

# A New Design Principle for Open-ended Evolution (OEE)

Takashi Ikegami

# A Social Network Service: RoomClip

<http://roomclip.jp/>



芝生をカット/植物/玄関/入り口のインテリア実例 - KOKUBOの部屋 - 2014-05-25 18:13:56

KOKUBO

171 いいね

写真についているタグ一覧

芝生をカット 植物 玄関/入り口

mow the lawn  
plant  
entrance

SELECTED!!  
DailyRoomClip vol. 28

このユーザーの人気の部屋写真

The screenshot shows a post from a user named KOKUBO. The post title is "芝生をカット/植物/玄関/入り口のインテリア実例 - KOKUBOの部屋 - 2014-05-25 18:13:56". It includes a profile picture of a cartoon character, a like count of 171, and a link to a list of tags. Three specific tags are highlighted with blue arrows pointing to them: "芝生をカット" (mow the lawn), "植物" (plant), and "玄関/入り口" (entrance). Below the tags is a green box with the text "SELECTED!! DailyRoomClip vol. 28". At the bottom, there's a section titled "このユーザーの人気の部屋写真" showing thumbnails of other photos from the user's gallery.

2014-05-25



2015-07-16 17:04:06

この写真をシェア

2015-07-16

allow me  
to like all at  
once

...Uco...

131 いいね

写真についているタグ一覧

玄関/入り口

まとめていいねする私を許してね♥

TODAY'S SPECIAL IKEA

無印良品 収納見直しブーム到来

NO WHITE NO LIFE

ホワイトシンプル連合会 整理収納部

収納 塩系インテリアに乗っかる

ごま塩系インテリア 白黒

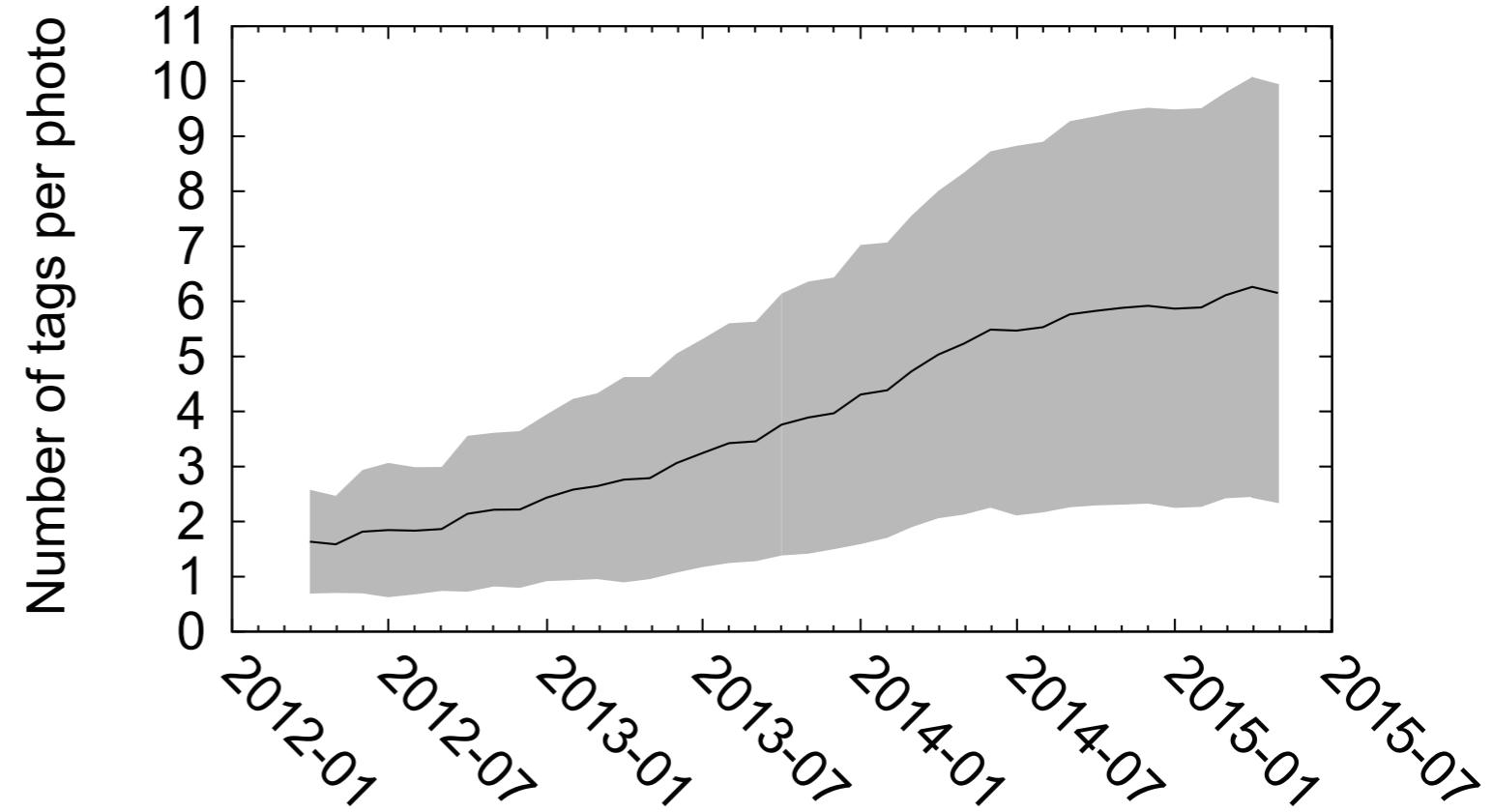
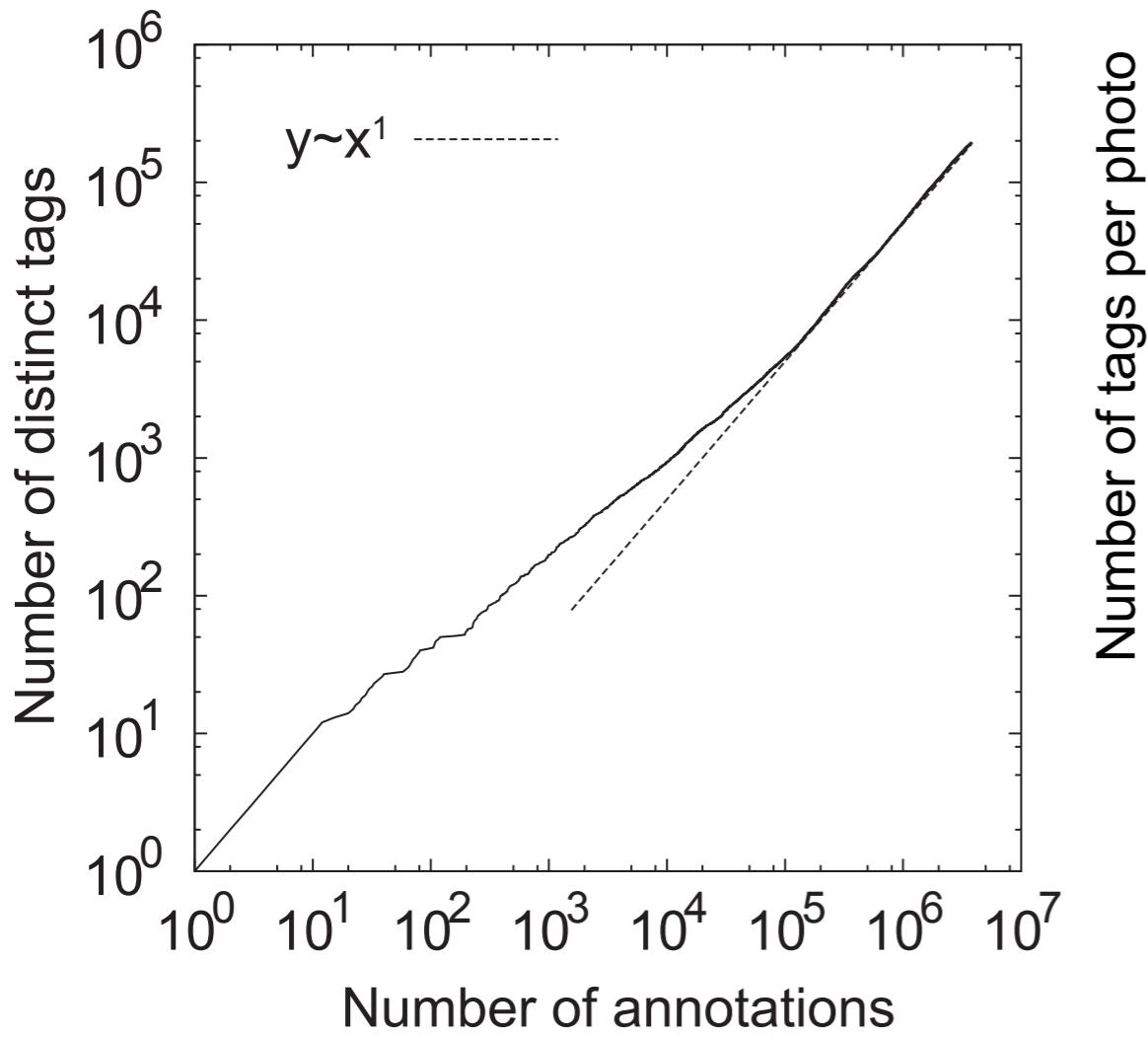
モノトーン IG→uco122

がんばっぺ福島！

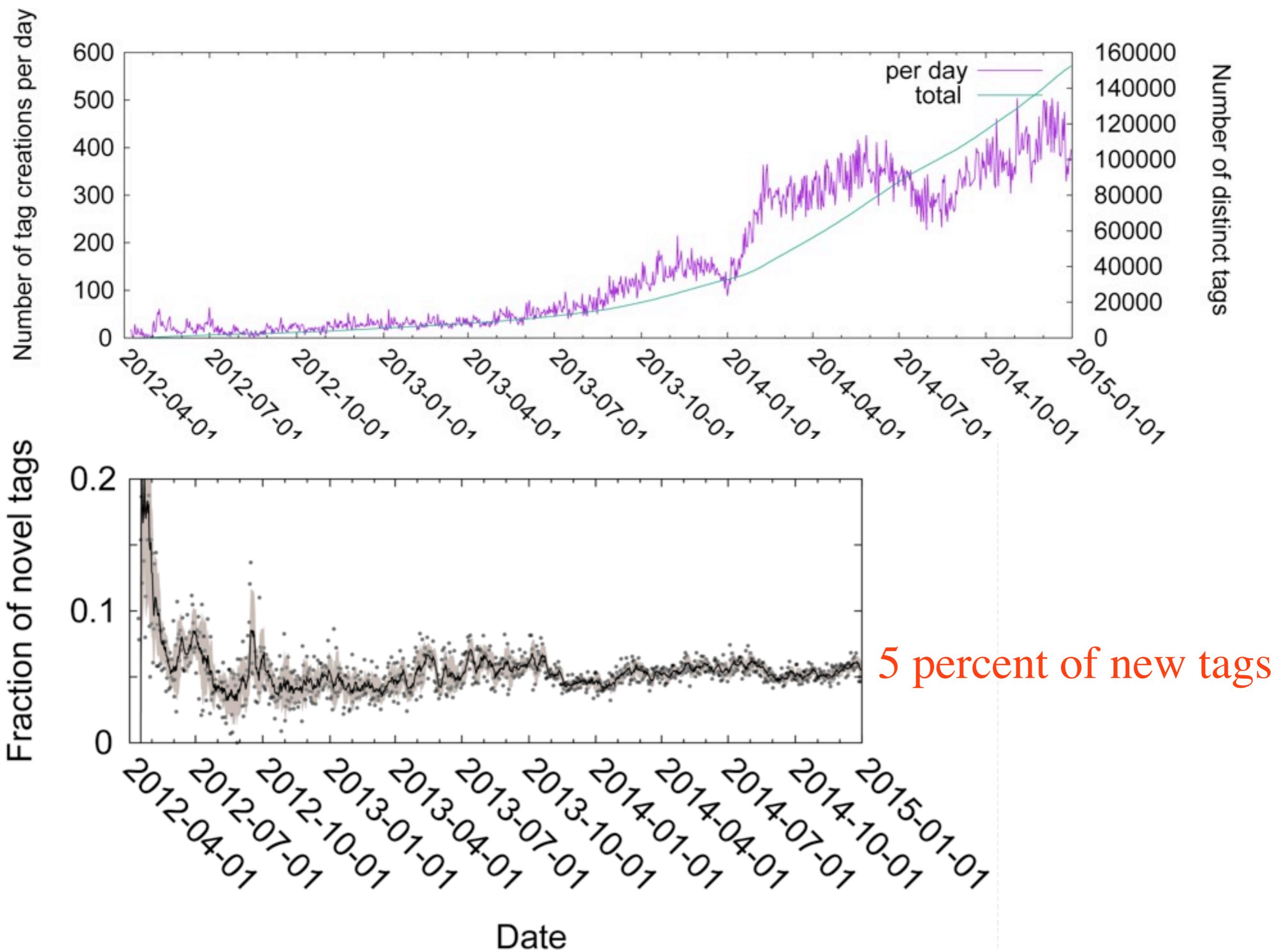
cheer up Fukushima

Let's review  
storage space

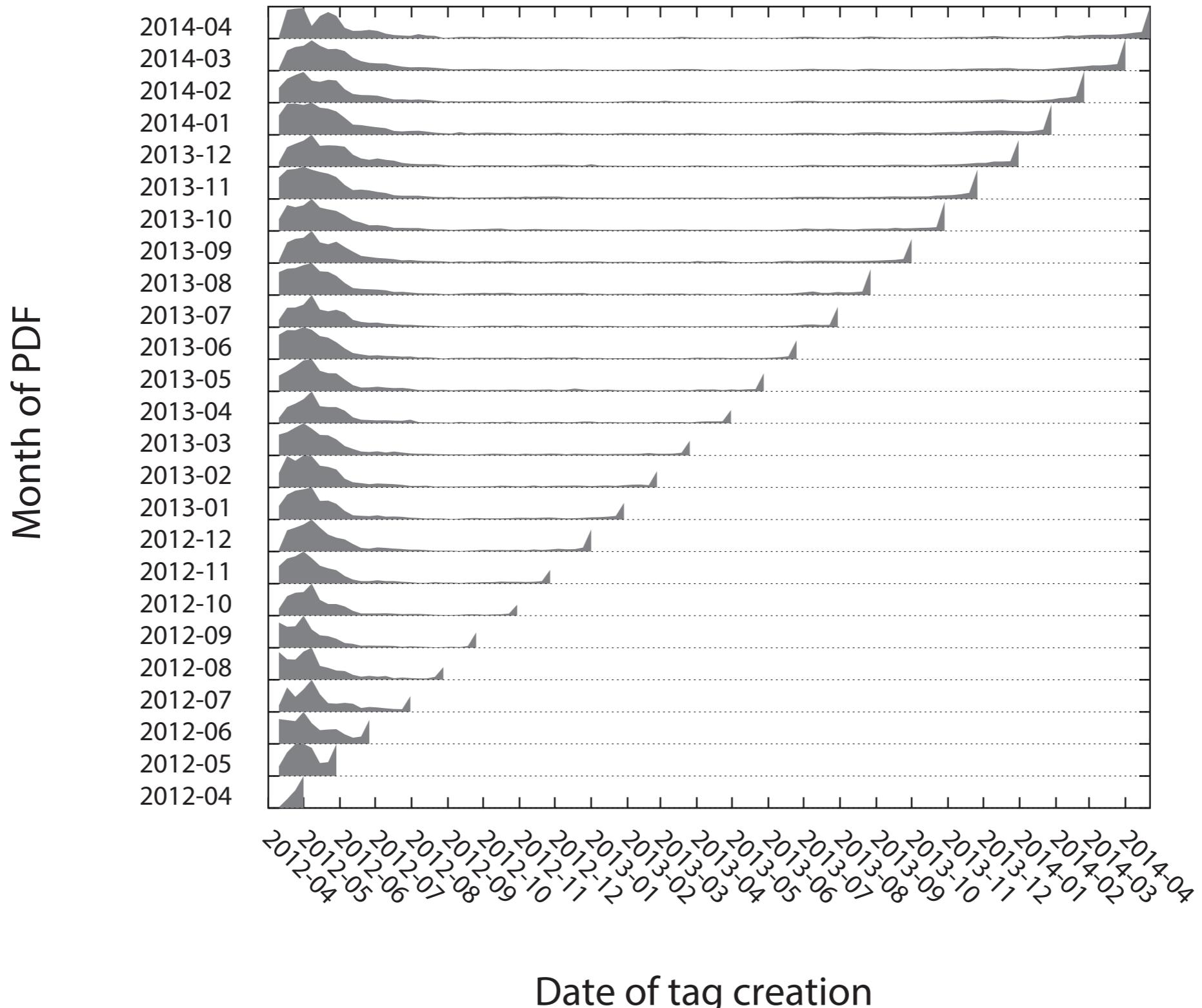
Since the launch of the service, the number of users has shown sustainable growth, and the total number of users is around 410,000, as of April 2015



distribution of the distinct number of tags (vocabularies) over the number of annotations (Left) and the average number of tags used per photo over time (Right).



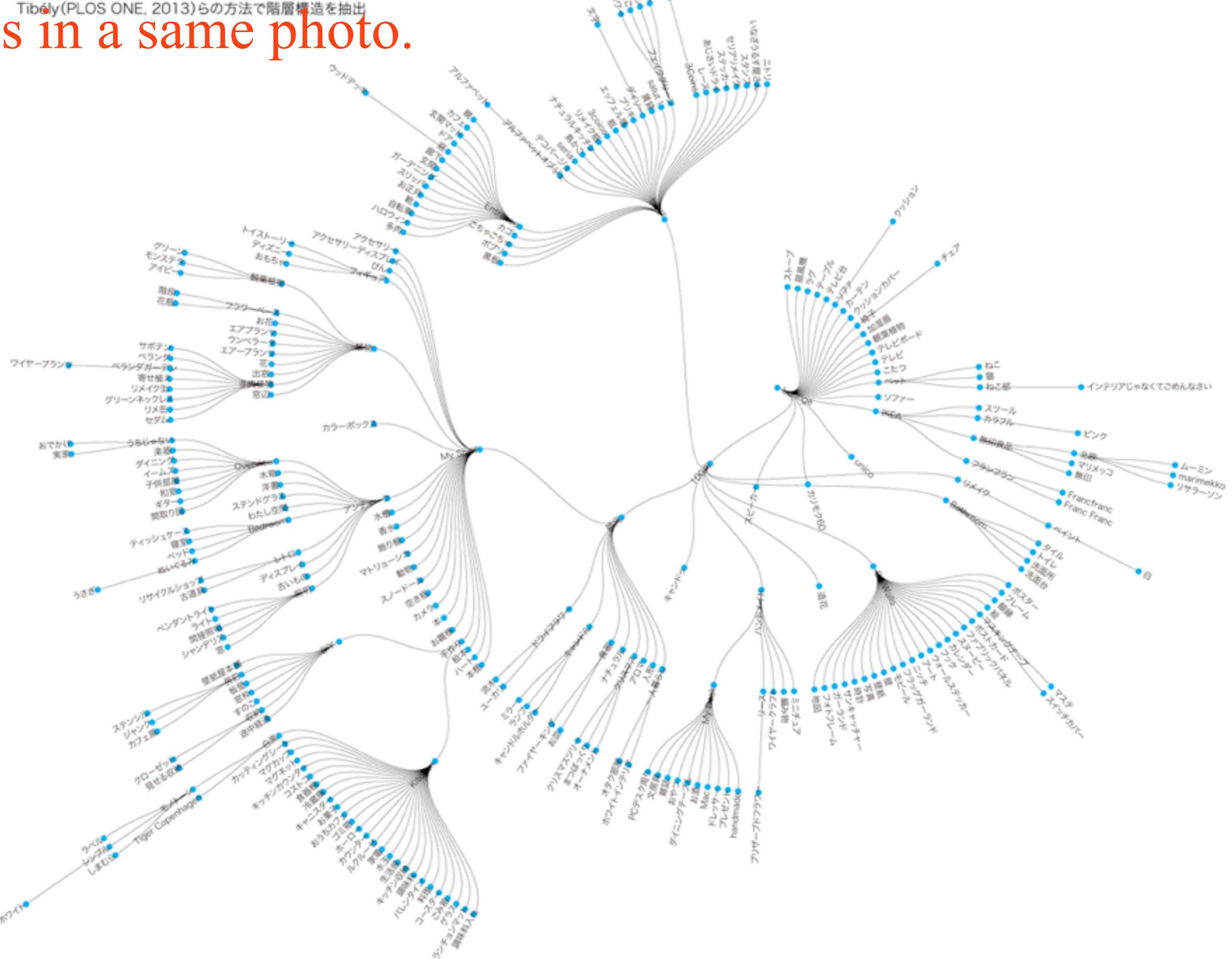
# Combinatorial evolution by the old and latest tags.



Histogram of used tags mapped to the time when they were created.

# A tree generated by the co-occurrence of frequent tags in a same photo.

100人以上のユーザに使われたタグについて、  
Tibély(PLOS ONE, 2013)らの方法で階層構造を抽出



# A tree generated by the co-occurrence of frequent tags in a same photo.

# Phylogeny from tags

Tibely(PLOS ONE, 2013)の方法で階層構造を抽出

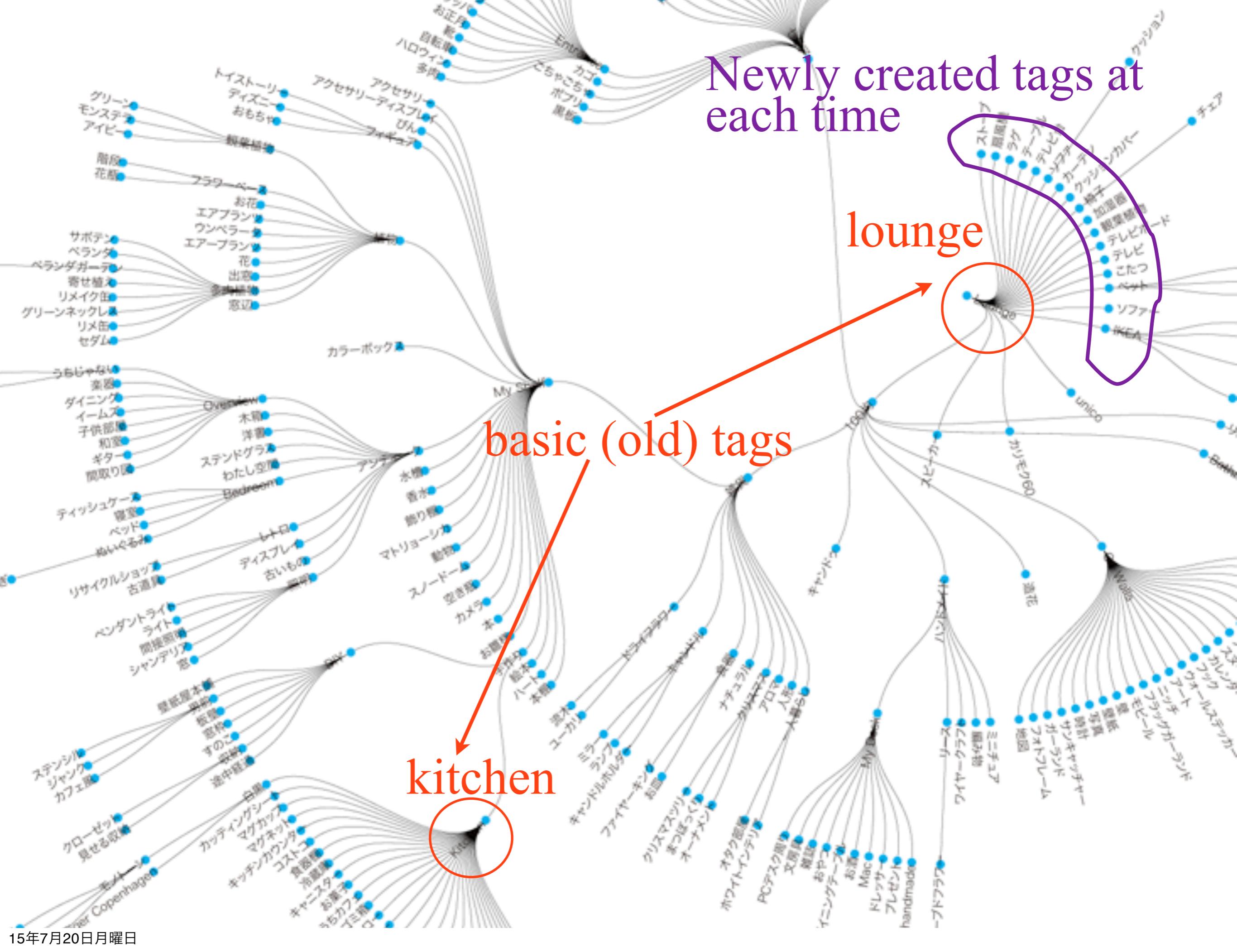
Tibély(PLOS ONE, 2013)の方法で階層構造を抽出

Newly created tags at each time

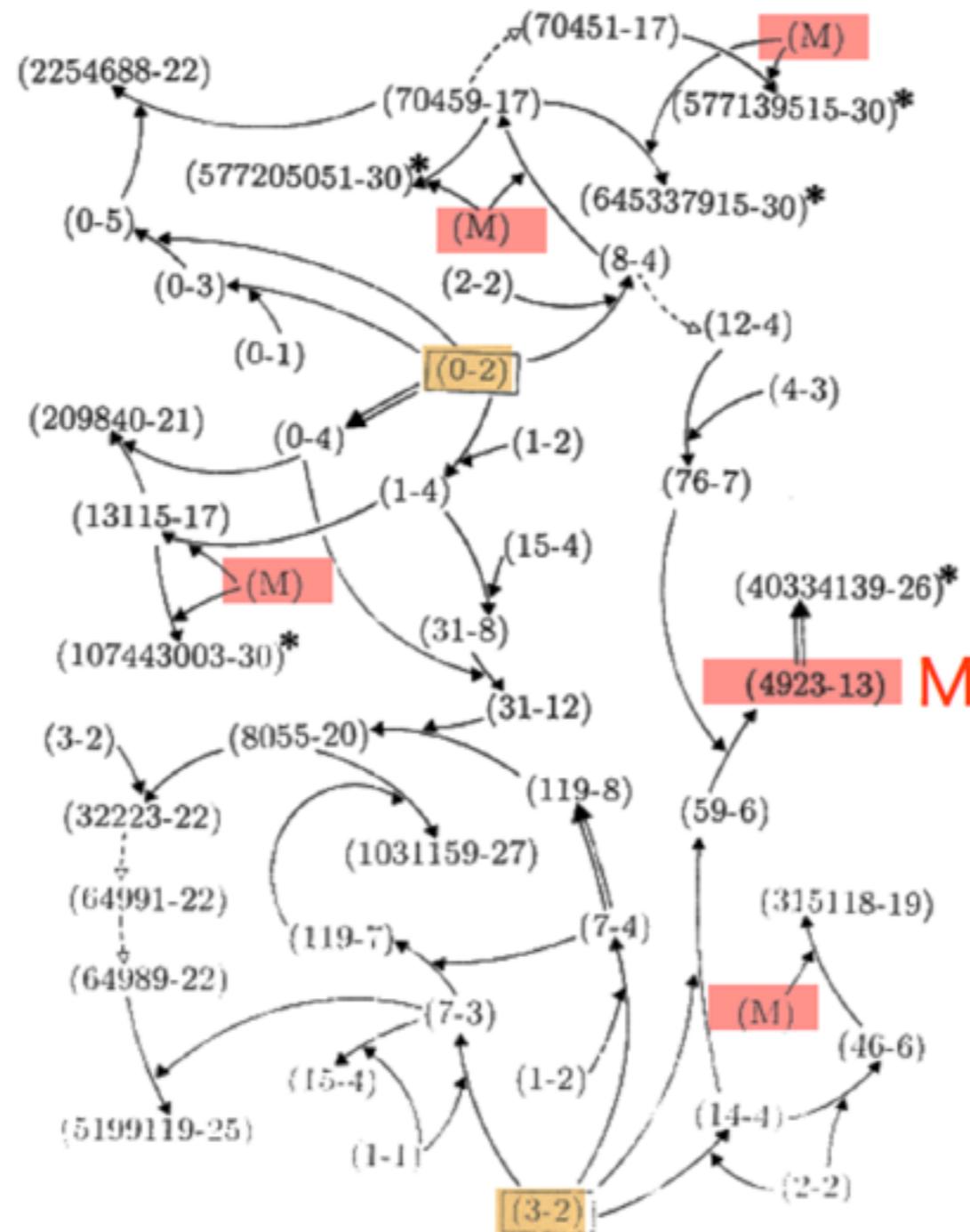
# lounge

# basic (old) tags

# kitchen

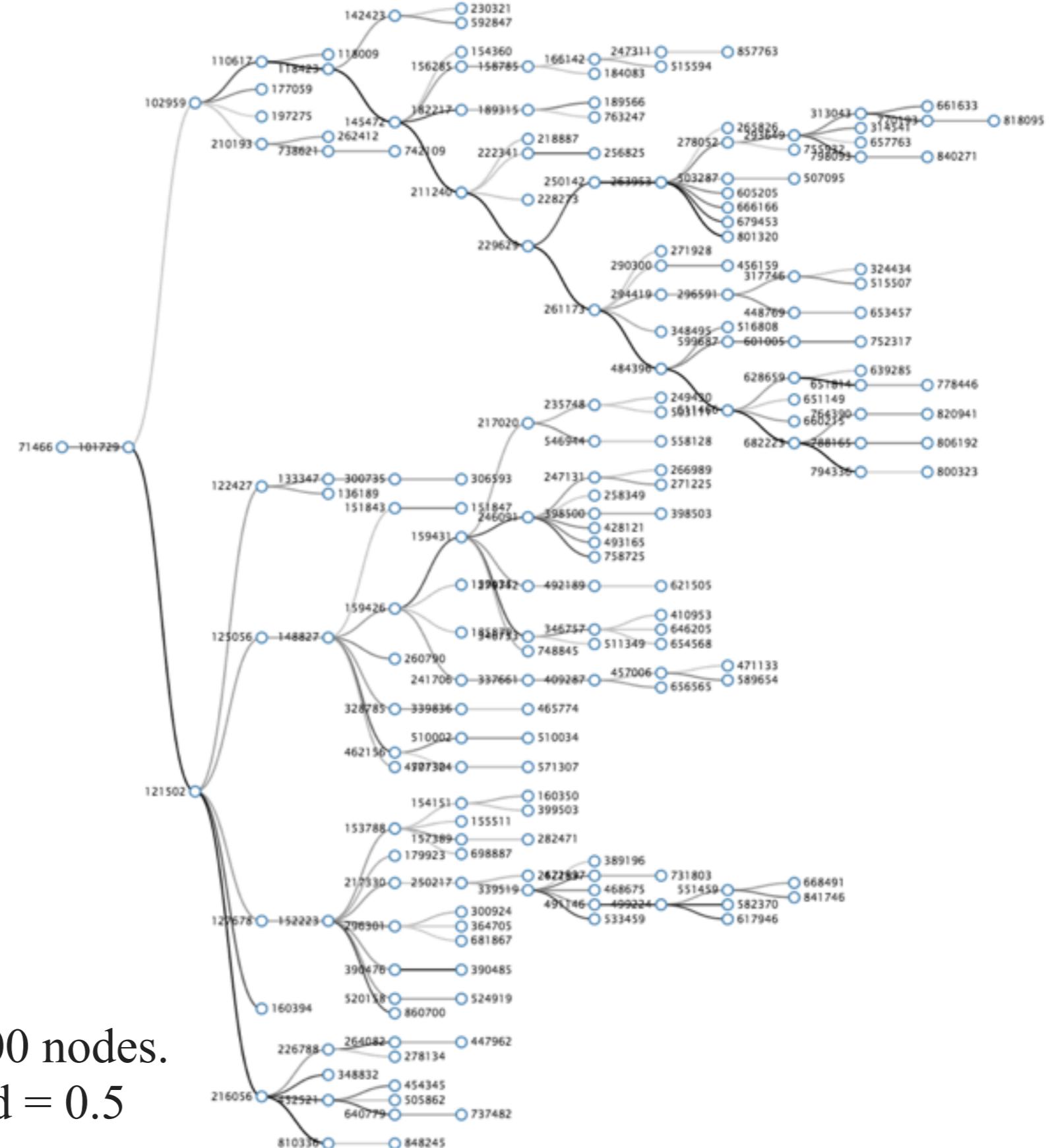


# cf. Genetic Fusion



Takashi Ikegami and Kunihiko Kaneko: **Genetic Fusion** *Phys. Rev. Lett.* 65:3352-3355, 1990.

Jaccard coefficient ( $|A \cap B|/|A \cup B|$ ) is computed from the annotated tags to define parent-child relationships between two photos:

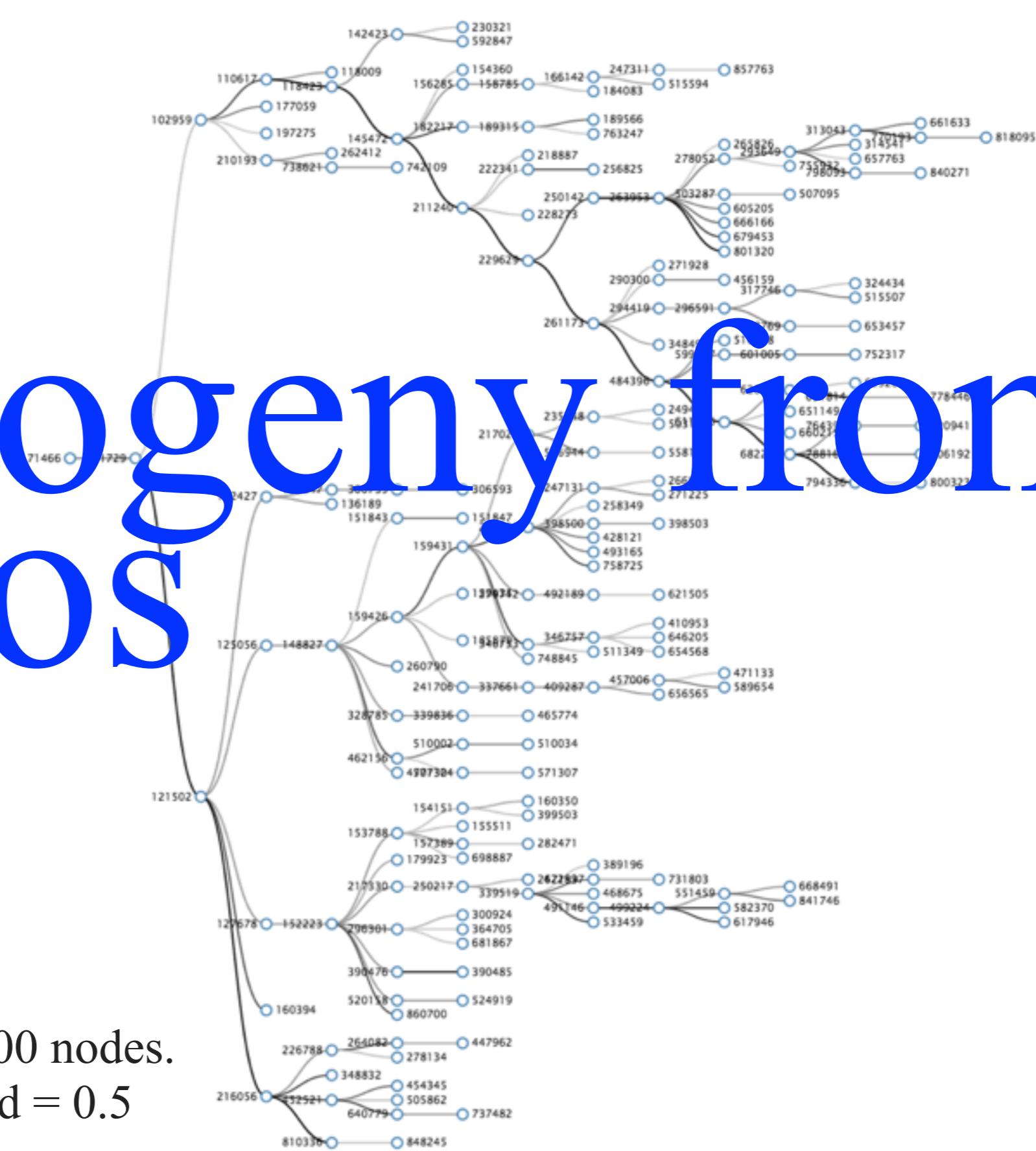


A tree with more than 100 nodes.  
A Jaccard coef. threshold = 0.5

Jaccard coefficient (  $|A \cap B|/|A \cup B|$  ) is computed from the annotated tags to define parent-child relationships between two photos:

# Phylogeny from photos

A tree with more than 100 nodes.  
A Jaccard coef. threshold = 0.5



broad lines indicate that the inheritance is strong.

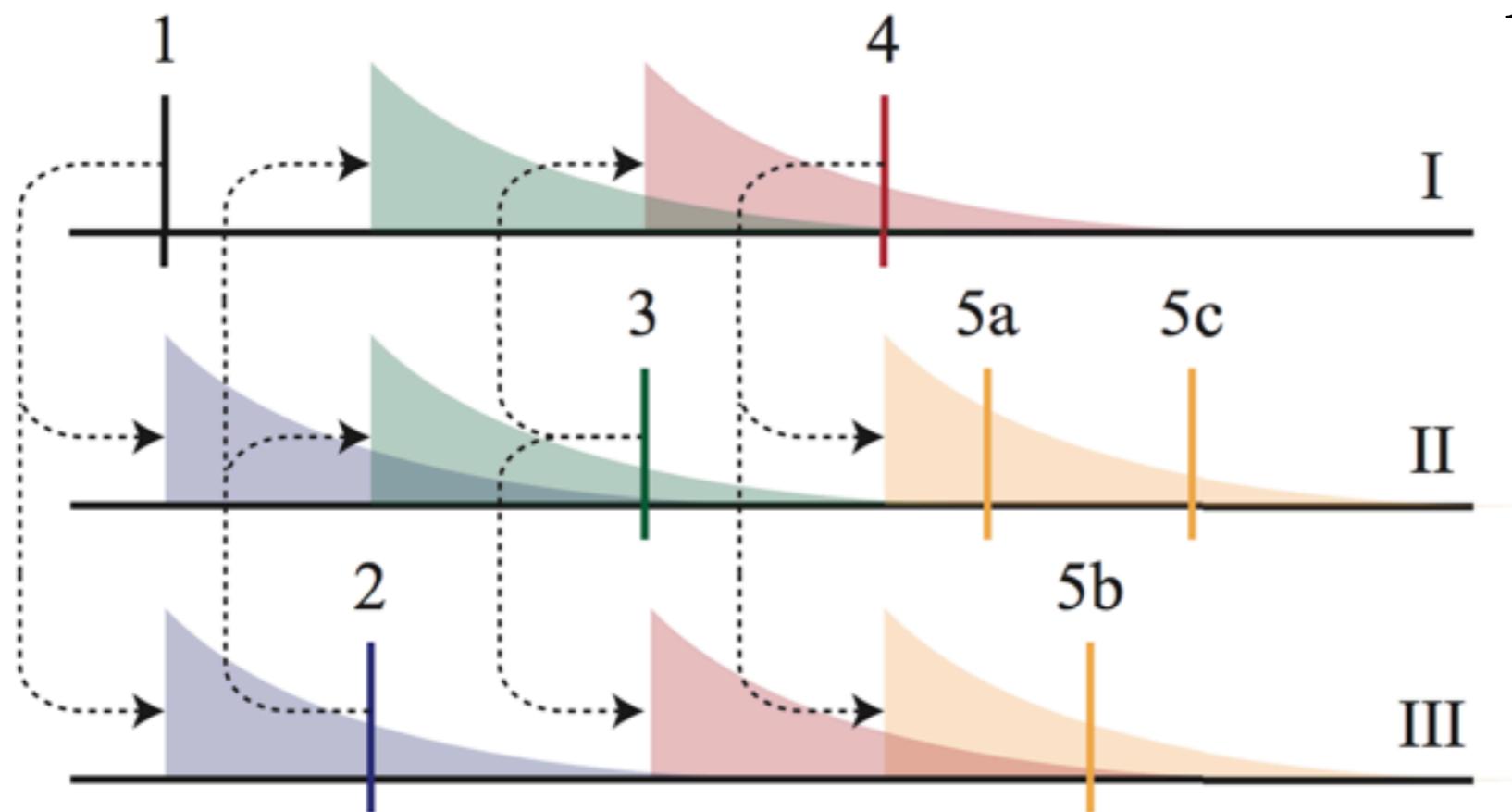


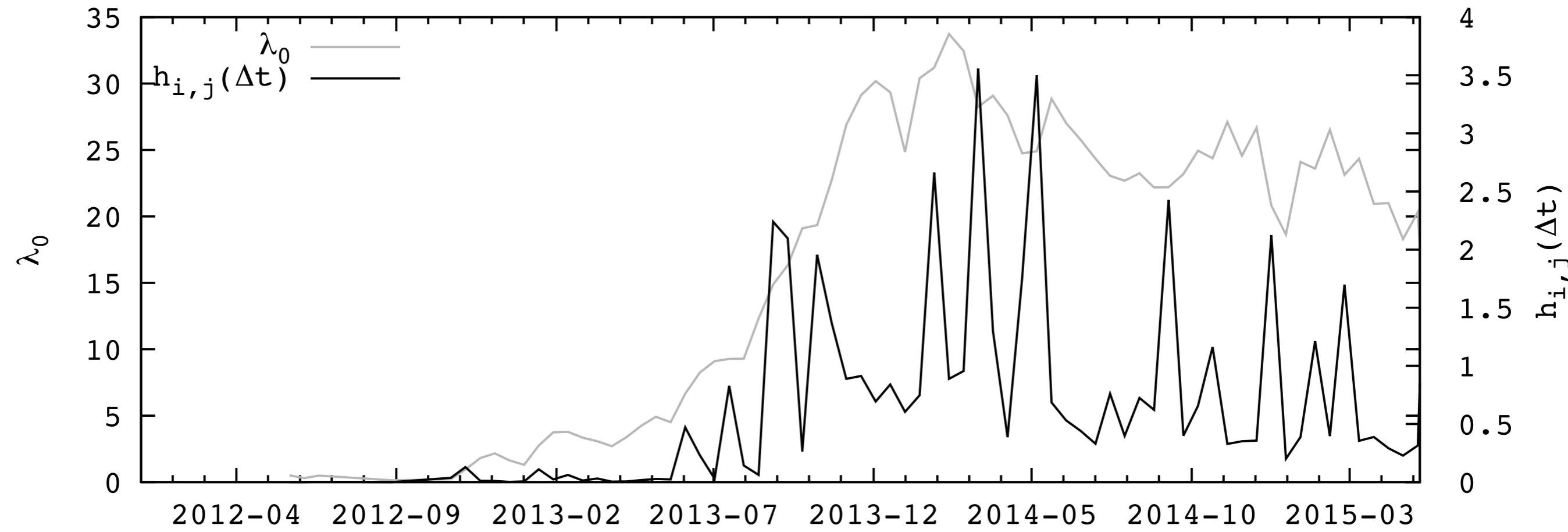
# Measuring *vitality* of the web service

We fitted the users 'time series of 'like' events by the Hawkes process by maximizing the likelihood and analysed the users those who posted more than 300 photos.

$$\lambda^k(t) = \lambda_0^k(t) + \sum_{k'} \int_0^\infty h^{k,k'}(t-\tau) \lambda^{k'}(t-\tau) d\tau$$

Hawkes process (1971)

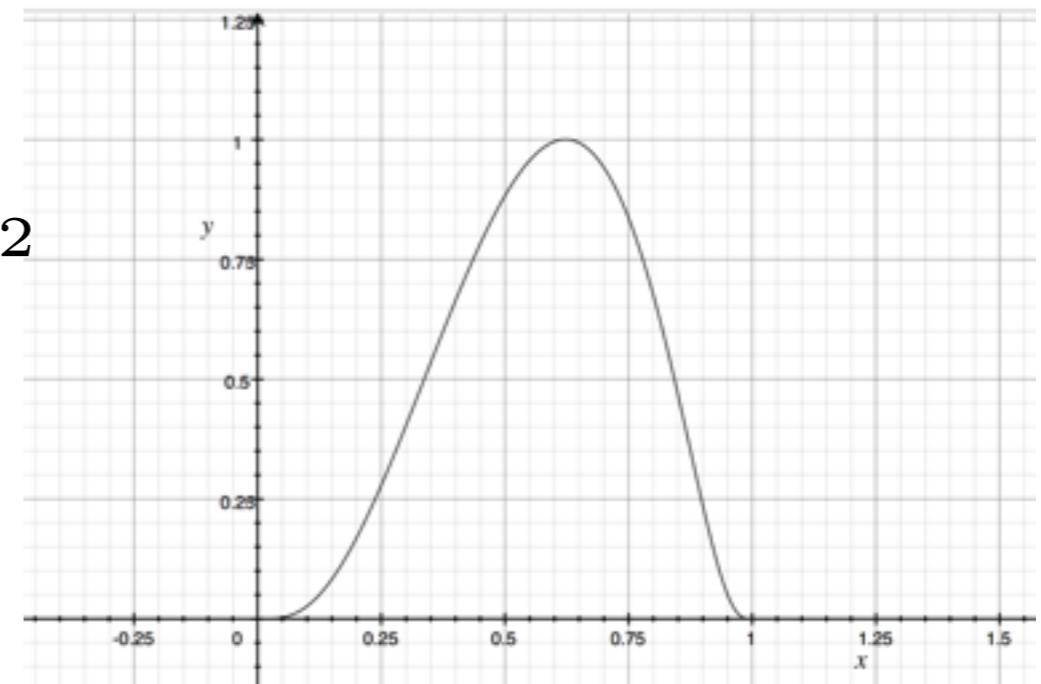




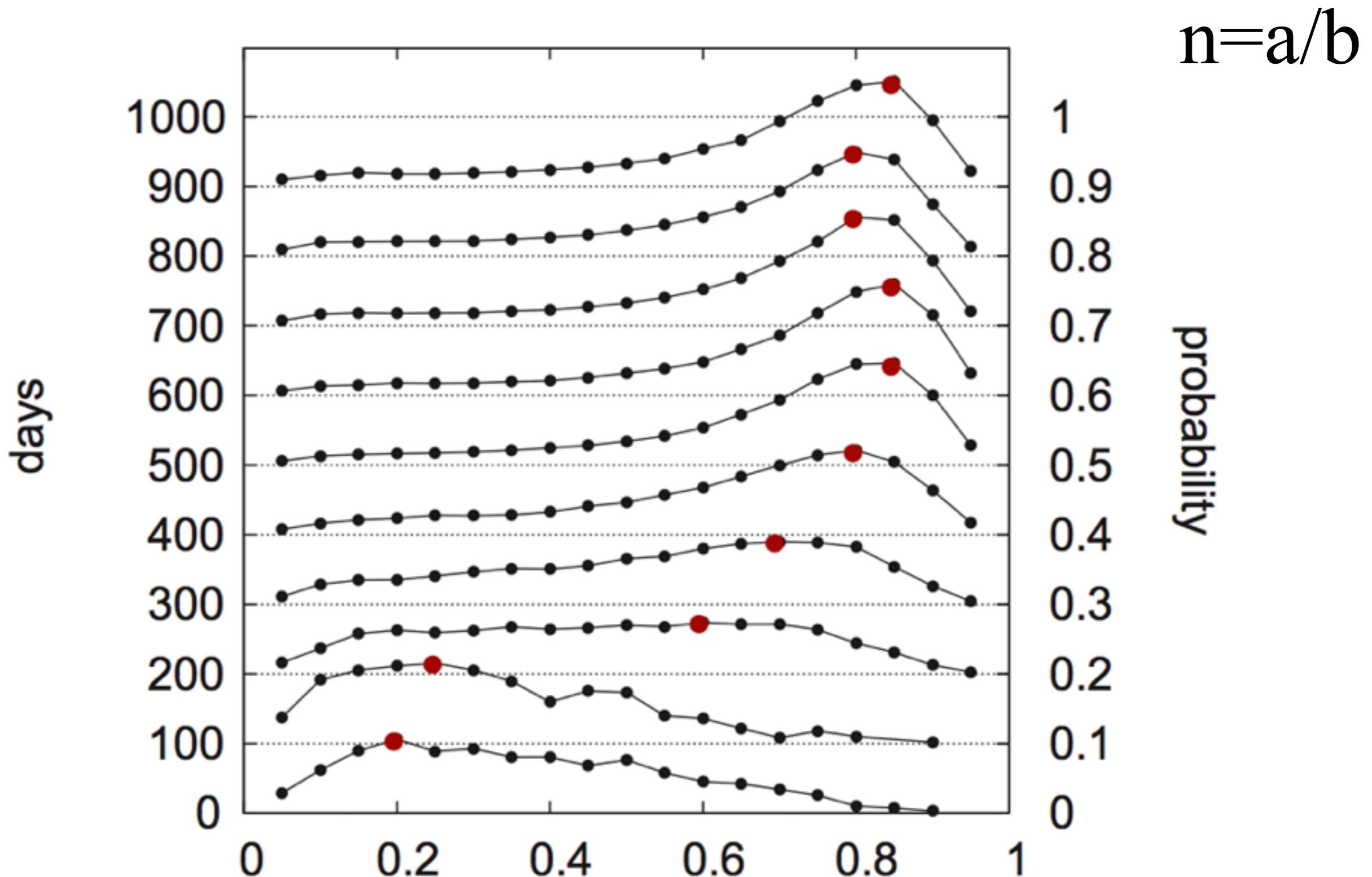
$$\lambda^k(t) = \lambda_0^k(t) + \sum_{k'} \int_0^\infty h^{k,k'}(t-\tau) \lambda^{k'}(t-\tau) d\tau$$

$y=\exp\left(-0.5\left(\ln\left(\frac{x}{(1-x)}\right)-0.5\right)^2\right)$

$$h(t-\tau) = ae^{-\tau(\ln(t/(1-t))-b)^2}$$



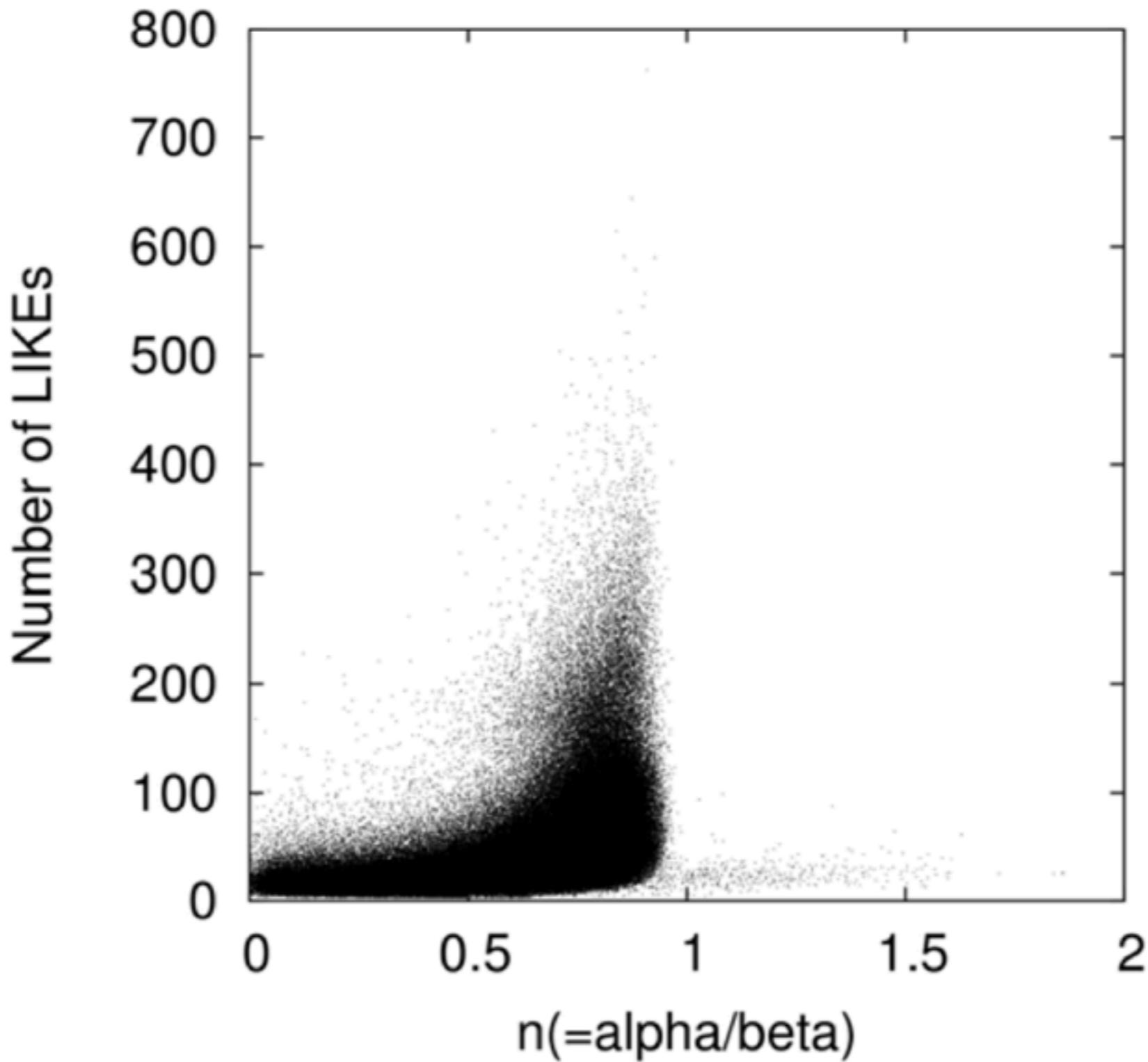
# Temporal Development of endogeneity (n)



$$h(t - \tau) = ae^{-bt}$$

Result :

Distribution on n ( $= \alpha / \beta$ )



# *A new design principle of OEE*

Web system maintains its activity by increasing vocabularies in a progressive way. *Certain types of tags stimulate users to invent new combinations. At the same time, users take photos to annotate with these tags. This type of tags, which we call innovative tags, can be used to derive the OEE of the service.* As this study shows, we claim that *genotype-phenotype mapping* is a powerful mechanism to maintain and create the OEE, and it is applicable to other nonbiological and, possibly, to biological systems.

# collaborators



**Yasuhiro Hashimoto**

**Mizuki Oka**

Please also come to the talk in the morning session 24th!!!!