New Perspectives on Digital Media Integrity

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“The battle for the mind of North America
will be fought in the video arena”

Brian Oblivion, *Videodrome*

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Videodrome (1983)

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Deep Fakes

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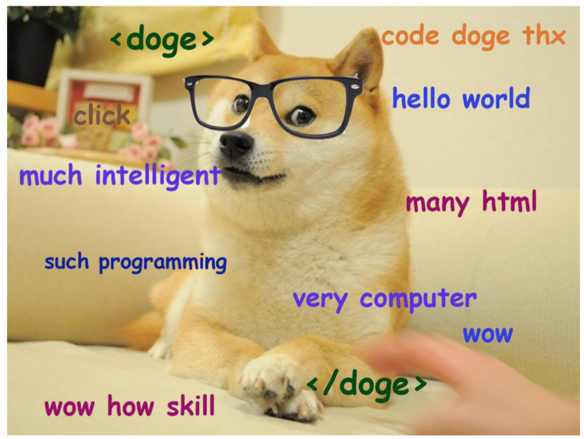
ISIS Execution Videos (Fake)

https://www.csmonitor.com/World/Global-News/2015/0124/ISIS-video-Is-this-Japanese-beheading-real-or-fake

The Intersection of Politics and Entertainment: Internet Memes

What is a Meme?

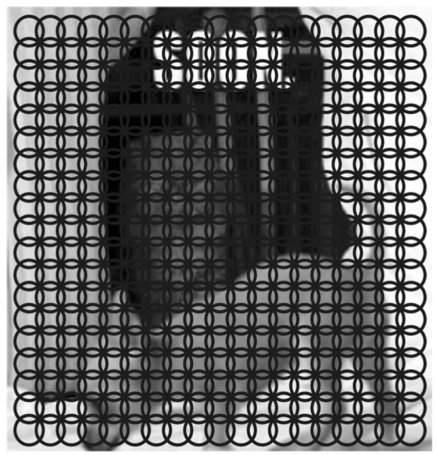


Forstall and Scheirer, *Quantitative Intertextuality*, Springer-Nature 2019

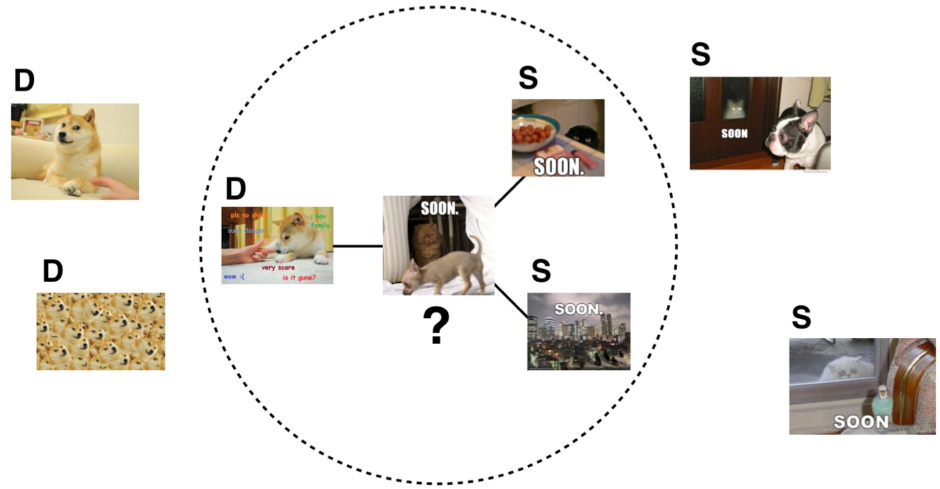
Memes, Visual Style, and Semantic Analysis

A naive approach:

Original



Dense grid of HOG descriptors



K-Nearest Neighbors

Related Work

Memes as Cultural Artifacts

L. Shifman, *Memes in Digital Culture*, MIT Press, 2014.

Visual Style in Computer Vision

J. Jupp and J. Gero, “Let’s look at style: Visual and spatial representation and reasoning in design,” In: S. Argamon, K. Burns, S. Dubnov (eds.) The Structure of Style: Algorithmic Approaches to Understanding Manner and Meaning. Springer-Verlag, 2010.

Q. Wu, H. Cai, P. Hall, “Learning graphs to model visual objects across different depictive styles,” ECCV, 2014.

Y. Lee, A. Efros, M. Hebert, “Style-aware mid-level representation for discovering visual connections in space and time,” IEEE ICCV, 2013.

Empirical Effects of Manipulated Media

Shen et al., “Fake images: The effects of source, intermediary, and digital media literacy on contextual assessment of image credibility online,” New Media & Society, 21 (2), 2018.

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Memes and Political Interference

Brazil

Legend

Bolsonaro's actual fraudulent employee: his brain

You better get used to him

The girl you like

Her father

Her brother

The guy she likes

Her ex

You

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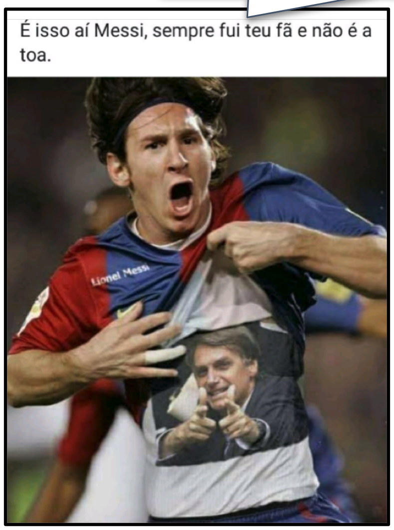
Brazil

That's it, Messi, I'm not your supporter for nothing...



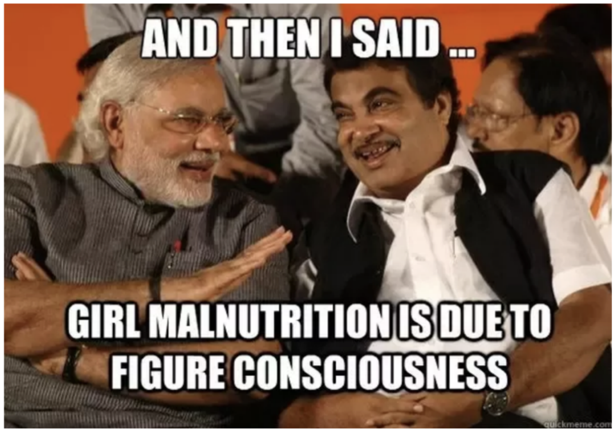
Manipulation to claim support

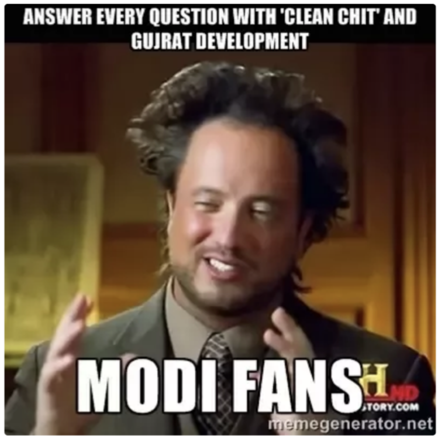
Original

A Federal University 'class'
We don't want to pay for it!

Image repurposing

India





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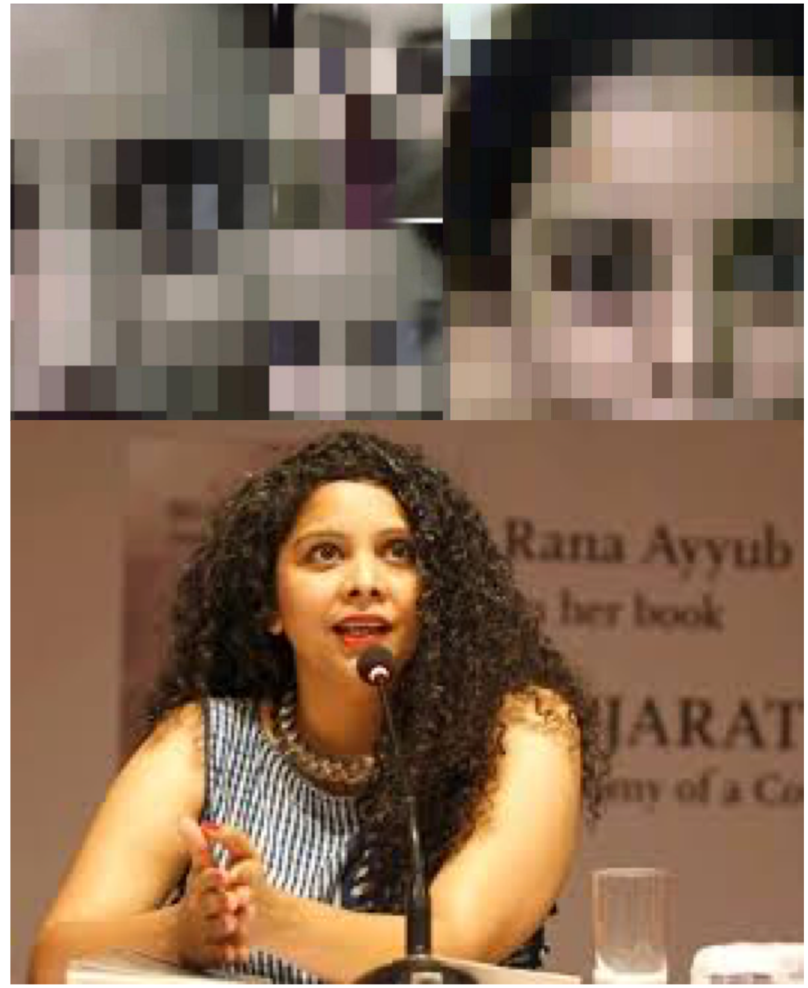
Deep Fakes as a Political Tool

2018: BJP supporters target investigative journalist Rana Ayyub with a doctored pornographic video containing her face

https://www.huffingtonpost.co.uk/entry/deepfake-porn_uk_5bf2c126e4b0f32bd58ba316



Credit: Huffington Post and Facebook

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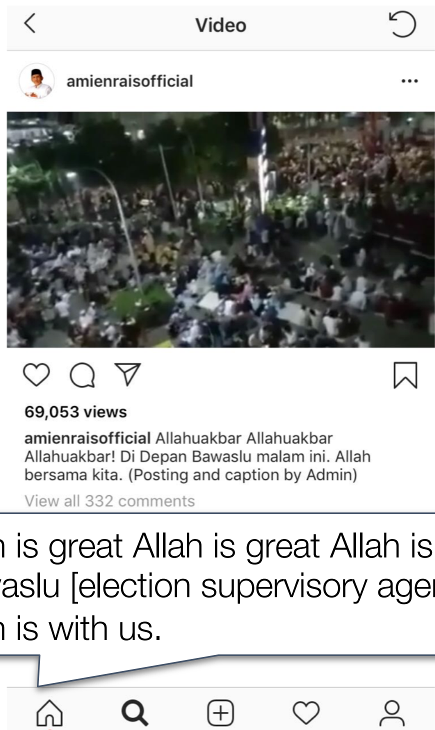
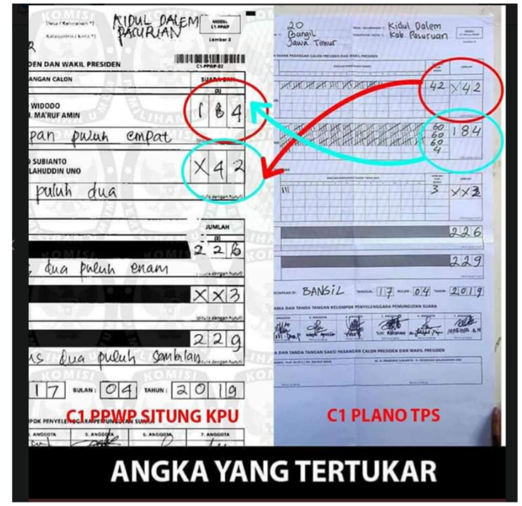
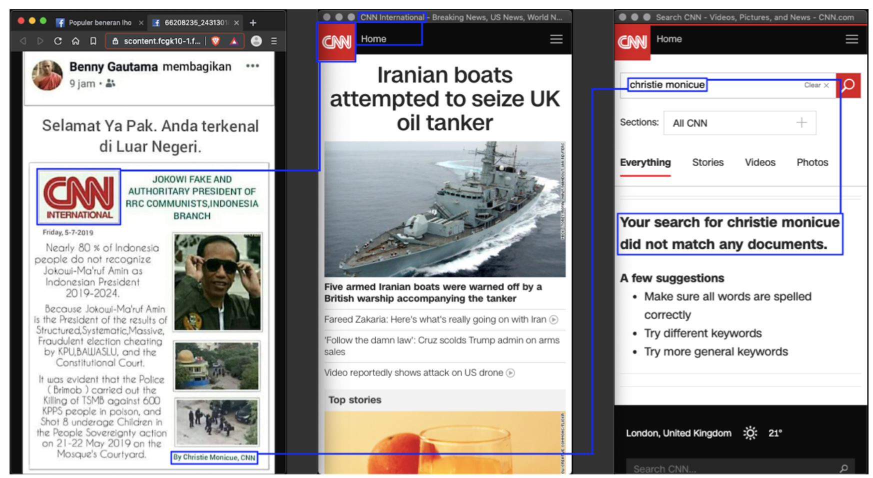
Indonesia



Allah is great Allah is great Allah is great! at Bawaslu [election supervisory agency] tonight. Allah is with us.





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Case Study: 2019 Indonesian Elections

Indonesian Presidential Election Overview

A voting station in Samarinda, East Kalimantan ⓒ BY-SA 4.0 Ezagren

- Direct general election
- Fourth presidential election
- Rematch of 2014 (five year terms)
- Joko Widodo re-elected with over 55% of the vote

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The Candidates

Joko “Jokowi” Widodo

- Incumbent
- PDI-P candidate (center-left party)
- Appealed to younger voters
- “Man of the people”

Prabowo Subianto

- Challenger
- Gerindra candidate (right populist party)
- Strongly Islamic
- Military background (Ties to Suharto dictatorship)

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Indonesian Election Aftermath

Prabowo claims a count fraud

Protests/Riots in Jakarta May 21-22, 8 dead

Indonesia restricts access to social media

https://www.straitstimes.com/asia/se-asia/old-age-poor-health-caused-deaths-of-poll-administrators-indonesia-government

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Survey of the Meme-space

Millions of images collected during the course of the election

Twitter
- ~170,000 images from 14 different sources

Instagram
- ~1.9 million images from 20 different sources

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The Data

Image sources identified by our partner in Indonesia, CekFakta

Images span from May 31st, 2018 to May 31st, 2019

Collected from 2 users and 12 popular hashtags (Twitter)

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Buzzer Accounts

Social media propaganda

Firms use fake accounts to generate “buzz”

Buzzers use upwards of 250 fake accounts each

https://www.reuters.com/article/us-indonesia-election-socialmedia-insigh/in-indonesia-facebook-and-twitter-are-buzzer-battlegrounds-as-elections-loom-idUSKBN1QU0AS

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Finding Trending Memes: Motif Mining

Objectives for an early warning system

- Real-time processing pipeline with content flagging
- Assess meme landscape with respect to political actors
- Allow humans to gauge the threat of violence
- Scale to the order of billions of images per day
- Match composite images to other composite and donor images

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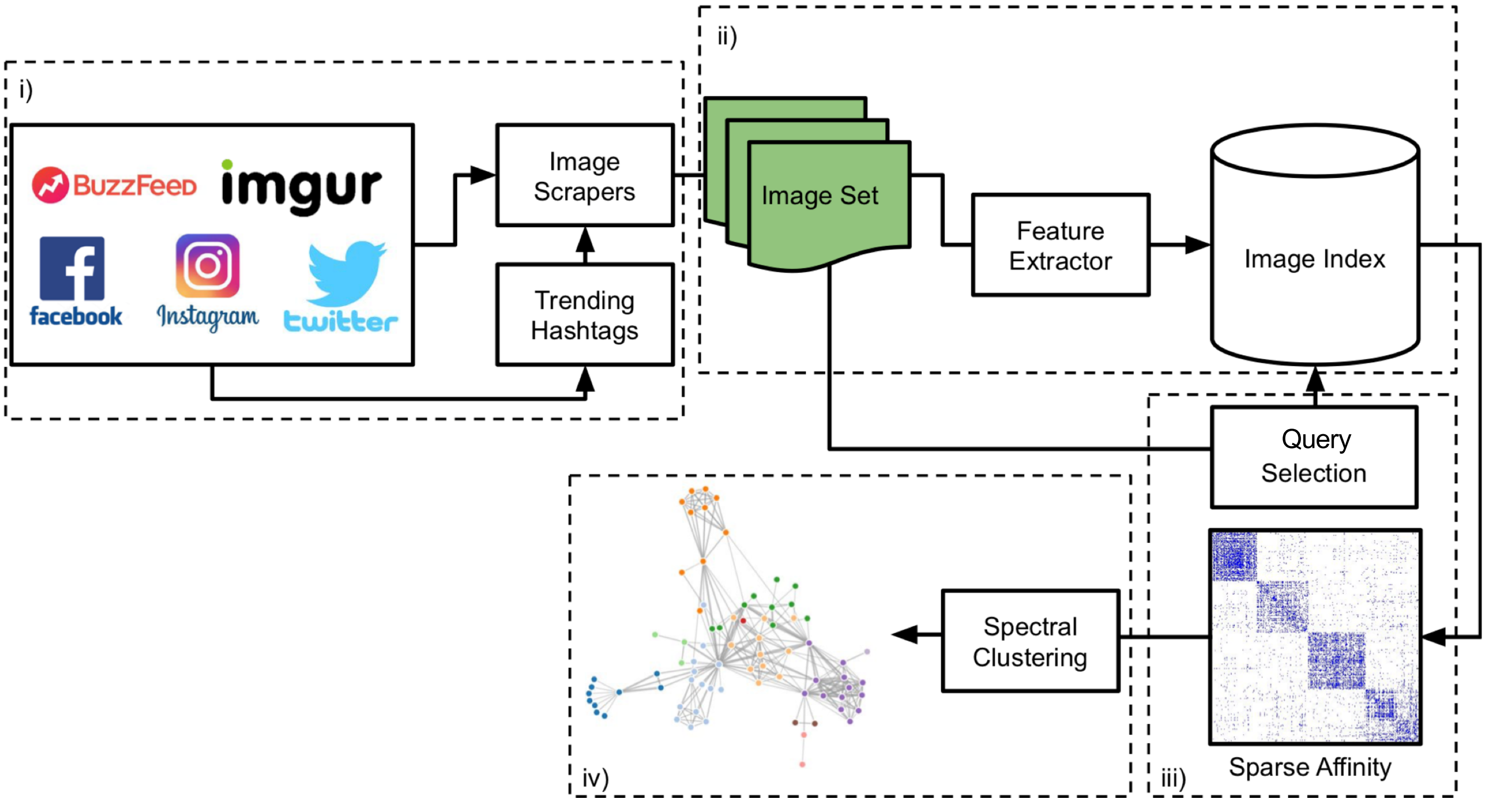
Motif Mining Pipeline



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Query Selection: Detecting Edited Objects

Use meme images to search for related meme content

- Option 1: Randomly sample images from known buzzers
- Option 2: Detect new memes via the identification of edits

http://reveal-mklab.iti.gr/reveal/

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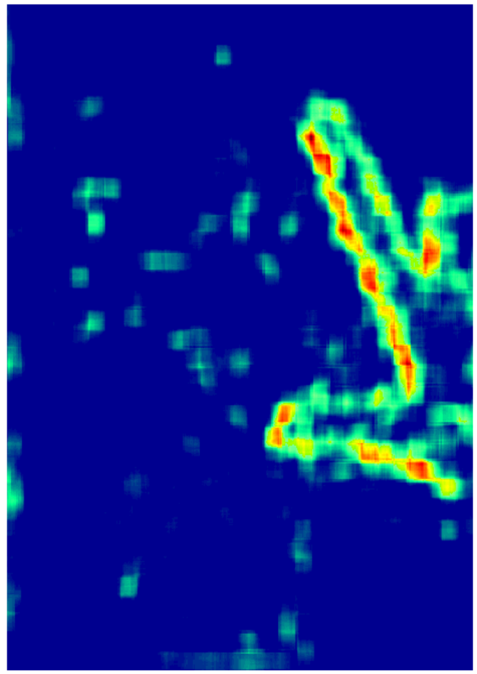
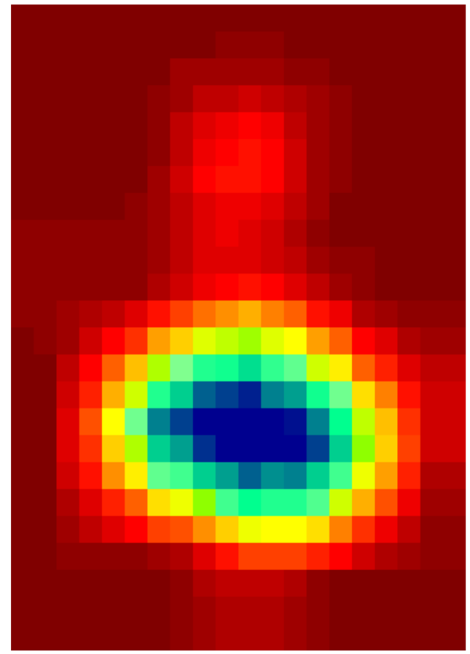
Detecting Image Edits



Farid 2009



Iakovidou et al. 2018

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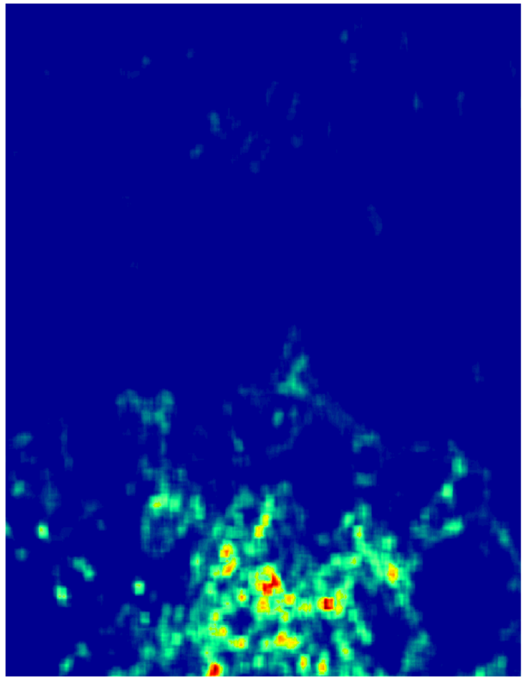
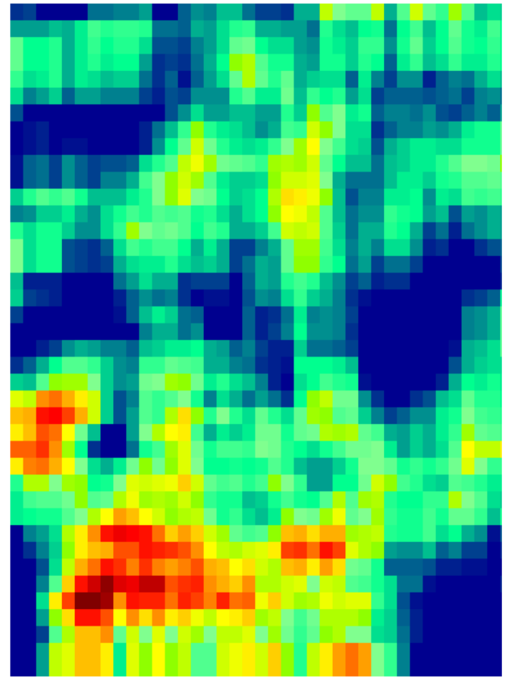
H. Farid, *Exposing digital forgeries from JPEG ghosts*. IEEE T-IFS, 2009.
Iakovidou et al. *Content-aware detection of JPEG grid inconsistencies for intuitive image forensics*. JVCIR, 2018.

Detecting Image Edits



Farid 2009



Weihai et al. 2009

H. Farid, *Exposing digital forgeries from JPEG ghosts*. IEEE T-IFS, 2009.
Weihai et al., *Passive detection of doctored JPEG image via block artifact grid extraction*. Signal Processing, 2009.

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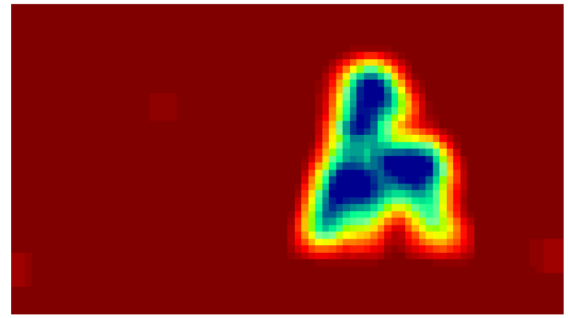
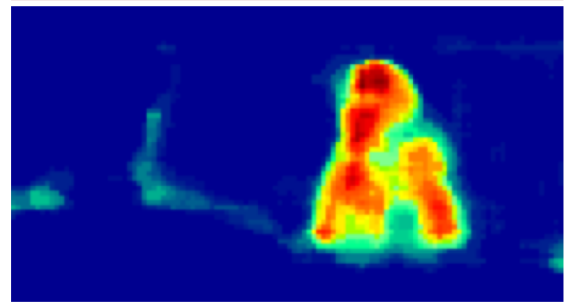
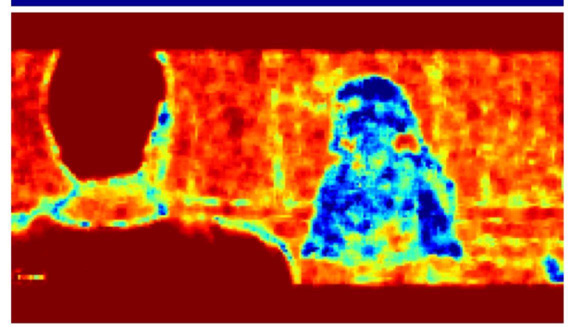
Detecting Deep Fakes



Iakovidou et al. 2018



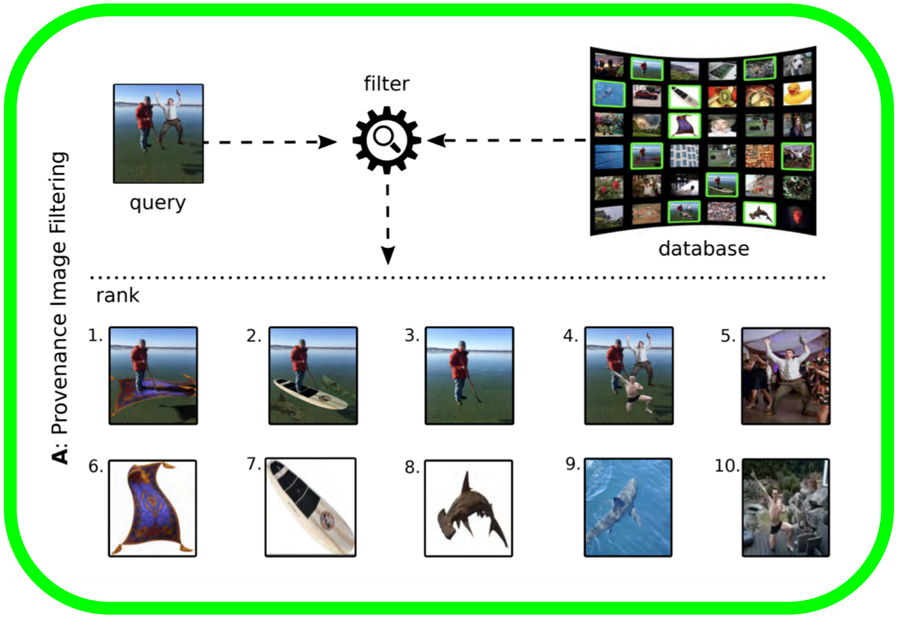
Mahdian et al. 2009

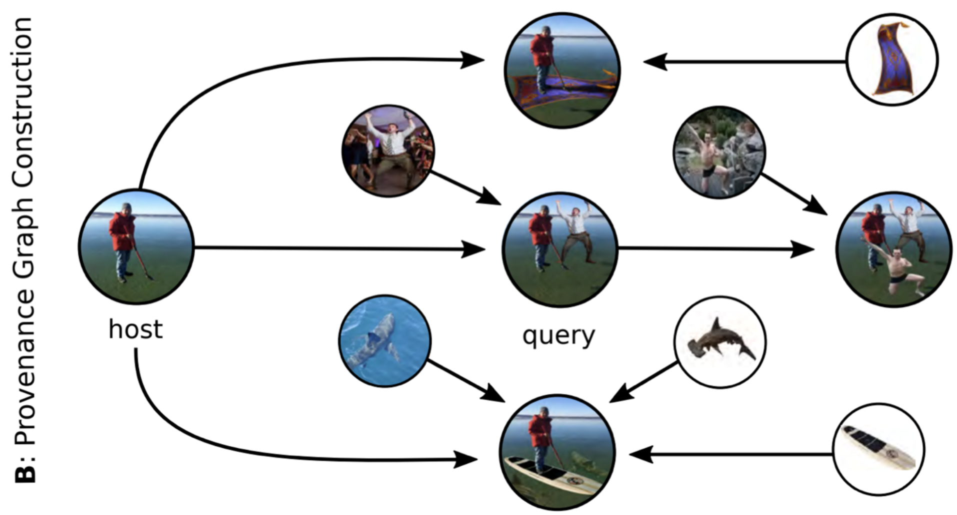


Weihai et al. 2009

Iakovidou et al. *Content-aware detection of JPEG grid inconsistencies for intuitive image forensics*. JVCIR, 2018
Mahdian et al. *Using noise inconsistencies for blind image forensics*. Elsever IVC, 2009
Weihai et al. *Passive detection of doctored JPEG image via block artifact grid extraction*. Signal Processing, 2009

Adapting a provenance pipeline to motif mining





Moreira, D., et al. *Image Provenance Analysis at Scale*. IEEE T-IP, 2018

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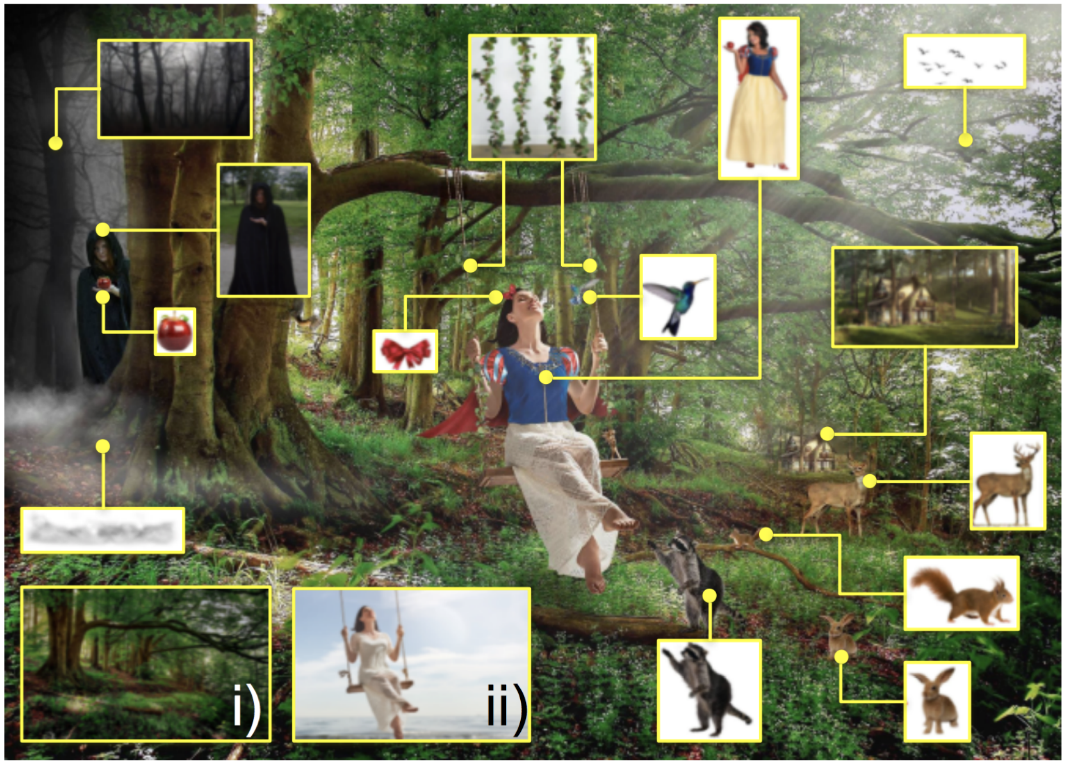
Add the ability to localize and match small objects



J. Brogan et al. *Needle in a Haystack: A Framework for Seeking Small Objects in Big Datasets*.
Arxiv preprint (https://arxiv.org/abs/1903.10019), 2019

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Add a spectral clustering stage

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Motif Mining (Twitter Dataset)

- 174,328 images scraped from Twitter
- Image Index was built in 6.2 hours on a single GPU machine with 12 CPU cores
- 10,000 Random queries were performed for matrix generation in 6.5 hours
- **No deep learning was used**

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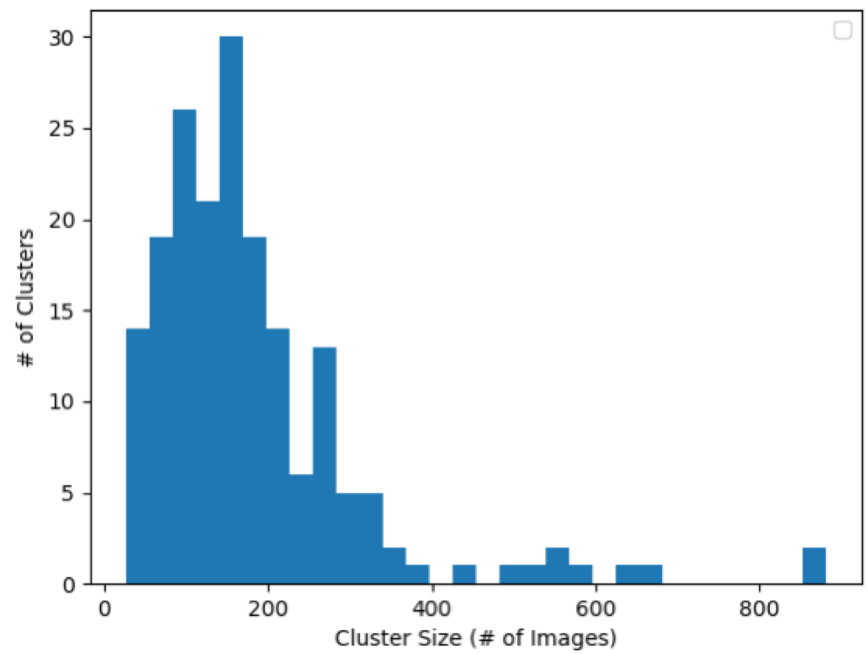
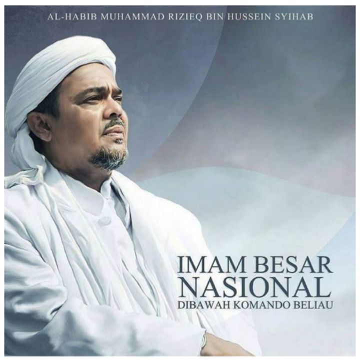
Motif Mining (Twitter Dataset)

- 174328 total images
- 197 computed clusters
- Mean cluster size: 895 images
- Median cluster size: 156
- Minimum cluster size: 26
- Maximum cluster size: 36304



Automatic Motif Detection



Automatic Motif Detection

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Automatic Motif Detection

Some Questions...

Q1: What capabilities do we still need for meme analysis?

Q2: What aspects of semantic analysis can improve the process?

Q3: What is a good process for data collection?

Q4: Who outside of the forensics community should we engage with?