

COMBATING AI-GENERATED FAKE IMAGES

With JavaScript Libraries

Kate Sills katelynsills.com



WE USE PHOTOS AS EVIDENCE OF WHAT IS TRUE









NOW WE CAN'T TRUST ANYTHING WE SEE

LOOKING FOR AI "TELLS"

How to Spot an AI-Generated Image Like the 'Balenciaga Pope'

A closer look at the Balenciaga Pope image

TIME

His **eyelid** appears to merge into his glasses then flow into their own shadow







His **fingers** are closed around thin air rather than the coffee cup he carries The **crucifix** is held inexplicably aloft with the other half of the chain missing

THE ARMS RACE: DETECTION VS GENERATION

CHEAP TO PRODUCE, EXPENSIVE TO VERIFY

WE NEED TO PREPARE FOR A FIREHOSE OF FAKE IMAGES



COMBATING AI-GENERATED FAKE IMAGES

With JavaScript Libraries

Kate Sills katelynsills.com

Hi! 👋 I'm Kate

I'm a software engineer and consultant in applied cryptography. I live in the beautiful Sierra Nevada mountains. (This is a picture I took!)

I was previously the lead engineer on Agoric's smart contract framework.

This talk is the product of work with Starling Lab. Starling Lab is an academic research lab, co-founded by Stanford Electrical Engineering and the USC Shoah Foundation.

THE ALTERNATIVE TO AI "DETECTION"



♥ Q ♥ ···· 2,168 likes interioryesplz Sunny kitchen ♥ ↓ ... more WhoWho iswas thepublishingphotographer?this?

How was the photo edited?

When was this photo taken? Where was this photo taken?

 ♥
 ●
 ↓

 2,353 likes
 apartmenttherapy Pro design couple Savannah and Kaitlyn

 Stone (@ainslie_design_studio) made an an all-white living

apartmenttherapy Morton Grove, Illinois

> Who has investigated the photo?

Who are the owners of the home?

TWO CLASSES OF IMAGES



WITHOUT CREDIBLE METADATA.

ATTESTATIONS, **& SUPPORTING** DOCUMENTS



CREDIBLE METADATA. ATTESTATIONS, & SUPPORTING DOCUMENTS

CAN'T AI JUST GENERATE FAKE DATA TO GO WITH THE IMAGES? WE CAN RAISE THE BAR IN HOW WE COLLECT, STORE, AND VERIFY IMAGES USING CRYPTOGRAPHY

I. WE CAN MAKE IT IMPOSSIBLE TO CREDIBLY BACKDATE AN IMAGE

2. WE CAN MAKE IT IMPOSSIBLE TO FAKE SOURCES AND TAMPER WITH CLAIMS





Date: June 5, 1989 Location: Tiananmen Square, Beijing, China

TO MAKE IT IMPOSSIBLE TO BACKDATE AN IMAGE: USE A TIMESTAMPING SERVICE

TIMESTAMPING SERVICE

Submit an image, get a proof that the image existed before a certain point in time.

Must timestamp proactively (ideally ASAP after file creation)

"All the News That's Fit to Print" The New York Times

Late Edition

New York, Tarley, sporada rain, High 14. Toirght, pendsy dense ing. Low tel Forestow, have shan and alternant

UNITS SAID TO CLASH

Troops in Capital Seem

to Assume Positions

Against an Attack

By NOCHOLAN & RELEDON

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NEW YORK, TUESDAY, JUNE 6, 1989

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Communists Concede Victory by Solidarity And Call for Coalition

By HENRY LAND

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BUSH BARS ARMS SALES TO CHINA

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Communists Concede Victory by Solidarity And Call for Coalition

By HENRY LAND

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UNITS SAID TO CLASH

Troops in Capital Seem to Assume Positions Against an Attack

By NOCHOLAN & RELEDON description from the Appendix

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"Dennial Cold War" Scon-"The thread of stord war toon on larger its excluded," a Western signs mar baid

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Superconductors Showing a Flaw democracy and the social order."



By LINDA CREENINGLISE. Approval or Providence Visite Transm



CRYPTOGRAPHIC HASH

A cryptographic hash is a unique identifier derived from the contents.

CRYPTOGRAPHIC HASH FUNCTIONS

- 1. Take any input size
- 2. Produce a fixed-size output
- 3. Are collision-resistant
 - a. Produce a unique "digital fingerprint"
- 4. "Hide" the input
- 5. Are cheap to compute



DEMO



Øx3a176c0ca3ea
 f4ad7d0532b946
 a514587bfa0827
 e236dc695c9d78
 802156e2cd

JAVASCRIPT LIBRARIES FOR HASHING

- Built-in Web Crypto API
 - crypto.subtle.digest('SHA-256', arrayBuffer)

• @noble/hashes

sha256.create().update(new
 Uint8Array(arrayBuffer)).digest()

CRYPTOGRAPHIC HASH FUNCTIONS

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0xb8668593b fe1ed03f11b 18db597fc22 1ea505936ad b0af3beb182 1e0ae0e53b6





"There exists an image of a man in front of tanks"











ANCHORING



ANCHORING







The hash is calculated on your browser preserving your privacy. **More**... Timestamping proof download will start automatically after uploading document.

Γ

JAVASCRIPT LIBRARIES FOR TIMESTAMPING

• OpenTimestamps

- const p = OpenTimestamps.DetachedTimestampFile.fromBytes(new OpenTimestamps.Ops.OpSHA256(), fileBytes,
 - await OpenTimestamps.stamp(p);

I. WE CAN MAKE IT IMPOSSIBLE TO CREDIBLY BACKDATE AN IMAGE

CAVEATS:

- MUST PROACTIVELY TIMESTAMP
- SOMEONE MUST KEEP THE PROOF
- DOESN'T HANDLE OTHER VERSIONS OF THE SAME FILE

2. WE CAN MAKE IT (NEARLY) IMPOSSIBLE TO FAKE SOURCES





DIGITAL SIGNATURES

Using cryptography, we can sign a piece of data in a way that can't be forged or repudiated

DIGITAL SIGNATURES ALLOW US TO SHARE SECONDHAND DATA AS IF IT CAME DIRECTLY FROM THE SOURCE



2,353 likes apartmenttherapy Pro design couple Savannah and Kaitlyn Stone (@ainslie_design_studio) made an an all-white living

WE CAN SIGN METADATA & ATTESTATIONS ABOUT IMAGES Hash of image

Location: Morton Grove, Illinois

PubKey: Uint8Array(32) Signature: Uint8Array(64)





Date: June 5, 1989 Location: Tiananmen Square, Beijing, China

Location: Tiananmen Square, Beijing, China



Signature by photographer
Signature by AP
Signature by open source investigators

Location: Tiananmen Square, Beijing, China



No signatures
Signatures by unknowns
Forged signatures that don't verify

CAVEATS:

- PEOPLE MUST KNOW OUR PUBLIC KEY
- SOMEONE MUST KEEP THE SIGNATURE DATA

JAVASCRIPT LIBRARIES FOR DIGITAL SIGNATURES

- @noble/ed25519 for server usage only!
 - signAsync(data, privateKey)
- Better: use a crypto wallet
 - o Metamask "personal_sign"
 - window.ethereum.request({
 "method": "personal_sign", "params": ... });

METAMASK "PERSONAL_SIGN" ECDSA SECP256K1



TWO CLASSES OF IMAGES



WITHOUT CREDIBLE METADATA.

ATTESTATIONS, **& SUPPORTING** DOCUMENTS



CREDIBLE METADATA. ATTESTATIONS, & SUPPORTING DOCUMENTS

PROJECT FROM STARLING LAB: AUTHENTICATED ATTRIBUTES

Status: demo released

CODE: github.com/starlinglab/authenticated-attributes

IN ORDER TO COMBAT FAKE IMAGES, WE HAVE TO RAISE THE BAR FOR WHAT WE EXPECT FROM REAL IMAGES

WE, THE SOFTWARE ENGINEERS, NEED TO BUILD SYSTEMS THAT ALLOW US TO MEET THAT HIGH BAR



THANKS!

github.com/starlinglab/authenticated-attributes

starlinglab.org katelynsills@gmail.com katelynsills.com

Please vote and leave feedback!



Remember to vote and share feedback on the QCon App. Any questions?