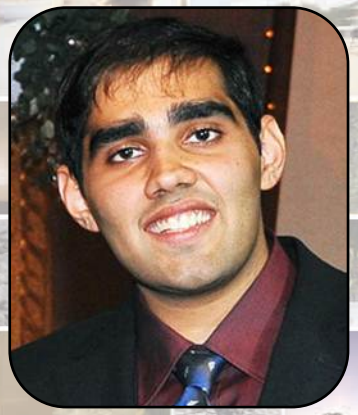
What makes an image popular?

Aditya Khosla



Atish Das Sarma

Raffay Hamid

Can we predict what will become popular?

Why does it matter?

content distribution

Why does it matter?

‘selfie selection’

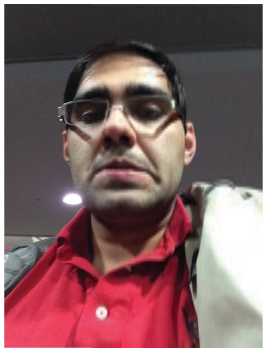
Why does it matter?

advertising

Why does it matter?

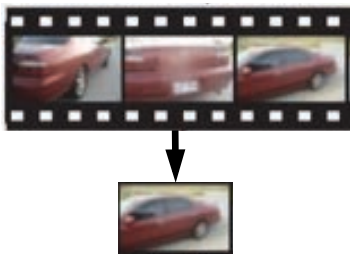
content distribution

‘selfie selection’



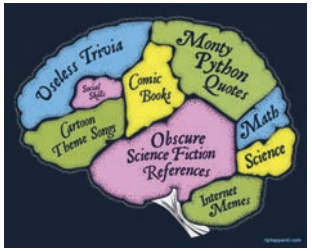
advertising

video summarization



modifying popularity

understanding user behavior



Related work

- Social networks
  - Gladwell, 2002
  - Rogers, 2003
  - Romero et al, 2011
- Video popularity
  - Pinto et al, 2013
  - Shamma et al, 2011
  - Nwana et al, 2013
- High-level attributes
  - Dhar et al, 2011
  - Isola et al, 2011
  - Patterson et al, 2012
  - Khosla et al, 2013
- Text popularity
  - Petrovic et al, 2011
  - Hong et al, 2011

Overview

- What is image popularity?
- Predict popularity using image content?
- How does this compare to social factors?
- What makes an image popular?
- Conclusions and future work

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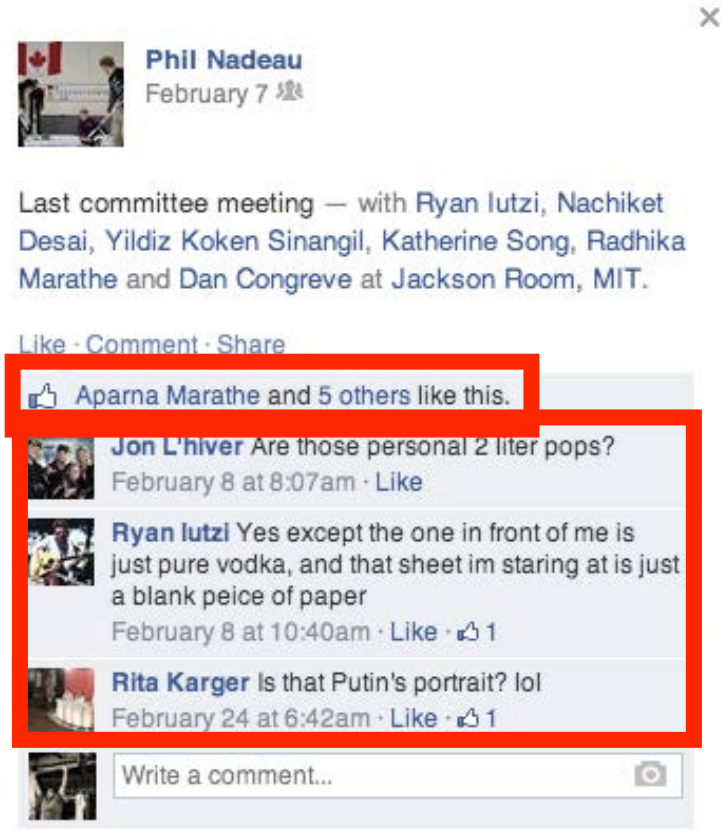
What is image popularity?

Instagram

What is image popularity?



facebook

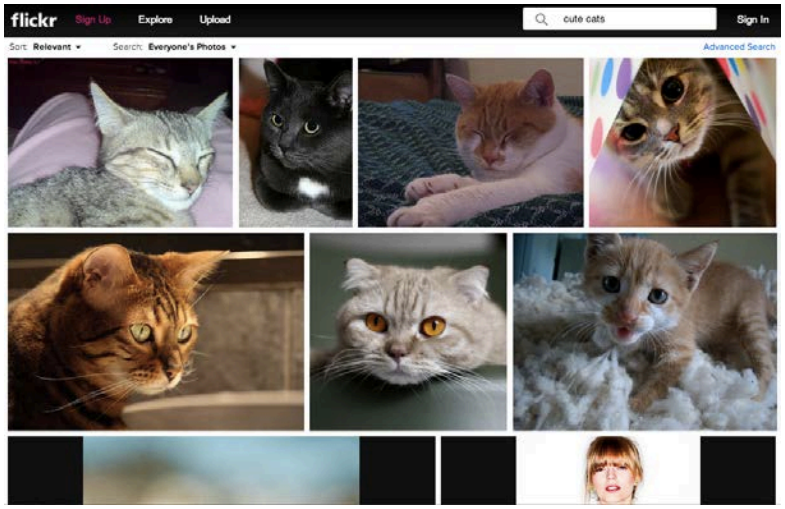
What is image popularity?

What is image popularity?

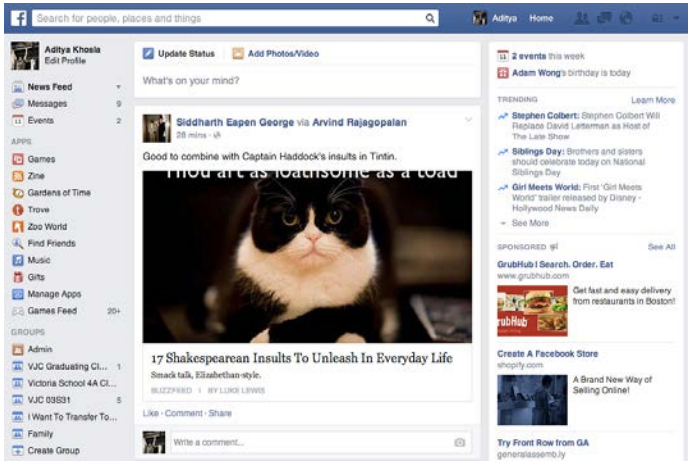
flickr

What is image popularity?

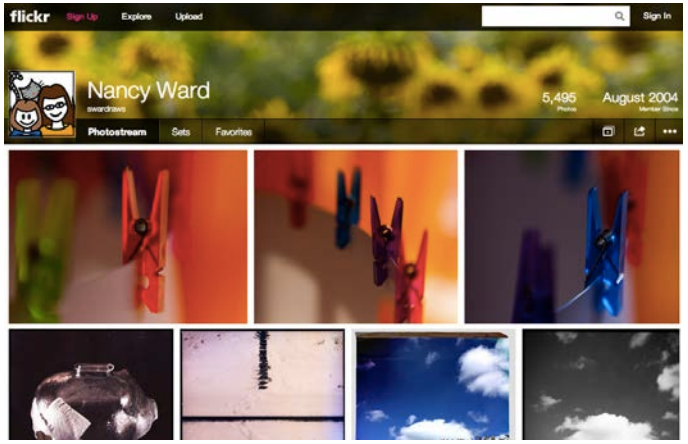
- Context dependent



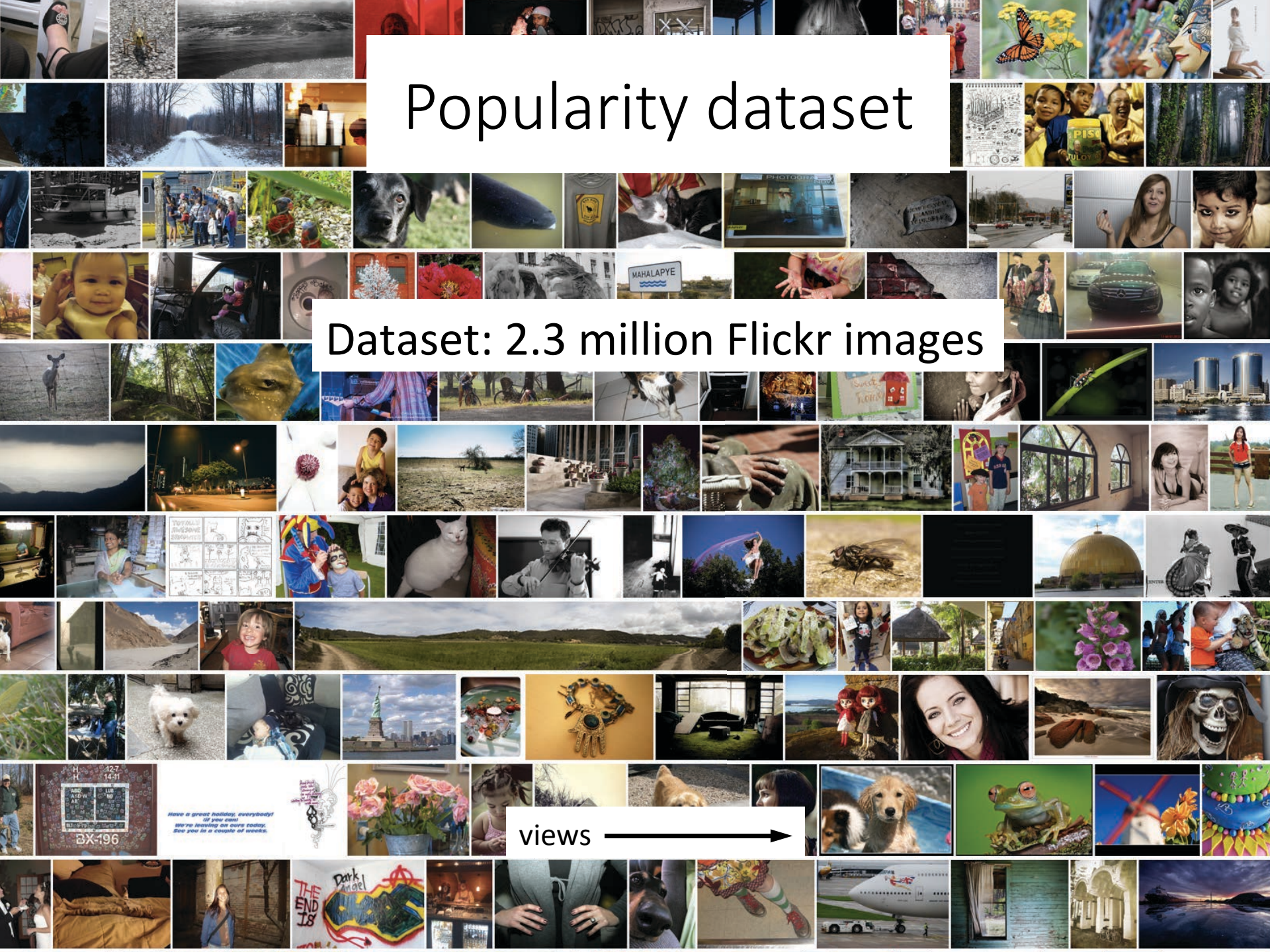
Flickr search results



Facebook newsfeed



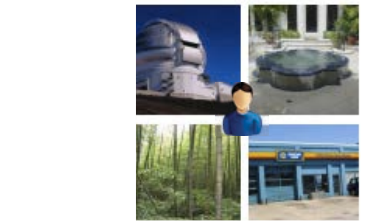
Flickr user


Popularity dataset
Dataset: 2.3 million Flickr images
views

Popularity contexts

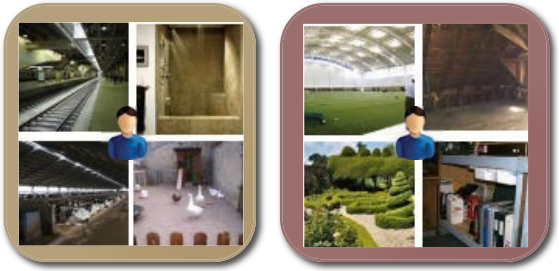
One-per-user

e.g. Flickr search results



User-mix

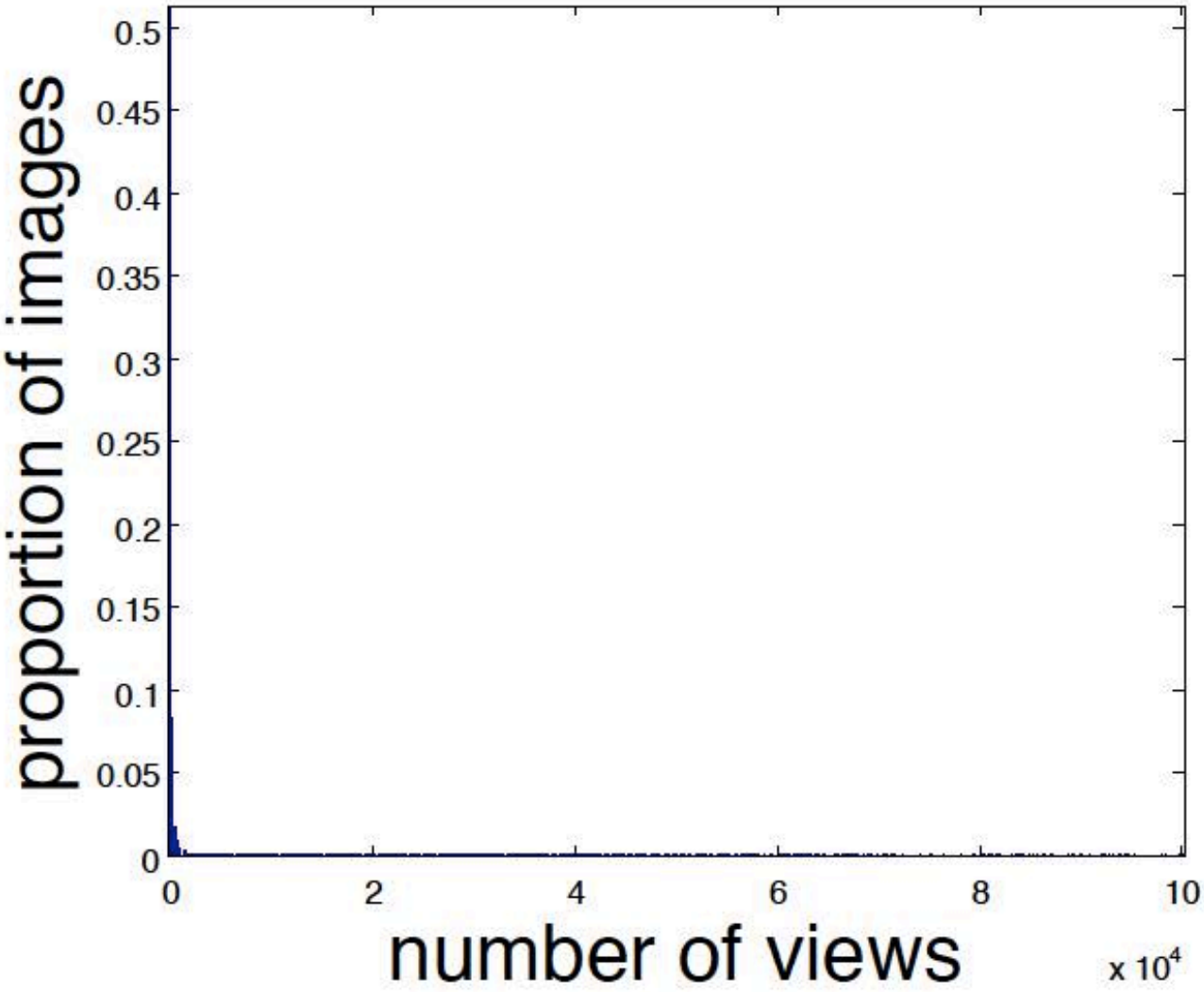
e.g. Facebook newsfeed



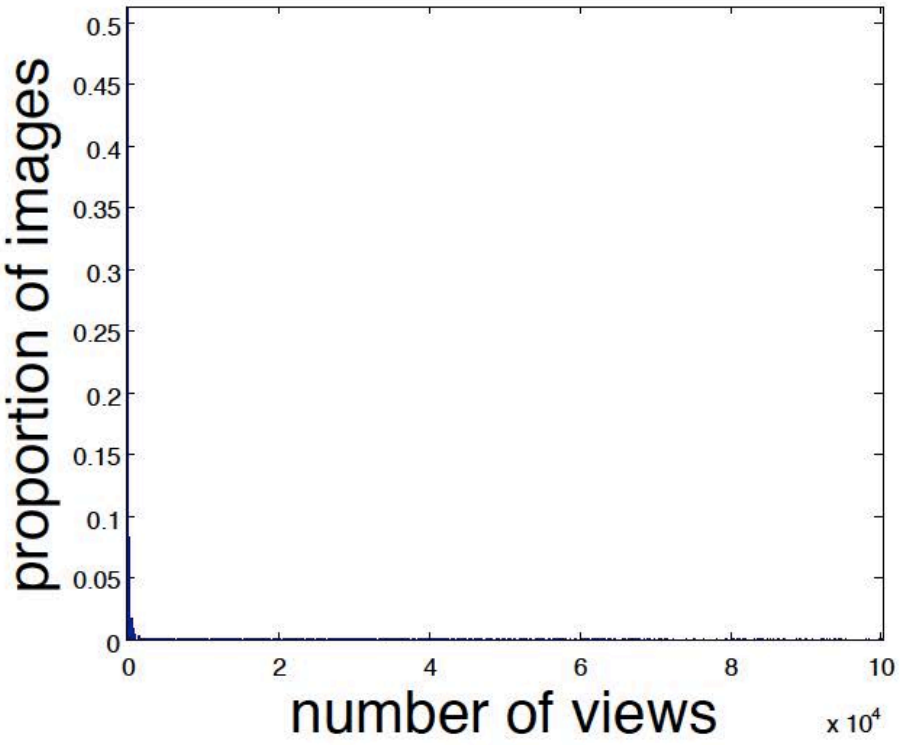
User-Specific

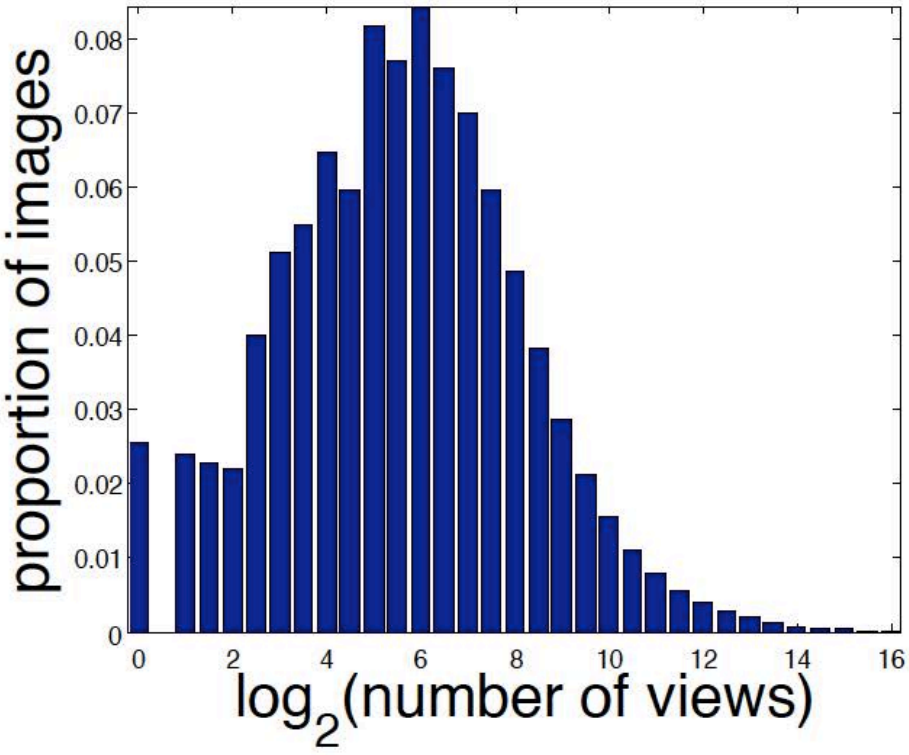
e.g. individual users

Popularity metric

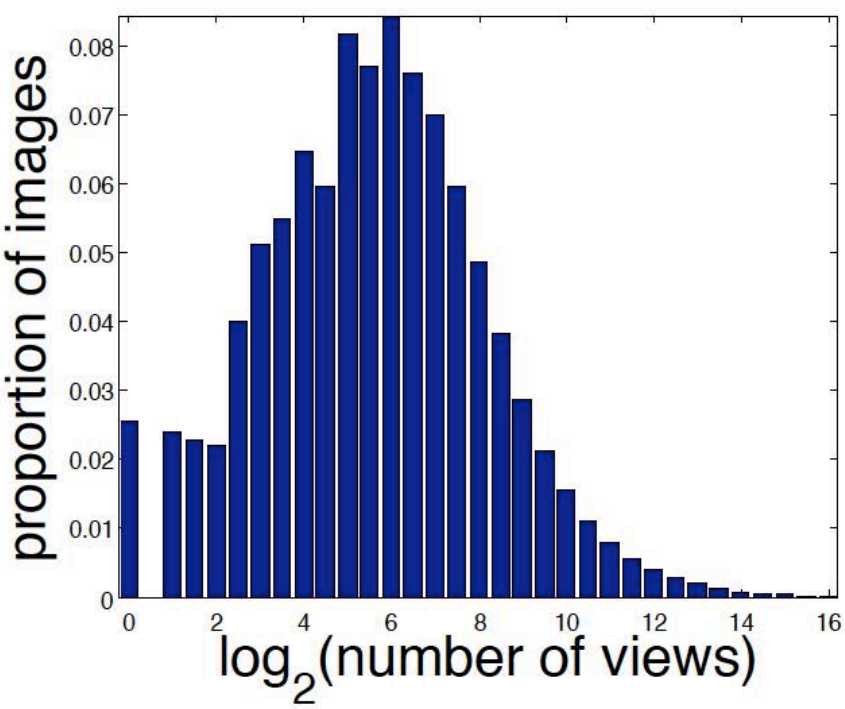


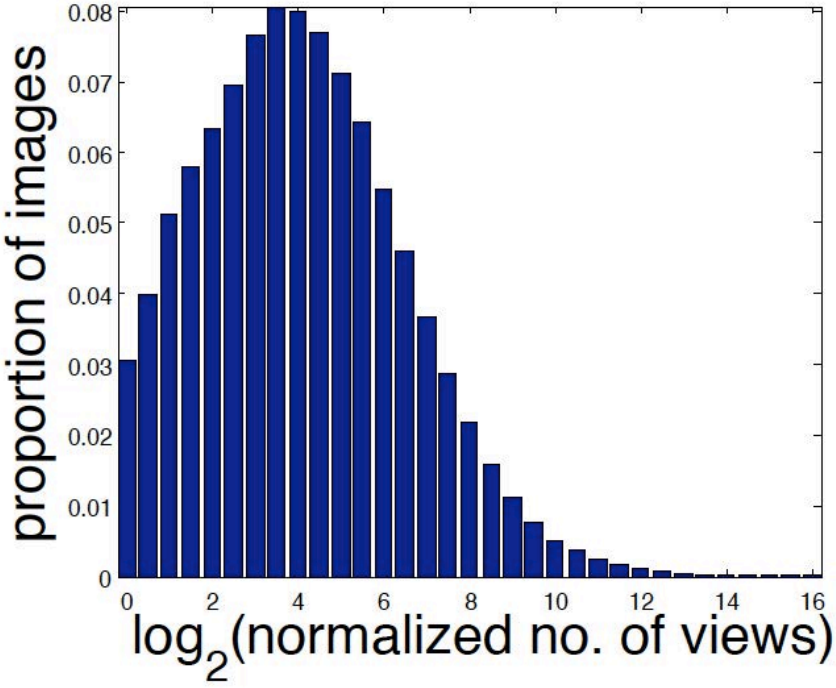
Popularity metric





Popularity metric





Task: predict log normalized views

Measure: rank correlation (ρ)

Szabo and Huberman, 2010

Overview

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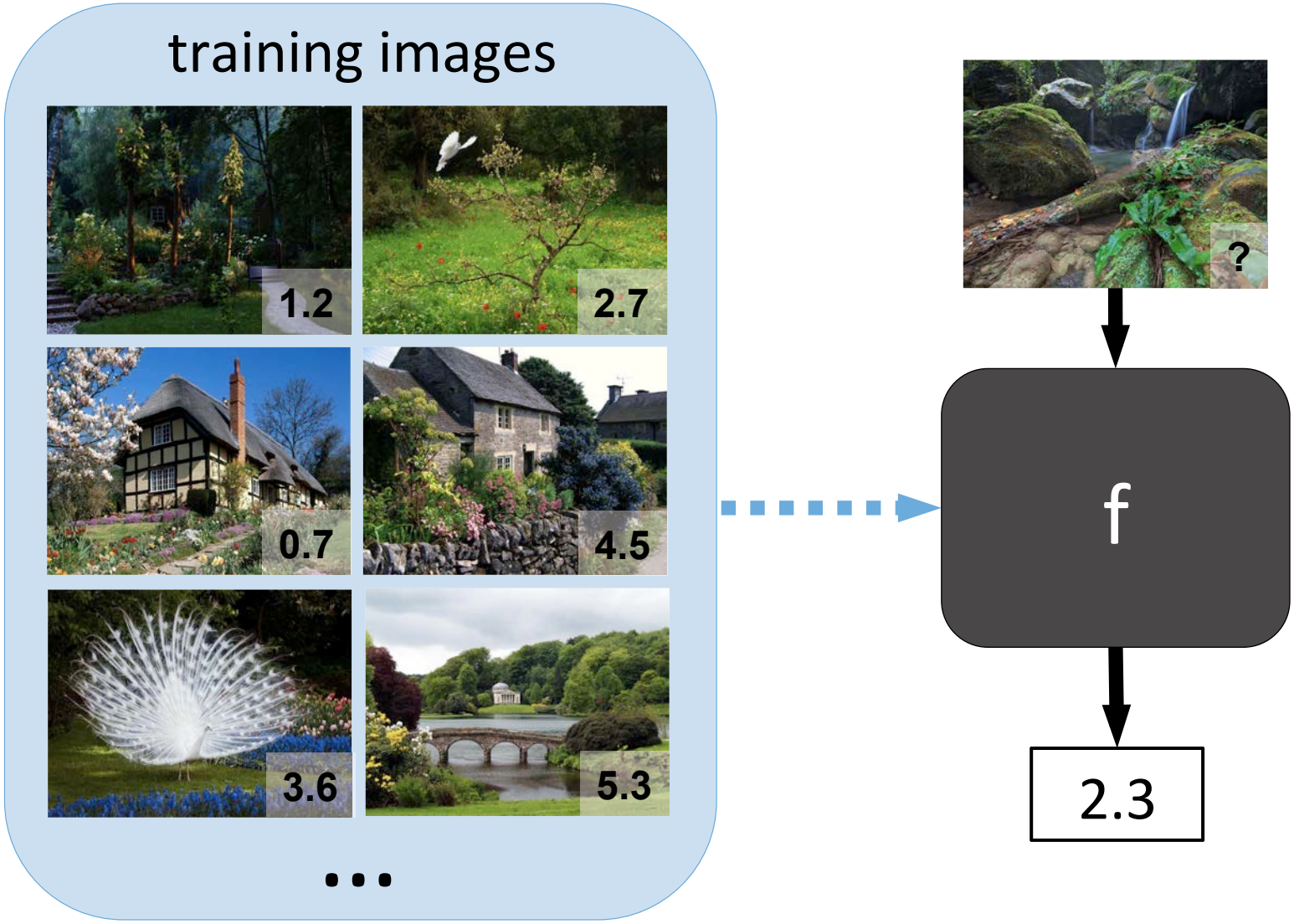
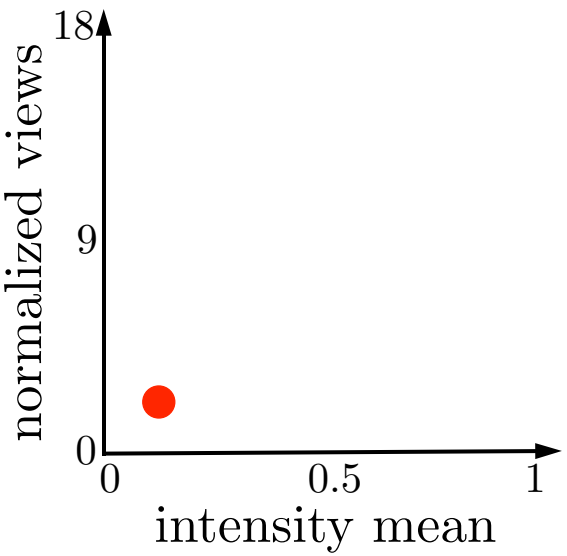
Predicting popularity using image content



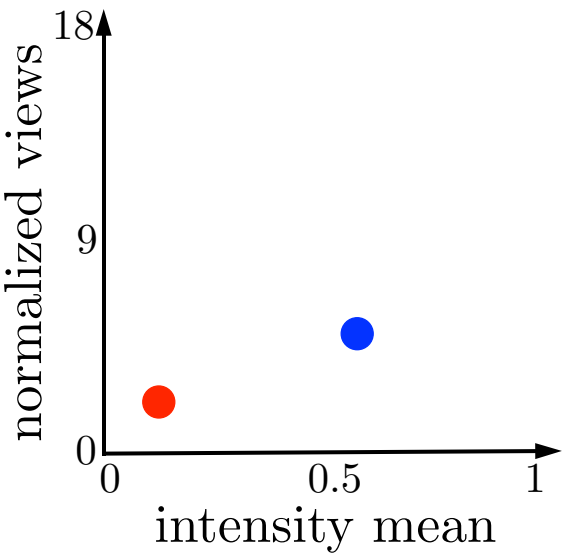
Predicting popularity using image content

- Simple image feature: image intensity



Predicting popularity using image content

- Simple image feature: image intensity



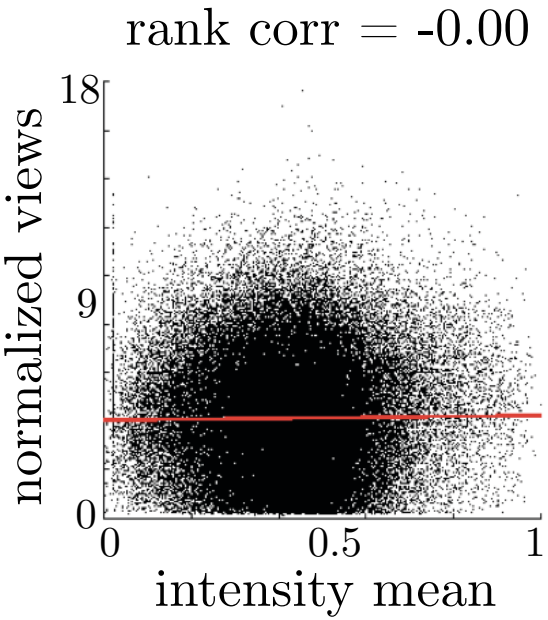
0.13

0.53

...

Predicting popularity using image content

- Simple image feature: image intensity



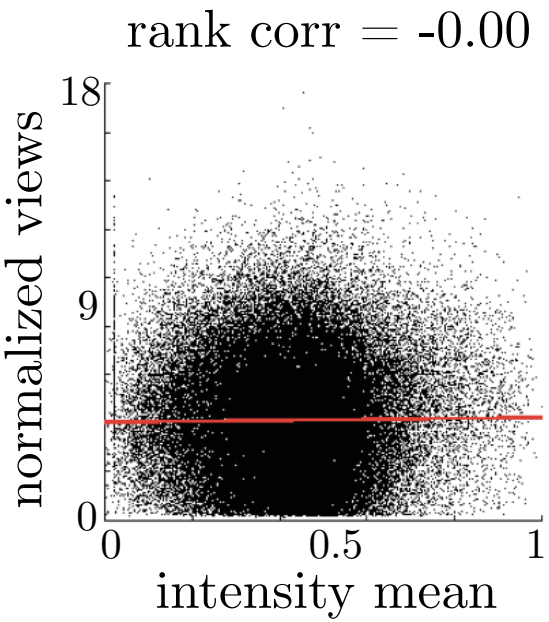
0.13

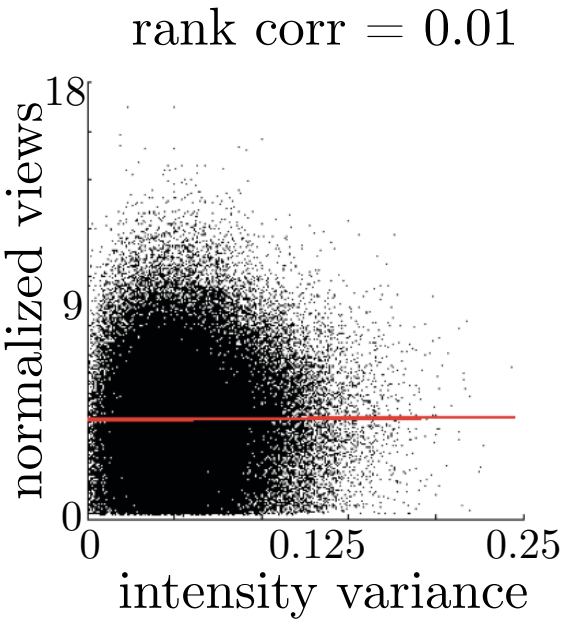
0.53

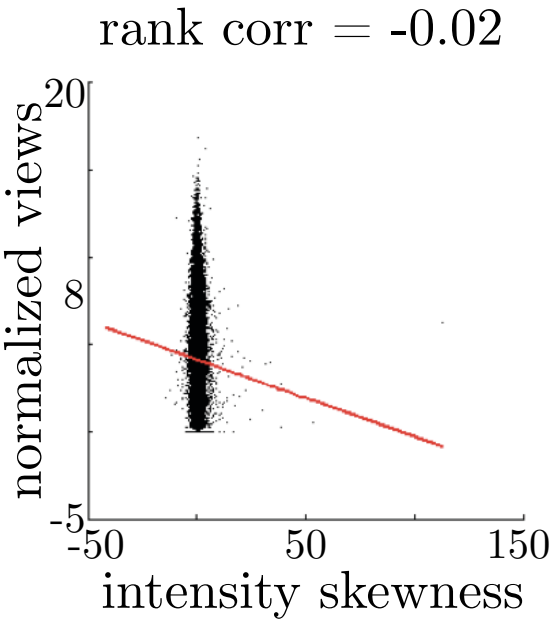
...

Predicting popularity using image content

- Simple image feature: image intensity





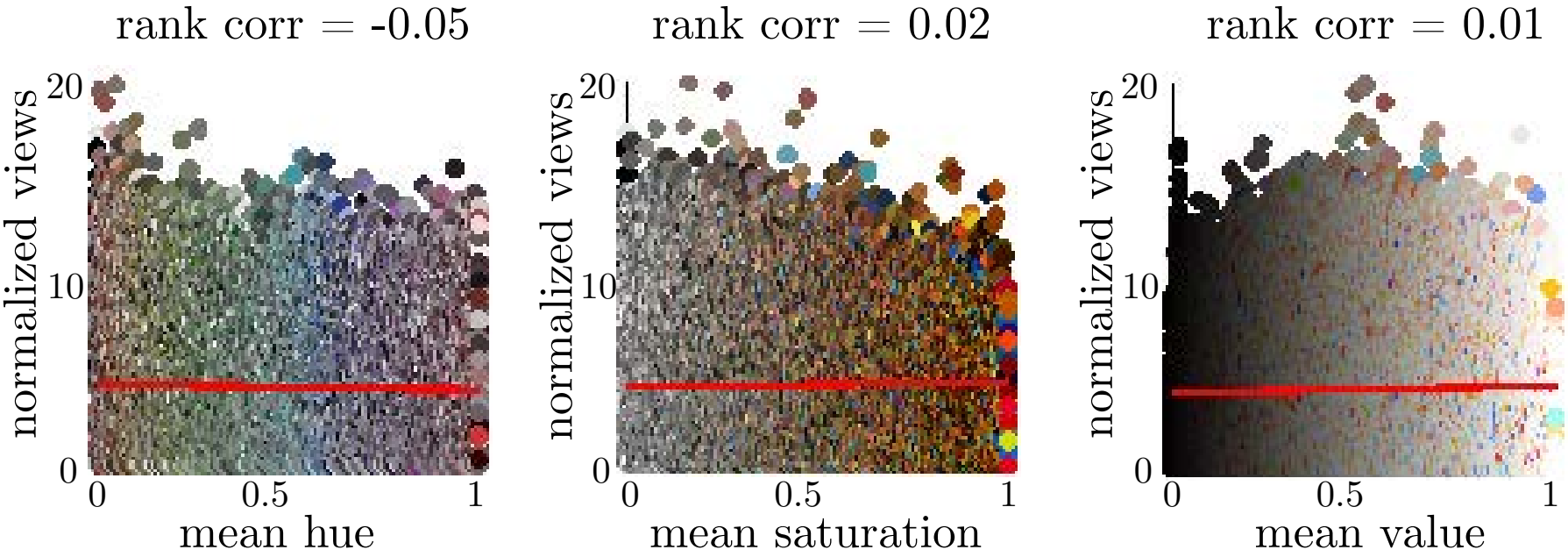


Predicting popularity using image content

- Simple image features: HSV color space

Predicting popularity using image content

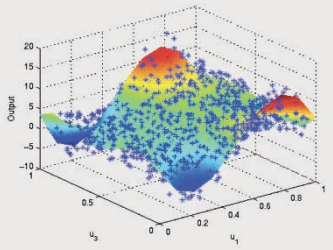
- Simple image features: HSV color space



Predicting popularity using image content

Input Image

Computer vision features



$$\min_{\boldsymbol{w},b,\boldsymbol{\xi},\boldsymbol{\xi}^*} \quad \frac{1}{2}\boldsymbol{w}^T\boldsymbol{w} + C\sum_{i=1}^{l}\xi_i + C\sum_{i=1}^{l}\xi_i^*$$

$$\text{subject to} \quad \boldsymbol{w}^T\phi(\boldsymbol{x}_i) + b - z_i \leq \epsilon + \xi_i,$$

$$z_i - \boldsymbol{w}^T\phi(\boldsymbol{x}_i) - b \leq \epsilon + \xi_i^*,$$

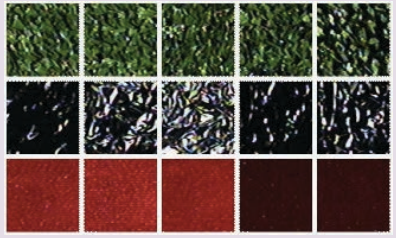
$$\xi_i, \xi_i^* \geq 0, i = 1, \ldots, l.$$

Support Vector Regression

1.9 **Image popularity**

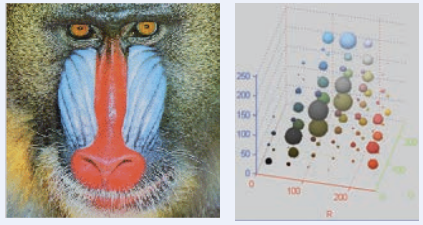
Predicting popularity using image content

Gist
e.g. GIST [Oliva 2001]

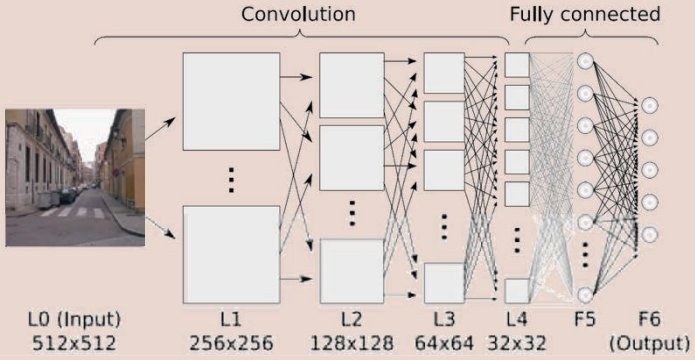


Texture
e.g. LBP [Ojala 2002]

Gradient
e.g. HOG [Dalal 2005]



Color
e.g. [van de Weijer 2009]

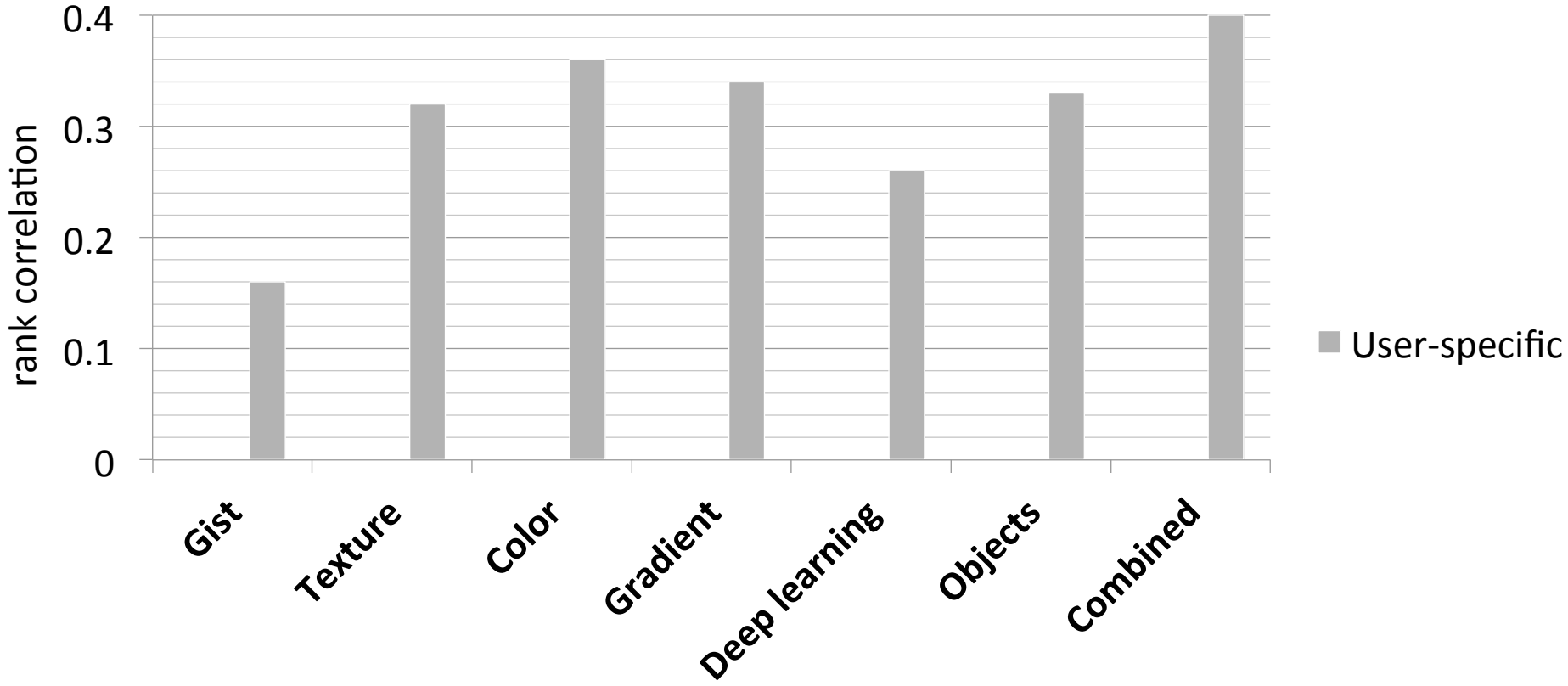


Deep learning
e.g. [Krizhevsky 2012]

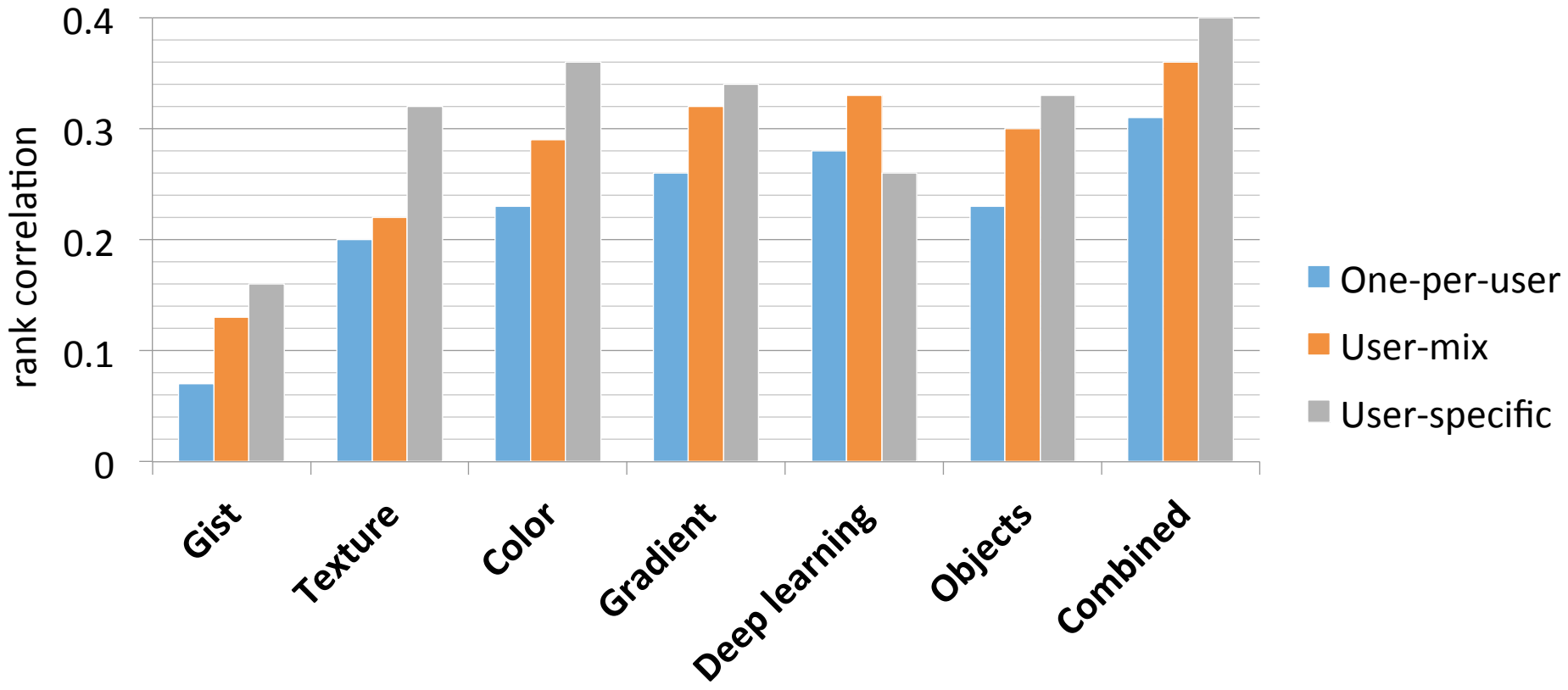
airplane	remote	…
bicycle	car	person
bird	stove	sheep
boat	table	train
bottle	apple	television
orange	cart	dog
bench	ray	fox

1000 Objects
e.g. [Krizhevsky 2012]

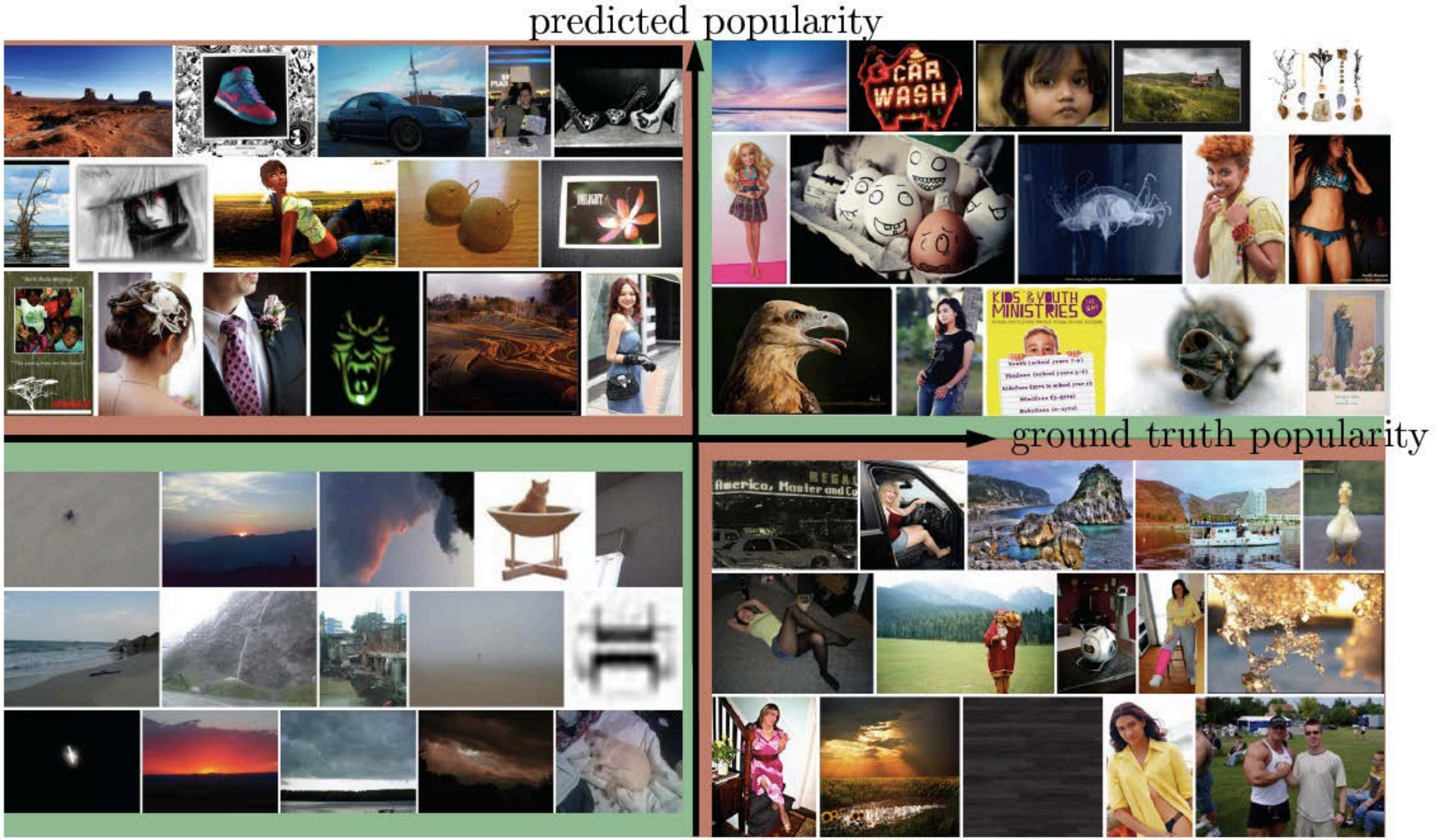
Predicting popularity using image content



Predicting popularity using image content



Predicting popularity using image content



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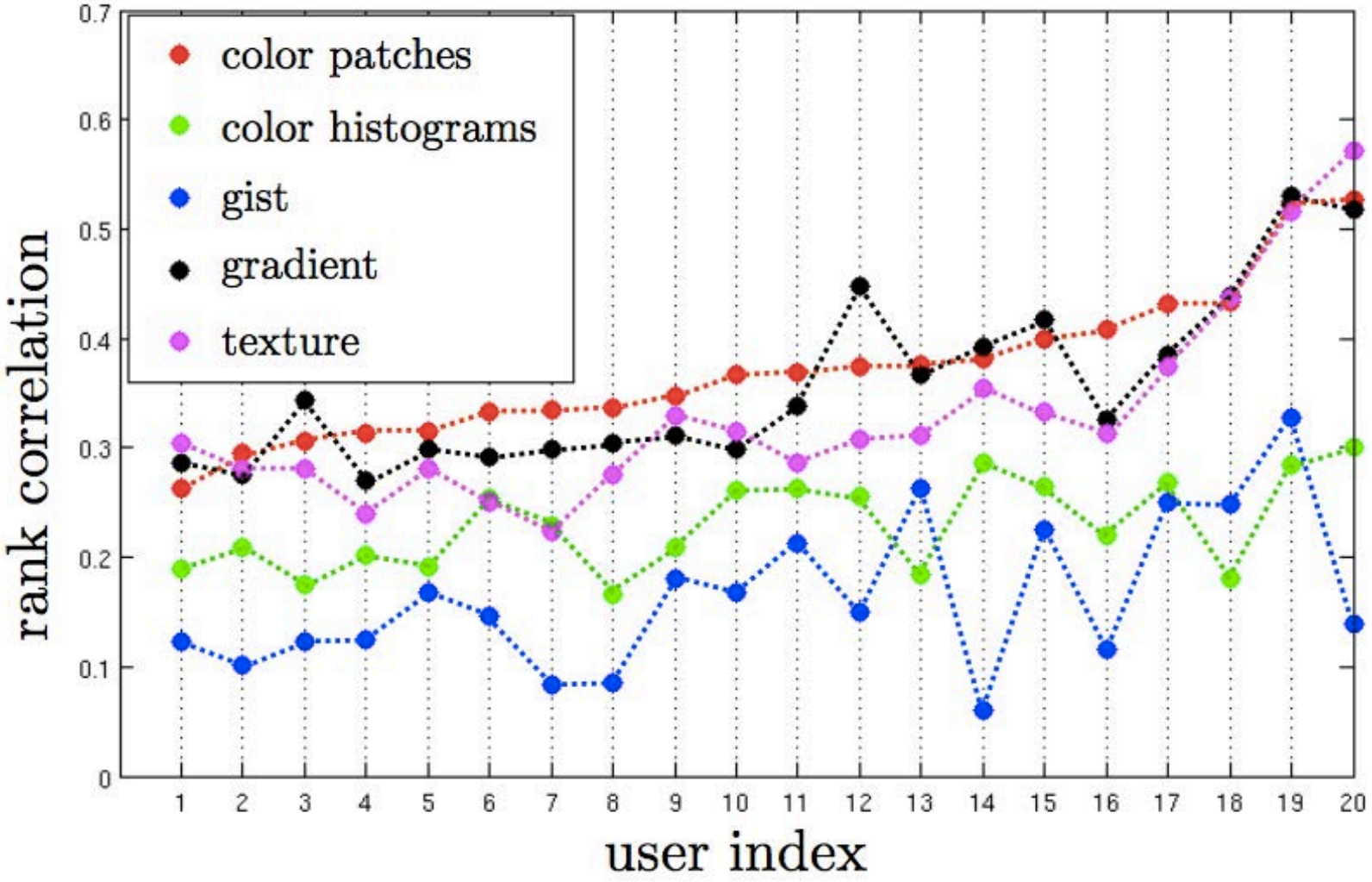

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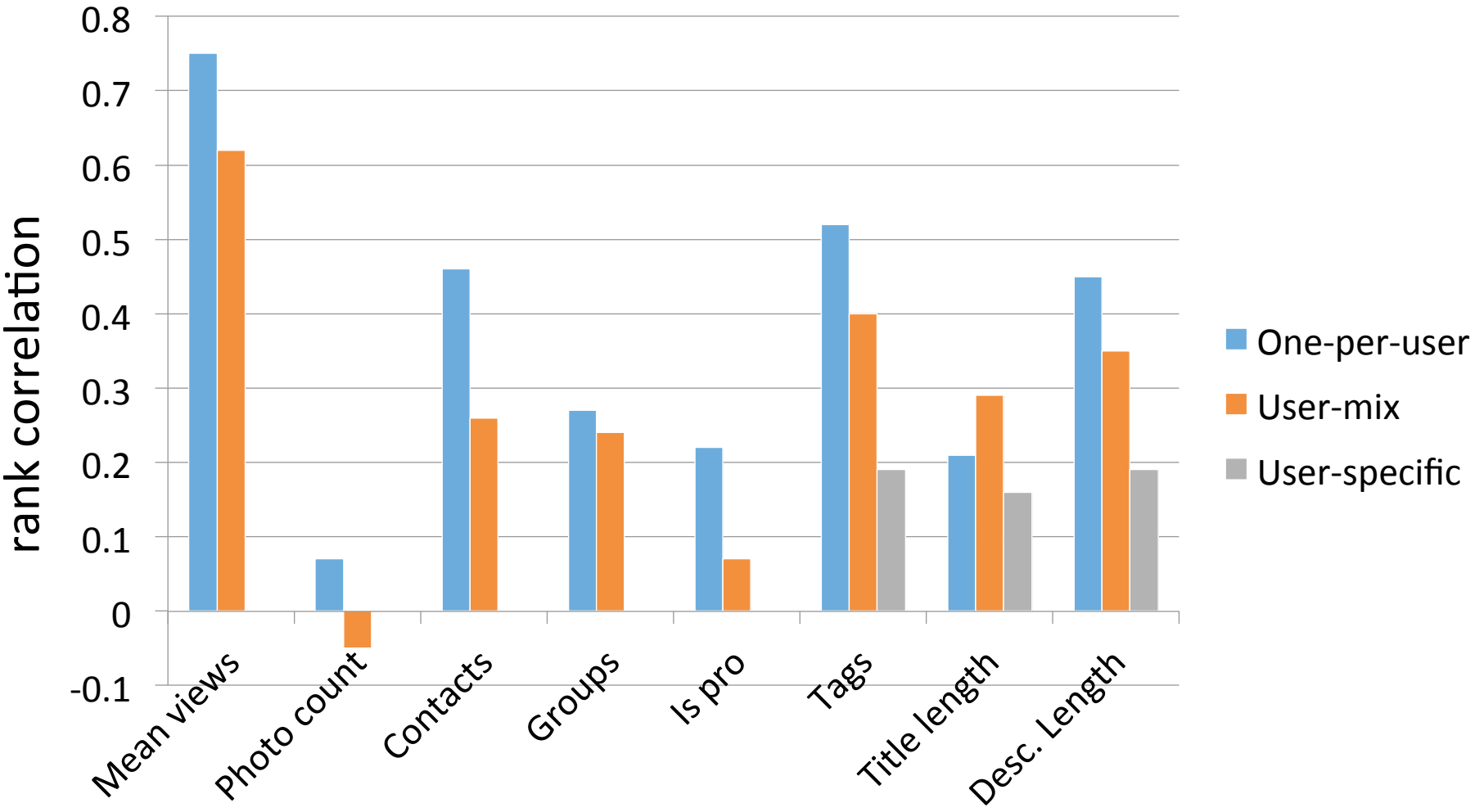
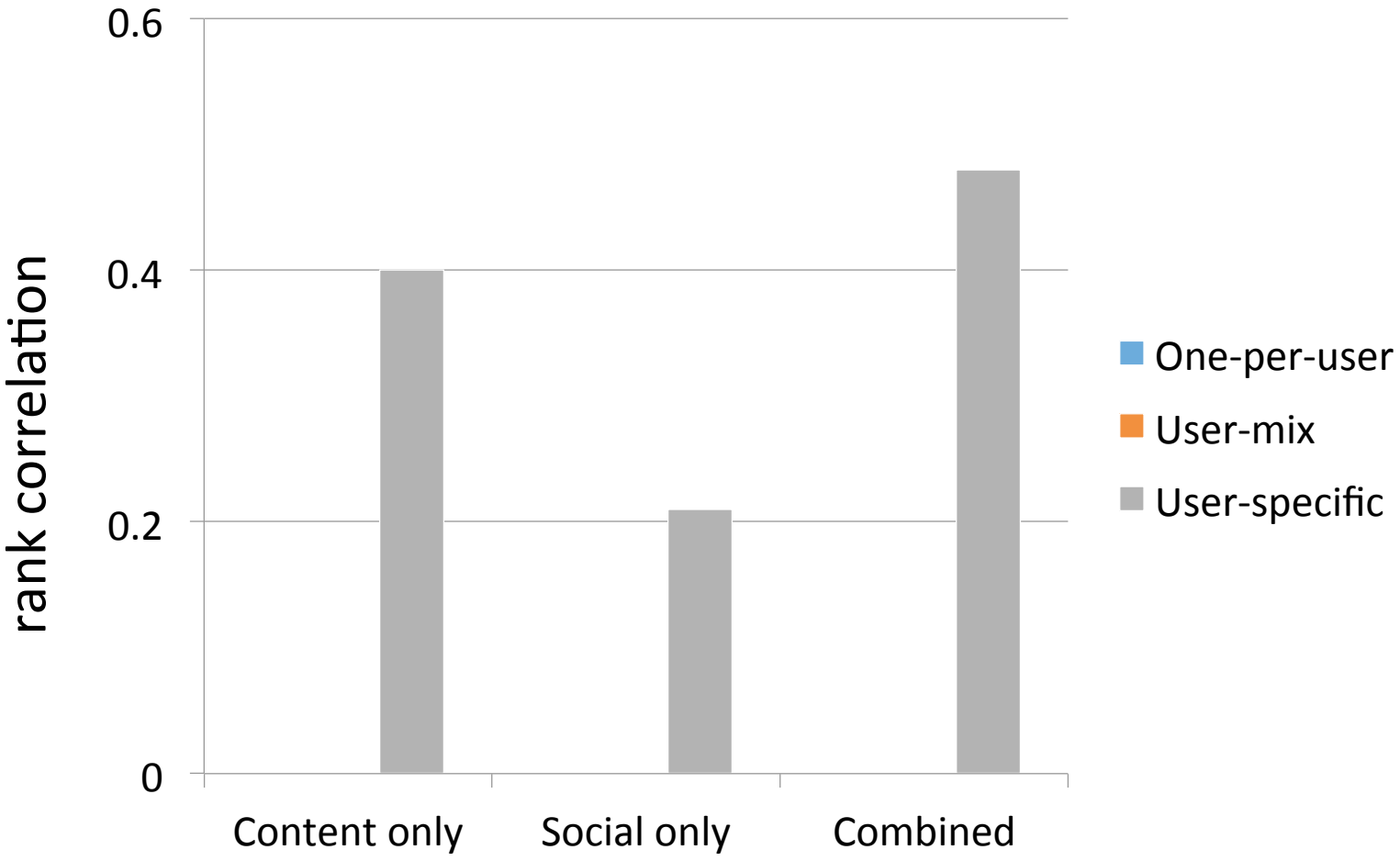
Predicting popularity using social cues

- User information
  - Mean views
  - Photo count
  - Contacts
  - Groups
  - Group members
  - Member duration
  - Is pro
- Image information
  - Tags
  - Title length
  - Description length

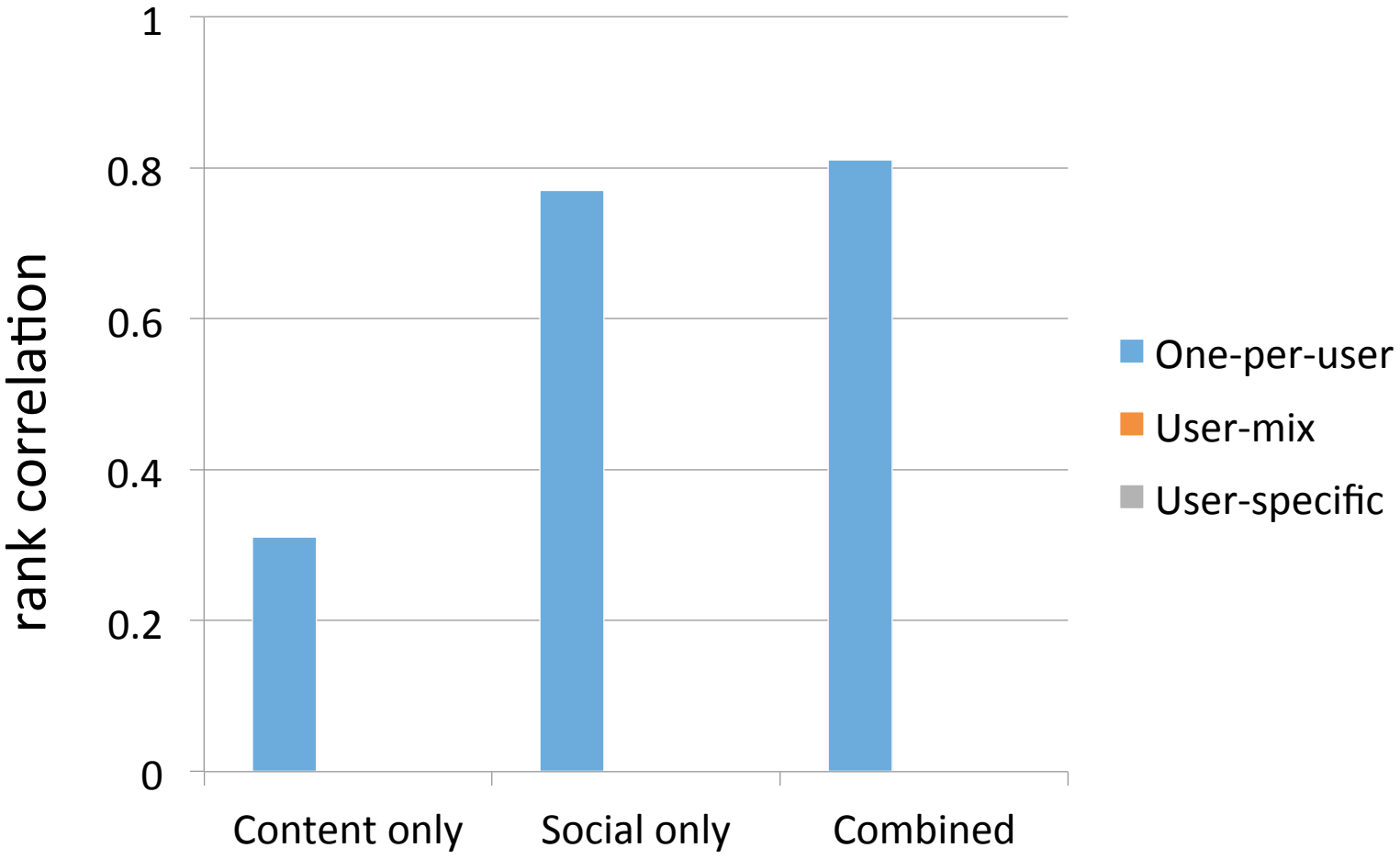
Predicting popularity using social cues



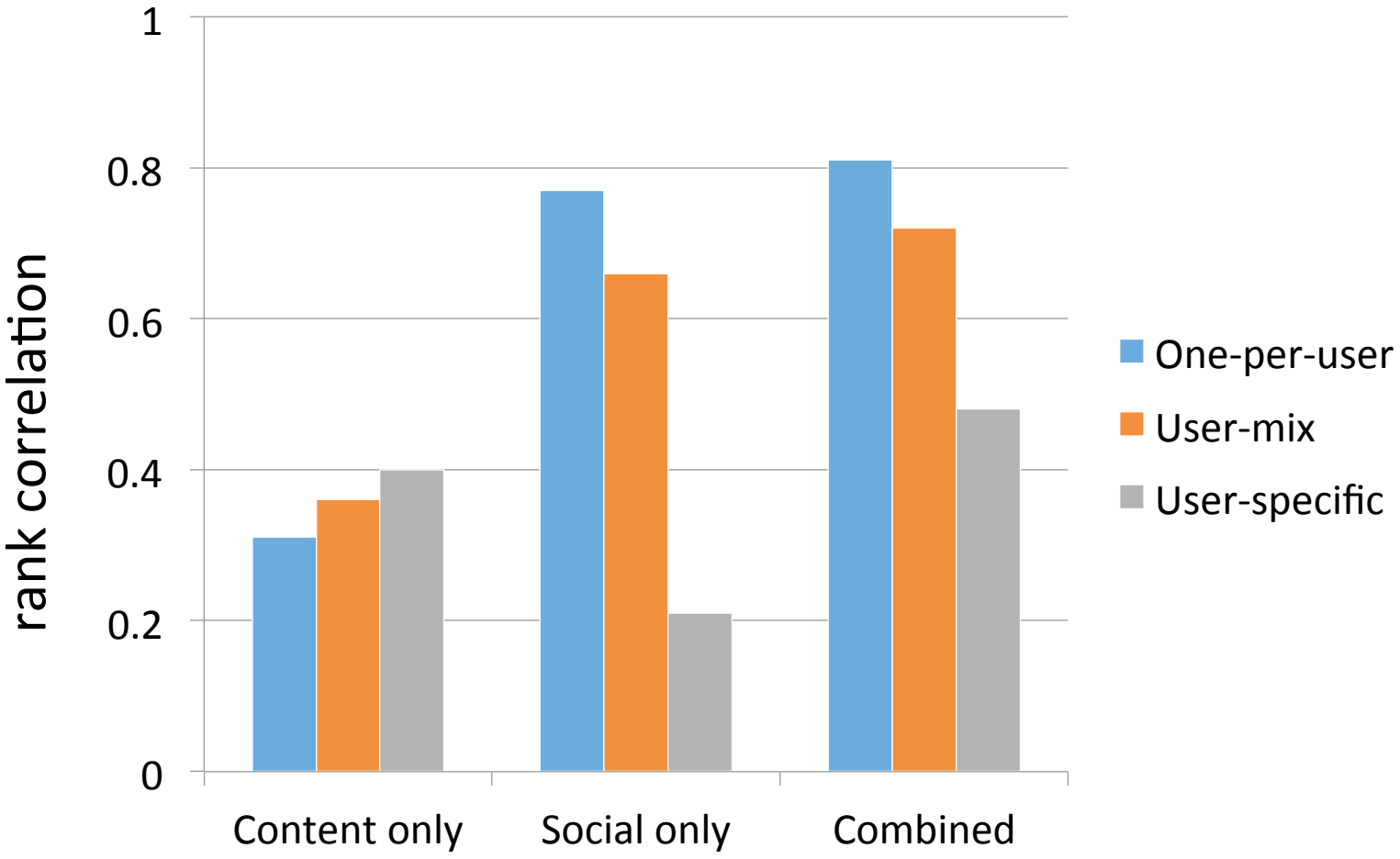
Predicting popularity using image + social cues



Predicting popularity using image + social cues



Predicting popularity using image + social cues



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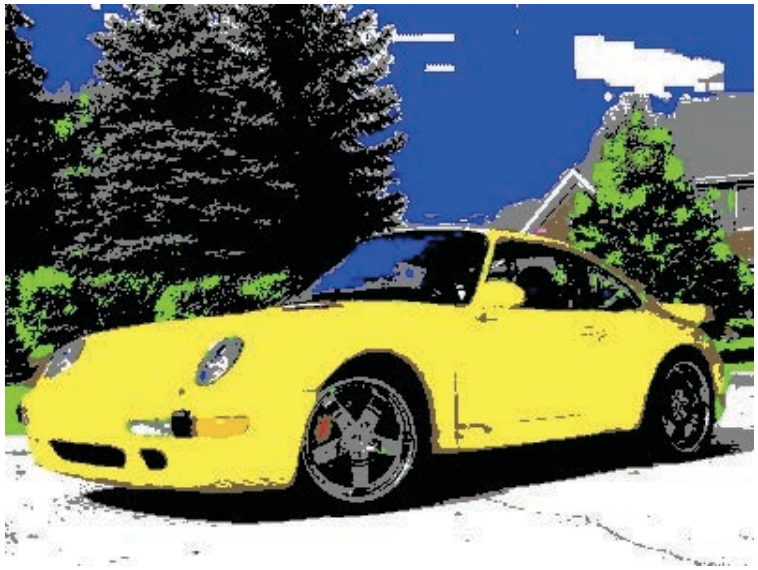
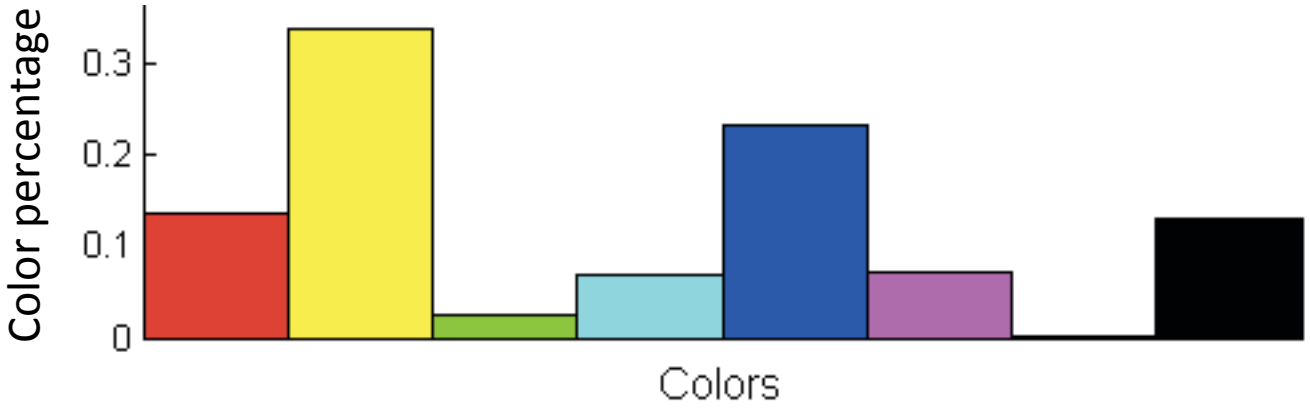
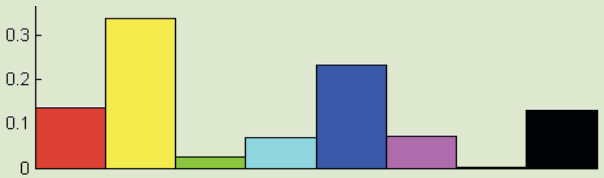




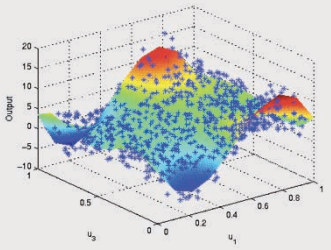
van de Weijer et al, CVPR 2007

What makes an image popular?

Input Image



Color histogram



$$\min_{\boldsymbol{w},b,\boldsymbol{\xi},\boldsymbol{\xi}^*} \quad \frac{1}{2}\boldsymbol{w}^T\boldsymbol{w} + C\sum_{i=1}^{l}\xi_i + C\sum_{i=1}^{l}\xi_i^*$$

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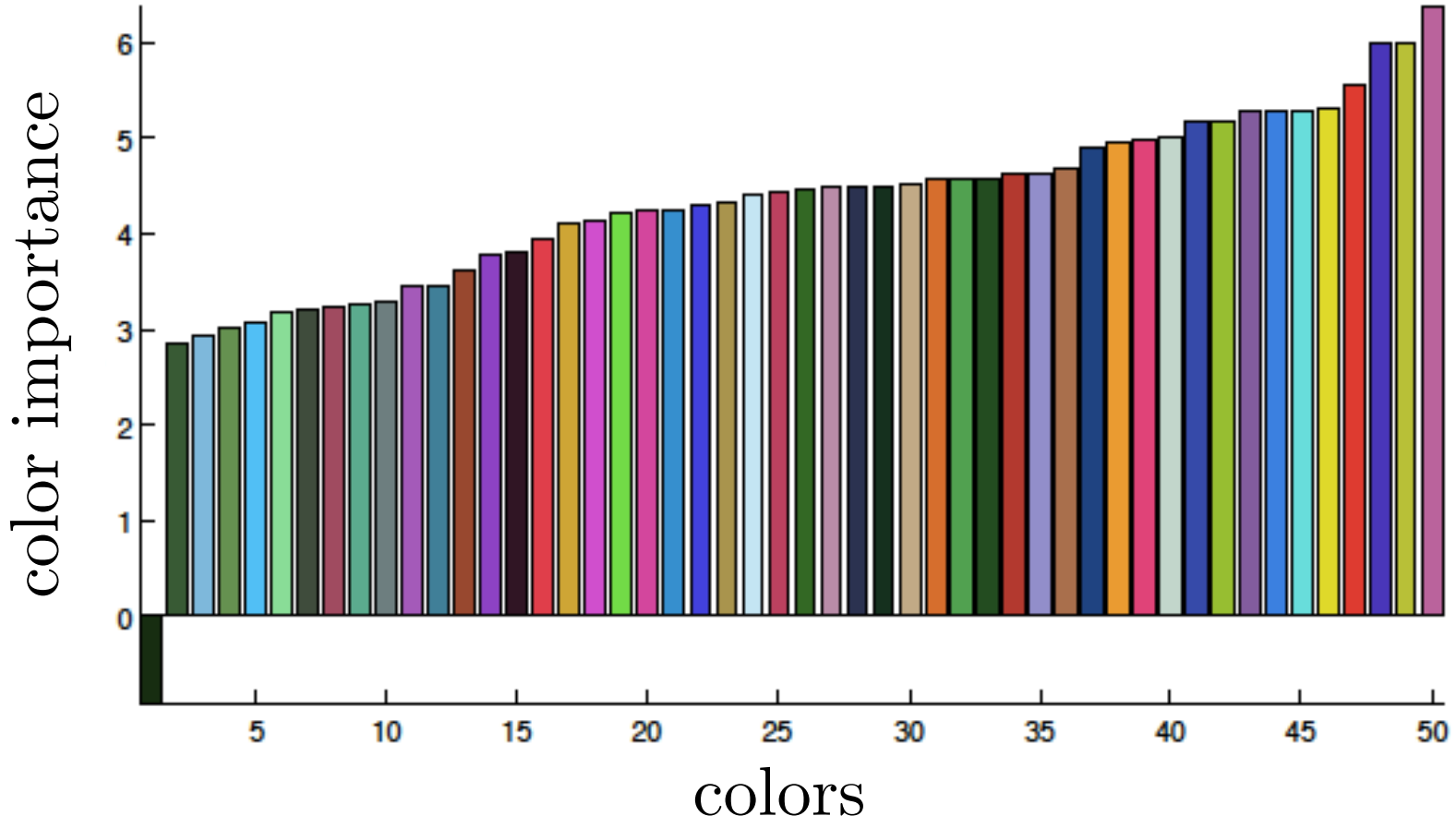
Support Vector Regression

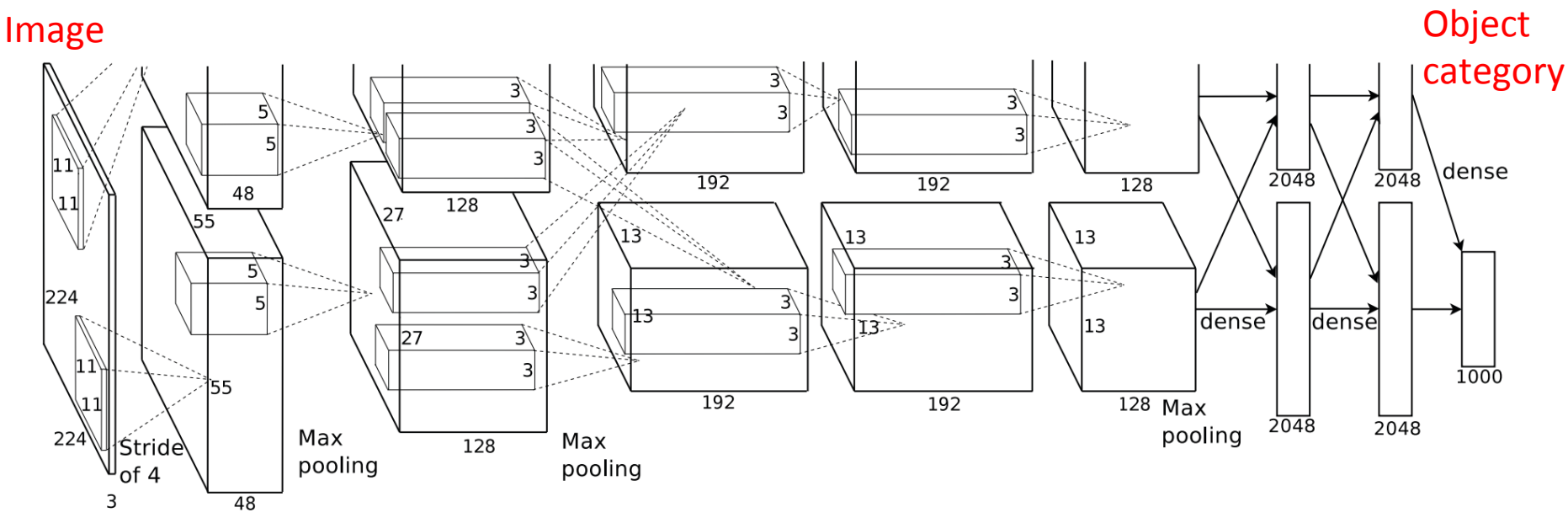
1.9 **Image popularity**

What makes an image popular?



What makes an image popular?

- Predicting object categories



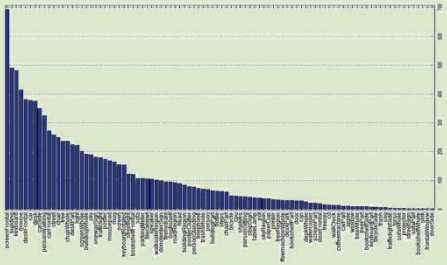
Krizhevsky et al, NIPS 2012

What makes an image popular?

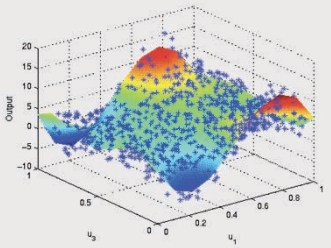
- tench, Tinca tinca
- goldfish, Carassius auratus
- great white shark
- tiger shark, Galeocerdo cuvieri
- hammerhead, hammerhead shark
- electric ray, crampfish, numbfish, torpedo
- stingray
- cock
- hen
- ostrich, Struthio camelus
- brambling, Fringilla montifringilla
- goldfinch, Carduelis carduelis
- house finch, linnet, Carpodacus mexicanus
- junco, snowbird
- indigo bunting
- robin, American robin
- bulbul
- jay
- magpie
- chickadee
- water ouzel, dipper
- kite
- bald eagle, American eagle, Haliaeetus leucocephalus
- vulture
- great grey owl, great gray owl, Strix nebulosa
- European fire salamander, Salamandra salamandra
- common newt, Triturus vulgaris
- eft
- spotted salamander, Ambystoma maculatum
- axolotl, mud puppy, Ambystoma mexicanum
- bullfrog, Rana catesbeiana
- tree frog, tree-frog
- tailed frog, bell toad, ribbed toad, tailed toad, Ascaphus trui
- loggerhead, loggerhead turtle, Caretta caretta

What makes an image popular?

Input Image



Object likelihood



$$\min_{\boldsymbol{w},b,\boldsymbol{\xi},\boldsymbol{\xi}^*} \quad \frac{1}{2}\boldsymbol{w}^T\boldsymbol{w} + C\sum_{i=1}^{l}\xi_i + C\sum_{i=1}^{l}\xi_i^*$$

$$\text{subject to} \quad \boldsymbol{w}^T\phi(\boldsymbol{x}_i) + b - z_i \leq \epsilon + \xi_i,$$

$$z_i - \boldsymbol{w}^T\phi(\boldsymbol{x}_i) - b \leq \epsilon + \xi_i^*,$$

$$\xi_i, \xi_i^* \geq 0, i = 1, \ldots, l.$$

Support Vector Regression

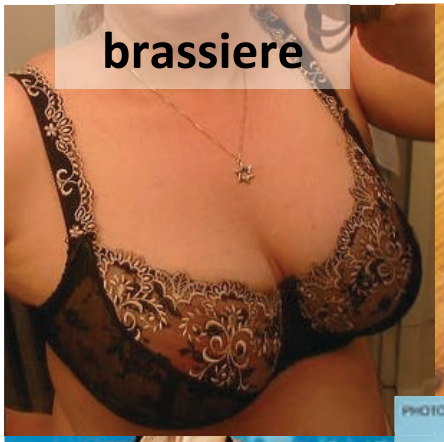
1.9 **Image popularity**

What makes an image popular?

Medium positive impact

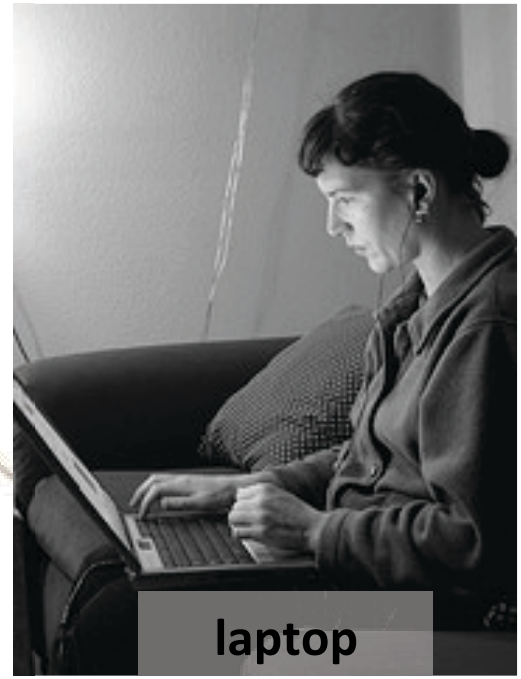
What makes an image popular?

Strong positive impact



What makes an image popular?

Negative impact



What makes an image popular?

Strong positive

- miniskirt
- maillot
- bikini
- cup
- brassiere
- revolver

Medium positive

- cheetah
- giant panda
- basketball
- llama
- plow
- ladybug

Negative

- spatula
- plunger
- laptop
- golfcart
- space heater

Overview

- What is image popularity?
- Predict popularity using image content?
- How does this compare to social factors?
- What makes an image popular?
- Conclusions and future work

Conclusion

- Image popularity can be predicted to a reasonable extent using content alone!
- Both image content and social cues are important for popularity prediction
- Content/social cues help to a different degree in different contexts
- We identify some factors that make an image popular

Future work

- Predicting other notions of popularity
  e.g. shareability, likeability, comments
- Temporal evolution of popularity
- Effect of high-level attributes such as emotions
- Automatically modifying image popularity

http://popularity.csail.mit.edu

Popularity Demo

How likely is your image to become popular? Upload it to find out!

Upload: Choose File No file chosen Run

or

URL: http://popularity.csail.mit.edu/demo Run

or

Click One:

Popularity API

Usage: http://popularity.csail.mit.edu/cgi-bin/image.py?url=IMG_URL

Example: http://popularity.csail.mit.edu/cgi-bin/image.py?url=http://popularity.csail.mit.edu/demo/1.jpg

Notice: Please do not overload our server by querying repeatedly in a short period of time. This is a free service for academic research and education purposes only. It has no guarantee of any kind. For any questions or comments regarding this API, please contact Aditya Khosla.

Thank you!