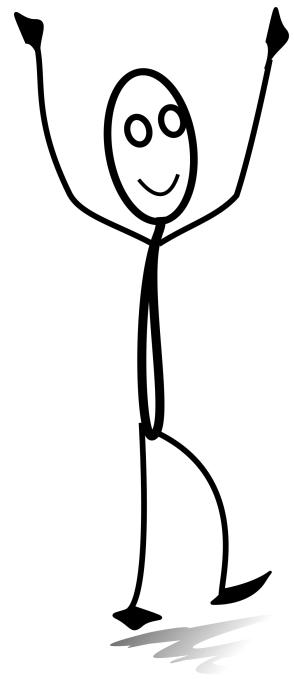
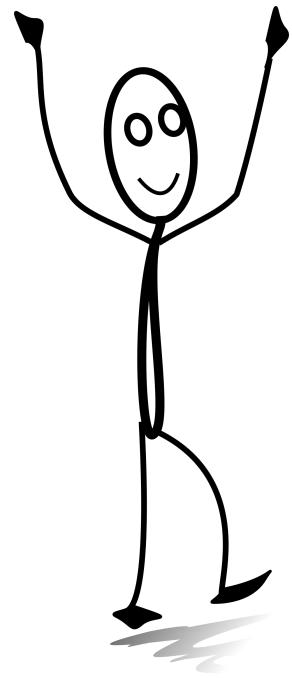


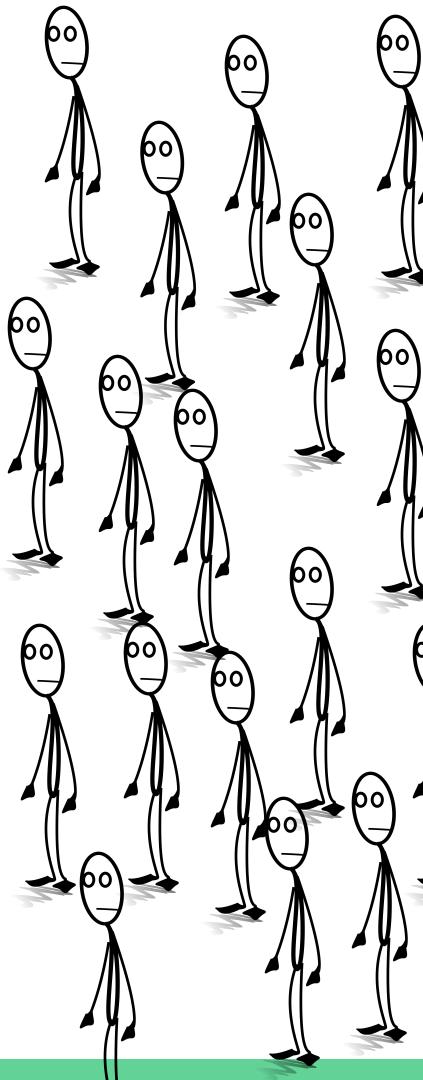
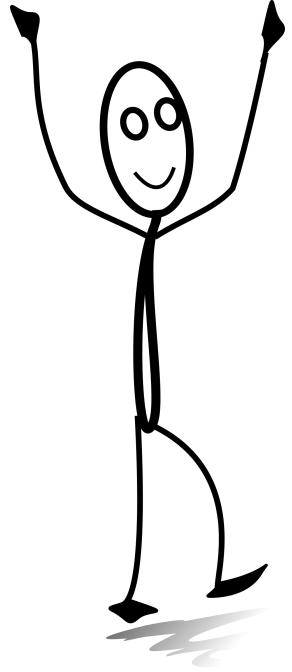
Cats and Captions vs. Creators and the Clock: *Comparing Multimodal Content to Context in Predicting Relative Popularity*

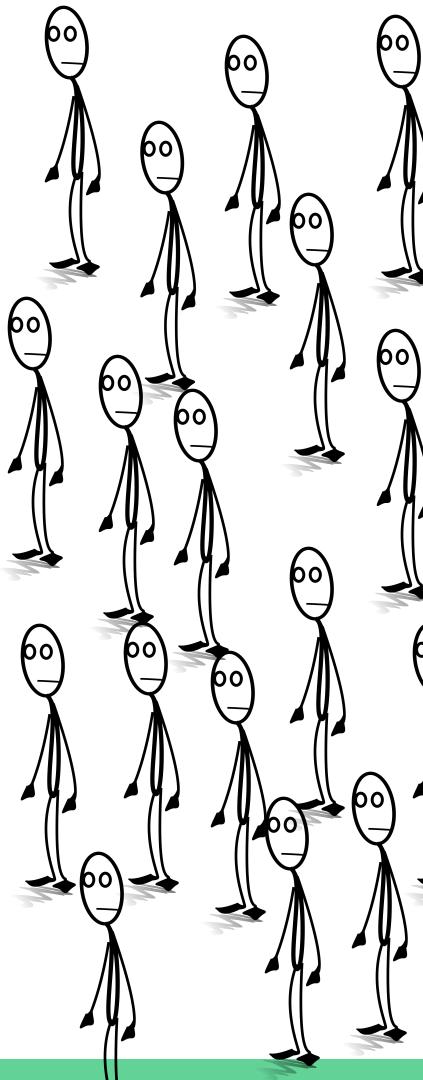
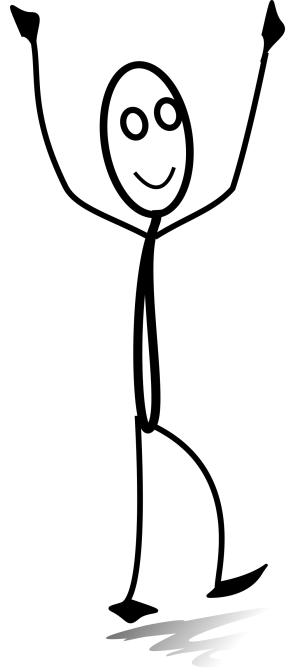


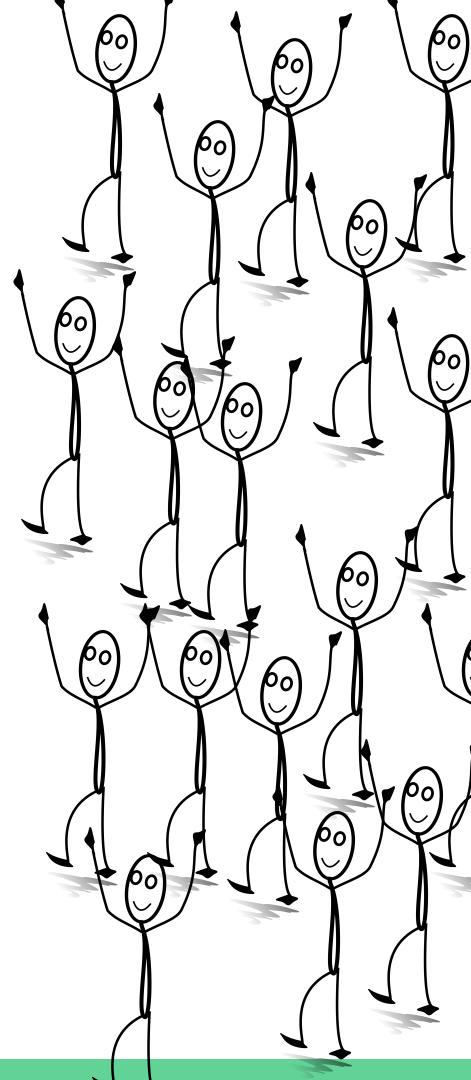
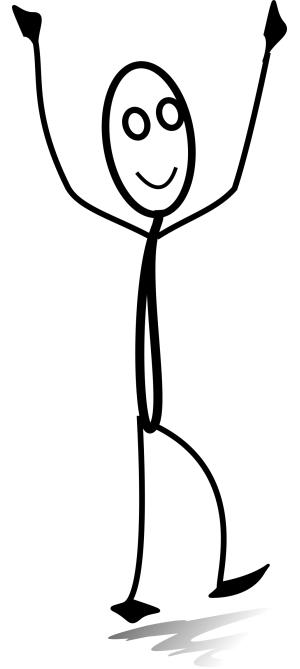
Jack Hessel, Lillian Lee, David Mimno
Cornell University

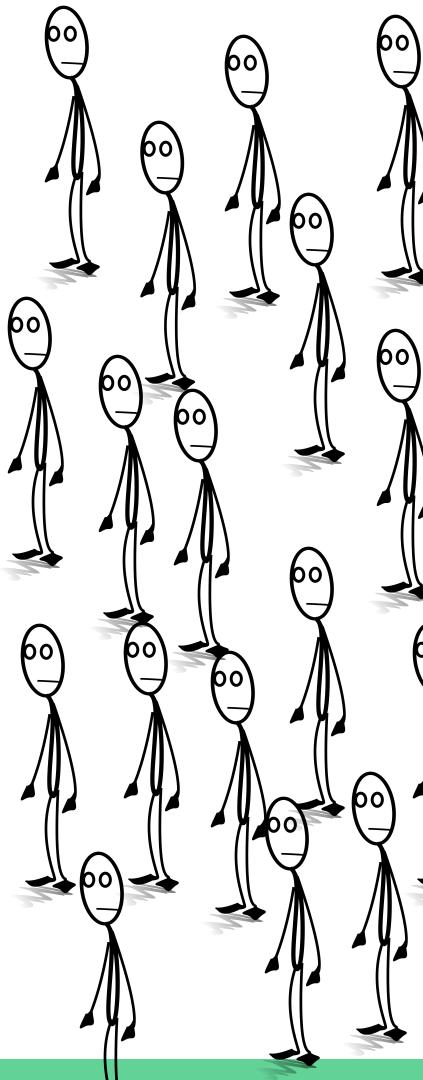


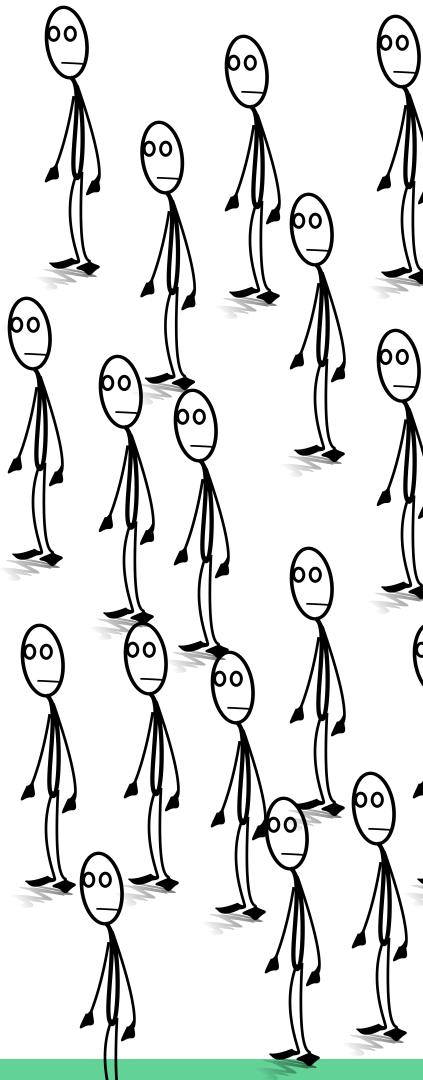
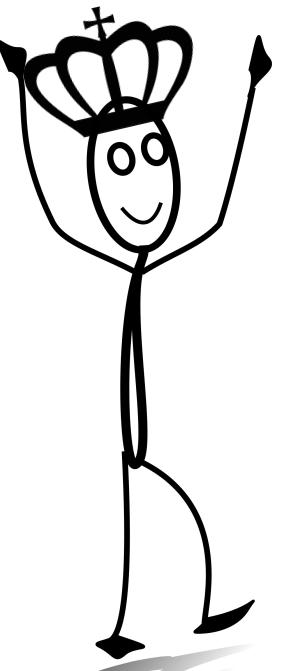


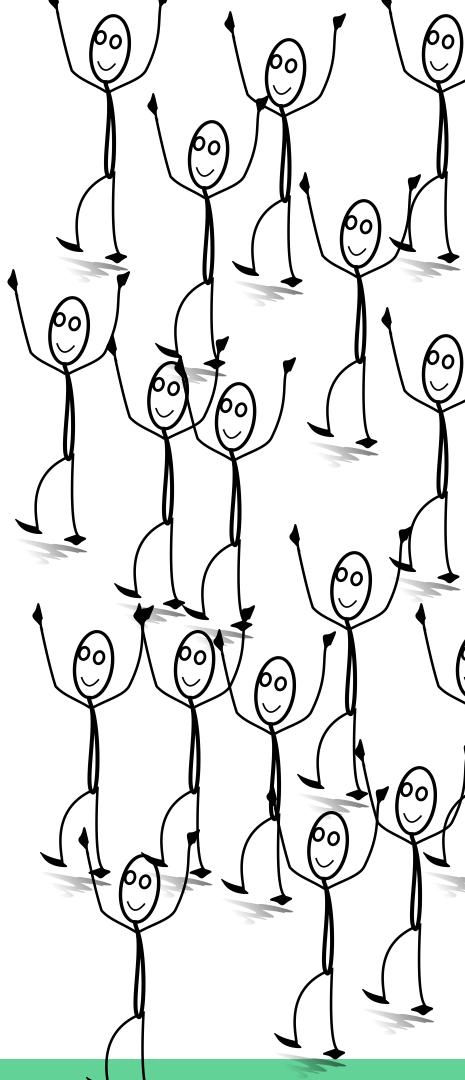
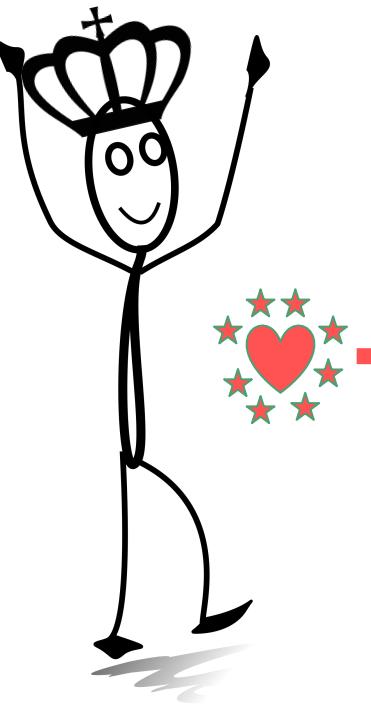


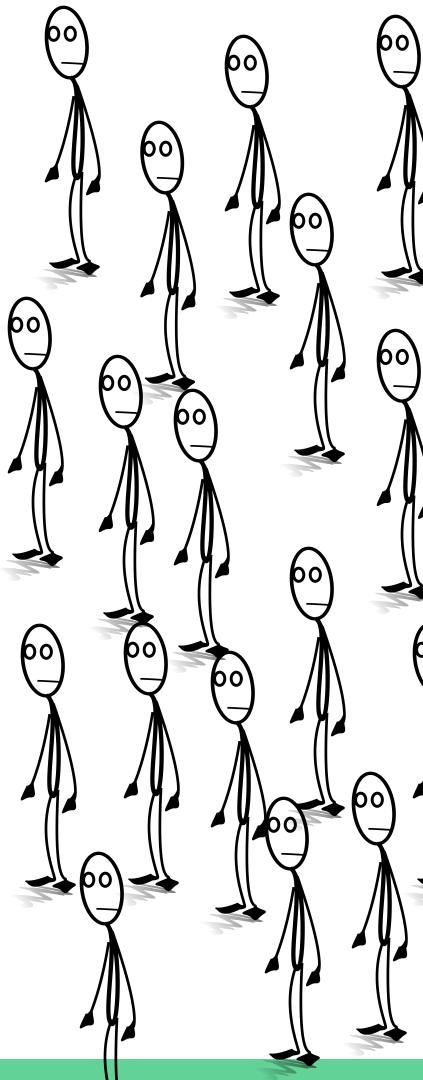


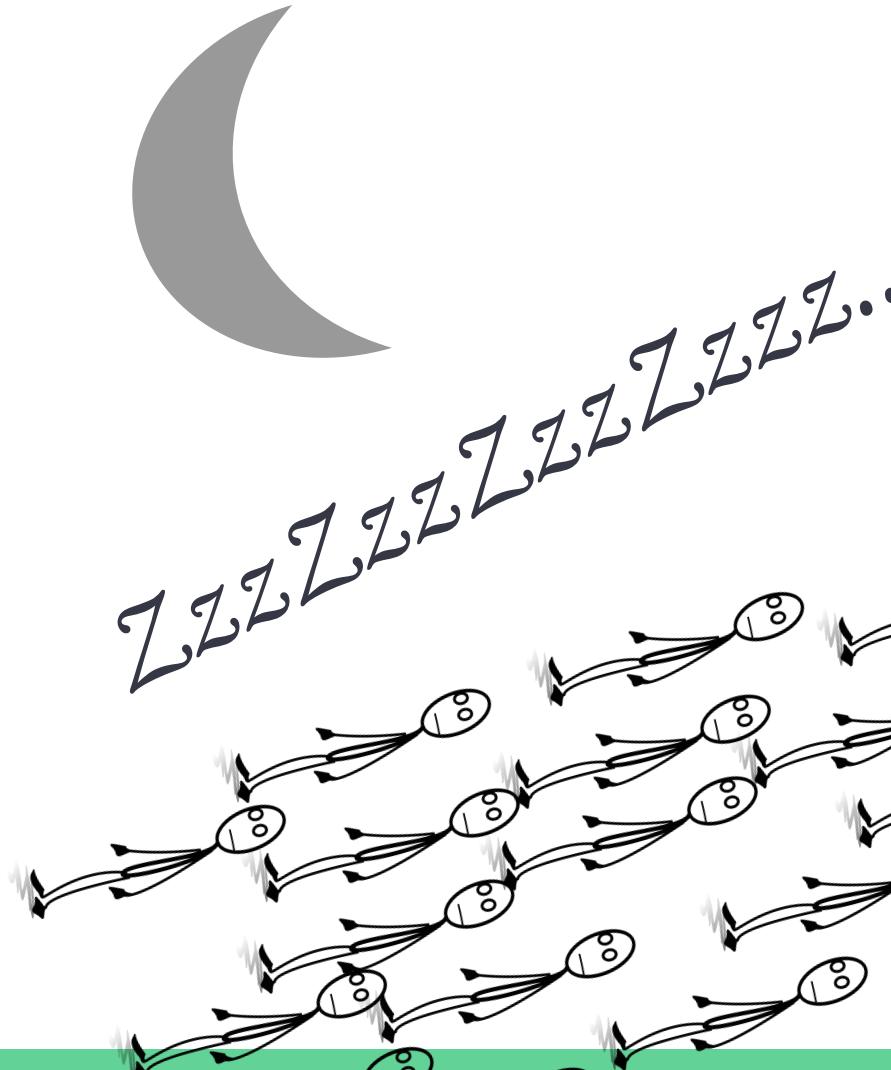






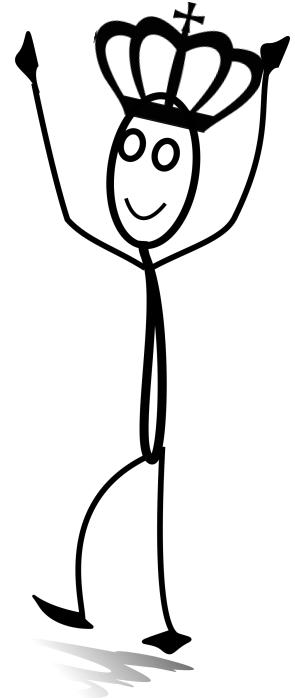






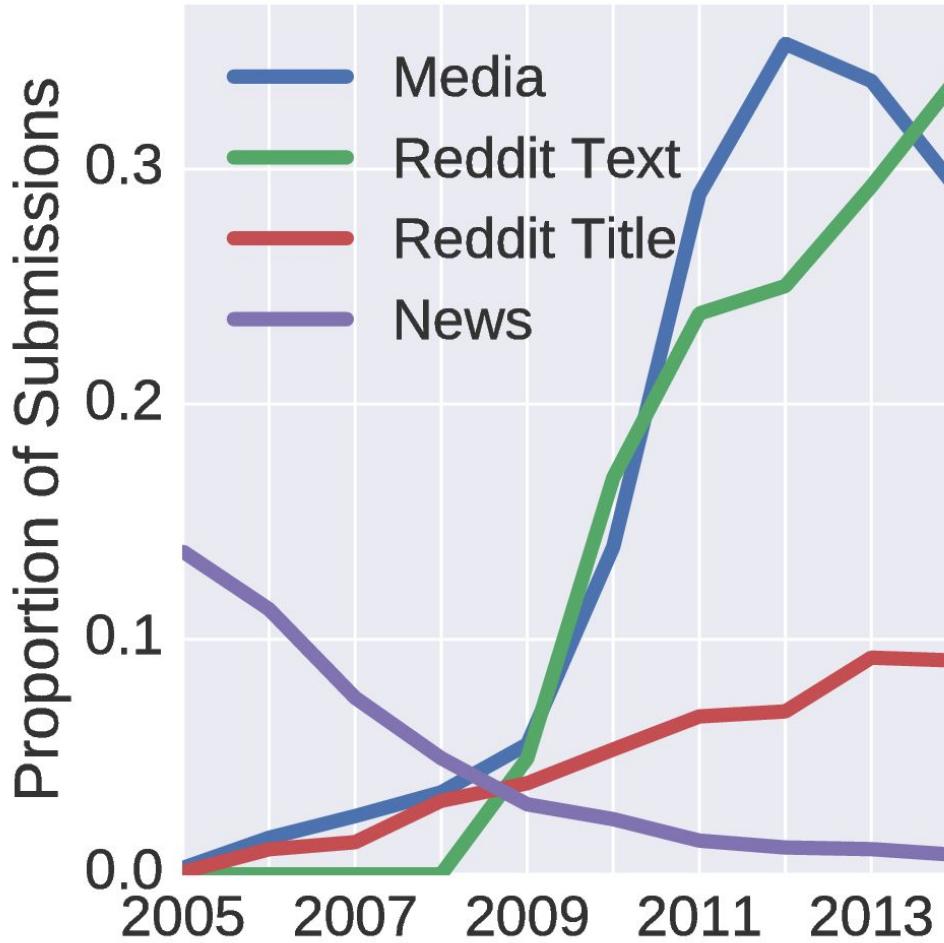


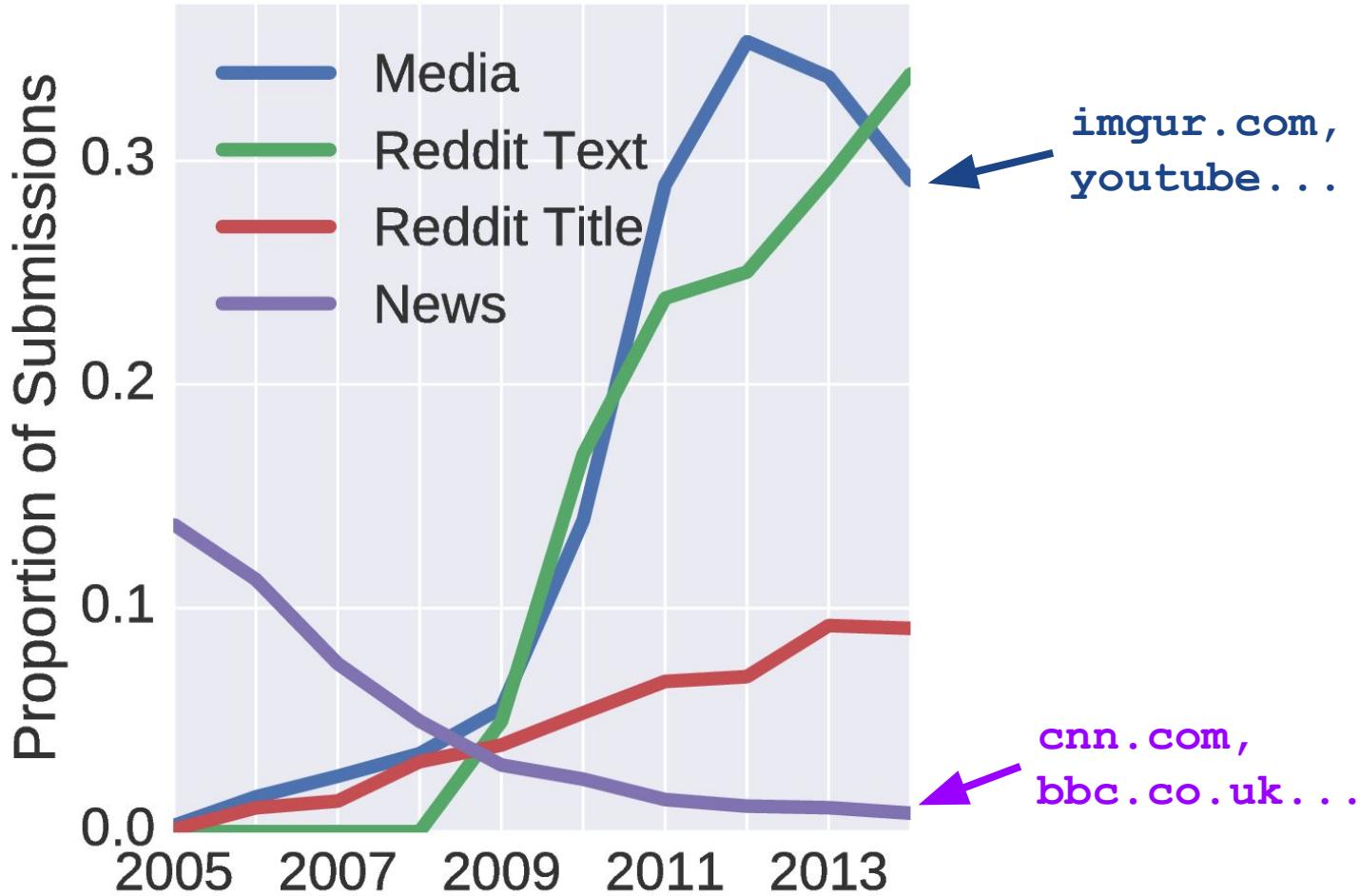
VS



Can we isolate the
effects of
content
rather than context?









"Tonight, I carved a pumpkin. I also doused it in lighter fluid and lit it on fire." - /r/pics



"Snacks!" - /r/aww



"You have to go to the border for food Fish Tacos [San Diego]" - /r/FoodPorn

| | # Users | #/% Img | Cap Len |
|------------------------|---------|-----------|---------|
| pics | 2108K | 2472K/70% | 9.84 |
| aww | 1010K | 954K/81% | 9.13 |
| cats | 109K | 100K/73% | 8.97 |
| MakeupAddiction (MA) | 77K | 58K/57% | 13.67 |
| FoodPorn (FP) | 74K | 50K/77% | 9.39 |
| RedditLaqueristas (RL) | 27K | 39K/73% | 11.12 |



"Glamor Leaves" - /r/RedditLaquersitas



The grass is always
greener



This is why you get
two cats

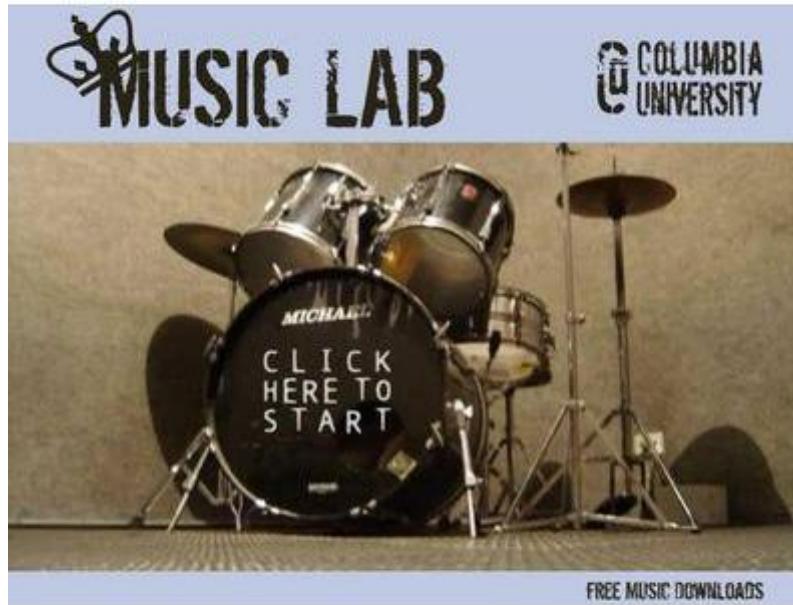


The grass is always
greener



This is why you get
two cats

Complication 1: Rich get richer



Complication 2: Identity Matters



LINKS FROM: PAST MONTH ▾

YOU ARE NOT A MEMBER OF THIS COMMUNITY. PLEASE RESPECT THAT BY NOT DOWNVOT



4040



A little late but I did a Frida look for Halloween I'm pretty proud of! [i.redd.it](#)

(+) submitted 27 days ago by osaosa [IG: selenaaasx]

[83 comments](#) share save hide report



3878



Bat makeup for halloween :) [i.reddituploads.com](#)

(+) submitted 29 days ago by sephovr

[44 comments](#) share save hide report



3813

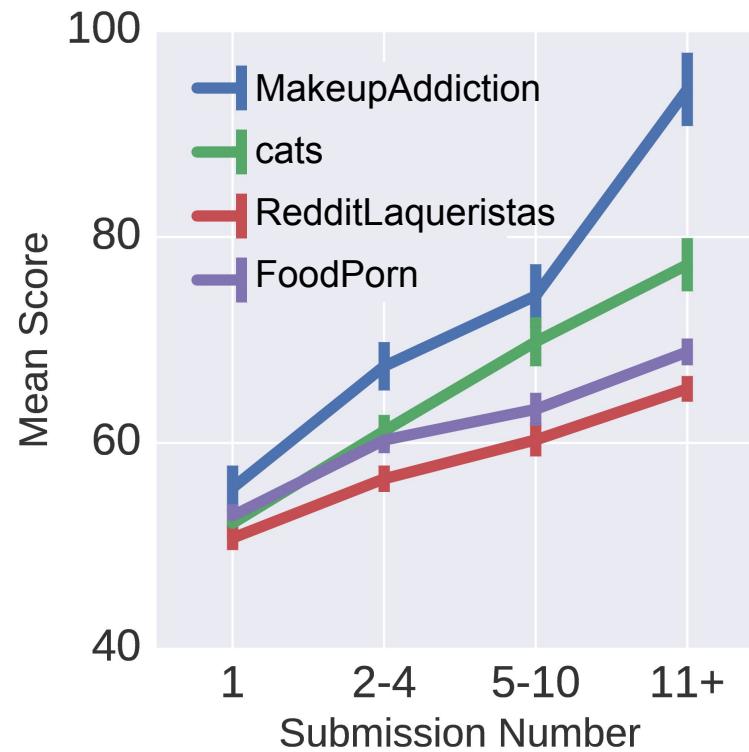


I can conquer the world in this makeup.

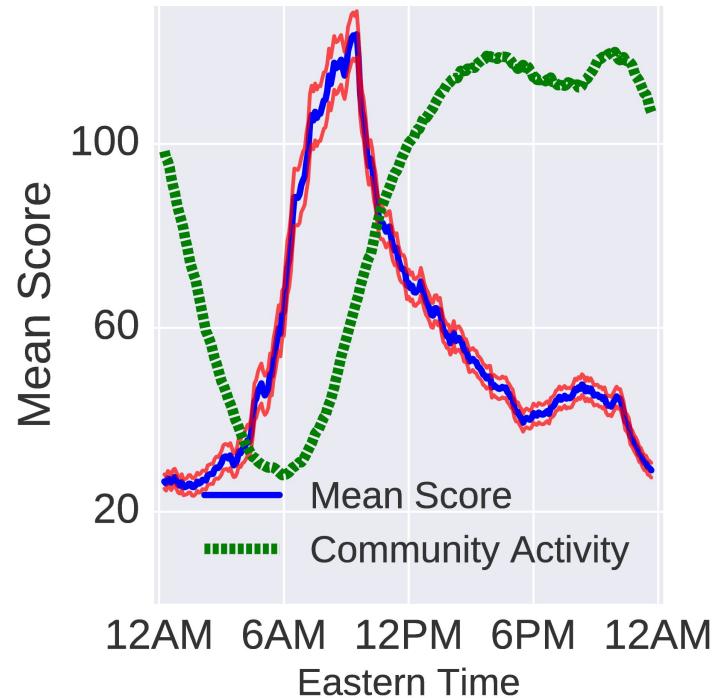
[i.reddituploads.com](#)

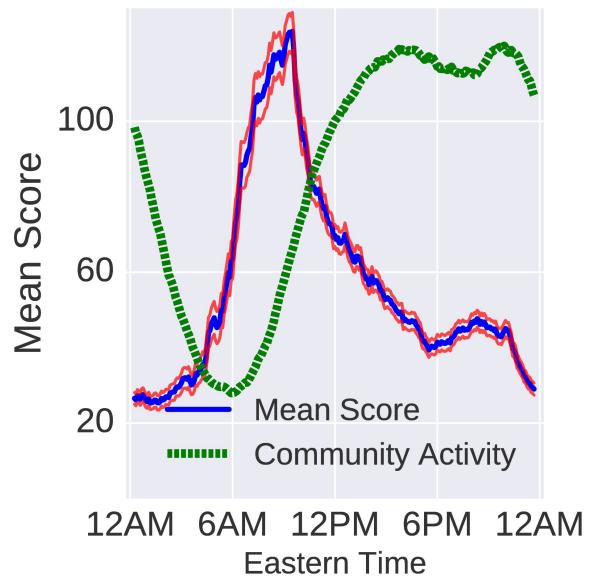
(+) submitted 15 days ago by Green-eyedgal

Complication 2: Identity Matters



Complication 3: Minutes matter





LINKS FROM: PAST MONTH ▾

YOU ARE NOT A MEMBER OF THIS COMMUNITY. PLEASE RESPECT THAT BY NOT DOWNGVOTING

A little late but I did a Frida look for Halloween I'm pretty proud of! [redd.it](#)
submitted 27 days ago by osaosa [selenaaxx](#)
83 comments share save hide report

Bat makeup for halloween :) [reddituploads.com](#)
submitted 29 days ago by sephovr
44 comments share save hide report

I can conquer the world in this makeup. [reddituploads.com](#)
submitted 15 days ago by Green-eyedgal



The grass is always
greener



This is why you get
two cats



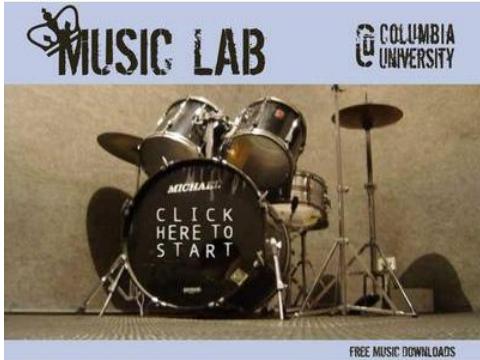
The grass is always
greener



This is why you get
two cats

13 Seconds Apart!

| | | aww | pics | cats | MA | FP | RL |
|--------|--------|------|------|------|------|------|------|
| Timing | Random | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 |
| | Time | 50.2 | 50.2 | 50.7 | 50.4 | 49.7 | 50.6 |



MakeupAddiction

HOT NEW RISING CONTROVERSIAL TOP

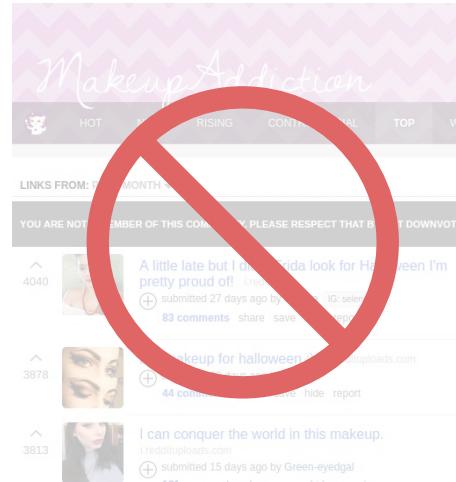
LINKS FROM: PAST MONTH ▾

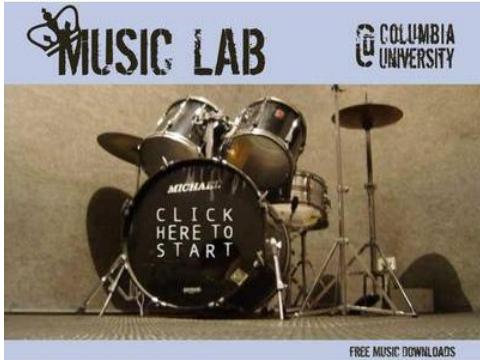
YOU ARE NOT A MEMBER OF THIS COMMUNITY. PLEASE RESPECT THAT BY NOT DOWNVOTING.

A little late but I did a Frida look for Halloween I'm pretty proud of! | reddit | 4040 | submitted 27 days ago by osaosa | 83 comments | share | save | hide | report

Bat makeup for halloween :) | reddituploads.com | 3878 | submitted 29 days ago by sephov | 44 comments | share | save | hide | report

I can conquer the world in this makeup. | reddituploads.com | 3813 | submitted 15 days ago by Green-eyedgal | 11 comments | share | save | hide | report





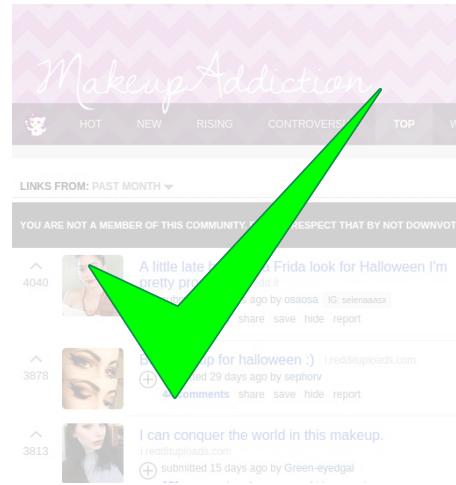
Links from: PAST MONTH ▾

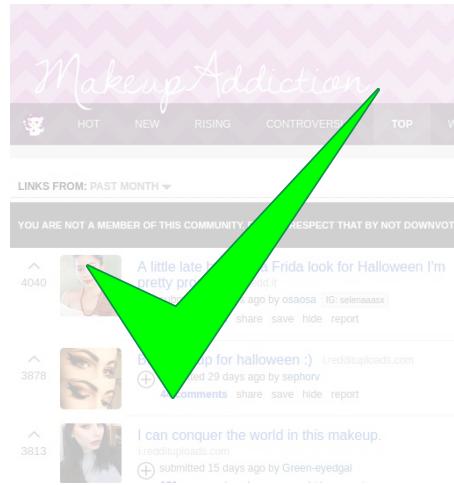
YOU ARE NOT A MEMBER OF THIS COMMUNITY. PLEASE RESPECT THAT BY NOT DOWNGVOTING OR UPVOTING.

A little late but I did Frida look for Halloween I'm pretty proud of myself. 4040 by osaosa · IQ: selemaax share save hide report

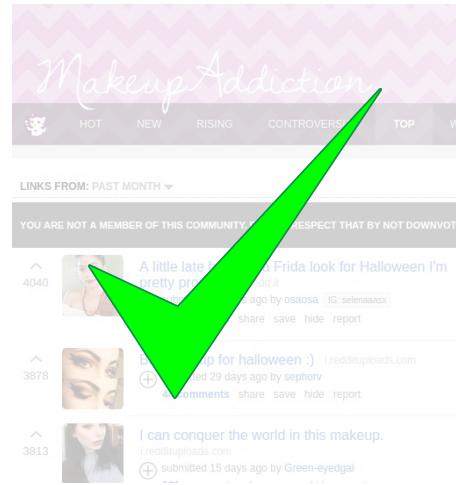
Halloween makeup idea for halloween :) 3878 by sephovr submitted 29 days ago share save hide report

I can conquer the world in this makeup. 3813 by Green-eyedgal submitted 15 days ago share save hide report





| | | aww | pics | cats | MA | FP | RL |
|--------|---------|------|------|------|------|------|------|
| Timing | Random | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 |
| | Earlier | 51.7 | 51.1 | 49.9 | 48.9 | 48.6 | 48.7 |
| | Time | 50.2 | 50.2 | 50.7 | 50.4 | 49.7 | 50.6 |





The grass is always
greener



This is why you get
two cats



The grass is always
greener

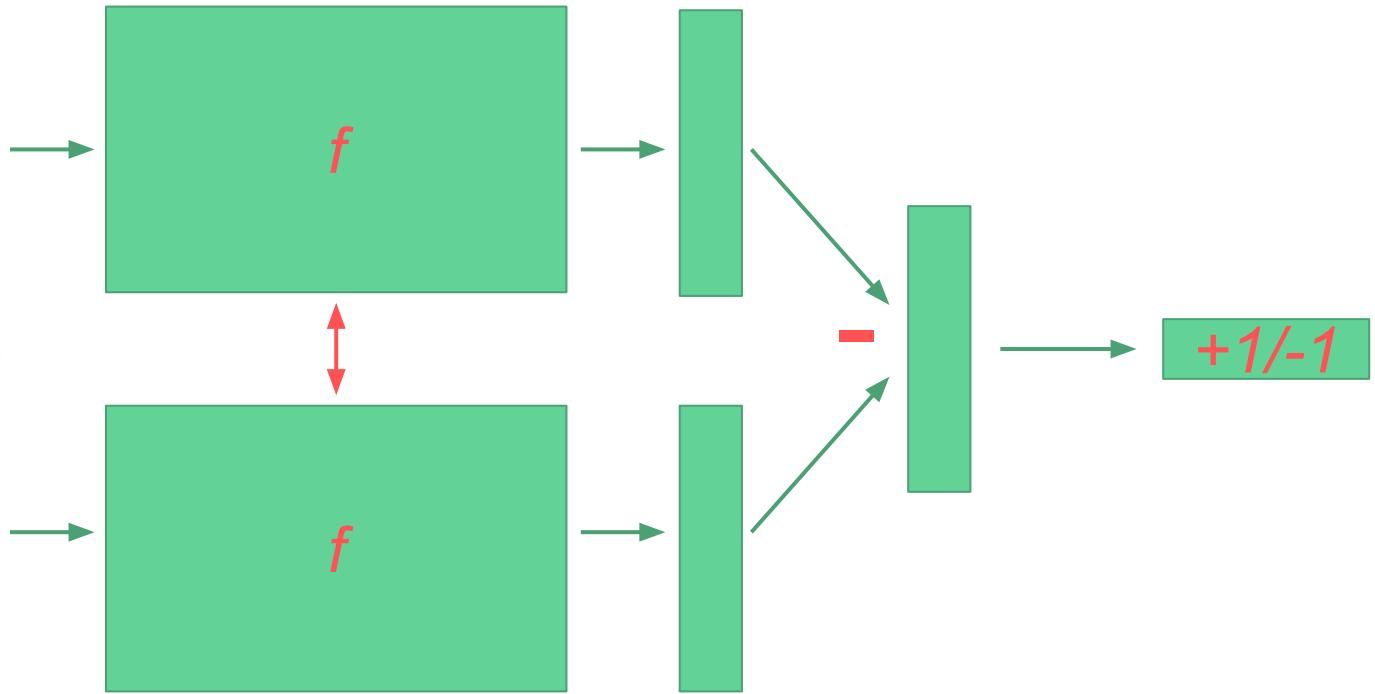


This is why you get
two cats

| | aww | pics | cats | MA | FP | RL |
|--------|------|------|------|------|------|------|
| Humans | 60.0 | 63.6 | 59.6 | 62.2 | 72.7 | 67.2 |

| | Max/Avg Win | Med/Avg Diff | # Pairs |
|------|-------------|--------------|---------|
| pics | 30/15 sec | 117/478 | 44K |
| aww | 30/15 sec | 90/393 | 33K |
| cats | 15/7 min | 69/231 | 15K |
| MA | 60/24 min | 88/227 | 10K |
| FP | 120/53 min | 62/188 | 8K |
| RL | 30/14 min | 56/118 | 9K |

Machine learning experiments



Unimodal Results (cross-val)

Unimodal Results (cross-val)

| | aww | pics | cats | MA | FP | RL |
|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| Type | 50.6 | 51.2 | 50.7 | 52.8 | 51.8 | 56.1 |
| Activity | 51.1 | 53.6 | 52.8 | 55.0 | 53.9 | 60.6 |
| Quality | 54.7 | 55.5 | 52.9 | 60.7 | 55.5 | 67.3 |
| Struct | 56.2 | 54.8 | 56.5 | 50.9 | 52.3 | 52.5 |
| Topic | 55.2 | 55.8 | 56.8 | 60.4 | 55.2 | 55.5 |
| DAN | 58.6 | 58.3 | 58.5 | 62.2 | 57.6 | 59.8 |
| LSTM | 59.4 | 58.8 | 58.7 | 61.0 | 57.0 | 59.1 |
| Bi-LSTM | 59.7 | 58.9 | 59.3 | 61.8 | 57.8 | 59.6 |
| Unigram | 59.7 | 58.6 | 59.5 | 63.0 | 57.6 | 60.8 |
| HOG | 51.7 | 52.8 | 51.9 | 53.5 | 53.5 | 53.5 |
| GIST | 52.7 | 53.0 | 53.5 | 55.9 | 56.5 | 56.3 |
| ColorHist | 55.3 | 53.7 | 55.6 | 55.0 | 56.5 | 54.5 |
| VGG-19 | 63.4 | 58.9 | 61.1 | 62.4 | 62.8 | 62.1 |
| ResNet50 | 64.8 | 60.0 | 62.6 | 64.9 | 65.2 | 64.2 |

User Features

Text Features

Image Features

Unimodal Results (cross-val)

| | aww | pics | cats | MA | FP | RL |
|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| Type | 50.6 | 51.2 | 50.7 | 52.8 | 51.8 | 56.1 |
| Activity | 51.1 | 53.6 | 52.8 | 55.0 | 53.9 | 60.6 |
| Quality | 54.7 | 55.5 | 52.9 | 60.7 | 55.5 | 67.3 |
| Struct | 56.2 | 54.8 | 56.5 | 50.9 | 52.3 | 52.5 |
| Topic | 55.2 | 55.8 | 56.8 | 60.4 | 55.2 | 55.5 |
| DAN | 58.6 | 58.3 | 58.5 | 62.2 | 57.6 | 59.8 |
| LSTM | 59.4 | 58.8 | 58.7 | 61.0 | 57.0 | 59.1 |
| Bi-LSTM | 59.7 | 58.9 | 59.3 | 61.8 | 57.8 | 59.6 |
| Unigram | 59.7 | 58.6 | 59.5 | 63.0 | 57.6 | 60.8 |
| HOG | 51.7 | 52.8 | 51.9 | 53.5 | 53.5 | 53.5 |
| GIST | 52.7 | 53.0 | 53.5 | 55.9 | 56.5 | 56.3 |
| ColorHist | 55.3 | 53.7 | 55.6 | 55.0 | 56.5 | 54.5 |
| VGG-19 | 63.4 | 58.9 | 61.1 | 62.4 | 62.8 | 62.1 |
| ResNet50 | 64.8 | 60.0 | 62.6 | 64.9 | 65.2 | 64.2 |

User Features

Text Features

Image Features

Multimodal Results

Multimodal Results (crossval)

Multimodal Results (crossval)

| | aww | pics | cats | MA | FP | RL |
|--------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Time + User | 54.1 | 54.7 | 52.1 | 58.8 | 54.2 | 64.8 |
| All User | 56.3 | 55.3 | 54.6 | 60.9 | 56.0 | <u>68.4</u> |
| ResNet50 | 64.8 | 60.0 | 62.6 | 64.9 | 65.2 | 64.2 |
| Text + Image | <u>67.1</u> | <u>62.7</u> | <u>65.9</u> | <u>67.7</u> | <u>65.8</u> | 66.4 |

Multimodal Results (crossval)

| | aww | pics | cats | MA | FP | RL |
|--------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Time + User | 54.1 | 54.7 | 52.1 | 58.8 | 54.2 | 64.8 |
| All User | 56.3 | 55.3 | 54.6 | 60.9 | 56.0 | <u>68.4</u> |
| ResNet50 | 64.8 | 60.0 | 62.6 | 64.9 | 65.2 | 64.2 |
| Text + Image | <u>67.1</u> | <u>62.7</u> | <u>65.9</u> | <u>67.7</u> | <u>65.8</u> | 66.4 |

Best unimodal



Multimodal Results (crossval)

| | aww | pics | cats | MA | FP | RL |
|--------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Time + User | 54.1 | 54.7 | 52.1 | 58.8 | 54.2 | 64.8 |
| All User | 56.3 | 55.3 | 54.6 | 60.9 | 56.0 | <u>68.4</u> |
| ResNet50 | 64.8 | 60.0 | 62.6 | 64.9 | 65.2 | 64.2 |
| Text + Image | <u>67.1</u> | <u>62.7</u> | <u>65.9</u> | <u>67.7</u> | <u>65.8</u> | 66.4 |

Best unimodal



Multimodal beats unimodal!



Multimodal Results (crossval + fully heldout)

| | aww | pics | cats | MA | FP | RL |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Time + User | 54.1 | 54.7 | 52.1 | 58.8 | 54.2 | 64.8 |
| All User | 56.3 | 55.3 | 54.6 | 60.9 | 56.0 | 68.4 |
| ResNet50 | 64.8 | 60.0 | 62.6 | 64.9 | 65.2 | 64.2 |
| Text + Image | 67.1 | 62.7 | 65.9 | 67.7 | 65.8 | 66.4 |

Best unimodal

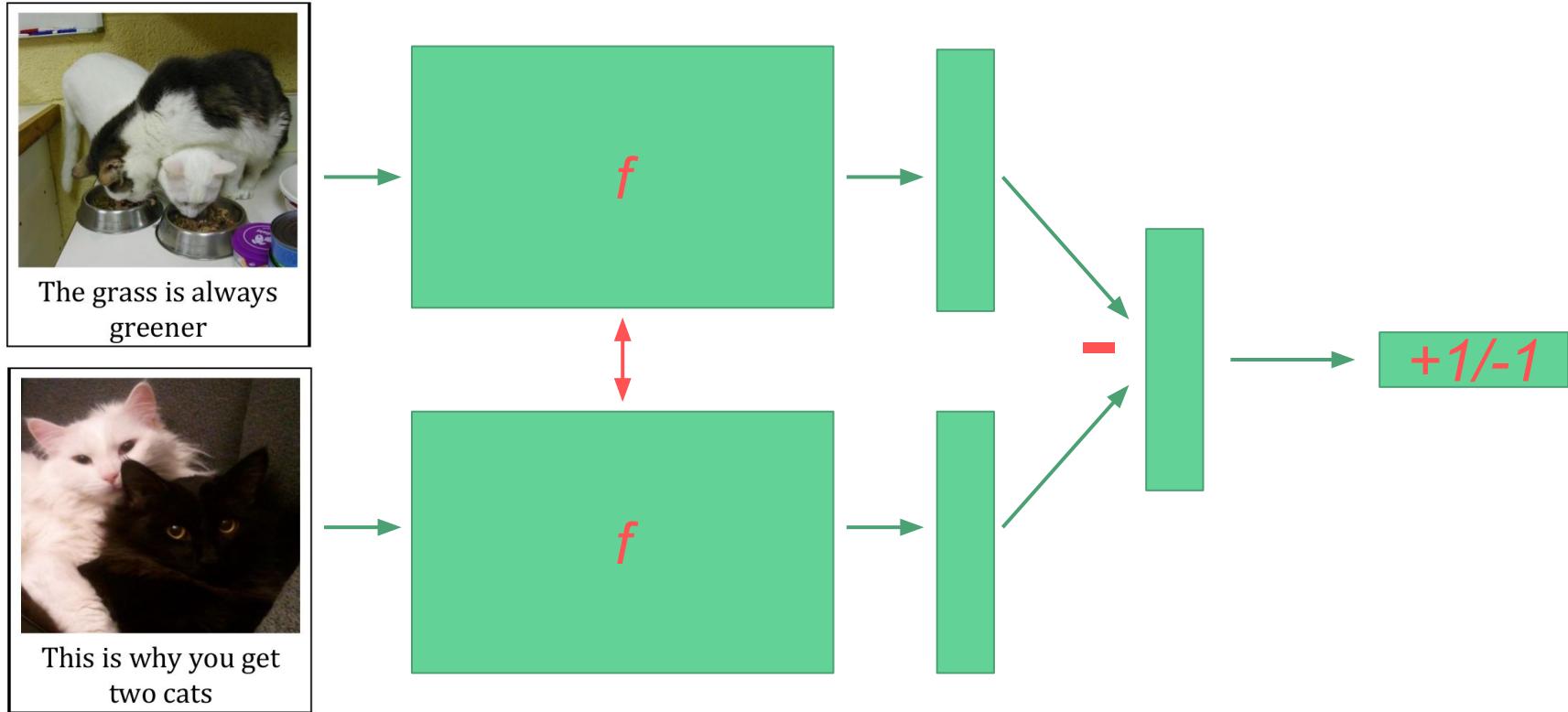


Multimodal beats unimodal!

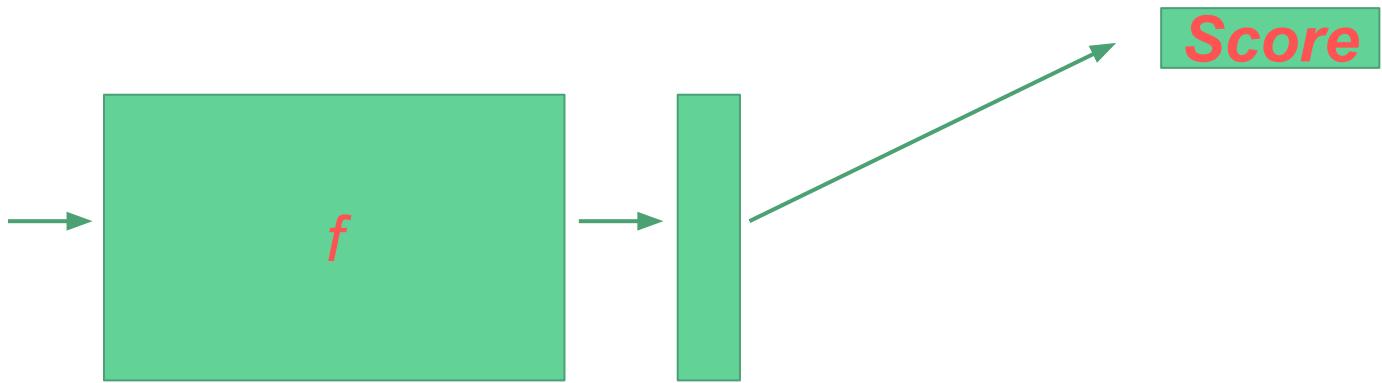


| | aww | pics | cats | MA | FP | RL |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Time + User | 55.5 | 51.7 | 52.6 | 56.9 | 52.8 | 60.5 |
| All User | 60.4 | 51.0 | 54.3 | 63.1 | 57.9 | 66.0 |
| Text + Image | 65.5 | 66.0 | 67.3 | 62.7 | 62.6 | 65.4 |

Machine learning experiments

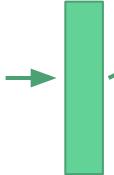


Machine learning experiments

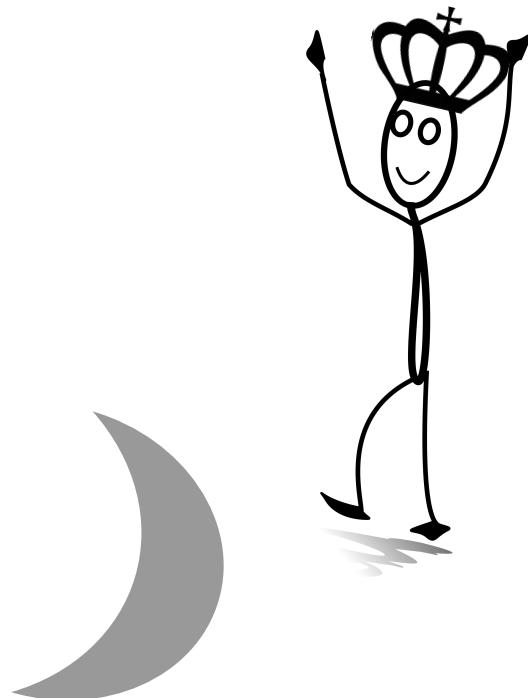


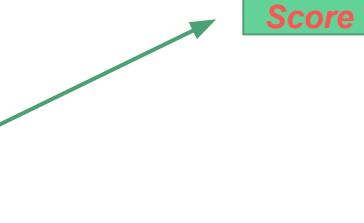
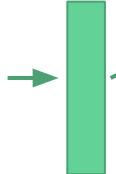


This is why you get
two cats

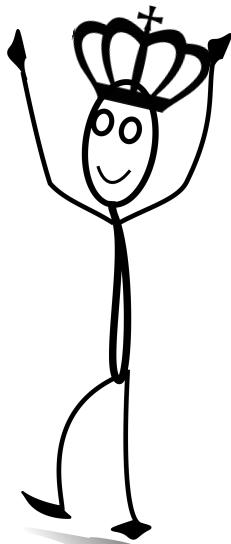
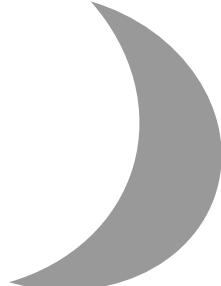


Score

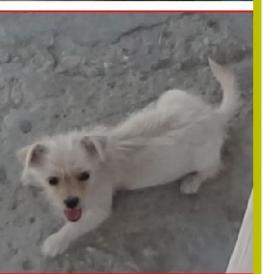




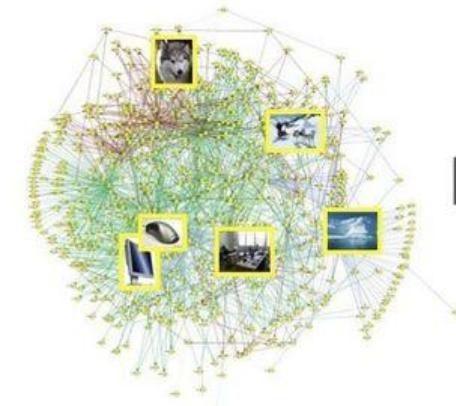
Promote quality
content posted at
the wrong time!



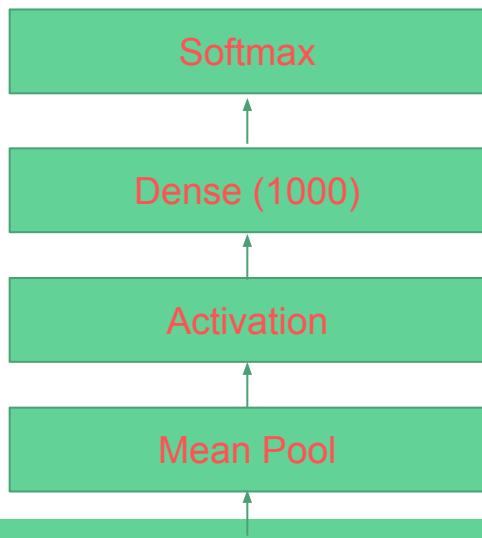
Promote quality
content posted by
non-celebrities!

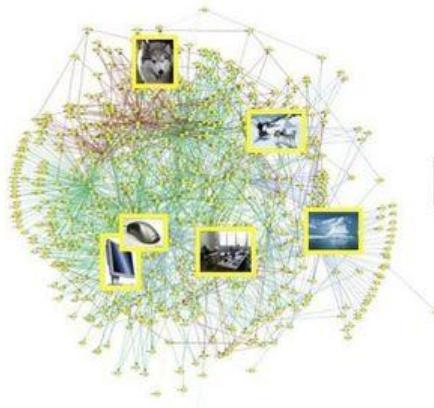






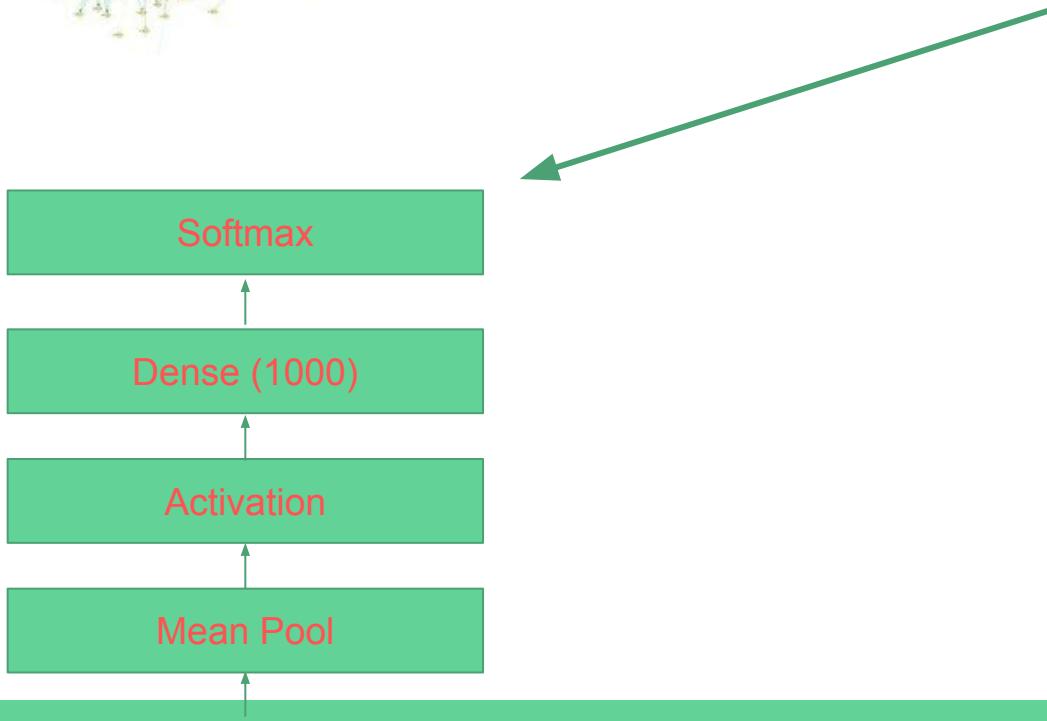
IMAGENET

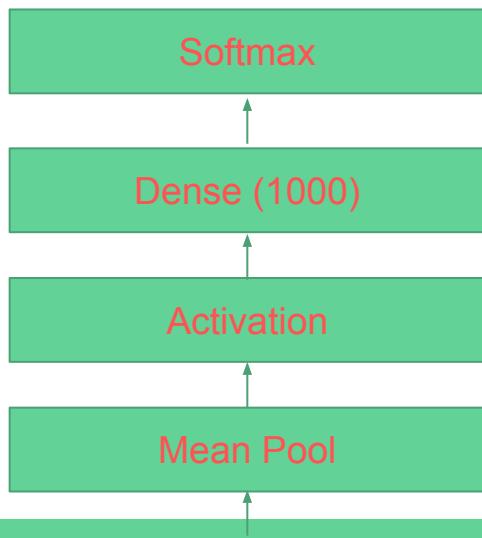


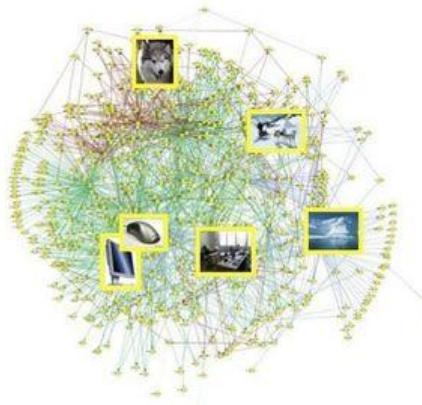


IMAGENET

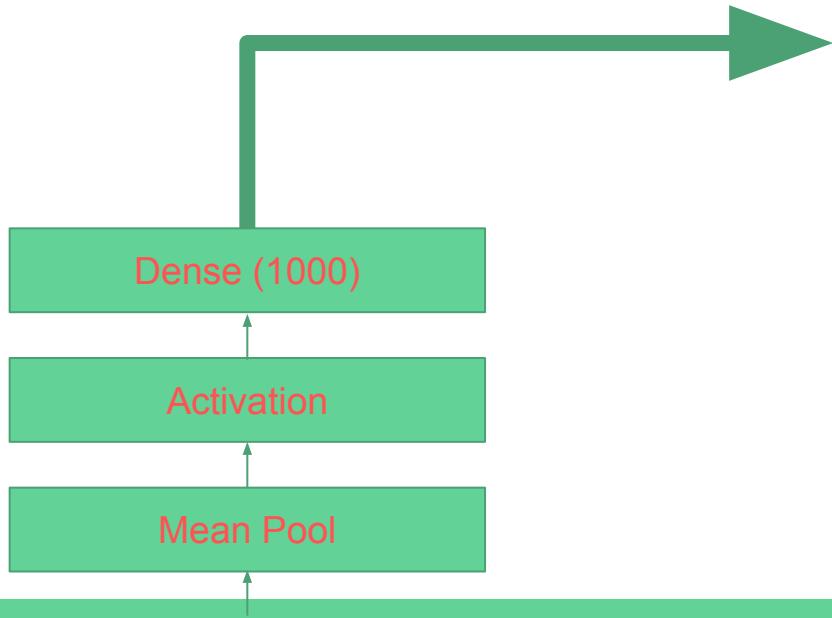
Lots of types of
animals!

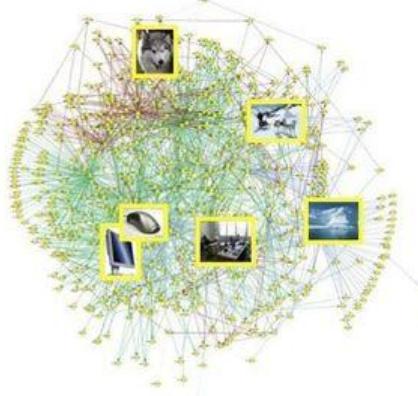




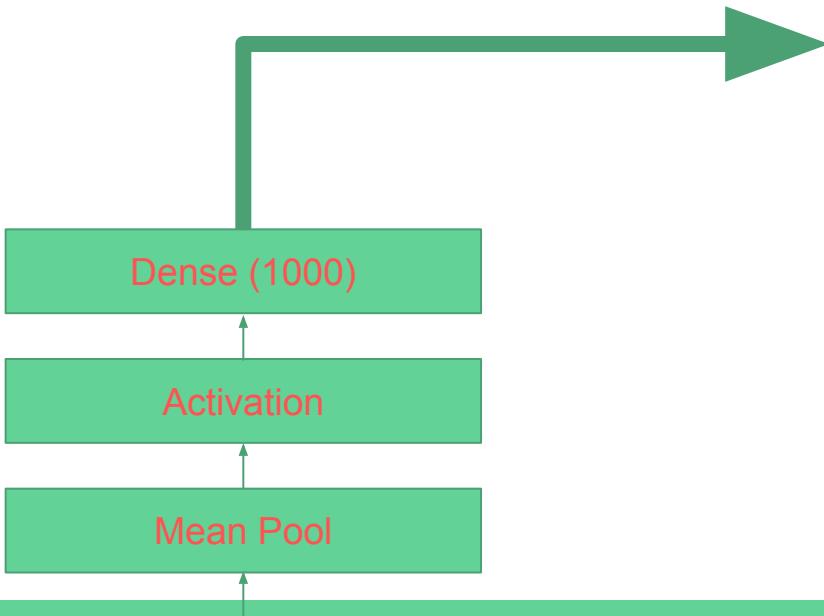


IM_AGENET





IMAGENET



golden_retriever +0.2290 ***
dingo +0.2126 ***
Labrador_retriever +0.1960 ***
worm_fence +0.1864 ***
cheetah +0.1851 ***
Tibetan_mastiff +0.1830 ***
...
Scotch_terrier -0.2193 ***
bassinet -0.2196 ***
wardrobe -0.2231 ***
miniature_schnauzer -0.2343 ***
four-poster -0.2841 ***
mosquito_net -0.2936 ***

(Significant after applying bonferroni correction)

Pretrained Models and Data Available!



www.cs.cornell.edu/~jhessel/cats/cats.html

Pretrained Models and Data Available!



My 20 year old little girl. Her sister p

- Score = 87.5/100



Please don't sit on me!

- Score = 27.4/100



Who says bulldogs can't be cute???

- Score = 13.8/100



www.cs.cornell.edu/~jhessel/cats/cats.html

Pretrained Models and Data Available!

lizzy



My 20 year old little girl. Her sister p

- Score = 87.5/100

taz



Please don't sit on me!

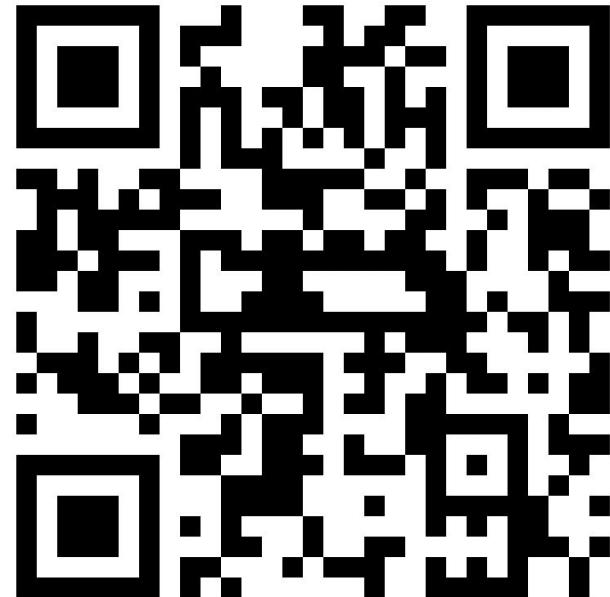
- Score = 27.4/100

bodhi



Who says bulldogs can't be cute???

- Score = 13.8/100



www.cs.cornell.edu/~jhessel/cats/cats.html

Pretrained Models and Data Available!

lizzy



My 20 year old little girl. Her sister p

- Score = 87.5/100

taz



Please don't sit on me!

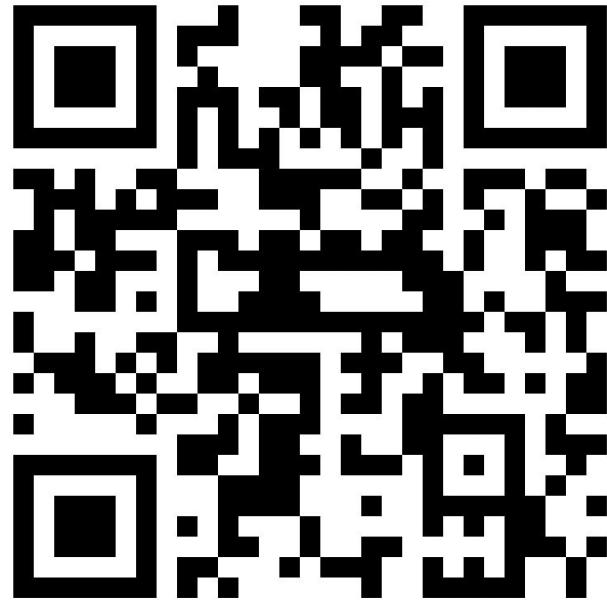
- Score = 27.4/100

bodhi



Who says bulldogs can't be cute???

- Score = 13.8/100

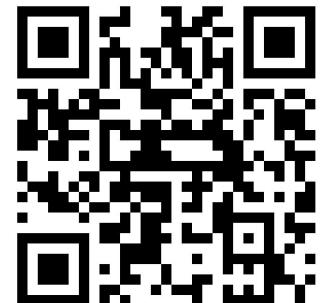
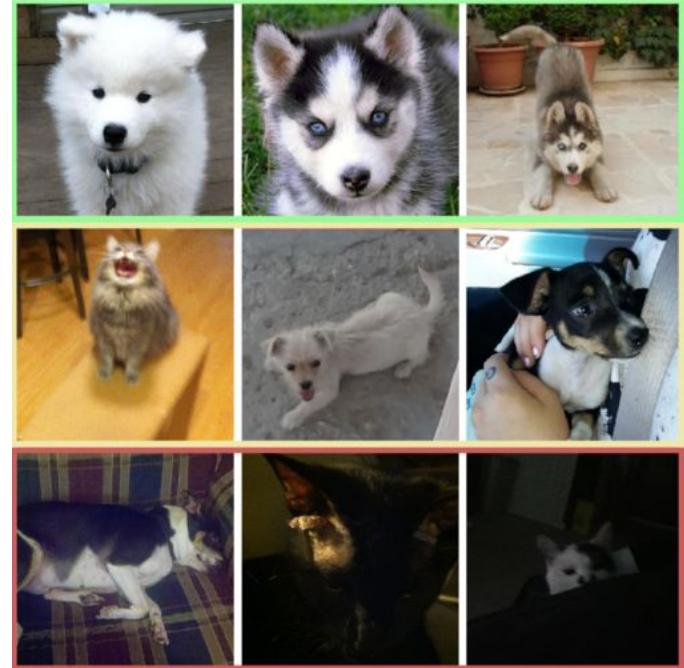


www.cs.cornell.edu/~jhessel/cats/cats.html

| | Max/Avg Win | Med/Avg Diff | # Pairs |
|------|-------------|--------------|---------|
| pics | 30/15 sec | 117/478 | 44K |
| aww | 30/15 sec | 90/393 | 33K |
| cats | 15/7 min | 69/231 | 15K |
| MA | 60/24 min | 88/227 | 10K |
| FP | 120/53 min | 62/188 | 8K |
| RL | 30/14 min | 56/118 | 9K |

Thanks to:

- Nvidia for the GPU donations
- Yahoo, Inc.
- National Science Foundation
- Vlad Niculae
- Volunteer human annotators
- Cornell NLP Seminar



Questions?

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