Identifying Almost Identical Files Using Context Triggered Piecewise Hashing

By

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ManTech SMA

Computer Forensics and Intrusion Analysis

Fuzzy Hashing

Jesse Kornblum

Overview

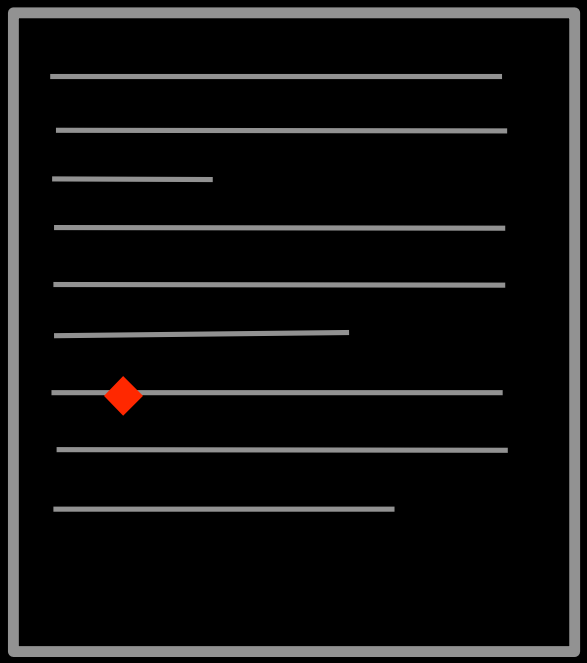
- Too Many Pictures
- Cryptographic Hashing
- Fuzzy Hashing
- Demonstration
- Issues
- Future Research
- Questions

Too Many Pictures

- Child Pornography cases
  - Hundreds of thousands of images
  - MD5 not effective for carved files

Cryptographic Hashing

- Algorithms like MD5, SHA-1
- Generate single hash for entire input
- Any change greatly alters hash

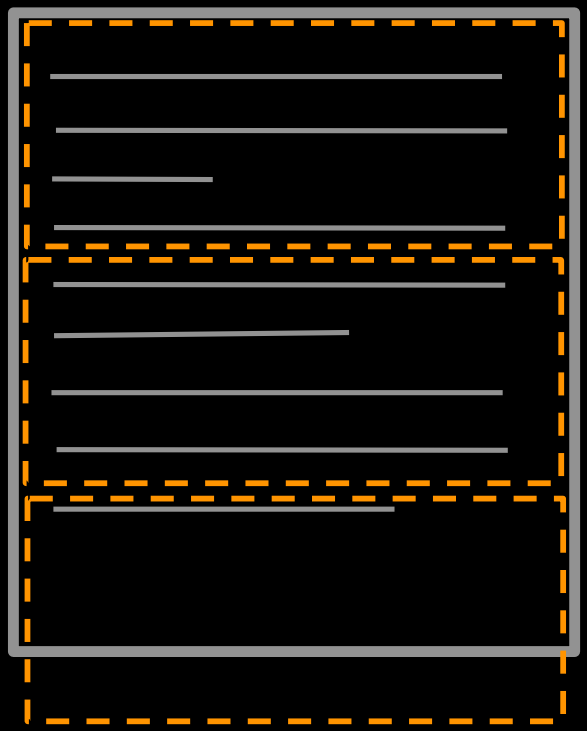


~~e41b1427a018fbb264c8adf0a~~

7f48e4b990a2d637fc363efc8

Piecewise Hashing

- Developed for integrity during imaging
- Divide input into equal sized sections and hash
- Insert or delete changes all subsequent hashes



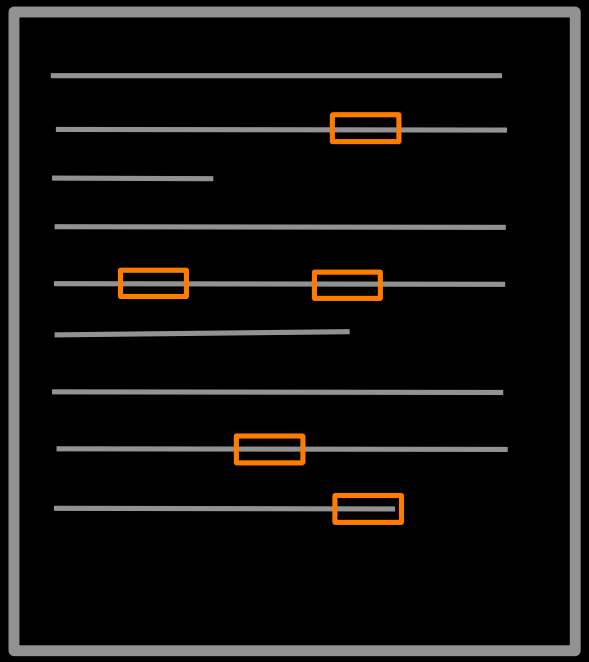
3b152e0baa367a8038373f6df

40c39f174a8756a2c266849b

fdb05977978a8bc69ecc46ec

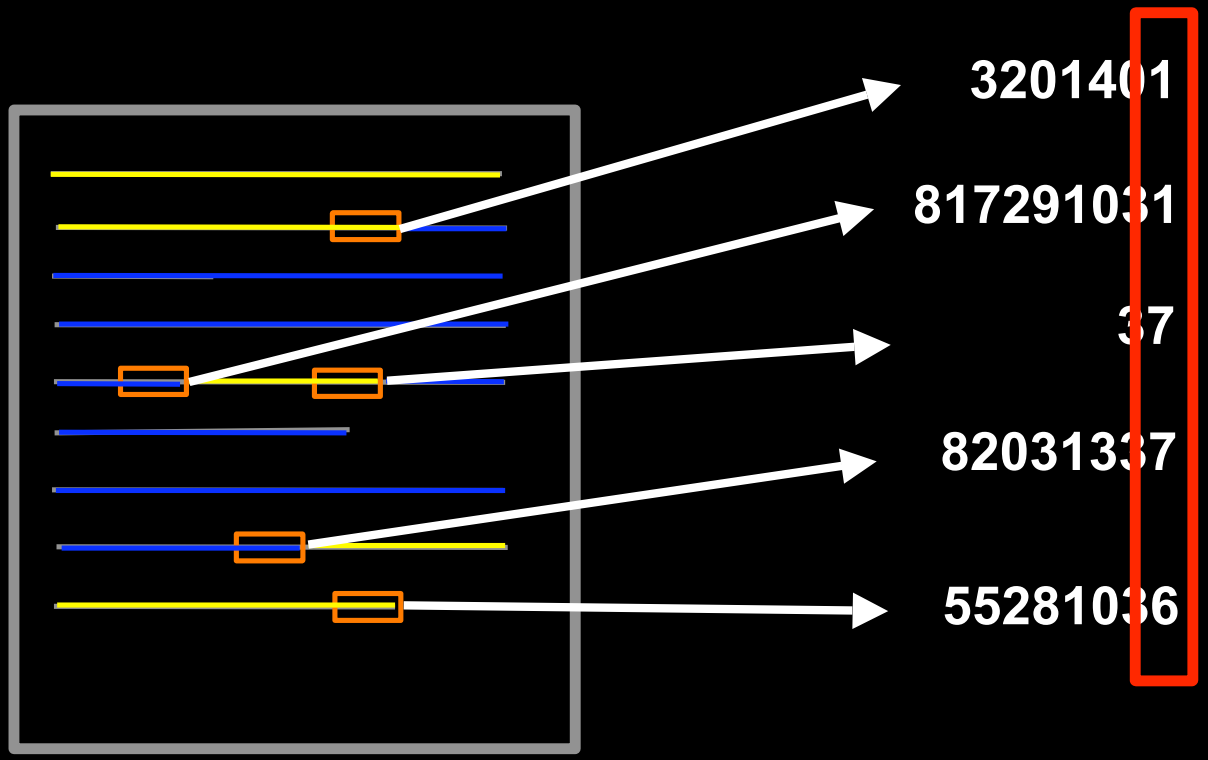
Rolling Hash

- Function triggered by current context of input



Fuzzy Hashing

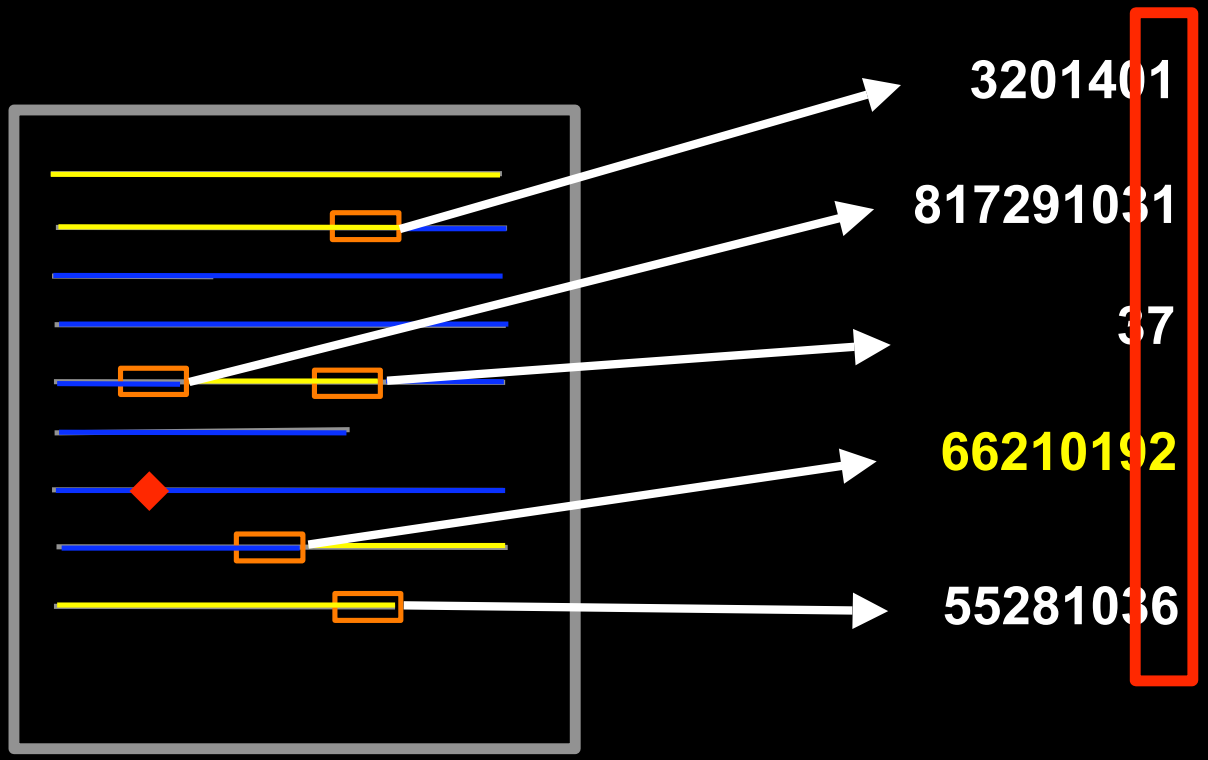
- Piecewise hashing with boundaries defined by when rolling hash triggers



Signature: 11776

Fuzzy Hashing

- Changes only affect one small part of signature



New Signature: 11726

Original: 11776

Rolling Hash

To update the hash for a byte d:

y = y – x

y = y + size * d

x = x + d

x = x – window[c mod size]

window[c mod size] = d

c = c + 1

z = z << 5

z = z XOR d

return (x + y + z)

Rolling Hash

- Choose triggers such that
  - rolling_hash(d) mod block_size = block_size – 1
  - Depends only on previous seven bytes

- Example
  - Excerpt from "The Raven" by Edgar Allan Poe
  - Based on file size, triggers on ood and ore

Rolling Hash

Deep into the darkness peering, long I stood there, wondering, fearing

Doubting, dreaming dreams no mortals ever dared to dream before;

But the silence was unbroken, and the stillness gave no token,

And the only word there spoken was the whispered word,

Lenore?, This I whispered, and an echo murmured back the word,

"Lenore!" Merely this, and nothing more.

Rolling Hash

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Rolling Hash

Deep into the darkness peering, long I stood 243732

there, wondering, fearing Doubting, dreaming dreams no mortals
ever dared to dream before 610

; But the silence was unbroken, and the stillness gave no token,

And the only word there spoken was the whispered word,Lenore
3270168

?, This I whispered, and an echo murmured back the word,"Lenore
53280

!" Merely this, and nothing more. 8381002

Demonstration

Demonstration

- Needle in a haystack

Known kitty porn

MATCH

Demonstration

- No false positives

Known kitty porn

no match
(00000380.JPG)

Demonstration

Known kitty porn

MATCH

Demonstration

- File footers

Known kitty porn

MATCH

Issues

- Not perfect
  - Confused by many small changes throughout input
  - Unable to handle cropping, resizing, and other edits
- Computationally intensive
  - 7-10 times slower than MD5
- No way to sort signatures
  - Must compare each input to all known signatures

Future Research

- Need Error Rate Computation
  - I am a practitioner, not math geek
- For court, need error rate
  - How similar is similar?

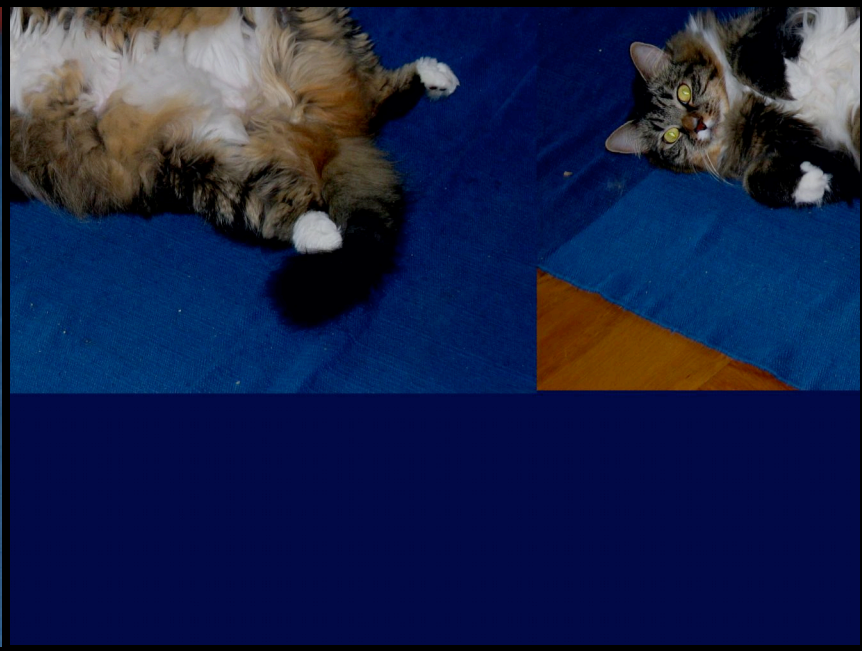
Future Research

- File Footer Reconstruction
  - Record headers when making signatures
  - Append recovered footers
- Need to parse known files
  - How much information to record?
  - Best storage method?

Future Research

- File footer Reconstruction

Known kitty porn



File header with footer appended

Future Research

- Finding footers and middles
  - Current carvers require true footer
  - Encase, iLook, Foremost, Scalpel, etc.
- The formatted drive scenario
- Find blocks that are "JPEGy" or "GIFy"
  - Lots of academic research
  - No practical tools

Coming Soon!

- ssdeep to be published August 14th
  - Free software!
  - http://ssdeep.sf.net/

Questions

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