

Provenance Analysis

Telling the story of composite images

What is Provenance Analysis?

A composite image. On the left, a man wearing a red baseball cap with 'ROYAL' and 'LAWRENCE' printed on it is shown from the chest up. He is wearing a white t-shirt and has his hands in his pockets. On the right, there is a portrait of Kurt Cobain, the lead singer of Nirvana, looking slightly upwards and to the side with a contemplative expression.

The Notorious B.I.G.
NY scene rapper

HANGING OUT?

Kurt Cobain
Grunge scene musician

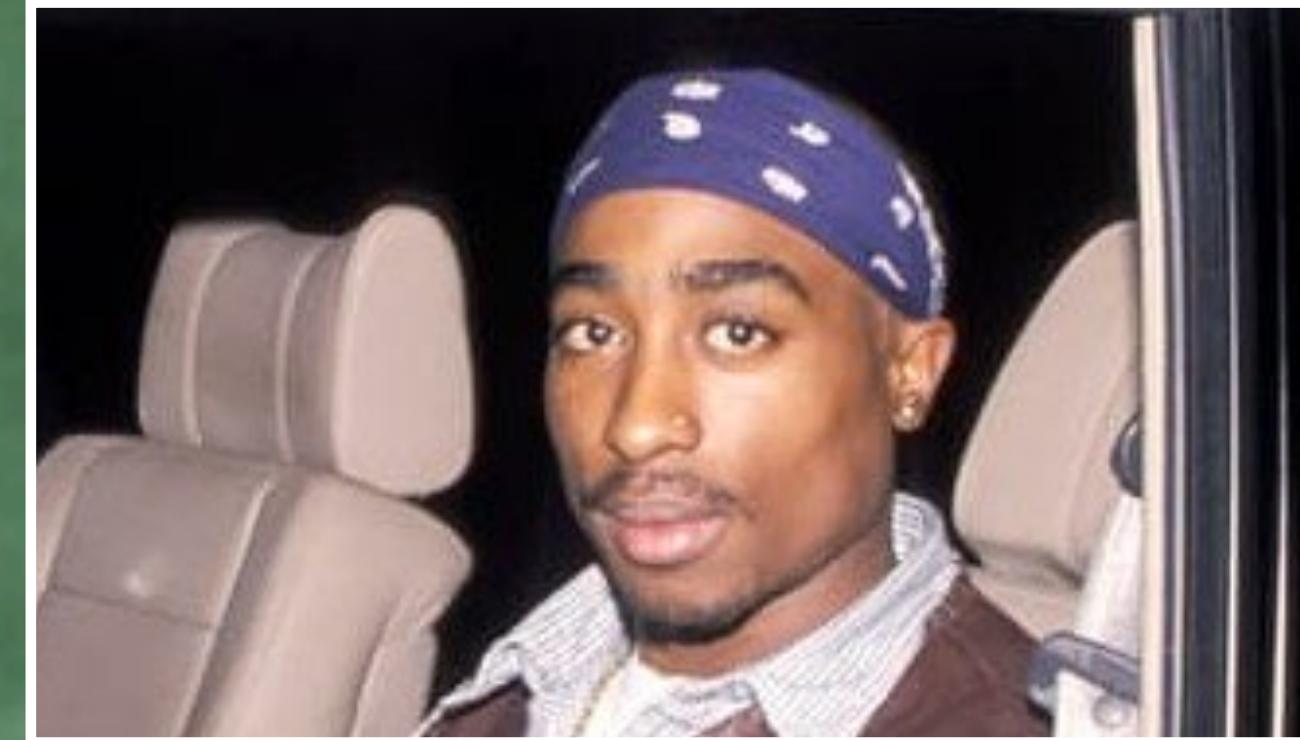


A collage of three images. On the left, a close-up of a person's face wearing a red baseball cap with 'RED' and 'DODGERS' on it. In the center, a woman with long blonde hair, wearing a green jacket with a fur-trimmed hood, looks directly at the camera. On the right, a portrait of Tupac Shakur looking slightly to the side.

Tupac Shakur
LA scene rapper



Provenance Graph



Who are we?

COMPUTER
VISION @ ND

MediFor

The Media Forensics (MediFor) Project
(www.darpa.mil/program/media-forensics)



POLITECNICO
MILANO 1863



UNIVERSITÀ
DI SIENA 1240



COMPUTER
VISION @ ND

Provenance Team



UNIVERSITY OF
NOTRE DAME



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Bharati



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Brogan



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Pinto

Who am I?

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Why do we care?





How do we do Provenance Analysis?

Two-Task Approach

Input

Solution

Output

Two-Task Approach

Input



questioned image



image database
(e.g., Internet)

Solution

Output

Two-Task Approach

Input



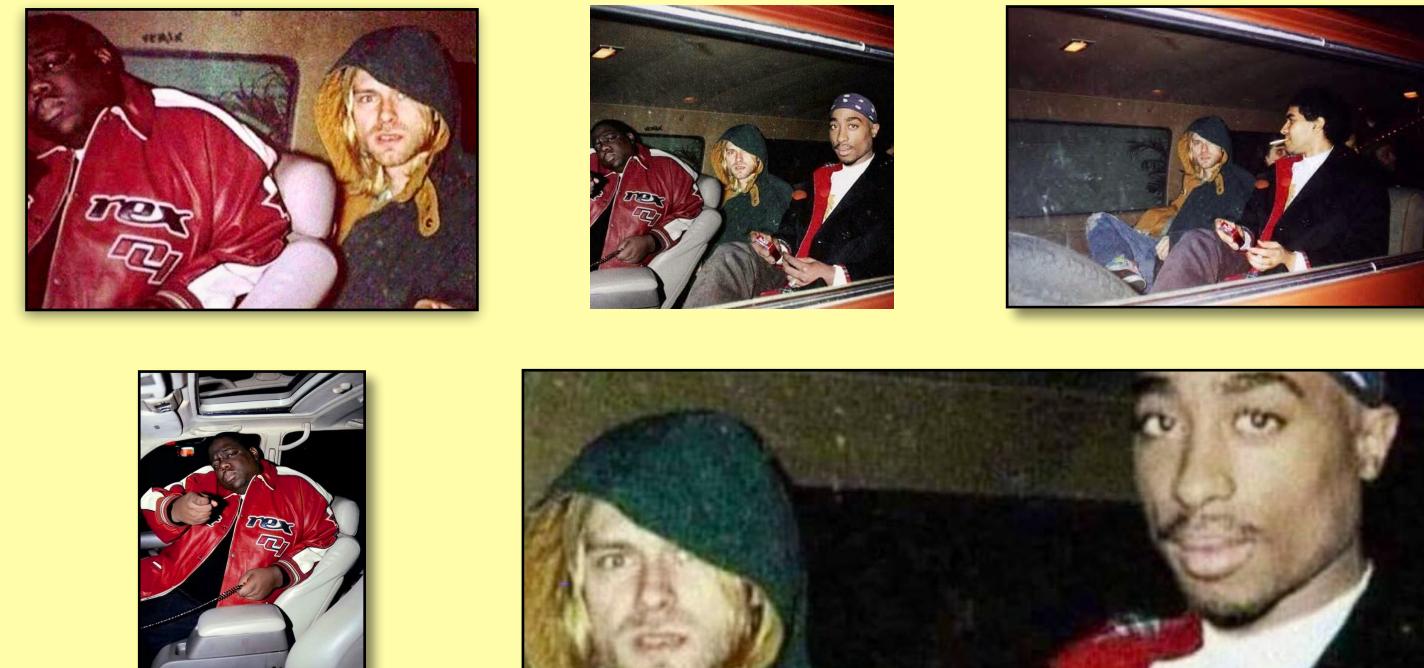
questioned image



image database
(e.g., Internet)

Solution

1. Image Filtering



Output

Two-Task Approach

Input



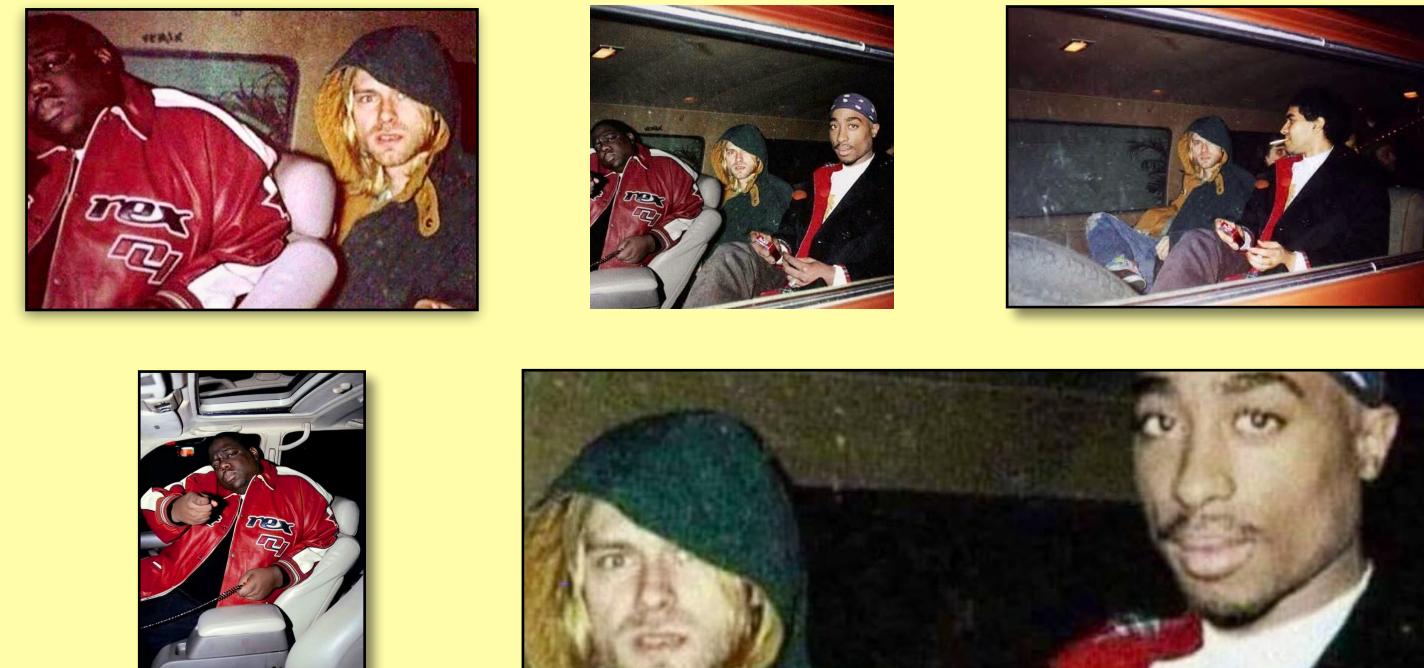
questioned image



image database
(e.g., Internet)

Solution

1. Image Filtering



2. Graph Construction



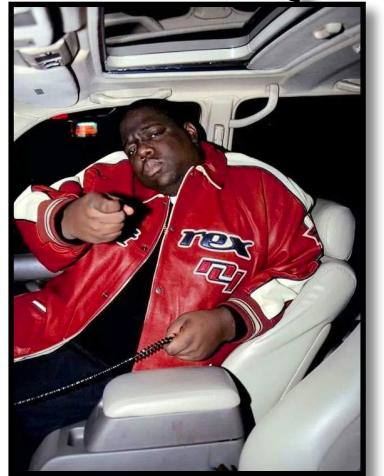
Output



composition



host

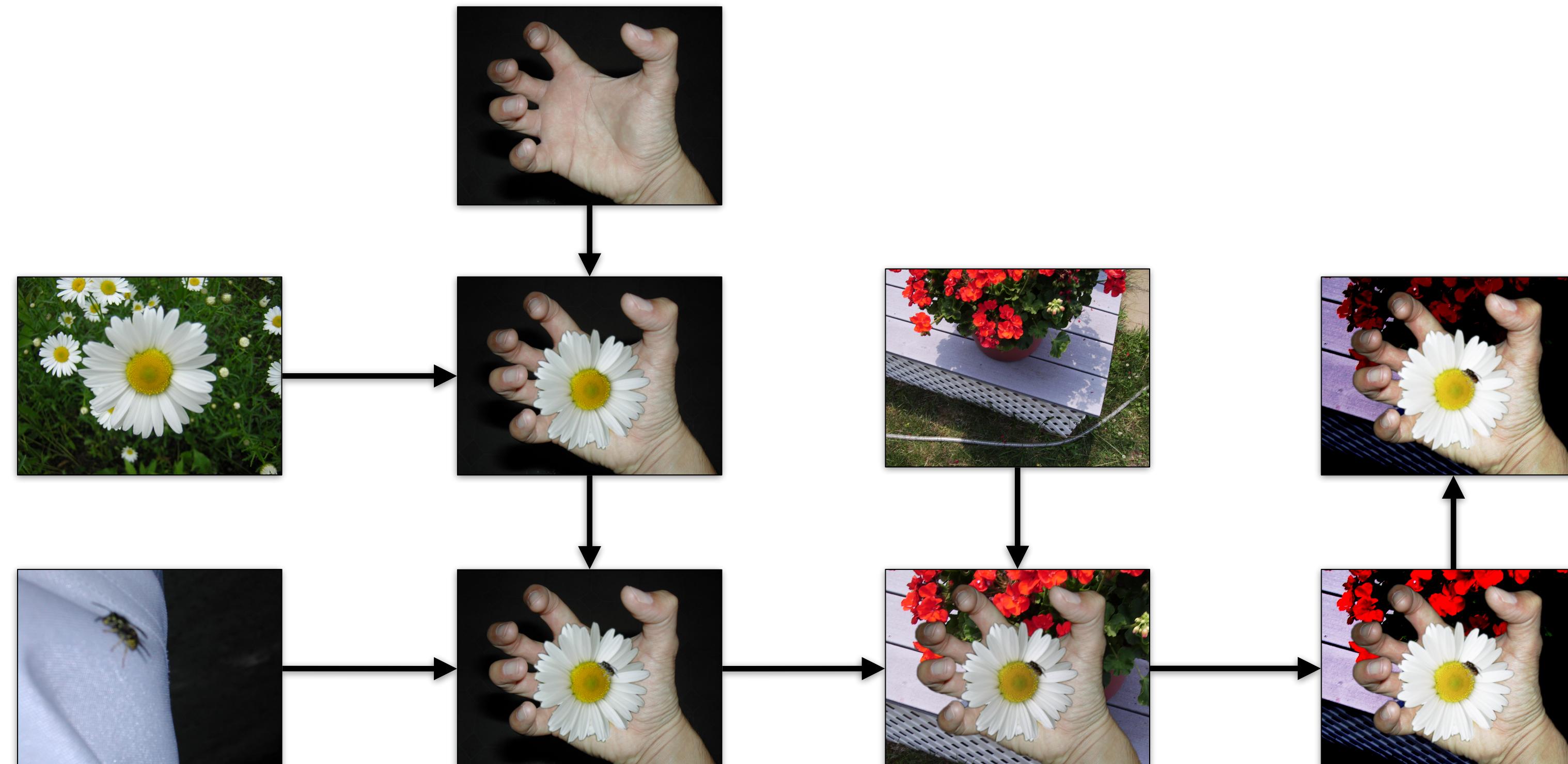


donor

Datasets



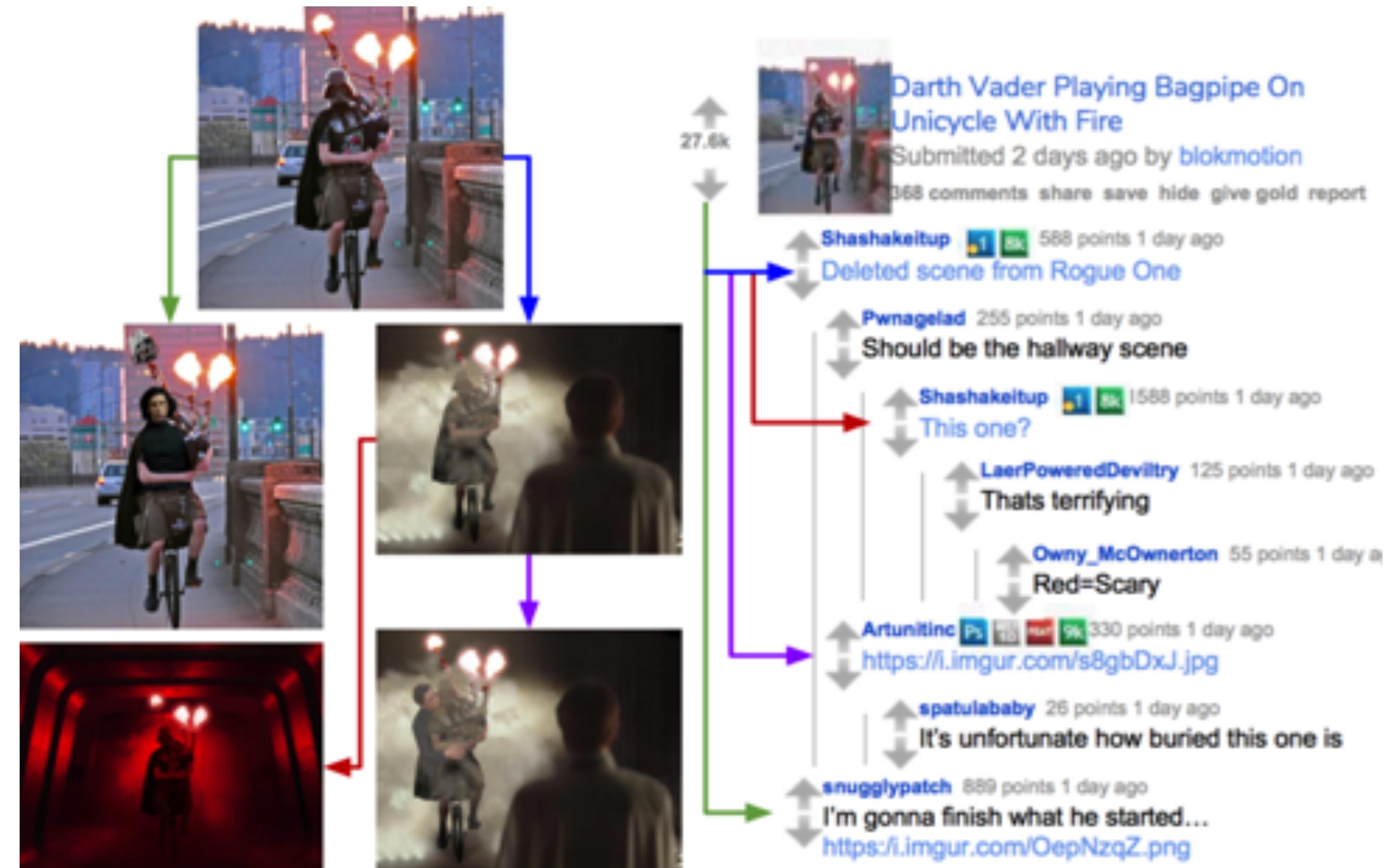
<https://www.nist.gov/publications/nimble-challenge-2017-evaluation-data-and-tool>



Datasets

Reddit Photoshop Battles

[https://github.com/CVRL/
Reddit_Provenance_Datasets](https://github.com/CVRL/Reddit_Provenance_Datasets)



Research Timeline

2017 (3 in IEEE ICIP)

- Pinto et al., *Provenance Filtering for Multimedia Phylogeny*

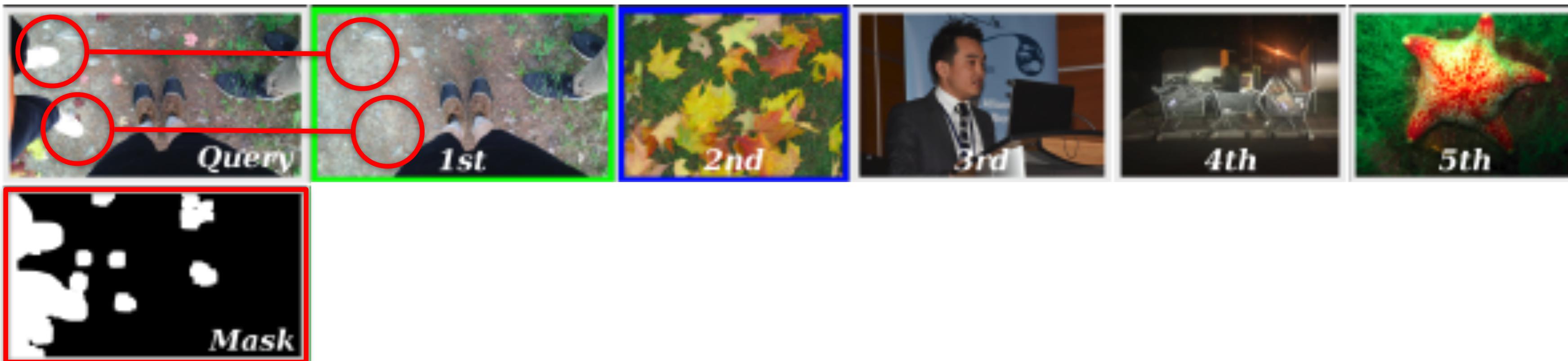


Typical Filtering

Research Timeline

2017 (3 in IEEE ICIP)

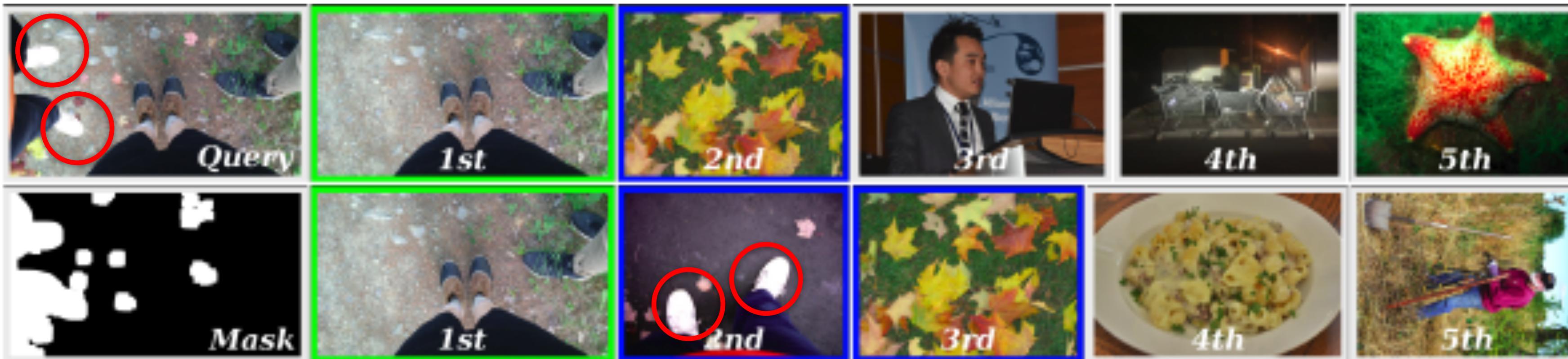
- Pinto et al., *Provenance Filtering for Multimedia Phylogeny*



Research Timeline

2017 (3 in IEEE ICIP)

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Typical Filtering

Provenance Filtering

Research Timeline

2017 (3 in IEEE ICIP)

Pinto et al., *Provenance Filtering for Multimedia Phylogeny*

Brogan et al., *Spotting the Difference: Context Retrieval and Analysis for Improved Forgery Detection and Localization*

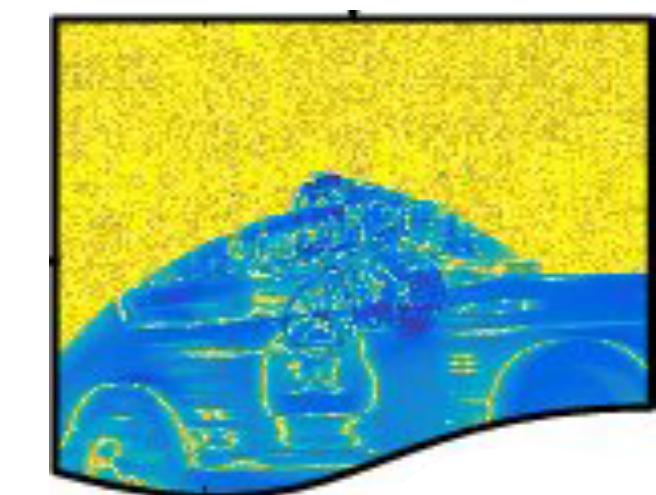


query



top retrieved

=



tampering

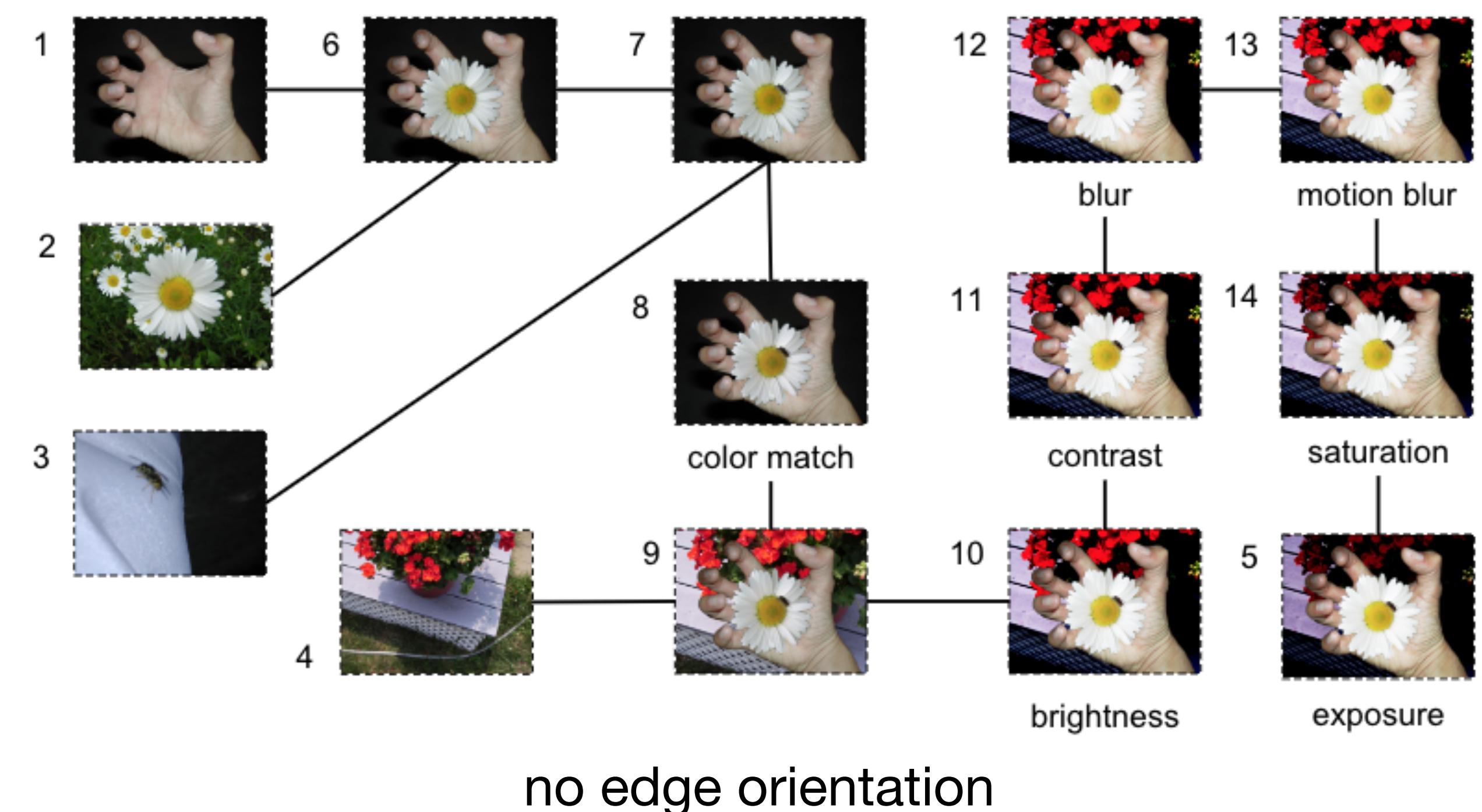


re-query

Research Timeline

2017 (3 in IEEE ICIP)

- Pinto et al., *Provenance Filtering for Multimedia Phylogeny*
- Brogan et al., *Spotting the Difference: Context Retrieval and Analysis for Improved Forgery Detection and Localization*
- Bharati et al., *U-Phylogeny: Undirected Provenance Graph Construction in the Wild*



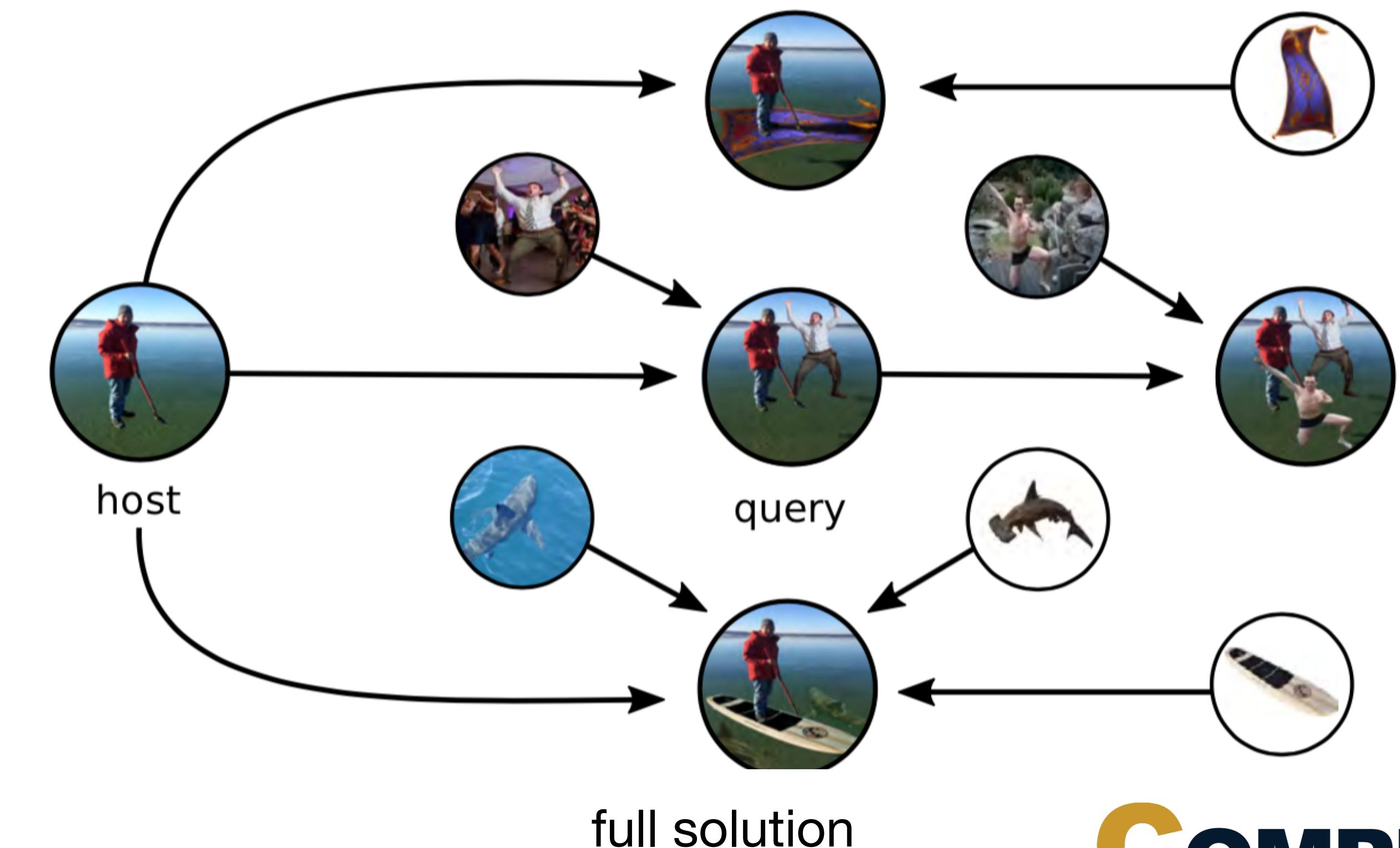
Research Timeline

2017 (3 in IEEE ICIP)

2018 (1 in IEEE T.I.P)

Moreira et al., *Image Provenance Analysis at Scale*

*Leading results in MediFor competition

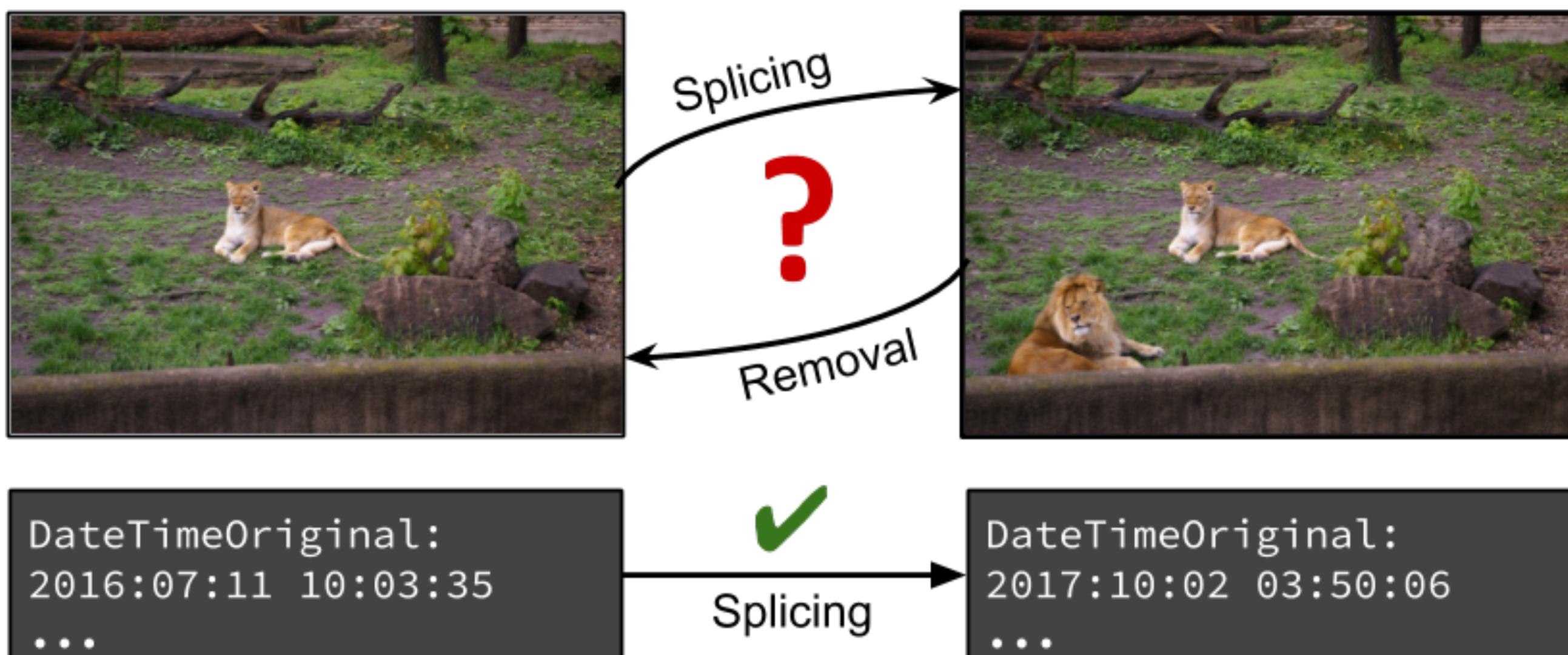


Research Timeline

2017 (3 in IEEE ICIP)

2018 (1 in IEEE T.I.P)

2019 (1 in IEEE WACV)

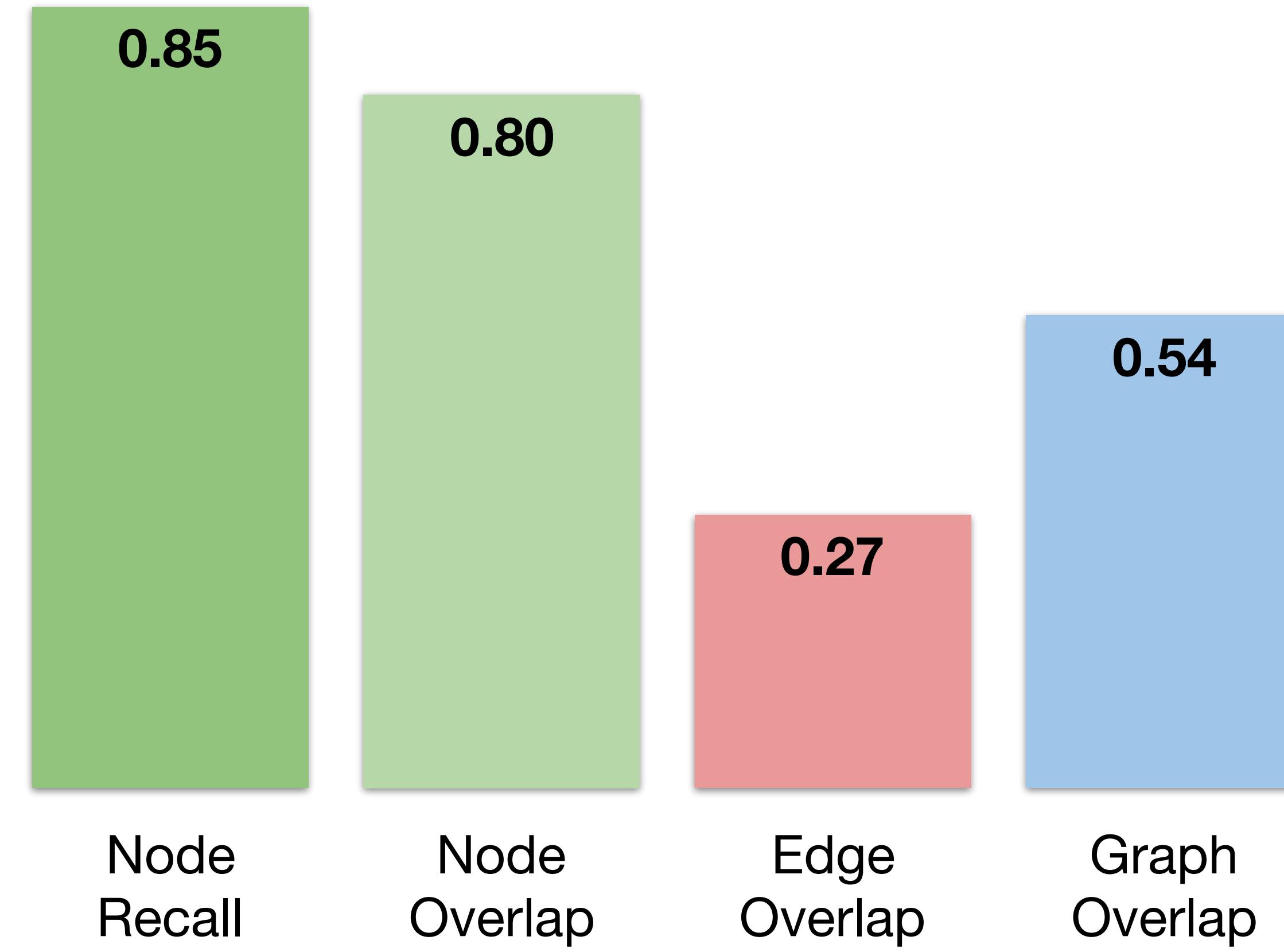


Bharati et al., *Beyond Pixels: Image Provenance Analysis Leveraging Metadata*



Poster later today

Best Results



Questions?



Thank you!

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