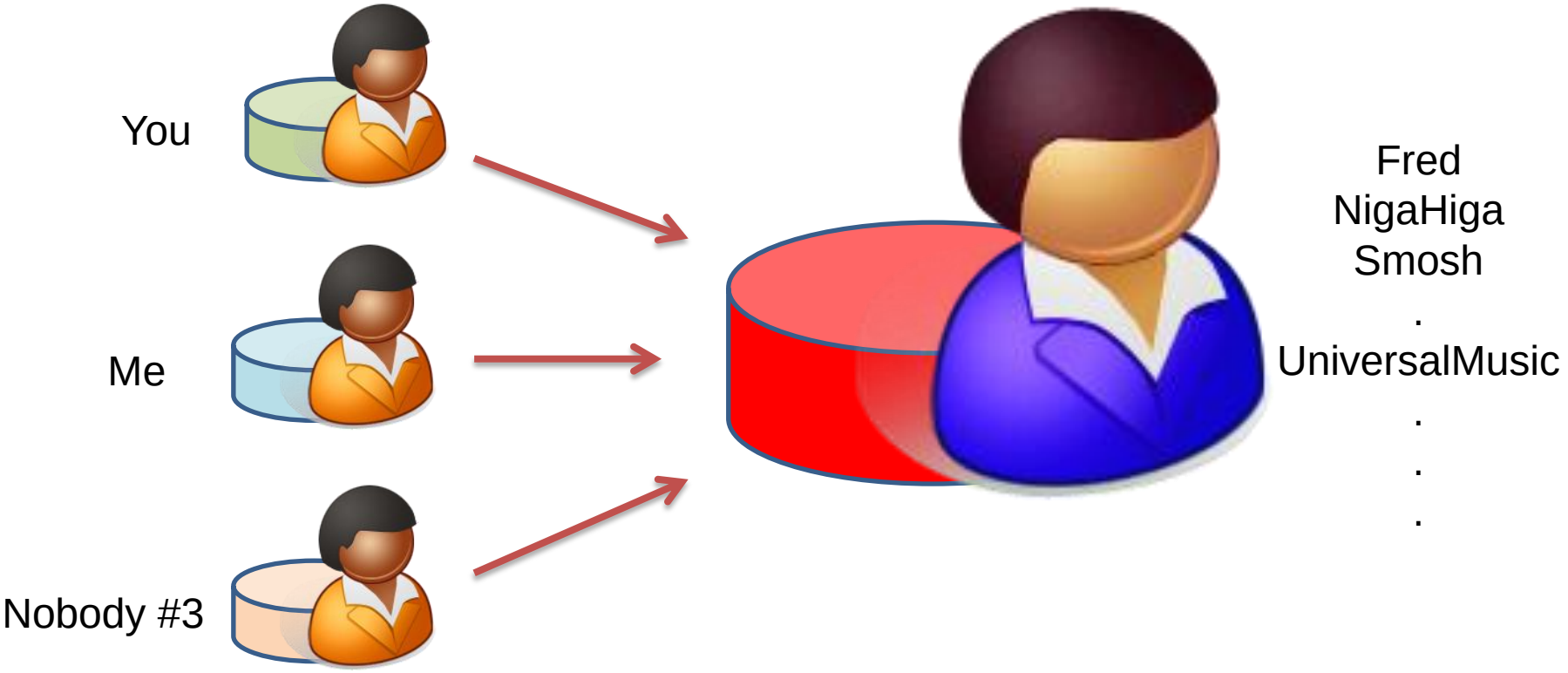
By analyzing mode upload category, we observe a **lack of homophily** on both the subscription and comment graphs. Concurs with *[Kwak et. al., 2010]*'s study of Twitter.

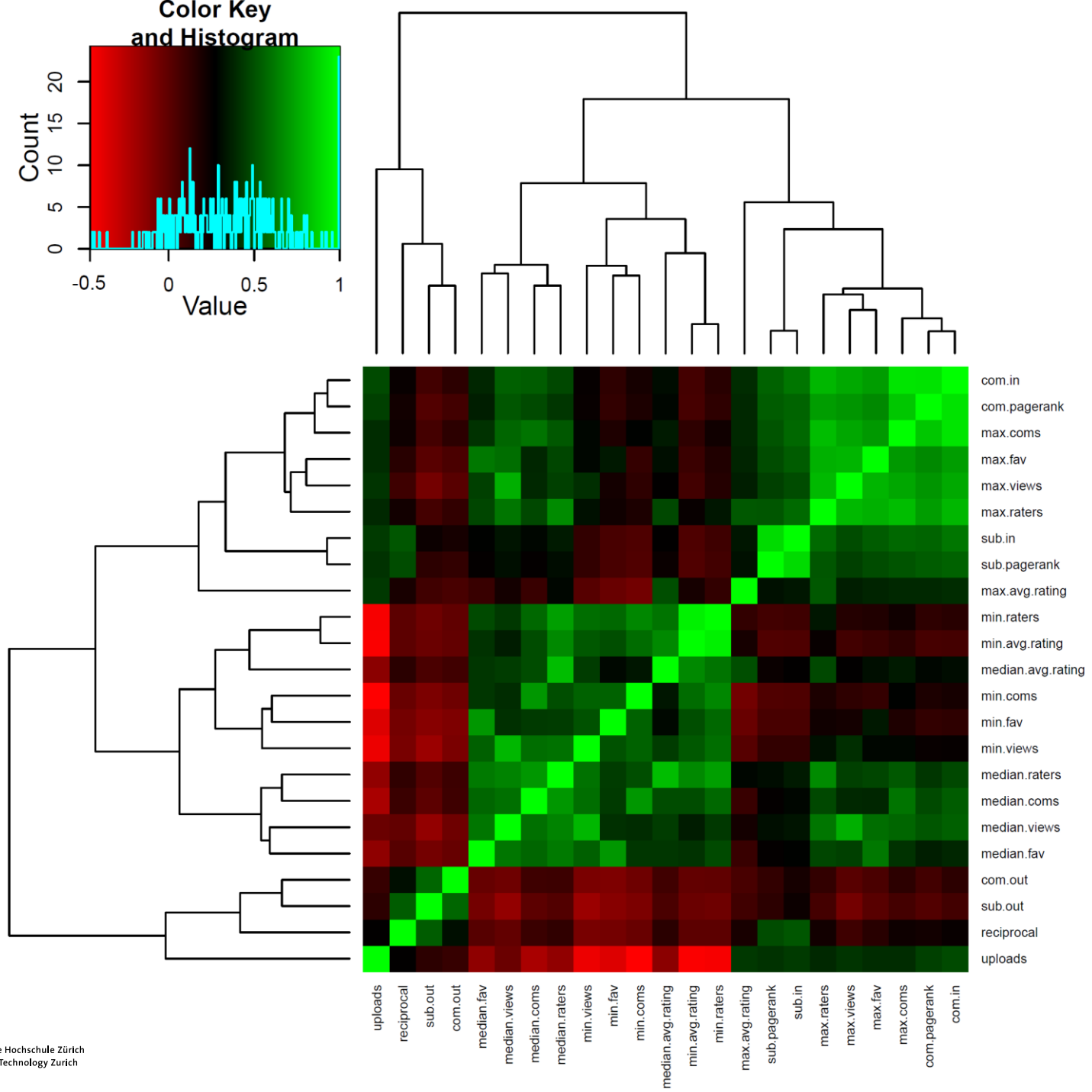
Social on YouTube



Social on YouTube stems from a relationship of **information generation and consumption** as opposed to real-world social relationships

YouTube &
Traditional Social Networks

Popularity &
YouTube Partners


Color Key
and Histogram
Count
0
5
10
15
20
-0.5
0
0.5
1
Value
com.in
com.pagerank
max.coms
max.fav
max.views
max.raters
sub.in
sub.pagerank
max.avg.rating
min.raters
min.avg.rating
median.avg.rating
min.coms
min.fav
min.views
median.raters
median.coms
median.views
median.fav
com.out
sub.out
reciprocal
uploads
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sub.out
com.out
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median.coms
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sub.pagerank
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max.raters
max.views
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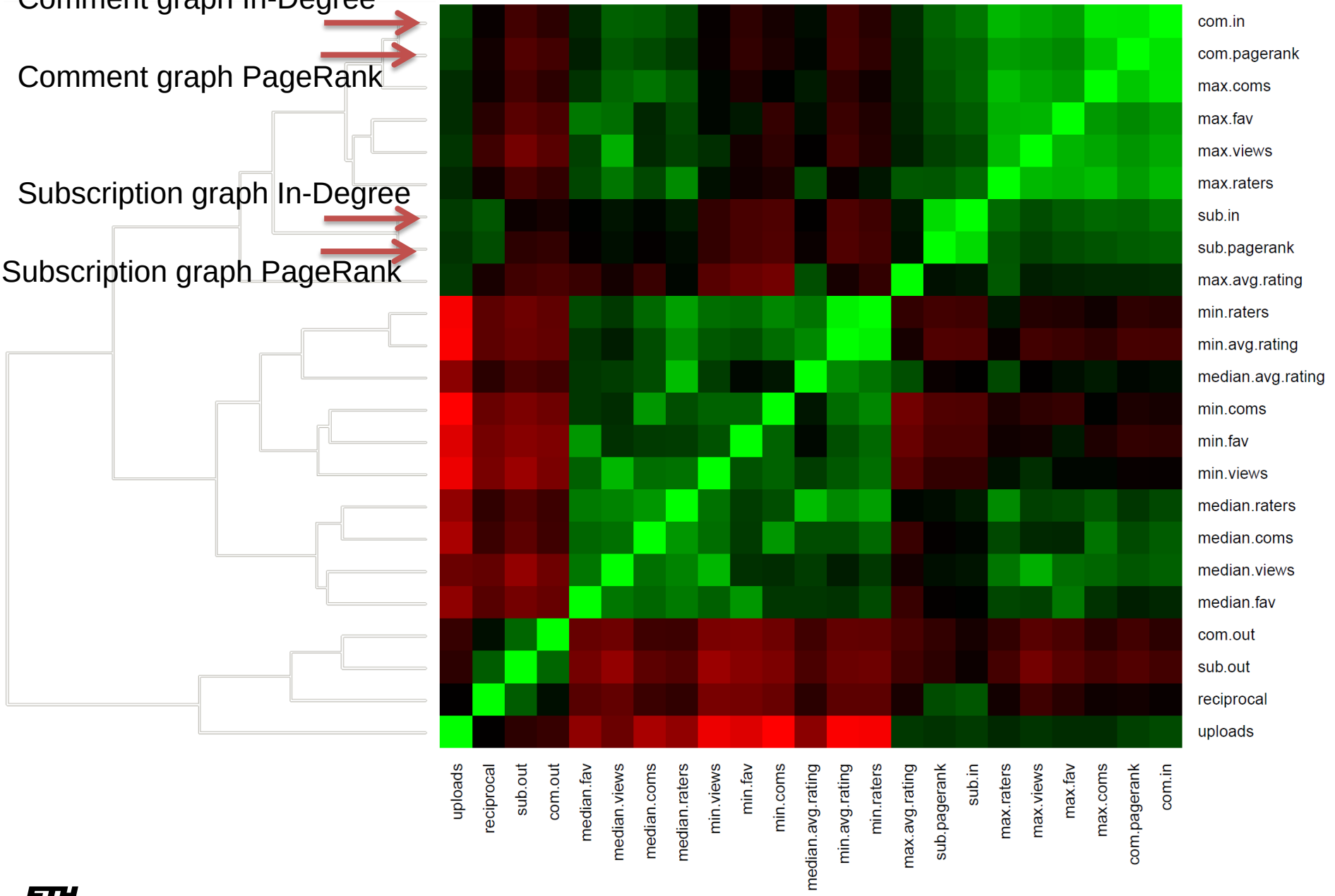
max.coms
com.pagerank
com.in

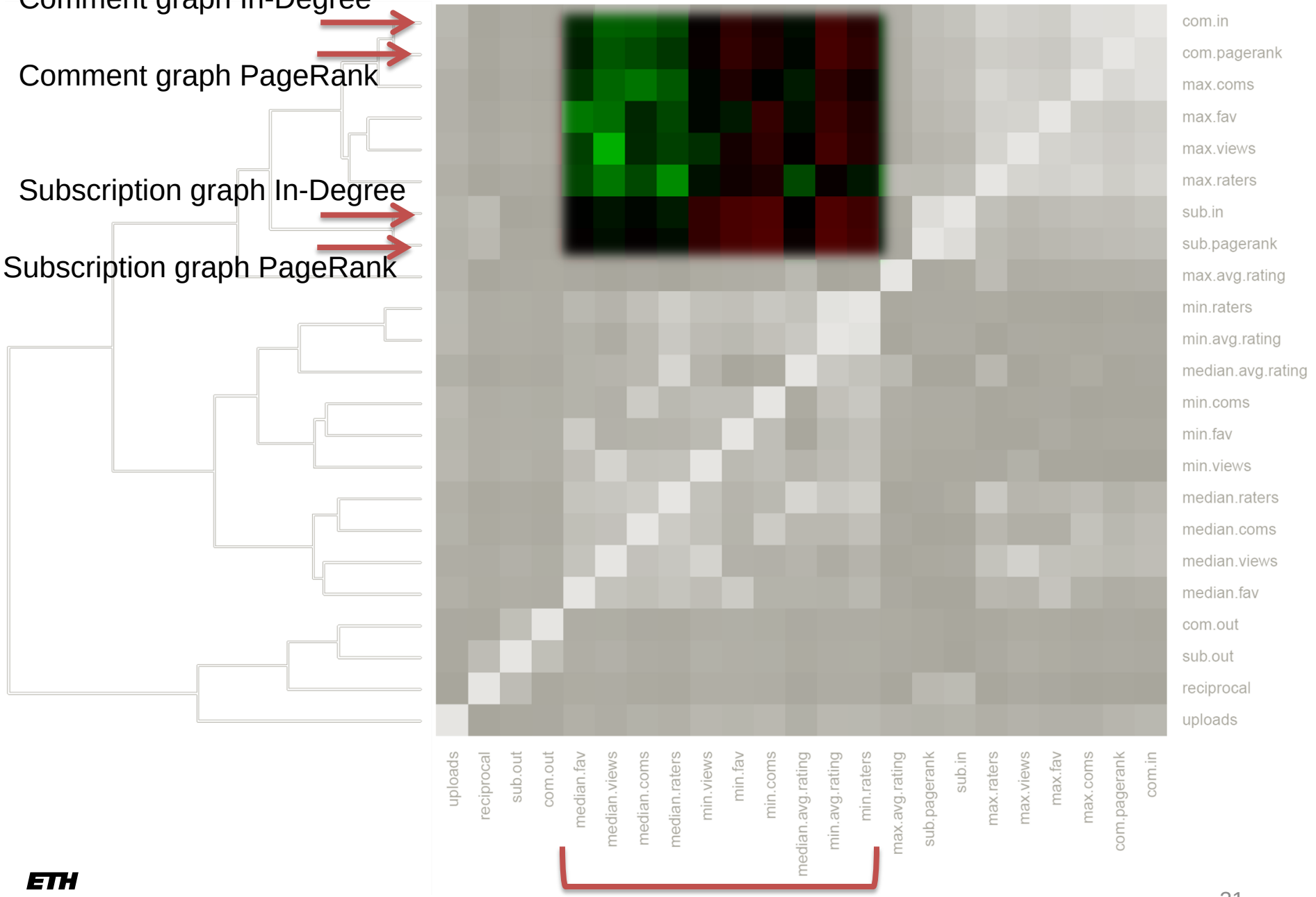
Comment graph In-Degree

Comment graph PageRank

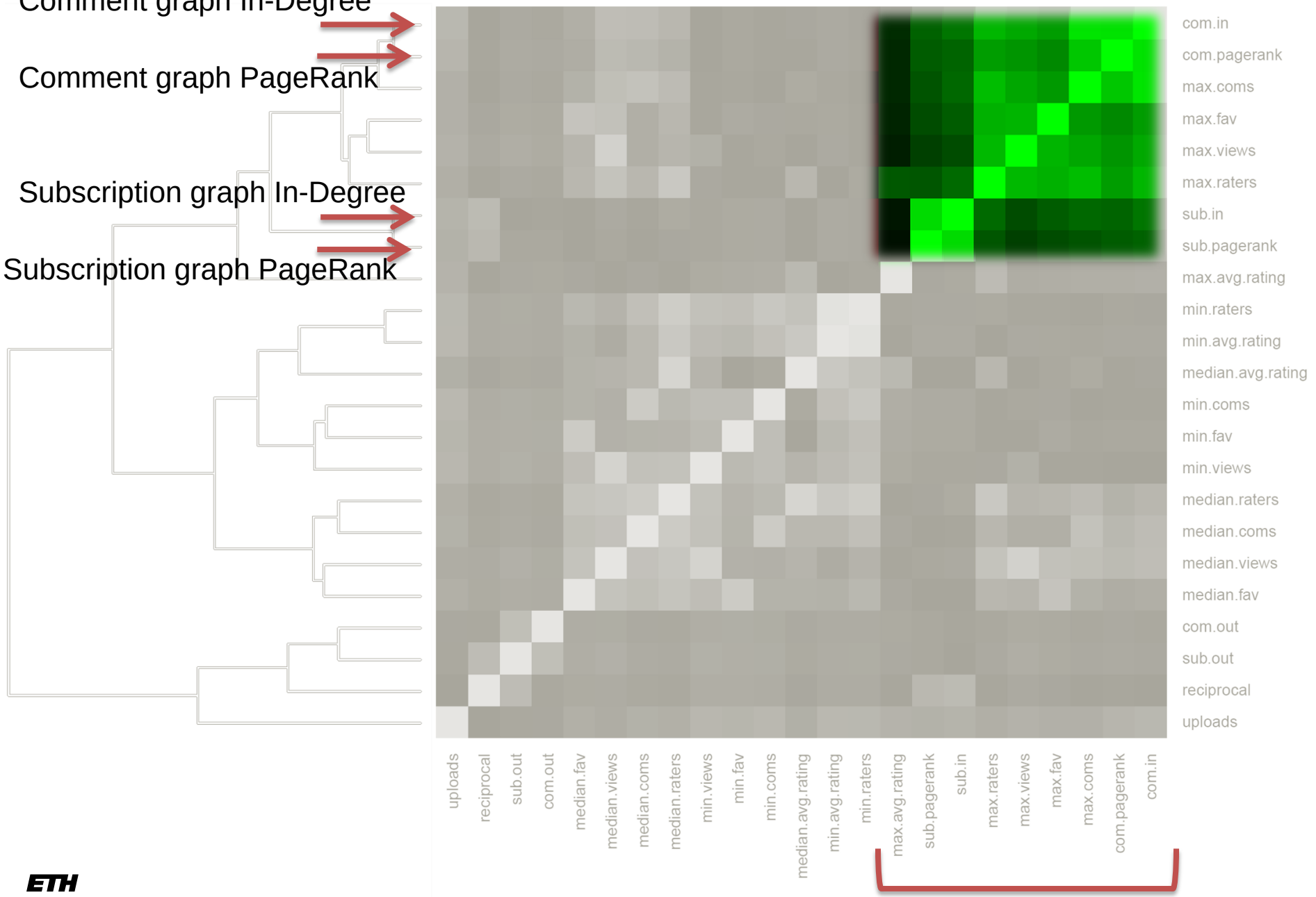
Subscription graph In-Degree

Subscription graph PageRank





Medians and minimums of content popularity


Comment graph In-Degree
Comment graph PageRank
Subscription graph In-Degree
Subscription graph PageRank
com.in
com.pagerank
max.coms
max.fav
max.views
max.raters
sub.in
sub.pagerank
max.avg.rating
min.raters
min.avg.rating
median.avg.rating
min.coms
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sub.in
max.raters
max.views
max.fav
max.coms
com.pagerank
com.in
Maximums of content popularity

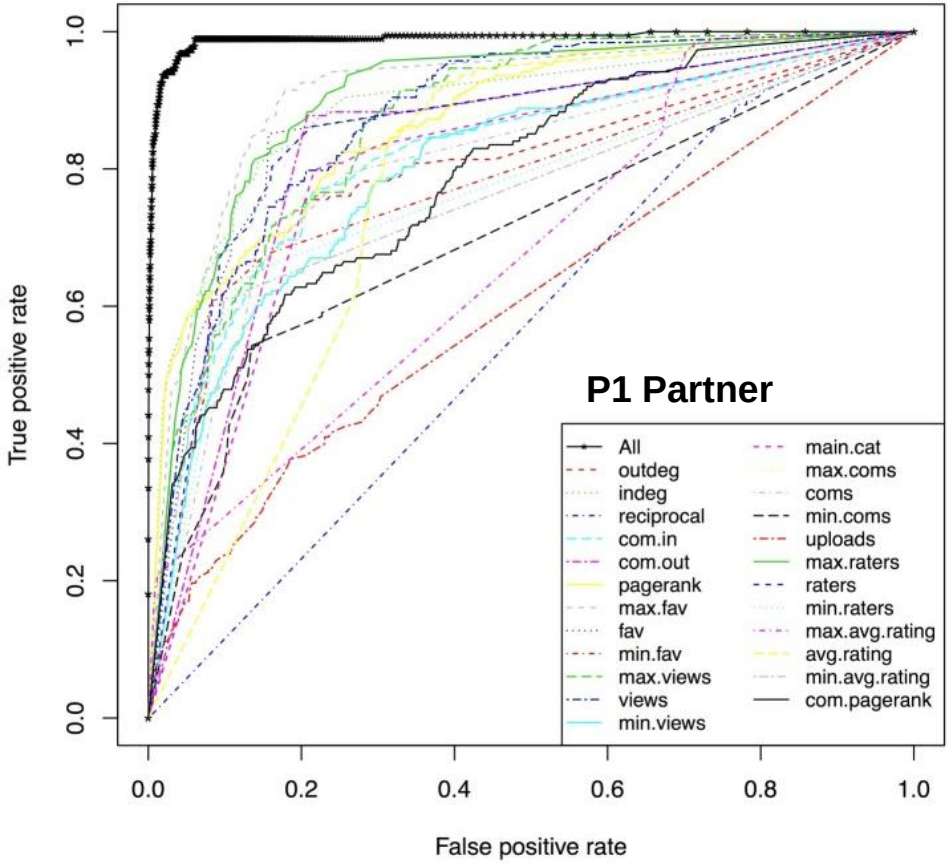
YouTube Partners

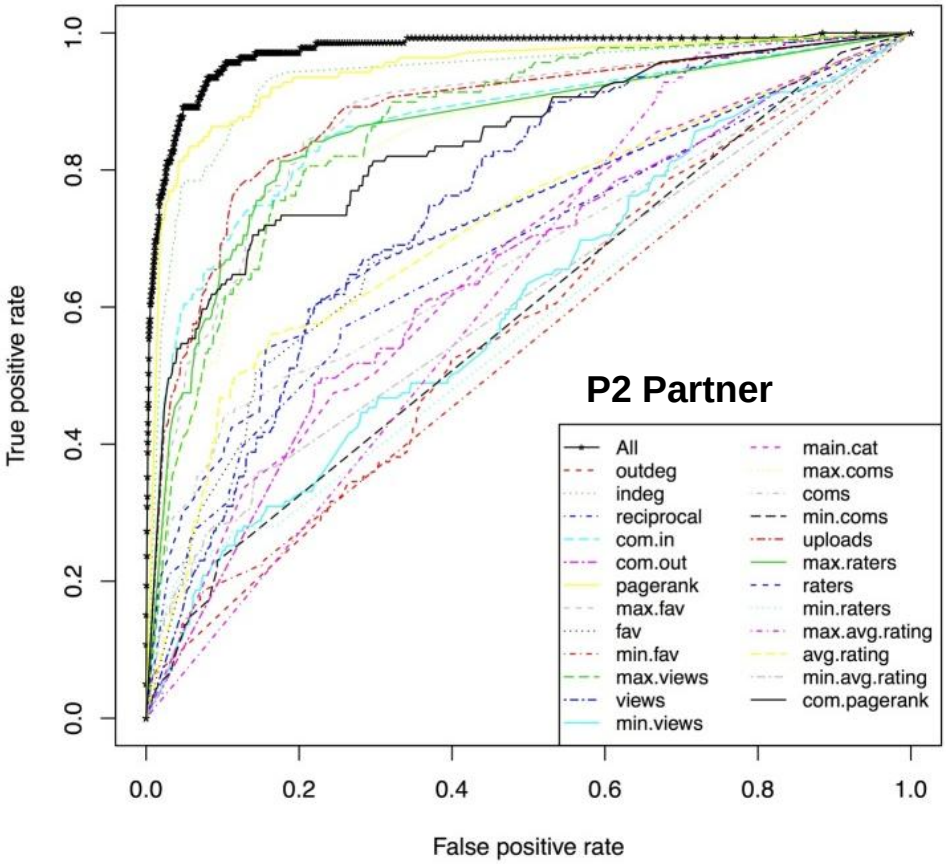
- YouTube Partner Program (YPP)[1]:
  - Created in 2007, top content contributors are selected to share ad revenue
  - Payout in the millions/year, top partners can make more than 100k/year
  - 30,000 partners from 27 countries

- Classify users as potential YPP members to aid the filtering process
  - Leverage **subscription graph**, **comment graph**, and **content metrics** as signals
  - Large-scale spotting problem
  - Focus on recall as opposed to precision

- Supervised-learning via Random Forest *[Liaw and Wiener, 2002]*
  - Three types of partners, formed as three **independent binary classification** problem
  - Feature selection via Gini entropy reduction

[1]www.youtube.com/t/press_statistics

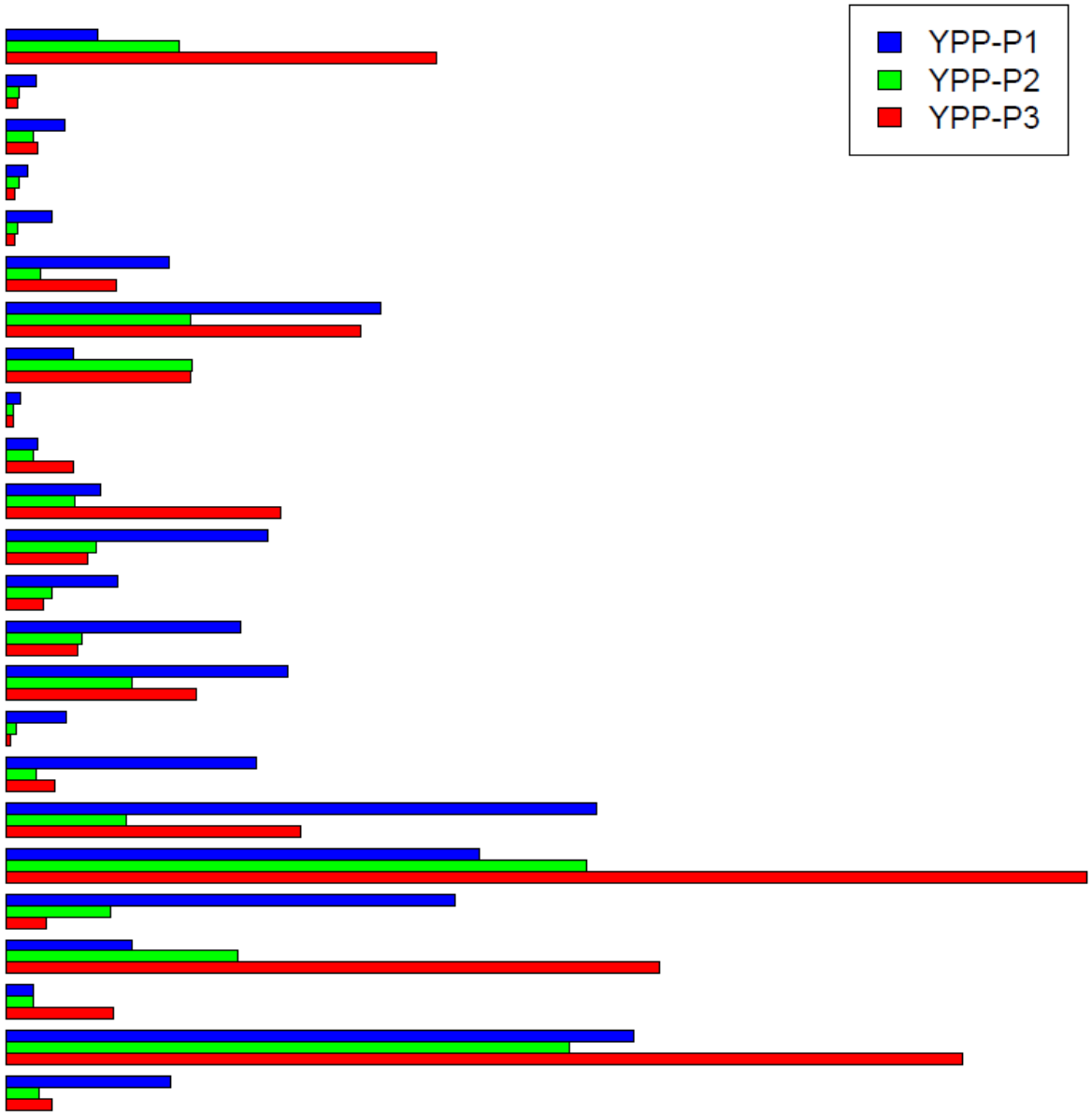




10-fold C.V. on imbalanced data

	Mean AUC	**Std. Dev.**
P1 Partners	0.968	0.0212
P2 Partner	0.958	0.0323
P3 Partners	0.943	0.0413

Entropy Reduction of Various Features



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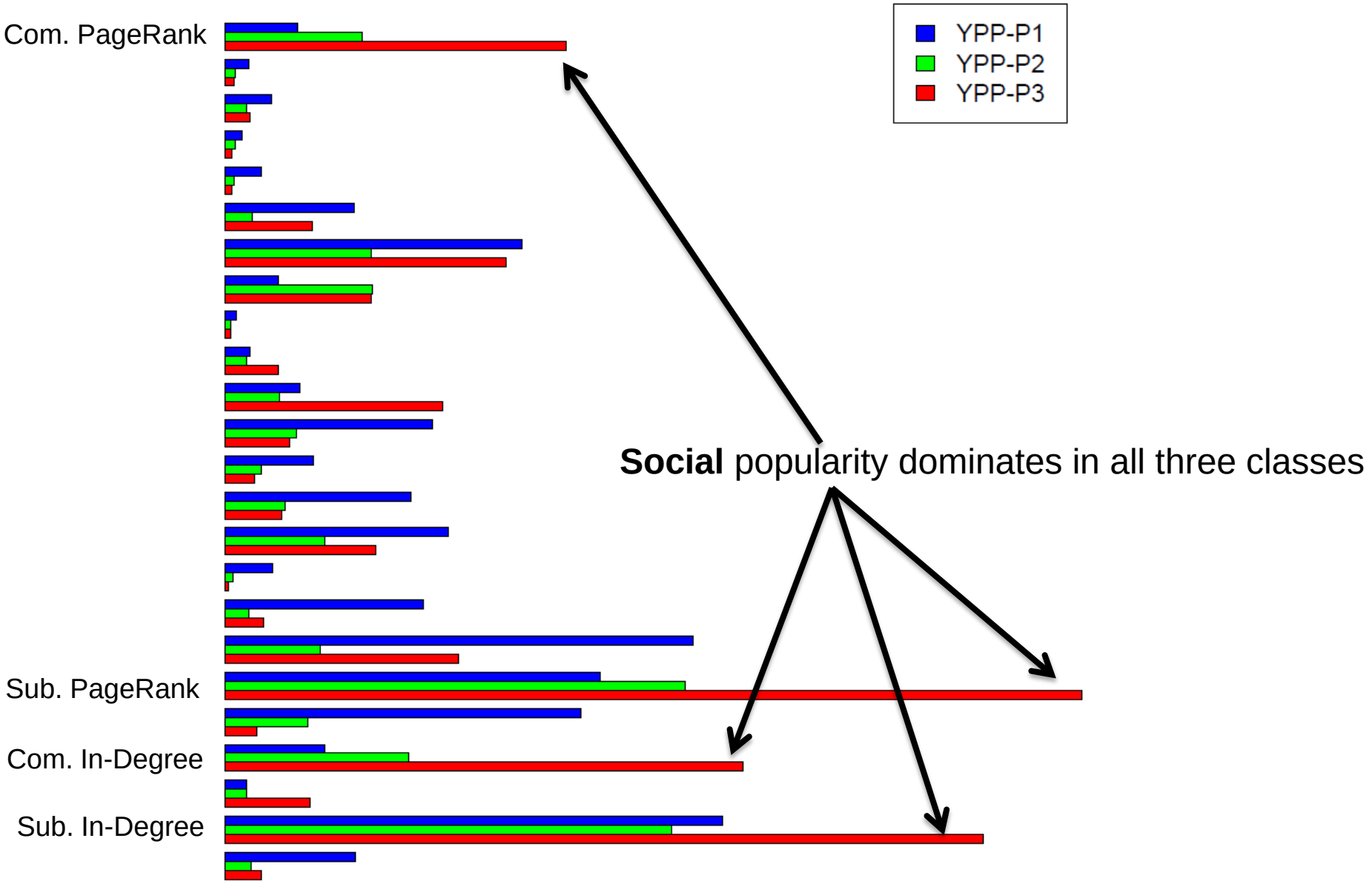

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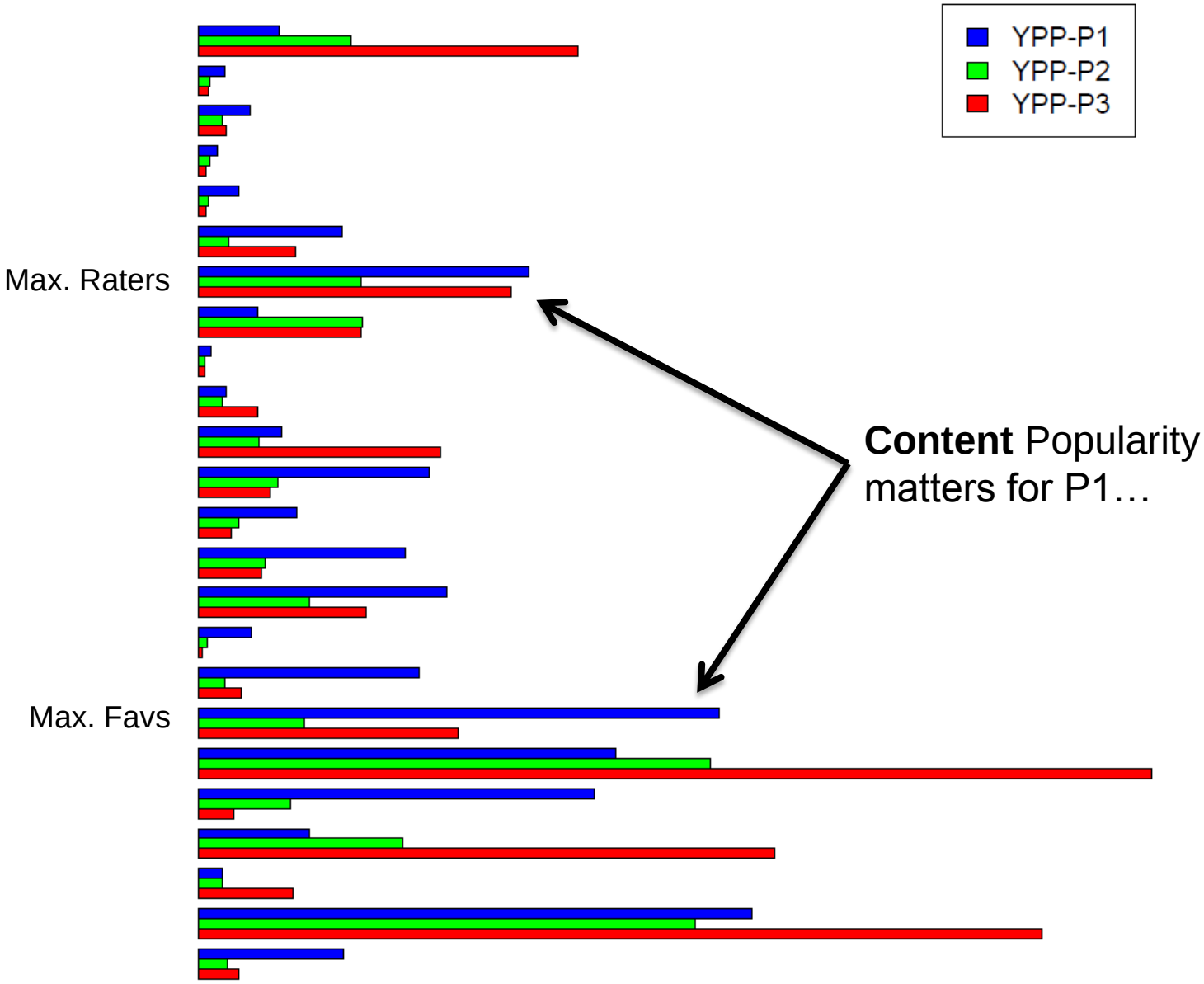

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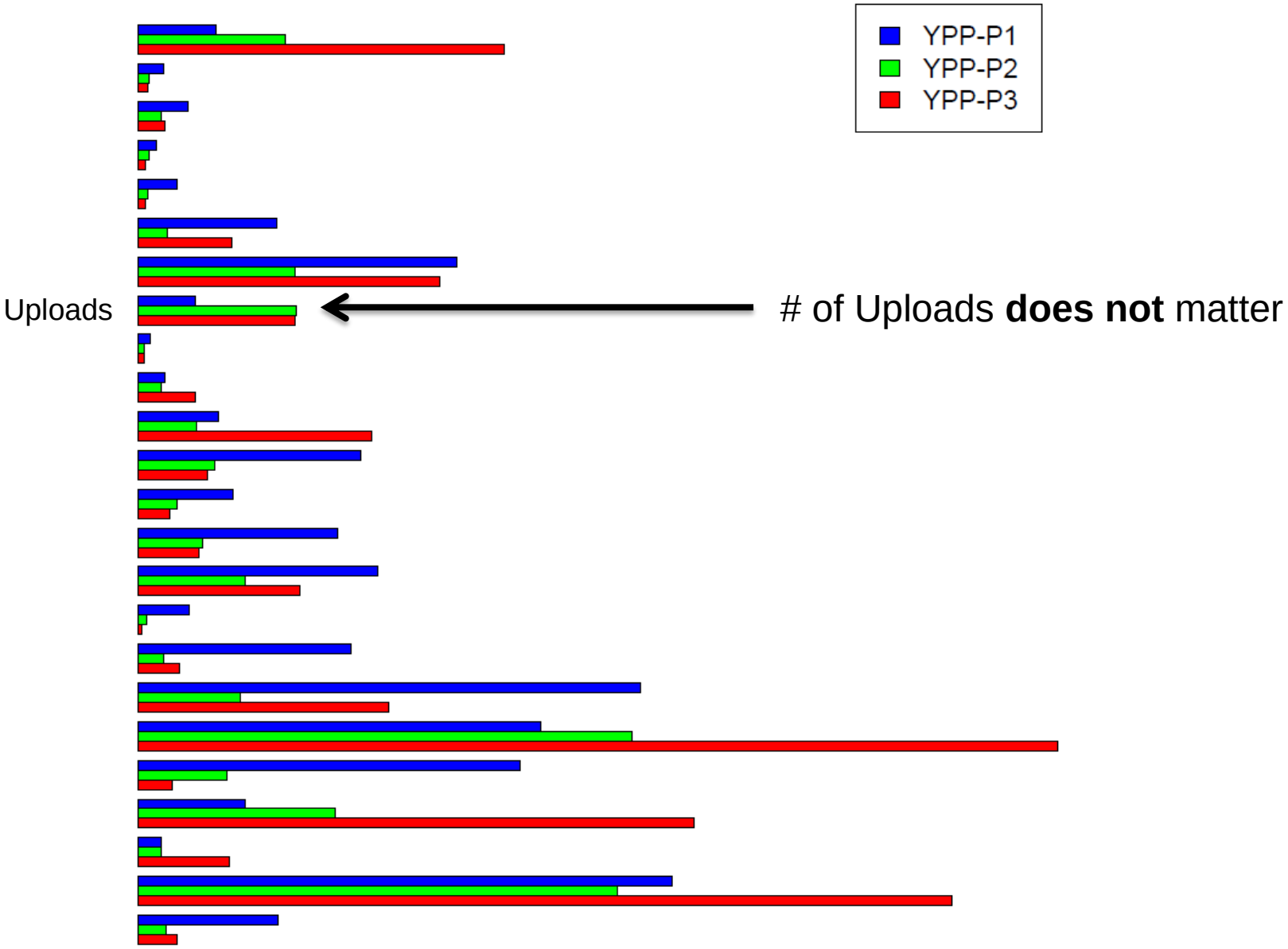

Take-Aways

- We found a significant **dichotomy** of social interaction and linking
- The YouTube social network **differs** from marked trait of traditional social networks - social relationships are driven by **information relationships**
- Social popularity is more in line with **top** content popularity
- **Social popularity** dominates the selection of YouTube Partners

Thanks!

Questions?

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