Photo Archive Image Analysis

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http://ejohn.org/research/

Ukiyo-e.org

Japanese Woodblock Print Search

Ukiyo-e Search provides an incredible resource: The ability to both search for Japanese woodblock prints by simply taking a picture of an existing print AND the ability to see similar prints across multiple collections of prints. Below is an example print, click to see it in action.

Search 213,657 prints:

Search | Search

Search by Image:

Upload a picture of a print to find similar prints across multiple collections.

Upload an Image | Paste image URL

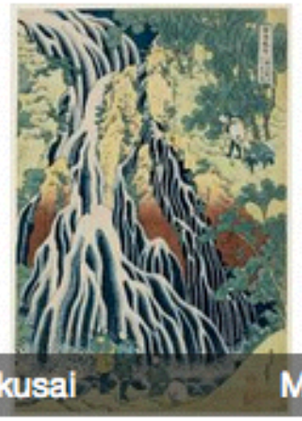
Choose File | No file chosen | Search by Image

Notice: This site is simply **demonstration** of what is possible using some of the data from a few museum collections. Better data, hundreds of thousands of additional images, and better search capabilities are forthcoming. Sign-up to be notified when additional features are ready.

Subscribe for Updates

Email Address | Subscribe

Early Ukiyo-e (Early-Mid 1700s)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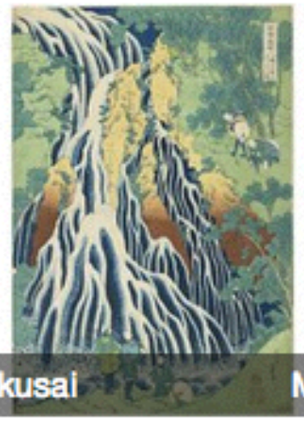
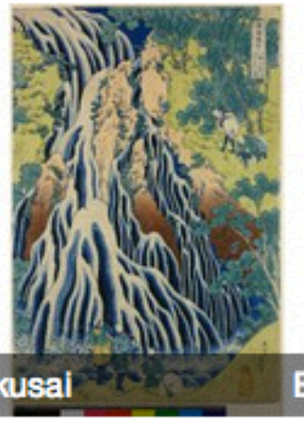
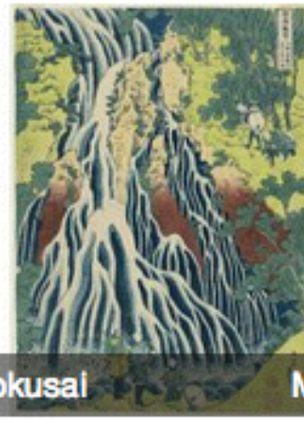
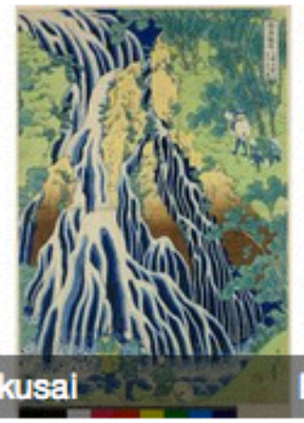

Hokusai MIA


Hokusai BM


Hokusai MF

Hokusai Hono.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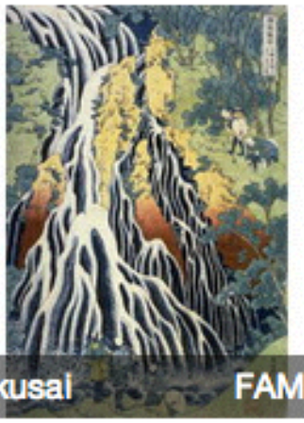

Hokusai FAMSF

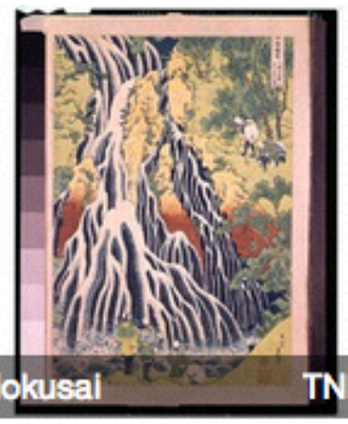
Hokusai Krum

Hokusai Harvard

Hokusai MET

Hokusai LoC

Hokusai TNM

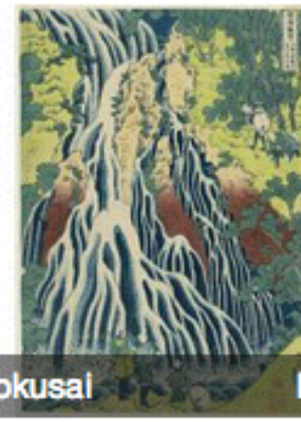

Hokusai TNM

Hokusai Rits

Hokusai MFA

Hokusai MIA

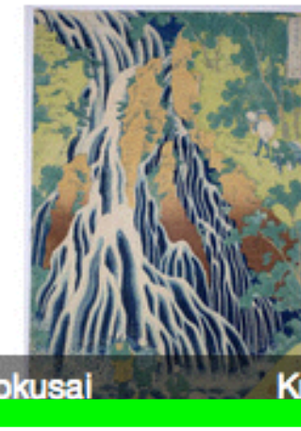
Hokusai BM


Hokusai MF

Hokusai Hono.

Hokusai BM

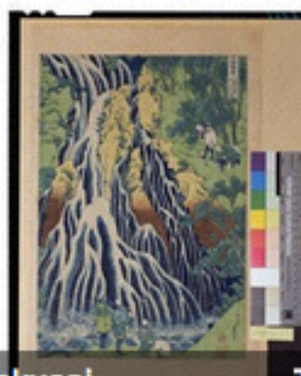
Hokusai FAMSF


Hokusai Krum

Hokusai Harvard

Hokusai MET

Hokusai LoC


Hokusai TNM

Hokusai TNM

Hokusai Rits

Similar Prints

Compare Prints...

Kiyonaga MET

Kiyonaga MFA

Kiyonaga Hono.

Kiyonaga MFA

Kiyonaga BM

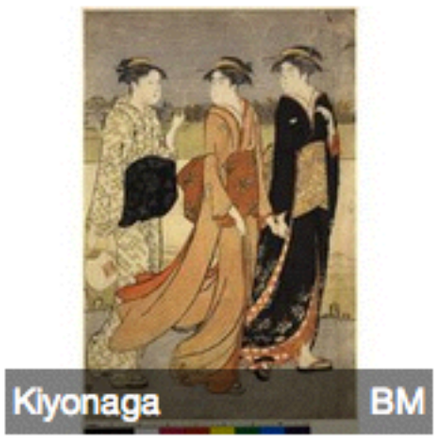
Kiyonaga MET

Kiyonaga Rits

Kiyonaga MFA

Similar Prints

Compare Prints...



Similar Prints

Compare Prints...

Kiyonaga MET

Kiyonaga MFA

Kiyonaga Hono.

Kiyonaga MFA

Kiyonaga BM

Kiyonaga MET

Kiyonaga Rits

Kiyonaga MFA

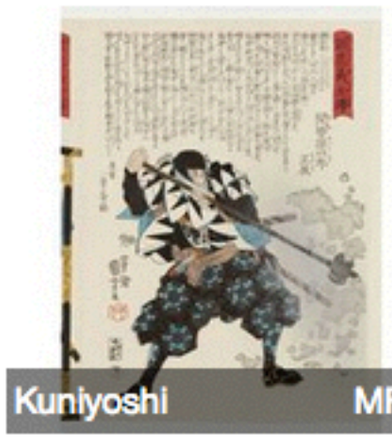
Similar Prints

Compare Prints...

Off
Options

Similar Prints

Compare Prints...


Kuniyoshi MFA

Kuniyoshi Tokyo

Unknown ETM

Kuniyoshi BM

Frick Art Reference Library Photoarchive

- Frick Art Reference Library Photoarchive established in 1920.
- Collects photographs of works of art from around the world, including sponsoring own photography.
- Traditionally image analysis has not been applied to photo archives.
- The Frick Photoarchive was interested in exploring image analysis more after seeing Ukiyo-e.org.

Test case: Anonymous Italian Art Photographs

- Anonymous Italian Art photographs are small part (~18,000) of over 1.2 million images in the Frick Photoarchive.
- Very few color photographs (makes most image analysis difficult, good test case).
- Analysis was performed by myself in collaboration with the Frick Photoarchive.

Digital Anonymous Italian Art

- Early digitization project.
- At the time there was no in-house digital lab at the Frick Photoarchive.
- Digitization self-funded and executed by an outside institution.
- When new images were added they were not “merged” -- too hard with no attribution.

Image Analysis

- I wrote custom software to automate matches using MatchEngine (a TinEye service).
- Extremely effective image matching technology.
- Matches same images and portions of images, even in black-and-white.

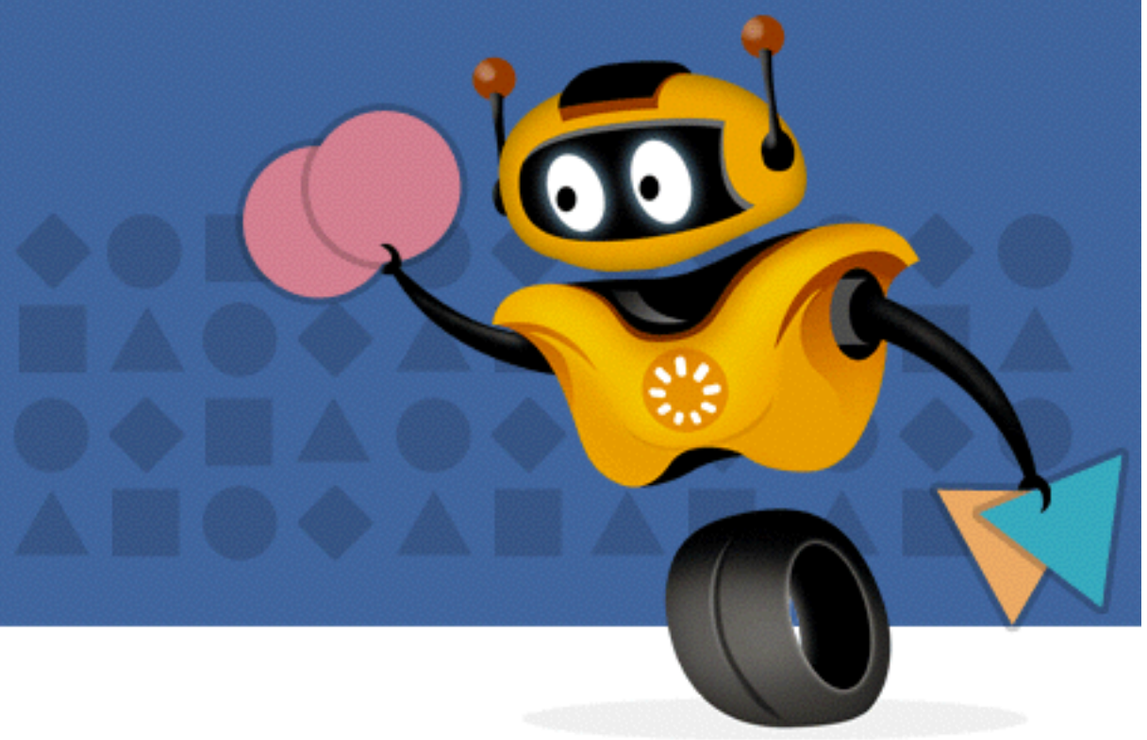
TinEye Services

Image recognition for your applications and enterprise.

MatchEngine

Deduplication, Matching, Filtering & Identification

Image recognition for your image collection, using TinEye's powerful algorithms.



What is MatchEngine?

MatchEngine is an automated image recognition service. It allows you to find duplicate, resized, and modified images in your image collection, using image recognition.

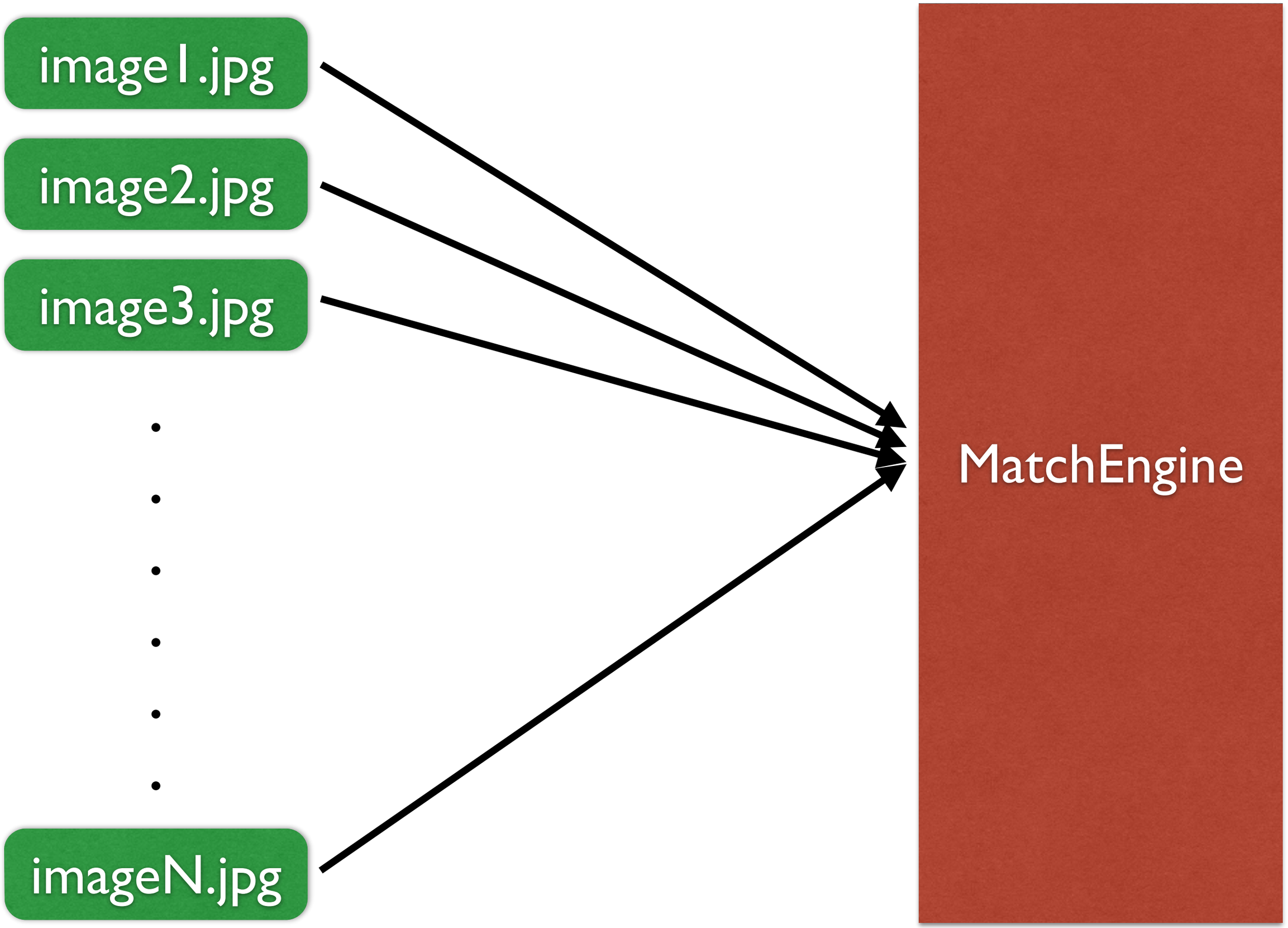
MatchEngine is a **fast and accurate image identification and recognition API** that is easily integrated with your own applications, enterprise solutions and web services.

MatchEngine deals with a broad range of image transformations, including resizing, cropping, Photoshop edits, occlusions, color changes, etc.

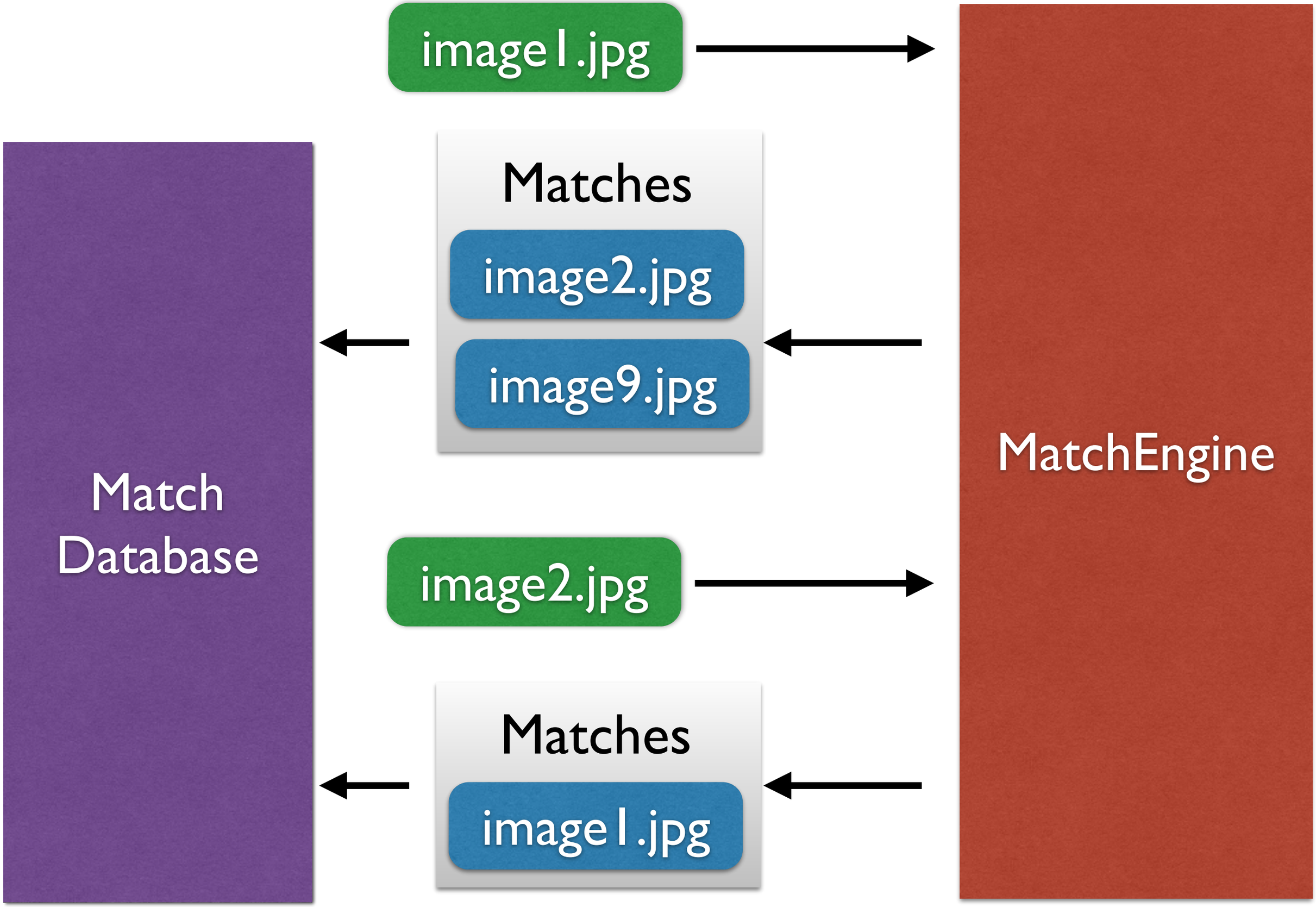
MatchEngine Features

- **Identifies duplicate images in large collections of images.**
- **Identifies modified versions of an original image.**
- **Can compare incoming images against an image whitelist or blacklist.**
- **Does not work for:**
  Identifying 3D objects, finding similar images, identifying faces, or mobile

Upload Images to MatchEngine



Retrieve Image Matches from MatchEngine



Archive (e.g. Frick Art Reference Library)

Artwork Image Image Image	Artwork Image Image Image	Artwork Image Image Image
Artwork Image Image Image	Artwork Image Image Image	Artwork Image Image Image

Confirming a Known Match

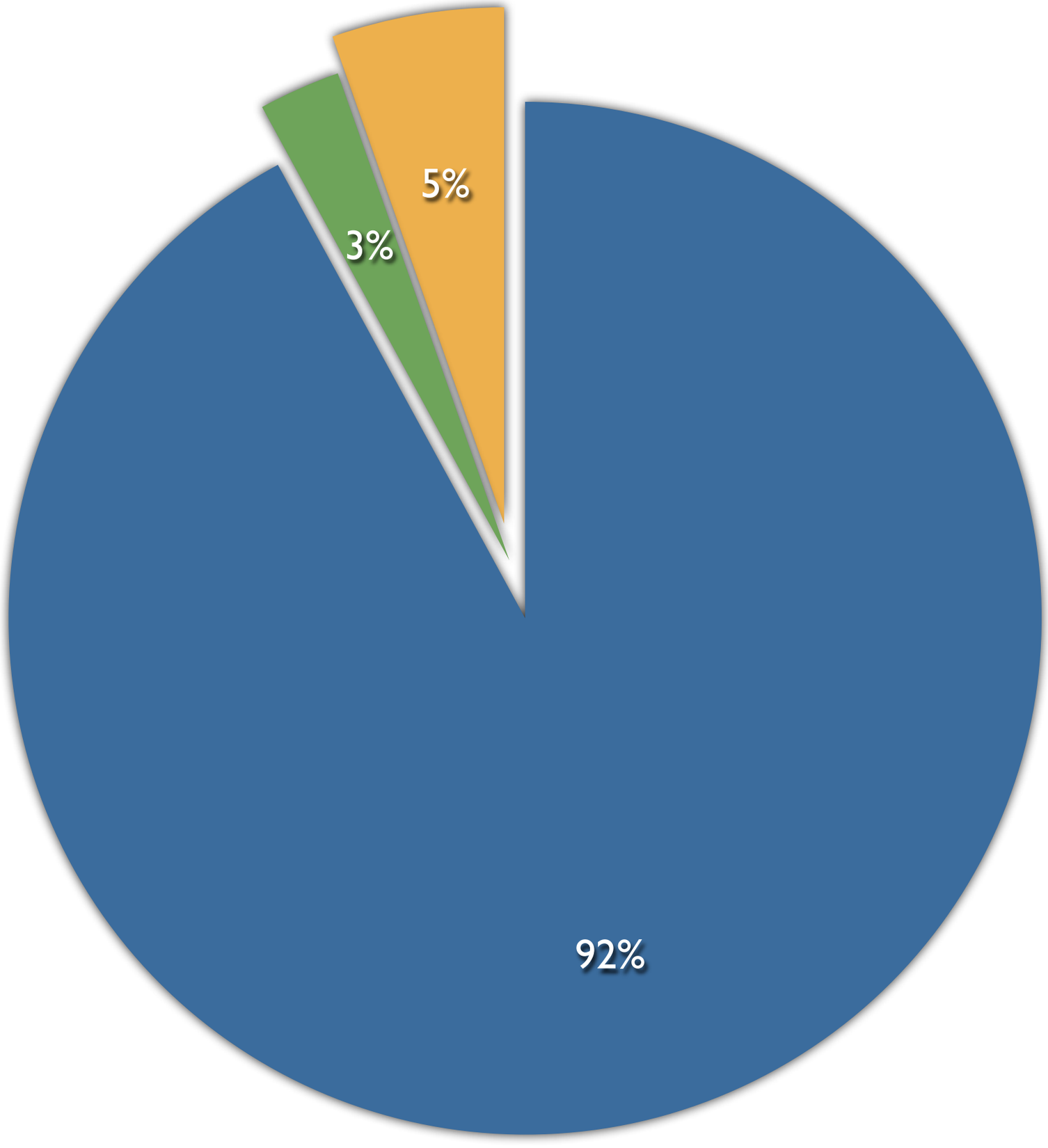
Artwork

Discovering a New Match

Artwork

Artwork

Frick Artworks That Have A Match



Artworks with no match

Confirms a known match

Matches a new work

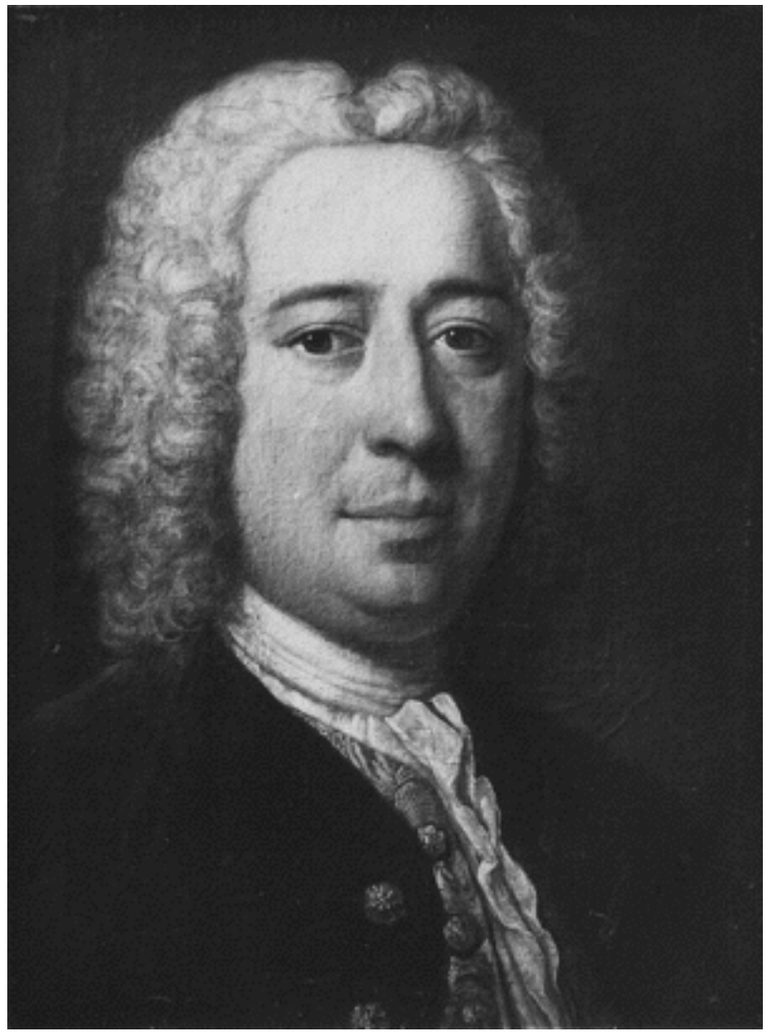
Similar Images

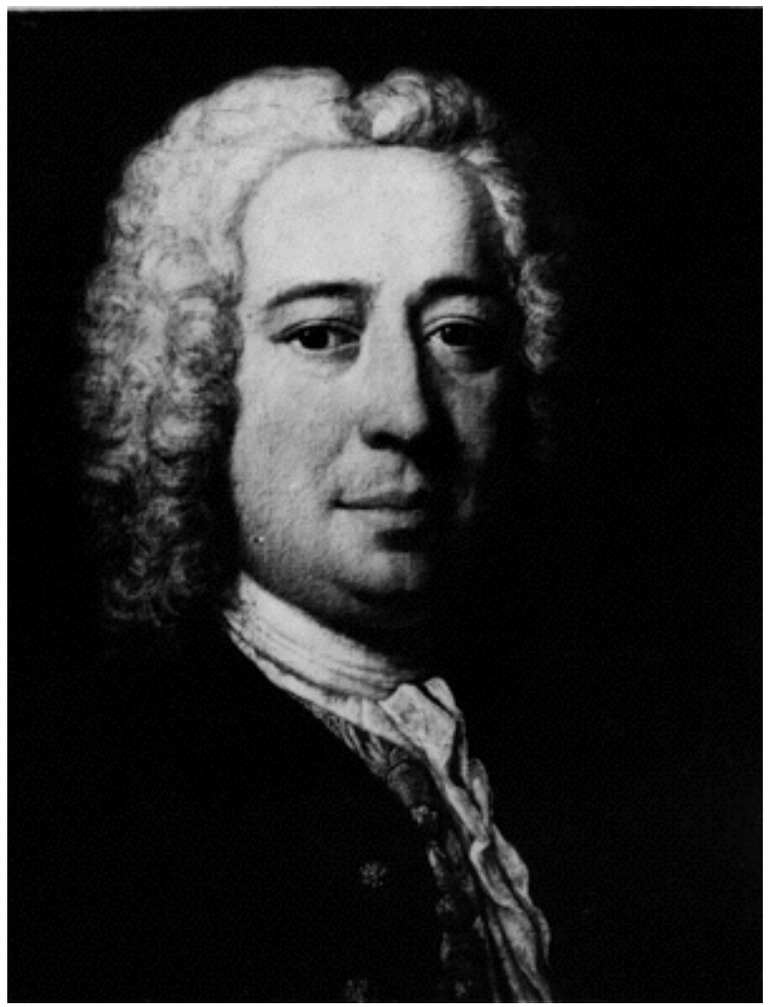
Different photo, same work of art.

Similar Images

Different photo, slightly different cropping.

Similar Images





Different photo, dramatically different lighting.

Alternate Images

Partial Image vs. Full Image

Alternate Images

Partial Image vs. Much Larger Image

Alternate Images

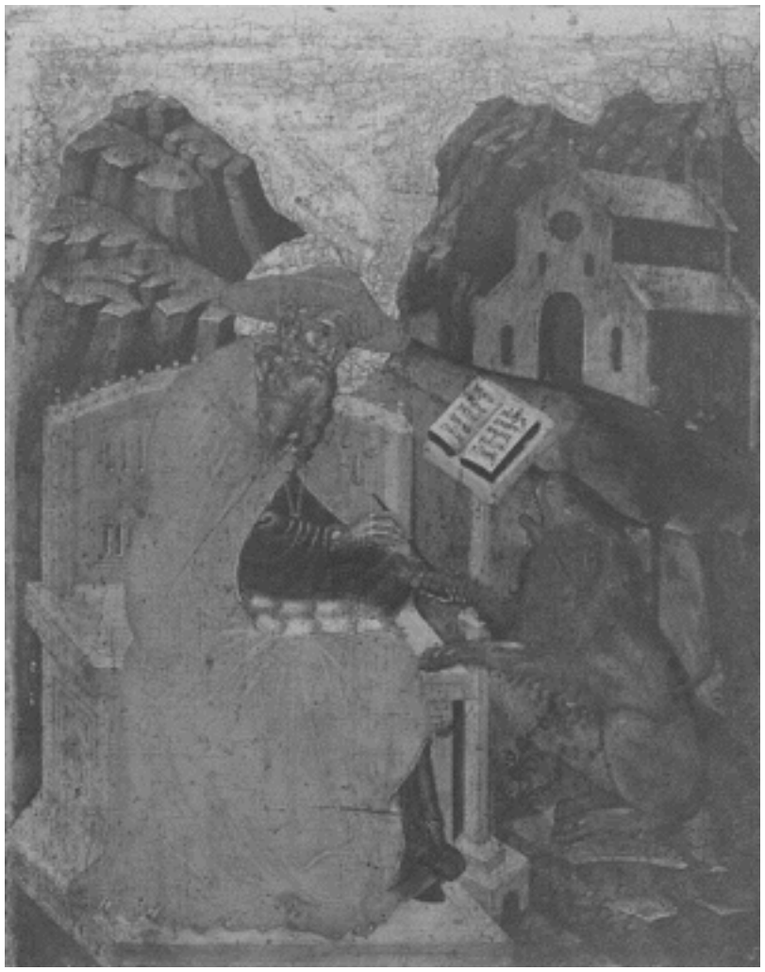
Color vs. Black-and-White

Conservation

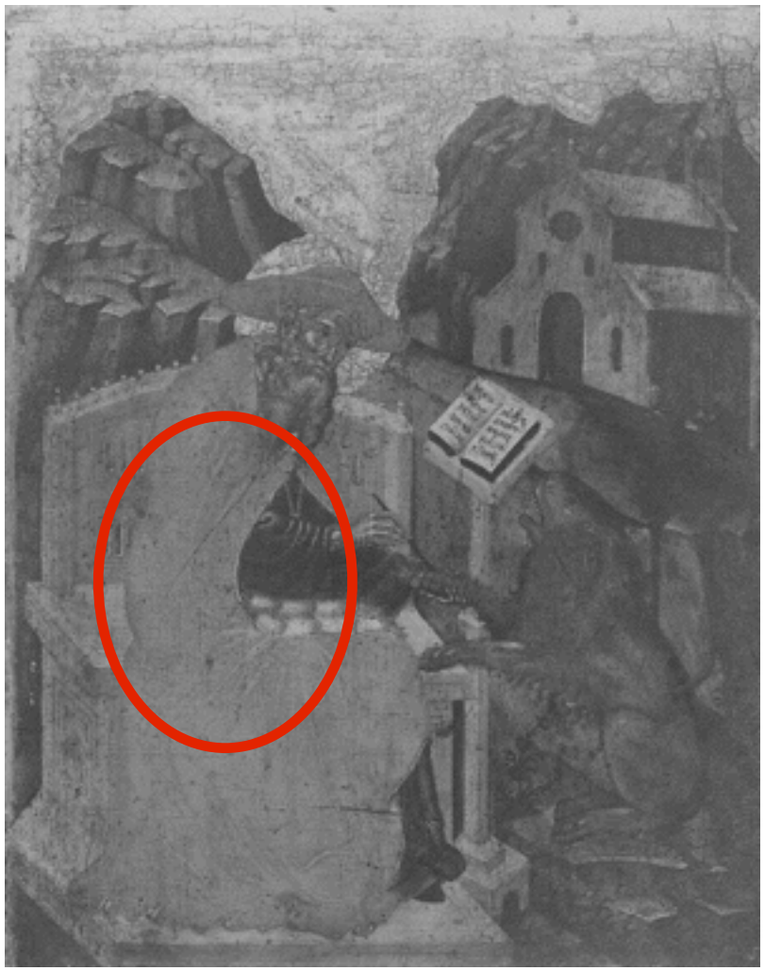
Conservation

Repairs and possibly removal of later additions.

Conservation



Conservation

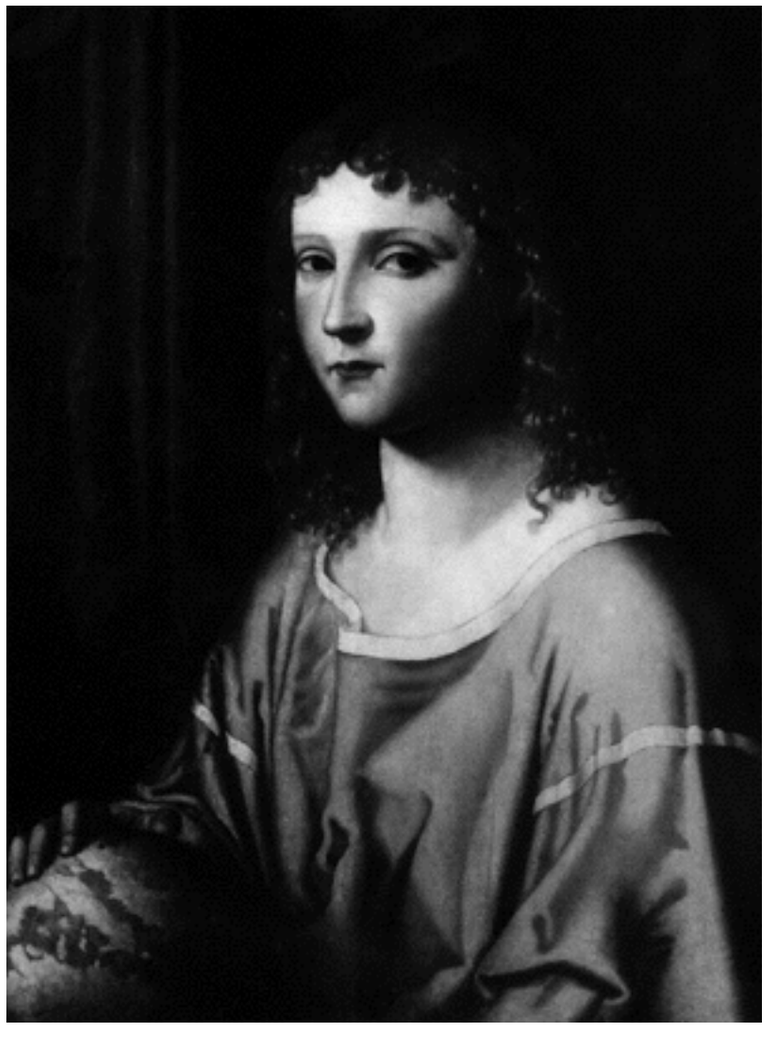


Possibly just a drastic difference in lighting?

Conservation

Analysis even spots dramatic conservation work.

Copies



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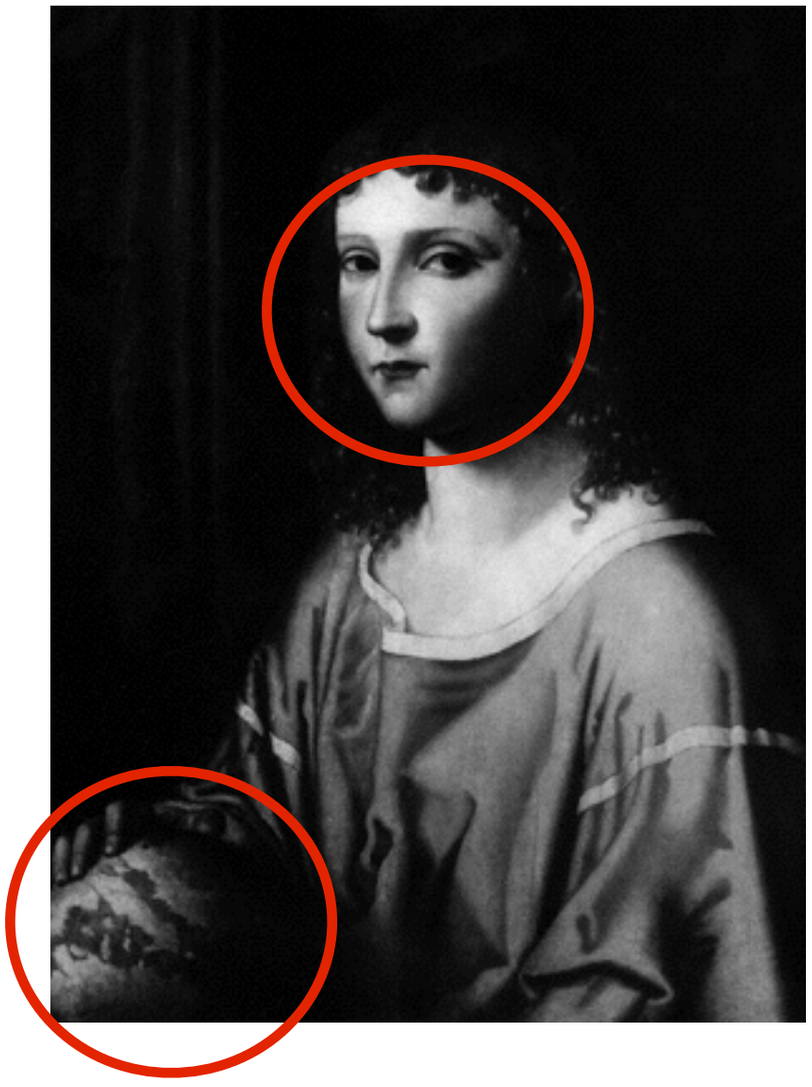
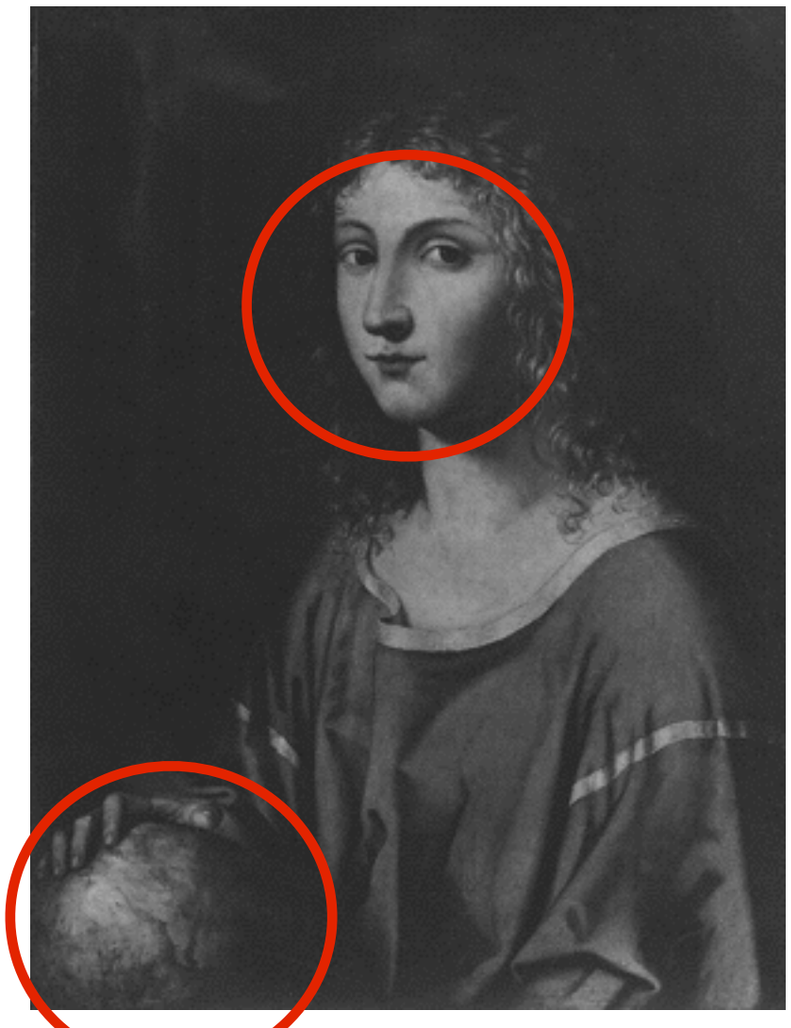
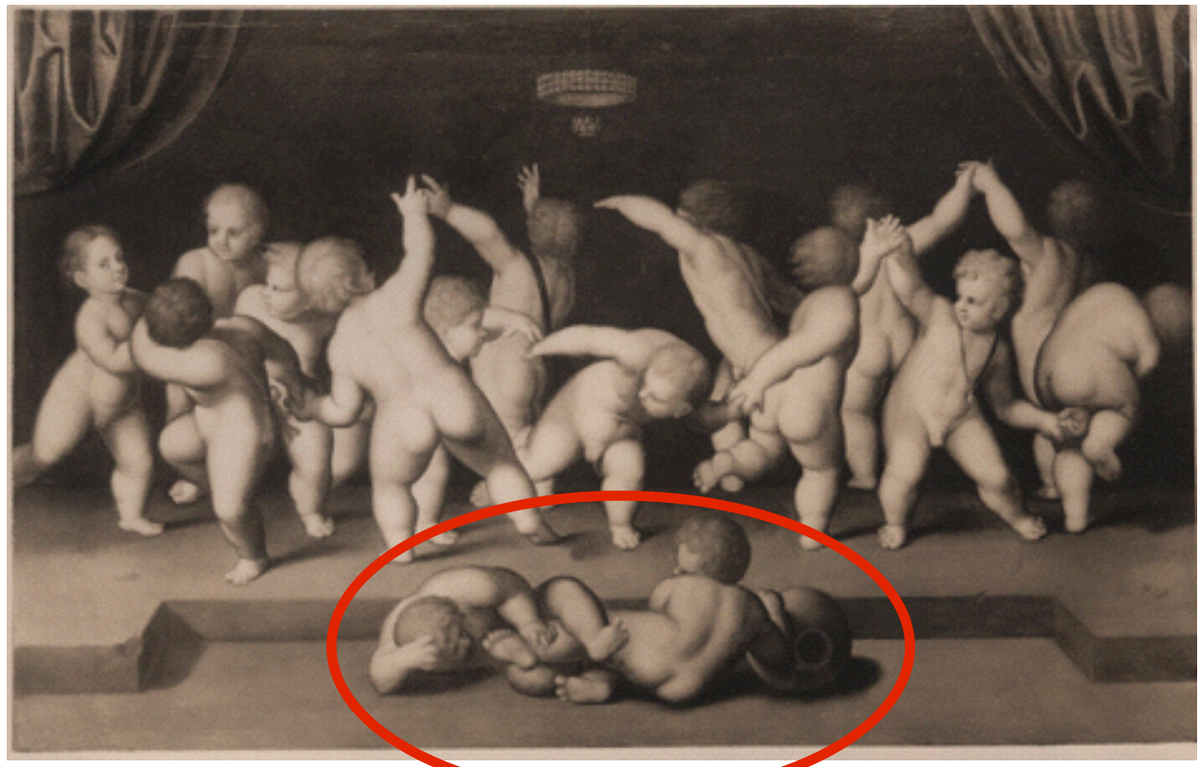




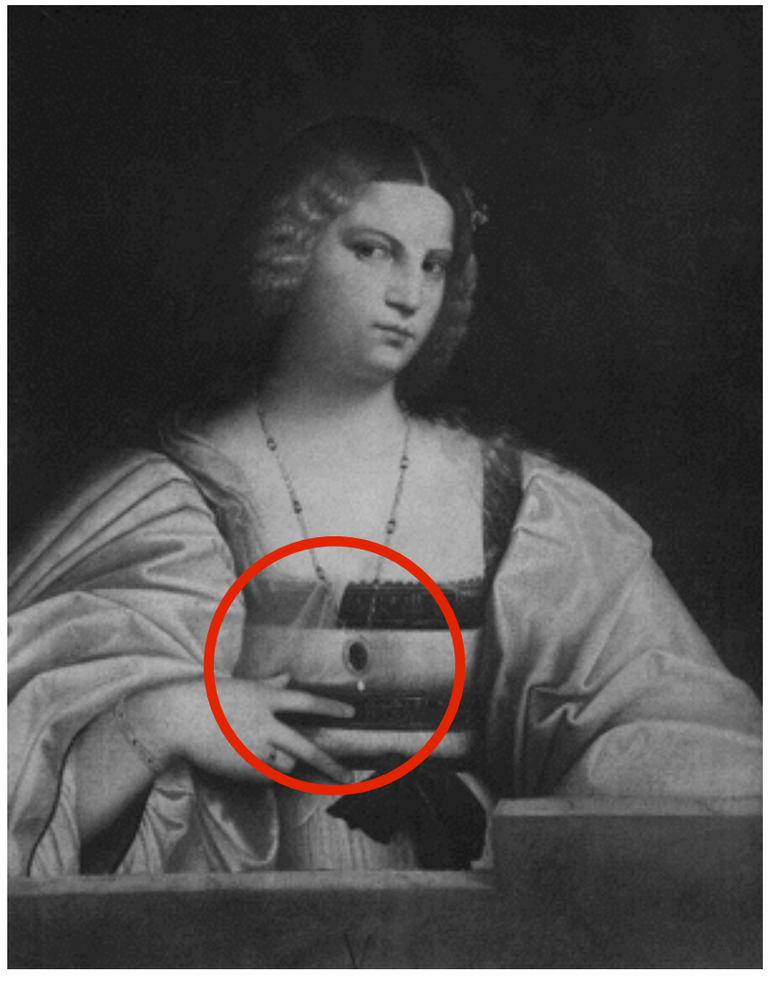
Copies

Copies



Copies

Copies



Digitization Errors

Arms with Folded Hands
Castello sforzesco, Milan.

Female Head
Gabinetto disegni e stampe
degli Uffizi, Florence.

Work doesn't match description, wrong cataloging.

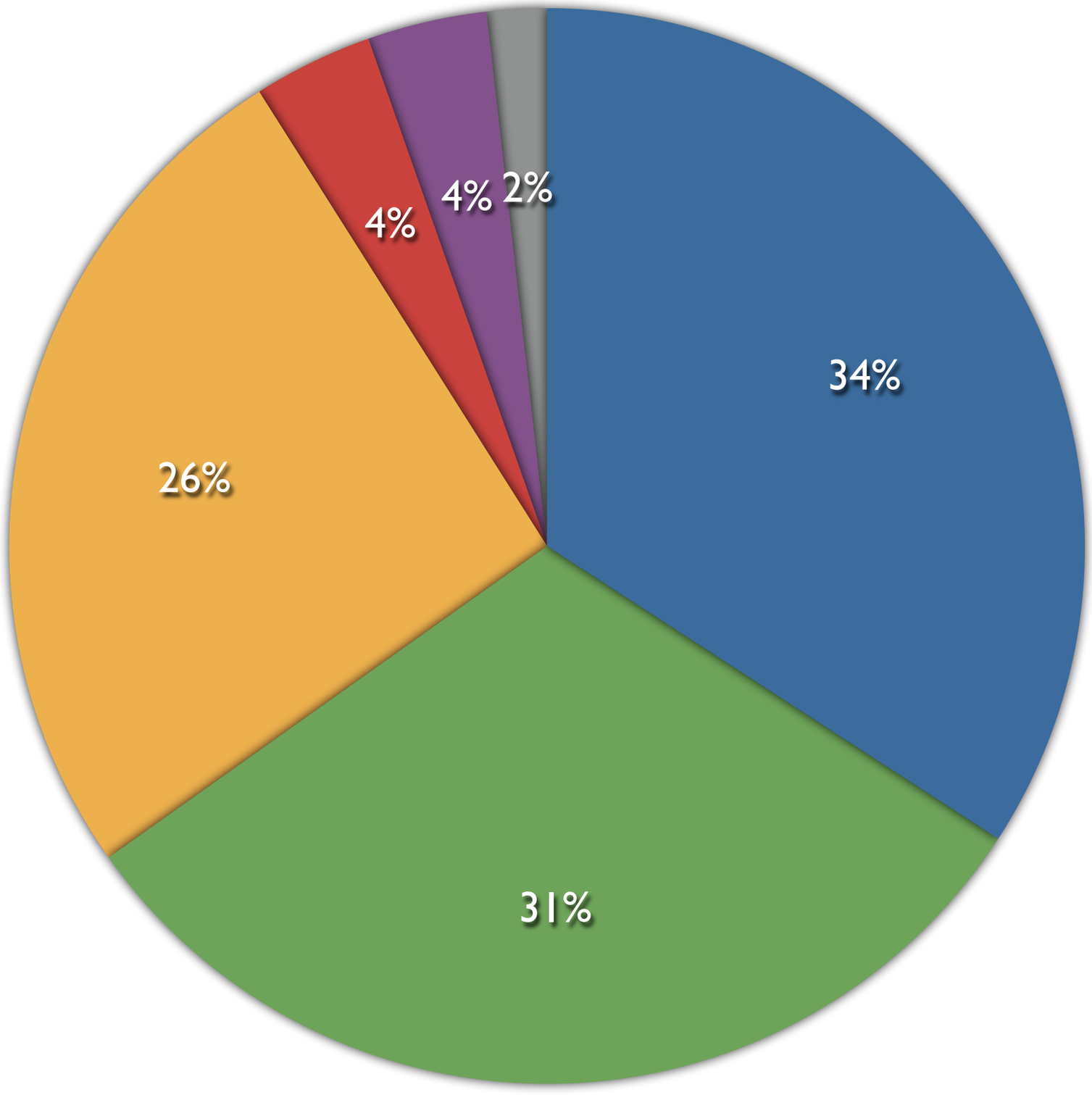
Still Life with a Bottle, a Plate, a Mortar and Pestle...

Virgin Enthroned Nursing Christ, Between Two Saints

S. Biovenale, Orvieto.

Work doesn't match description, wrong cataloging.

Types of New Matches Discovered



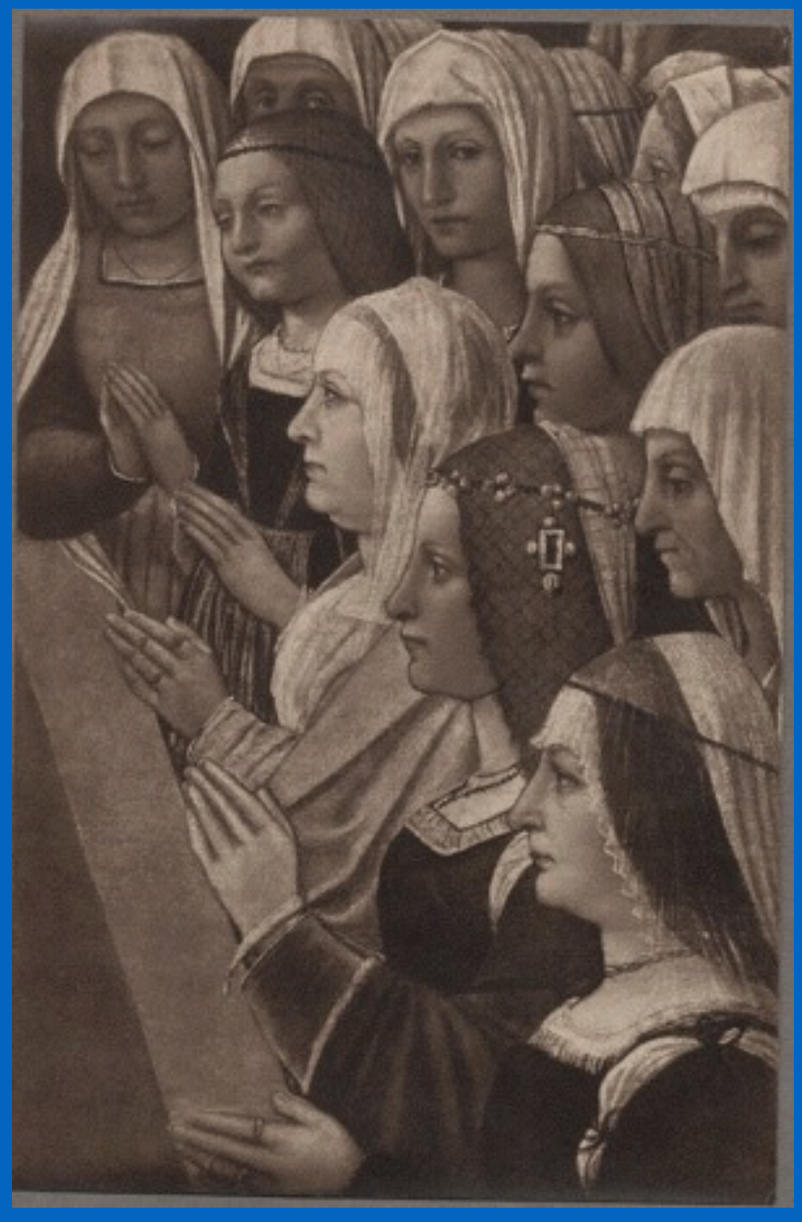
Measuring Image Analysis Efficacy

Confirming a Known Match

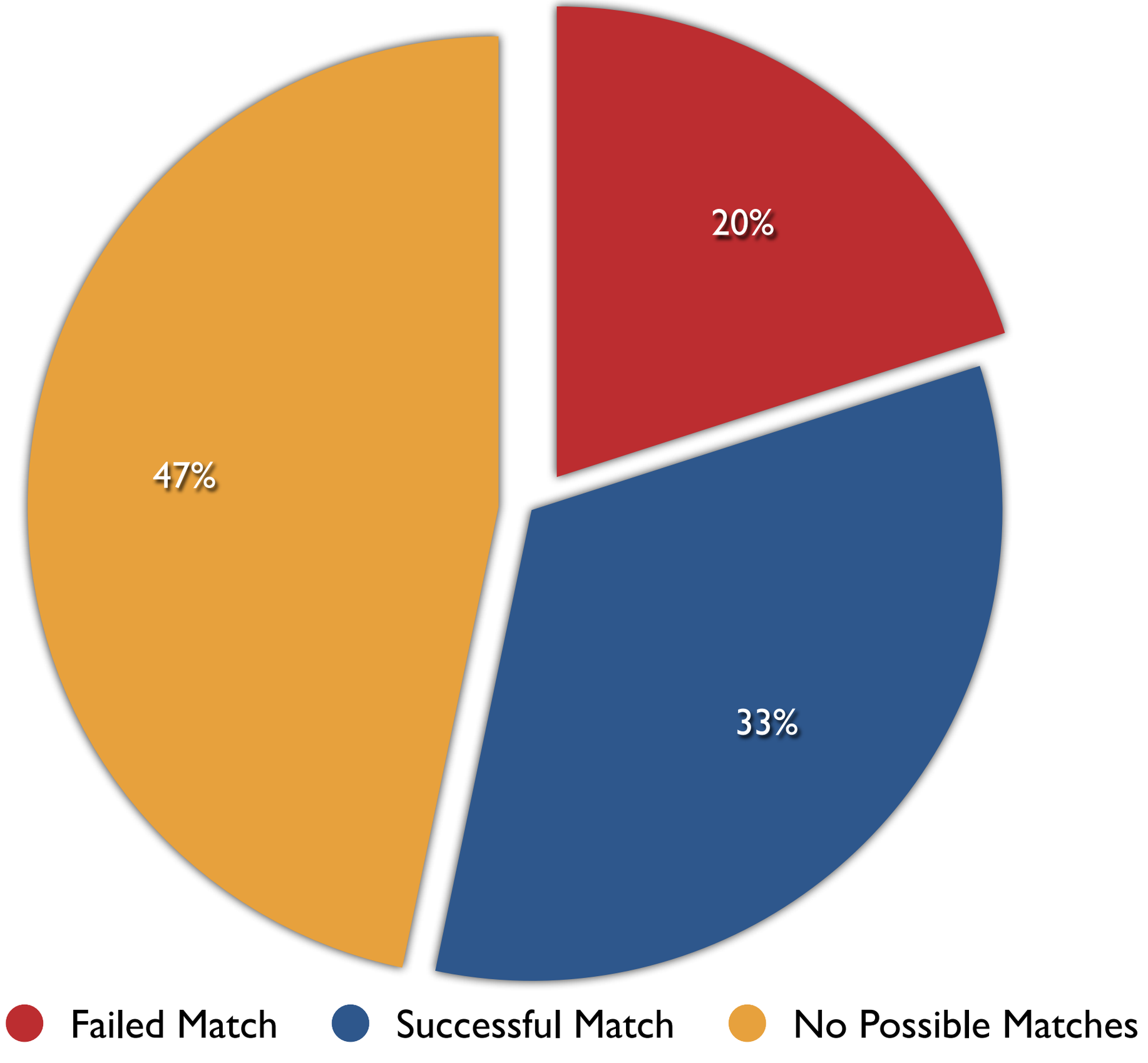
Artwork

Impossible to Confirm Match

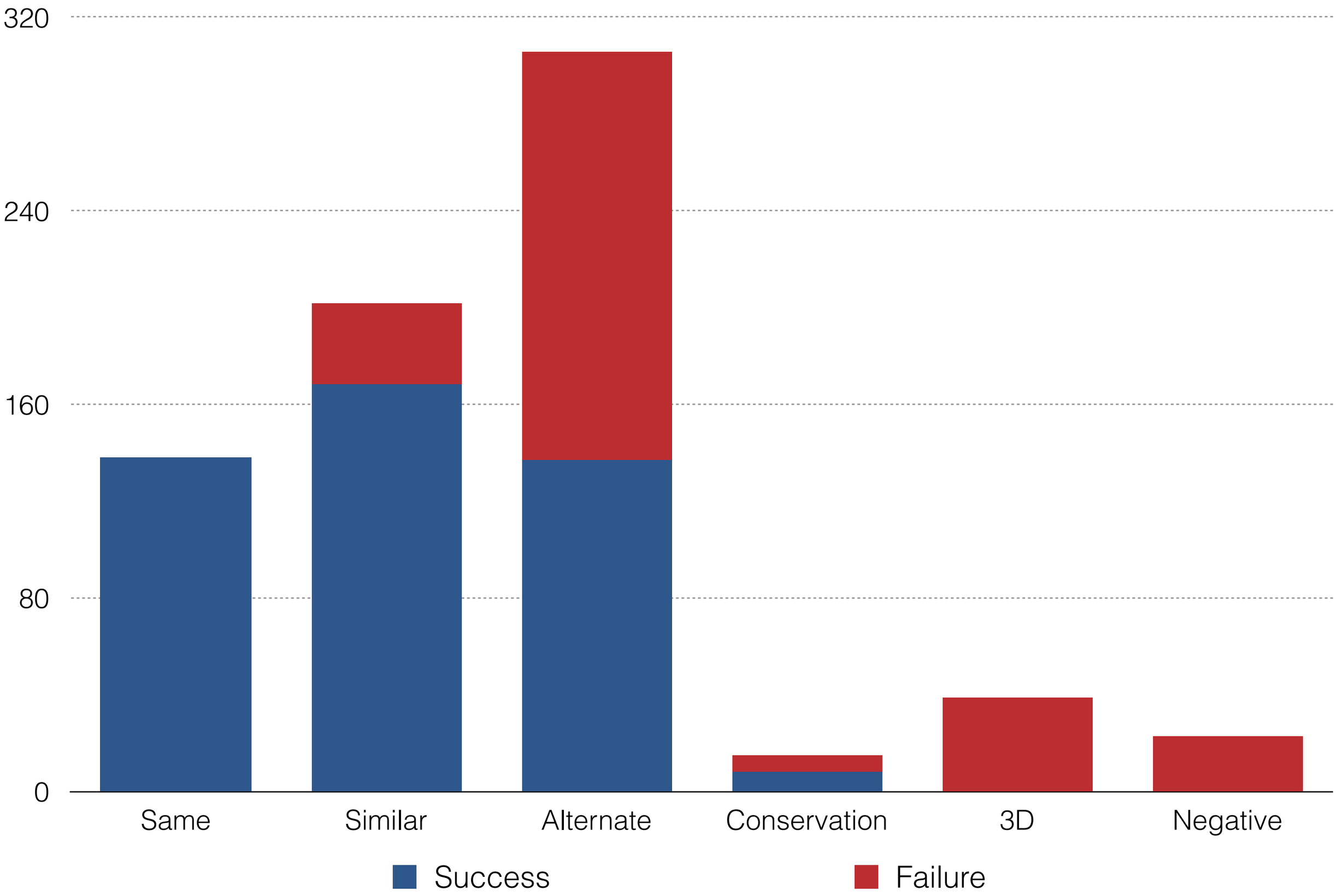
Artwork



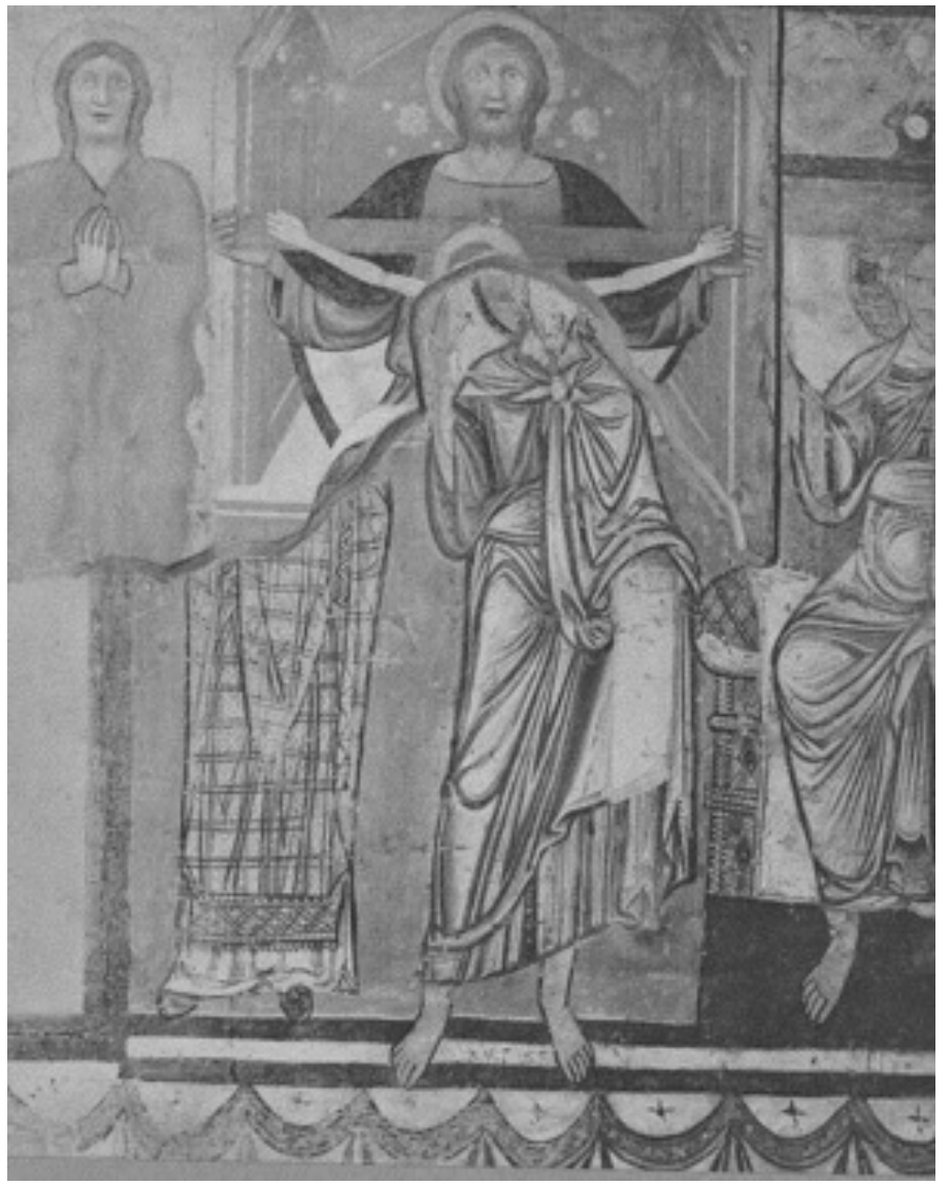
Artworks With Multiple Photos



of Match Successes and Failures by Type



Failed Similar Image Match



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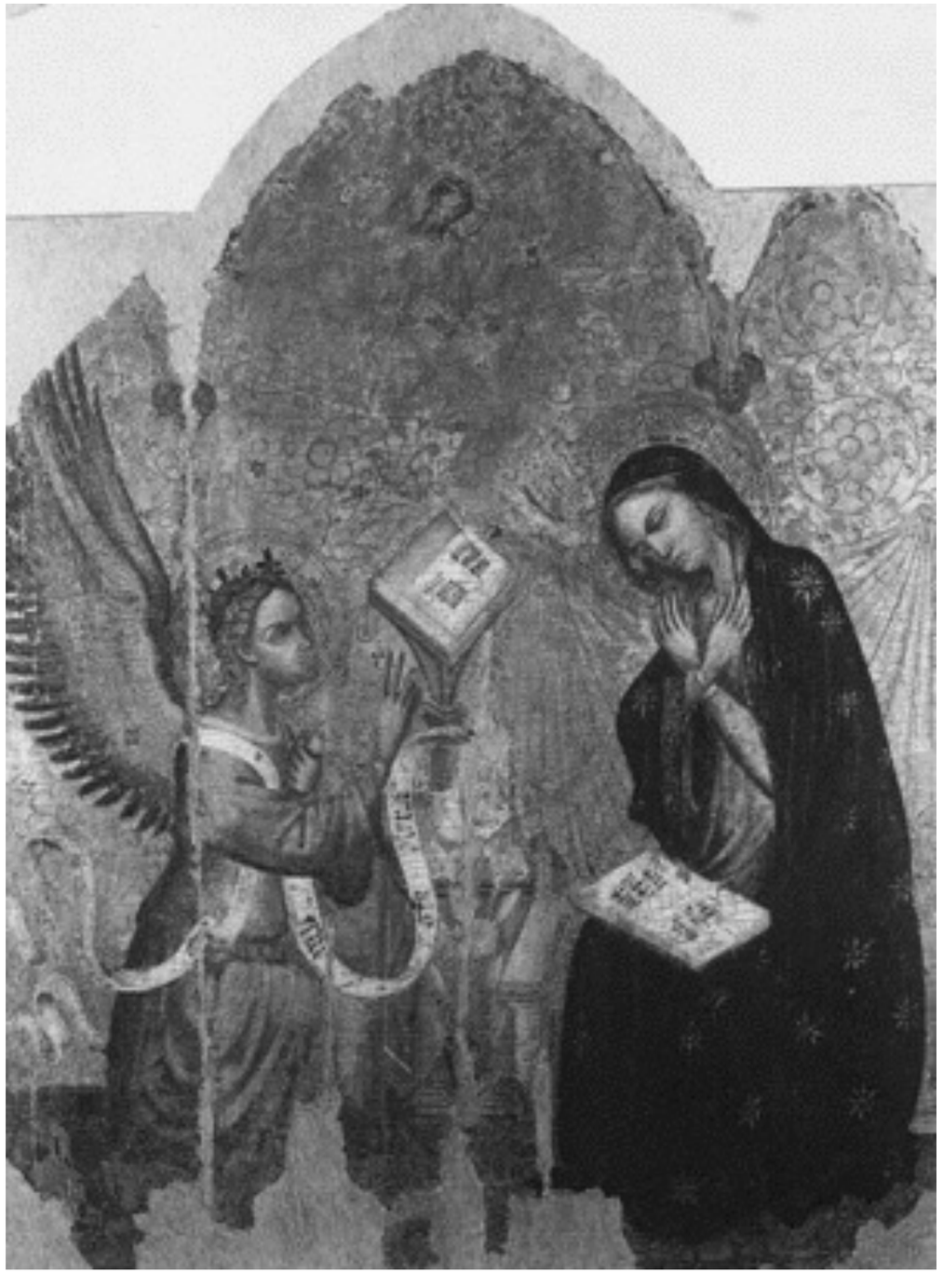
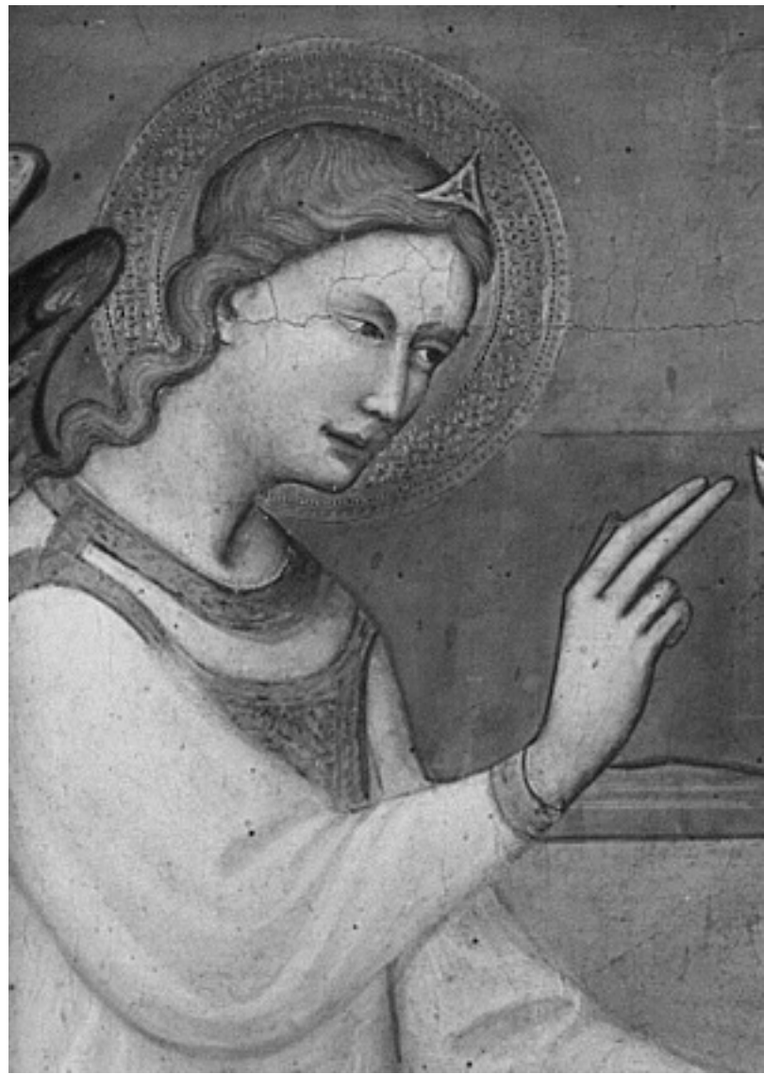
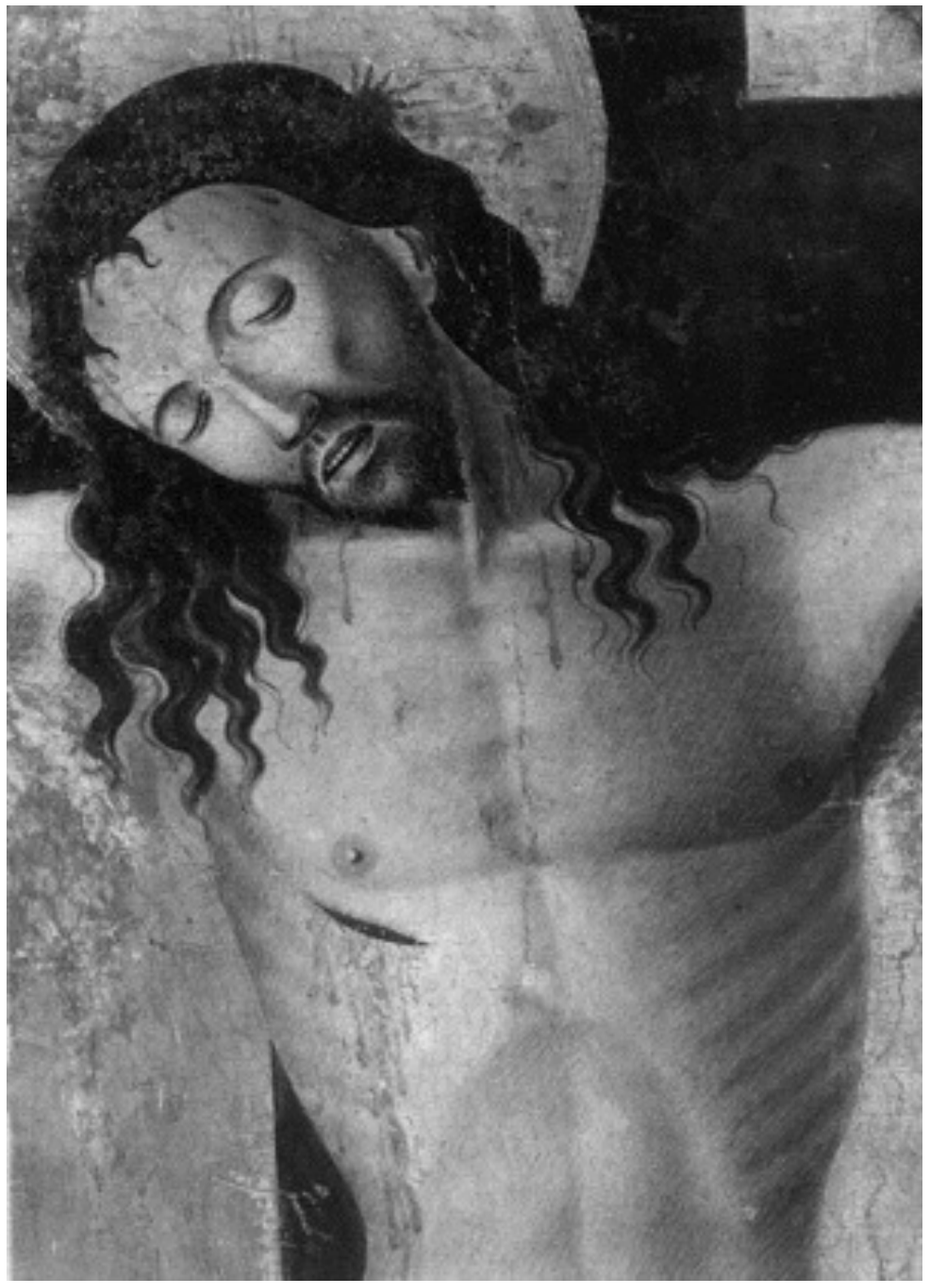


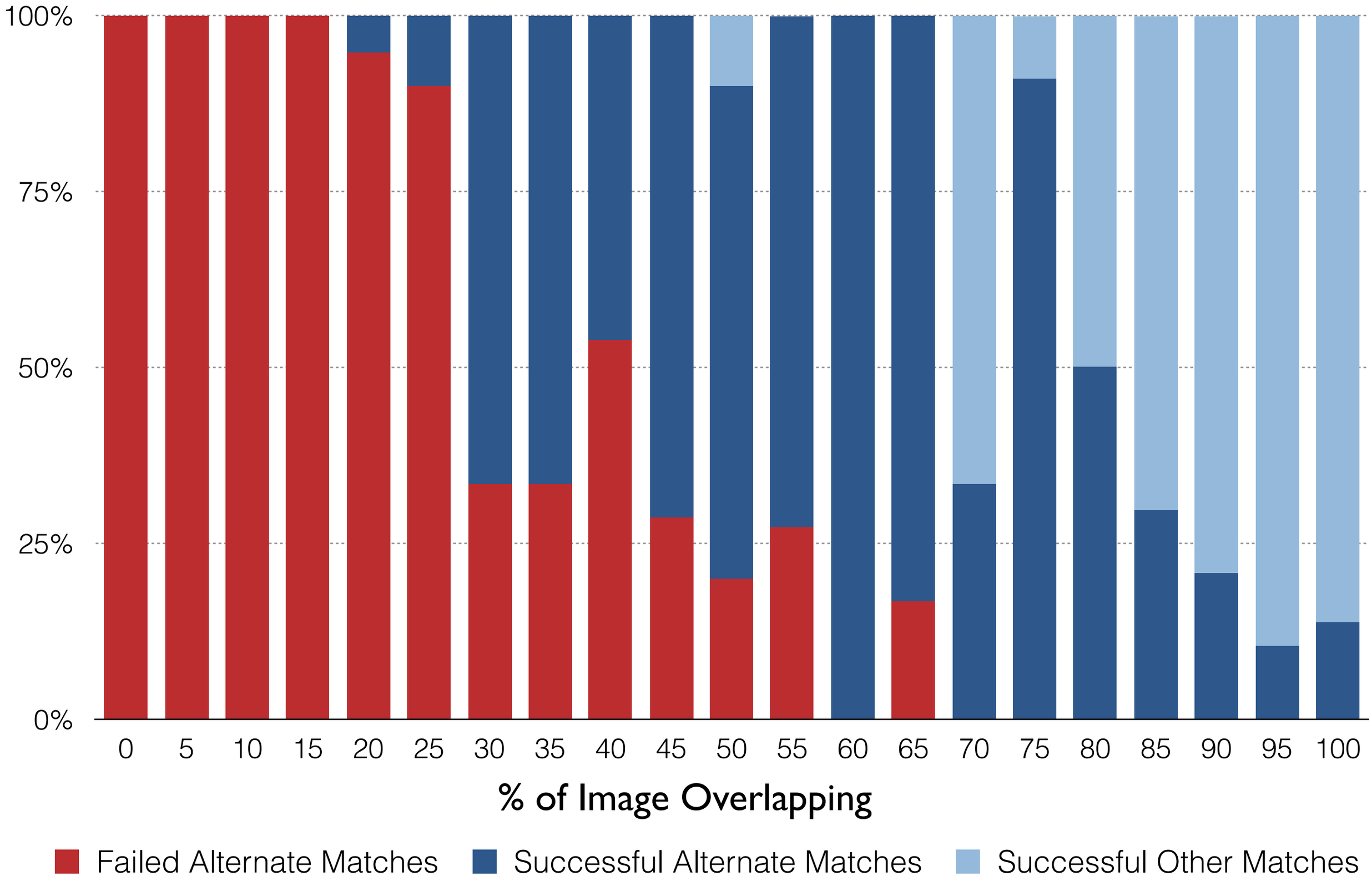
Failed Alternate Image Match



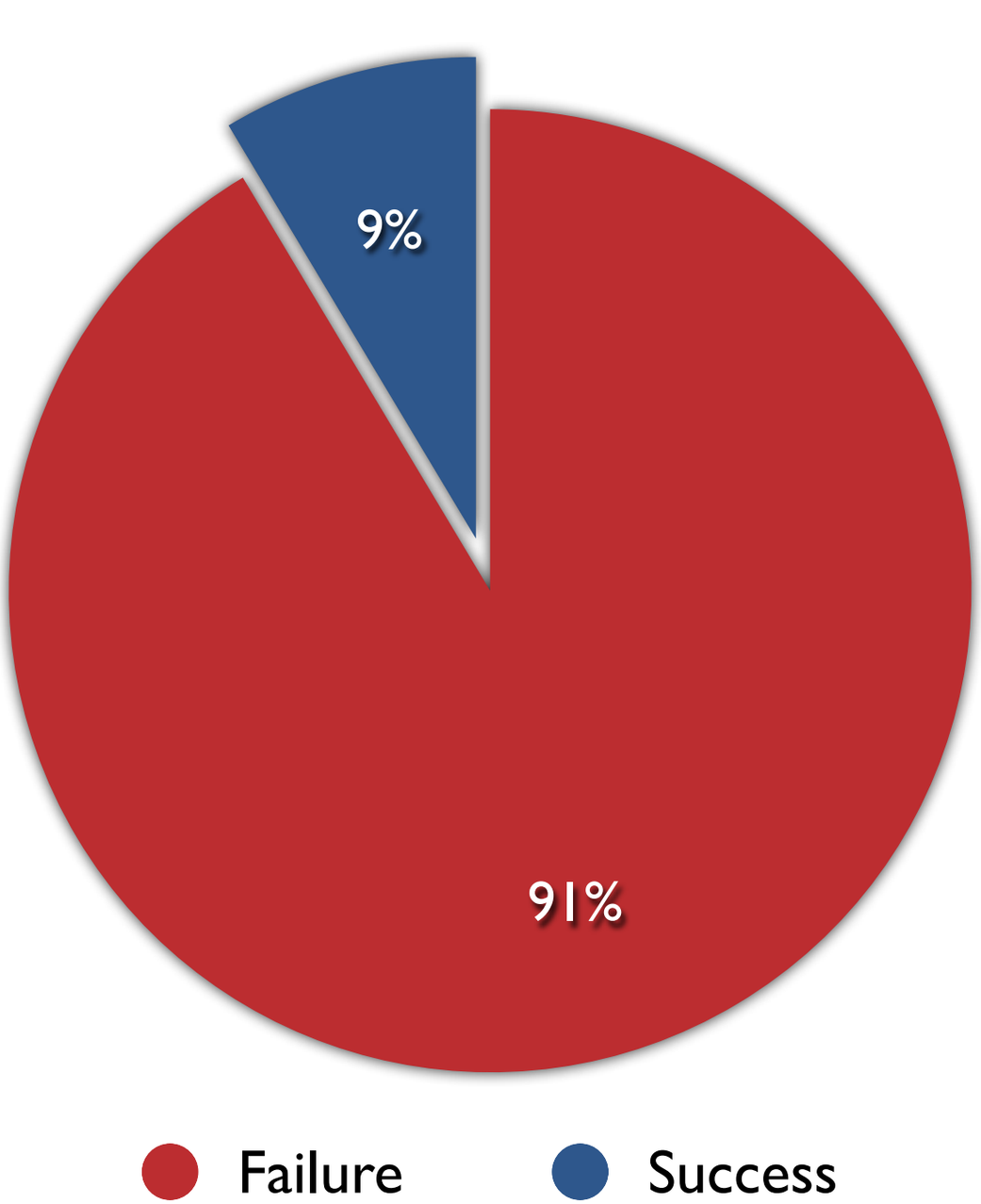
Failed Alternate Image Match



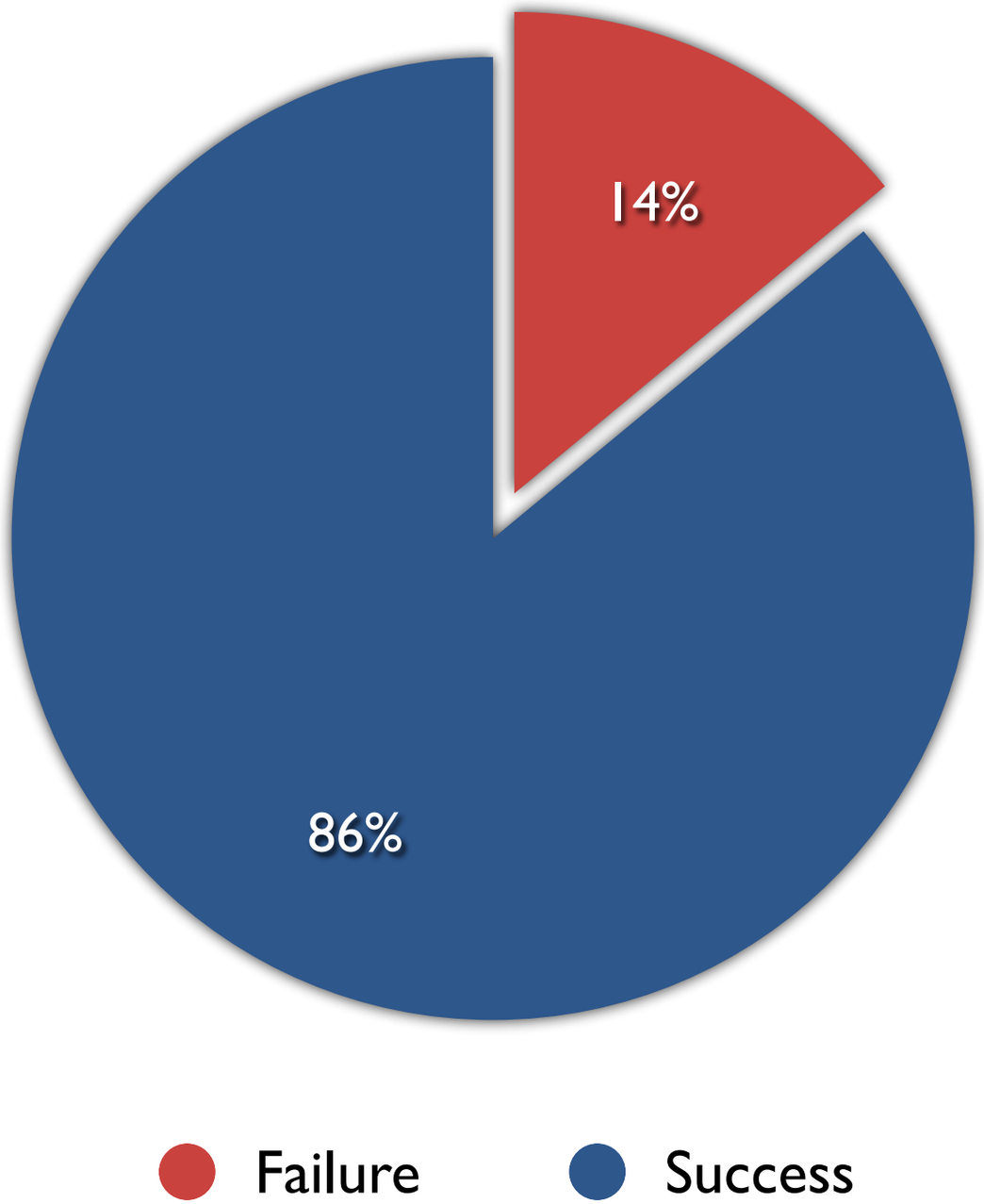
Likelihood of a match by % of image overlap



Likelihood of an ‘Alternate Image’ match by % of image overlap



Under 30% Overlap



Over 30% Overlap

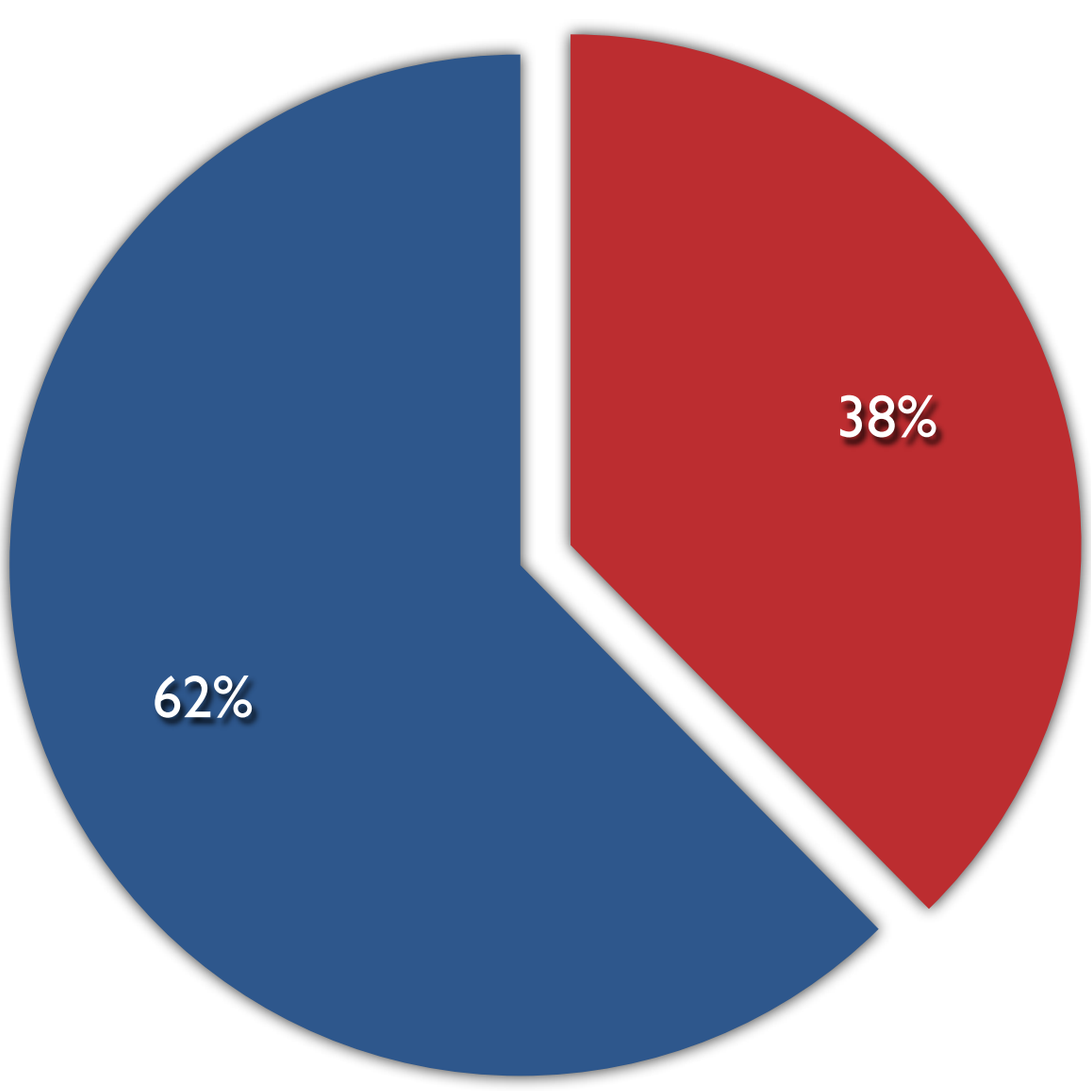
Failed Conservation Match

Failed 3D Work Match

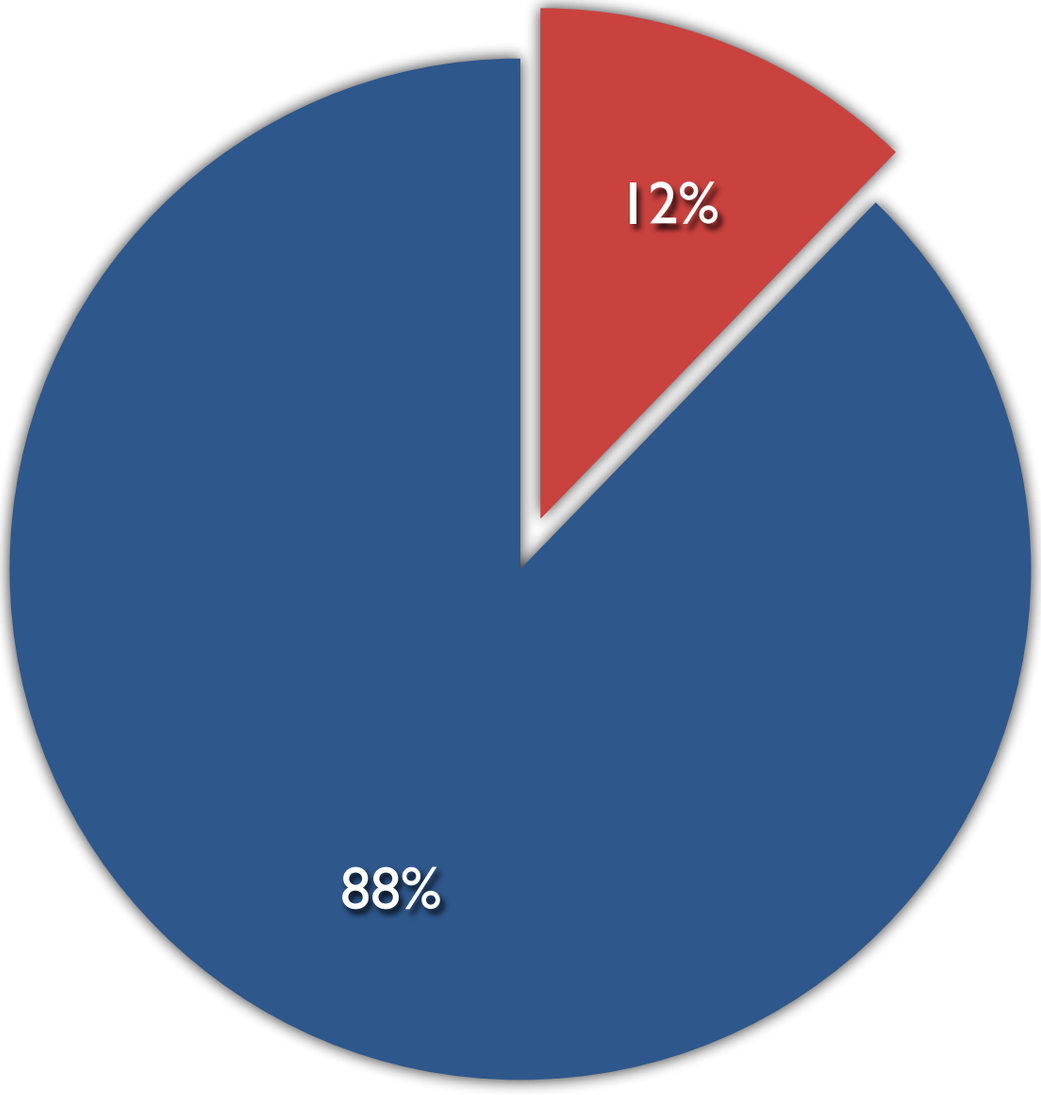
Failed 3D Work Match

Failed Negative Image Match

Overall MatchEngine Quality



All Potential Matches



No: Under 30% Overlap, 3D, or Negative

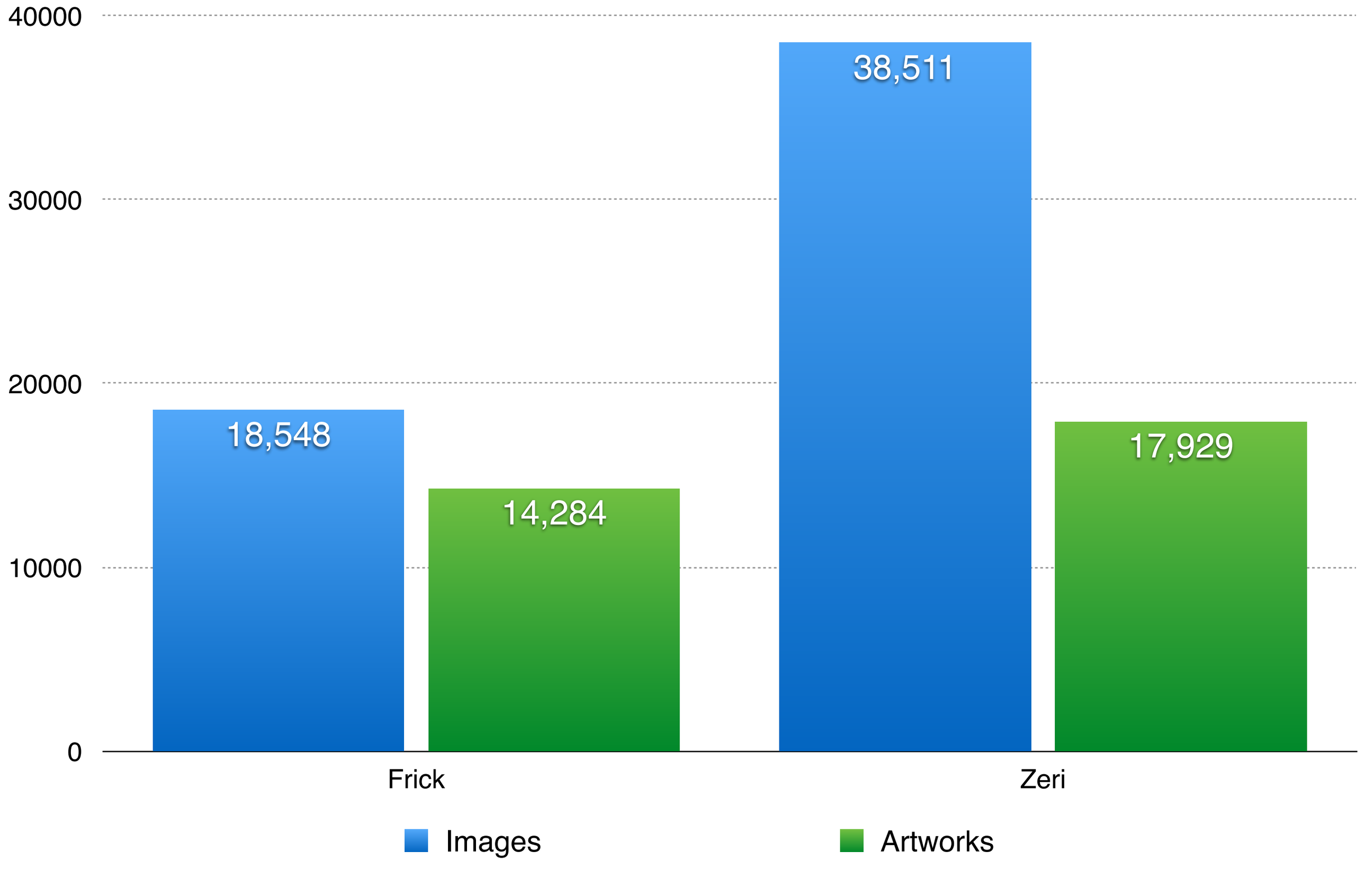
Frederico Zeri Foundation

- University of Bologna
- 290,000 photos of artworks from national archives, private archives, museums, etc.

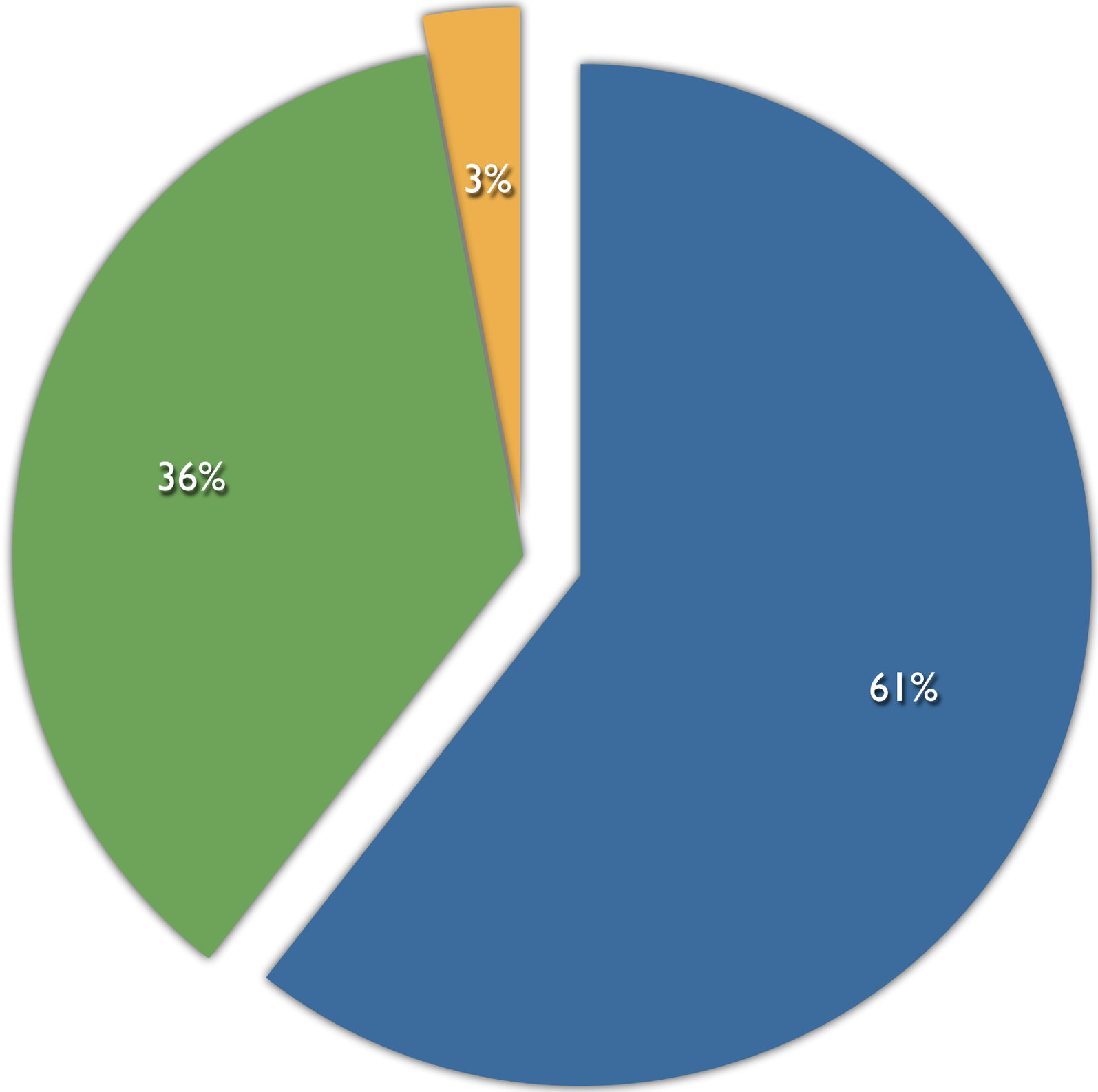
Zeri 15thC Italian Art

- Digitized 15th century Italian art
- Persumably some overlap with the Frick's Anonymous Italian Art archive

Image-to-Artwork Ratio



Zeri Artworks That Have A Match



Artworks with no match
Confirms a known match
Matches a new work

Image Analysis Matches

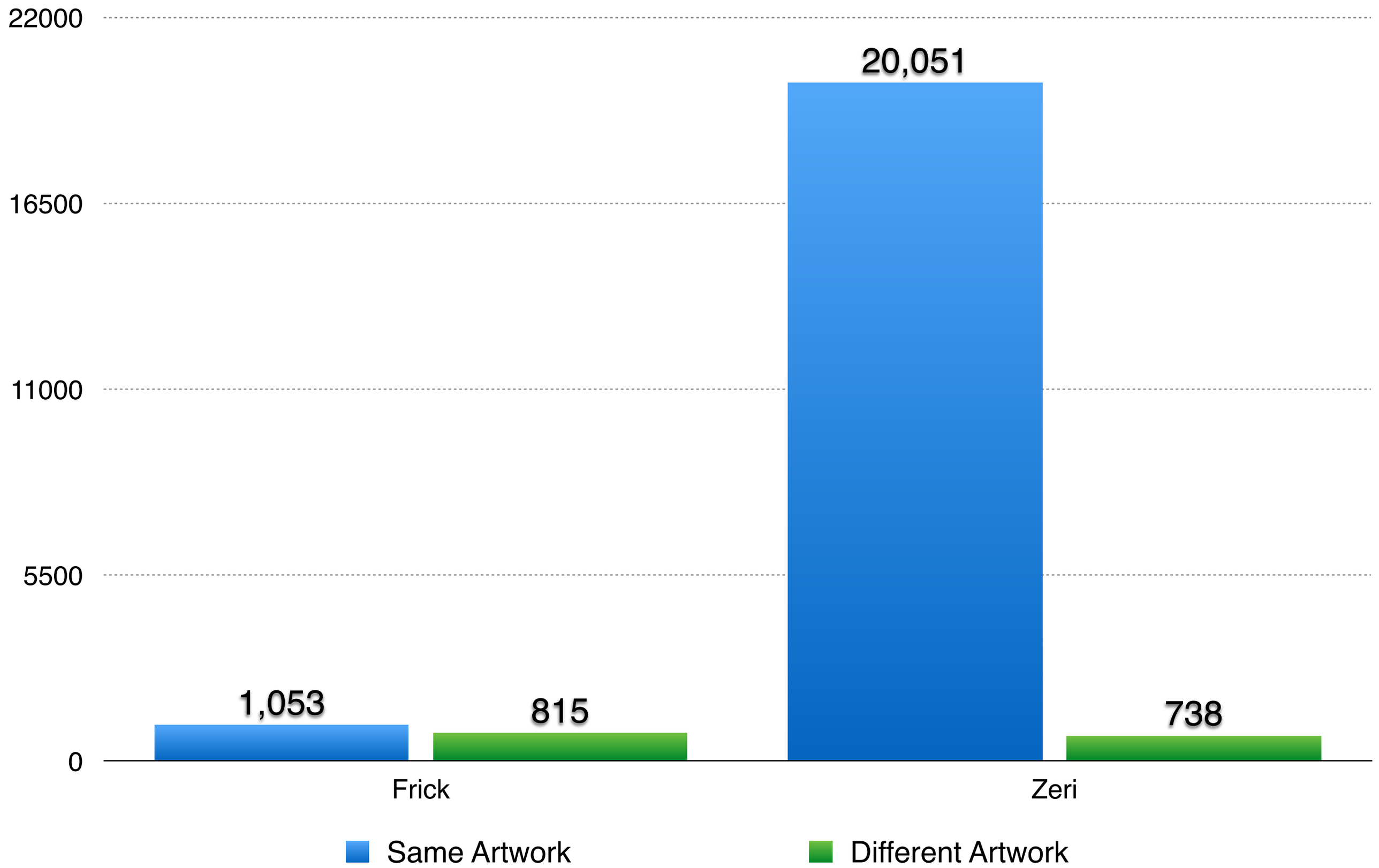
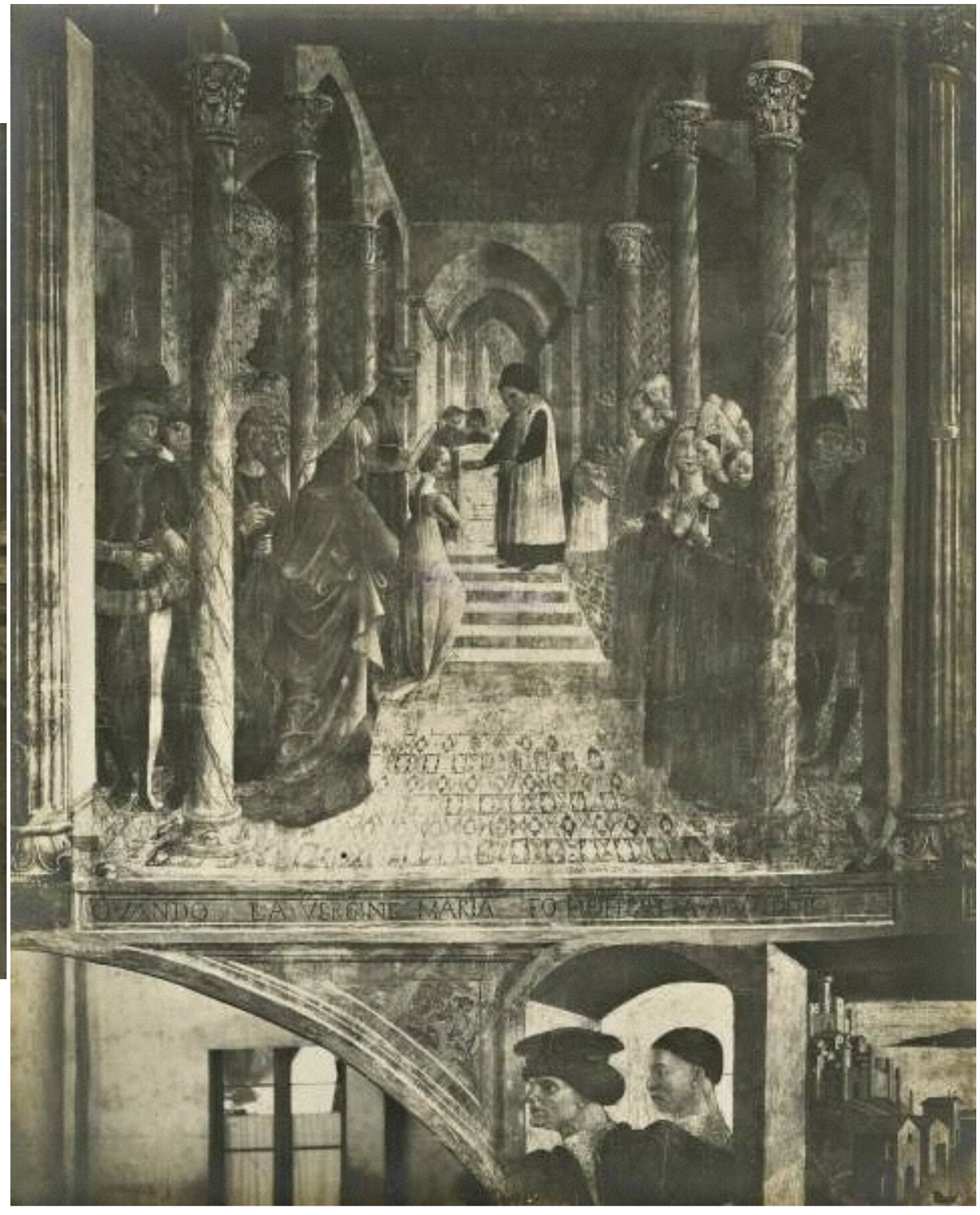


Image Detail

Image Detail



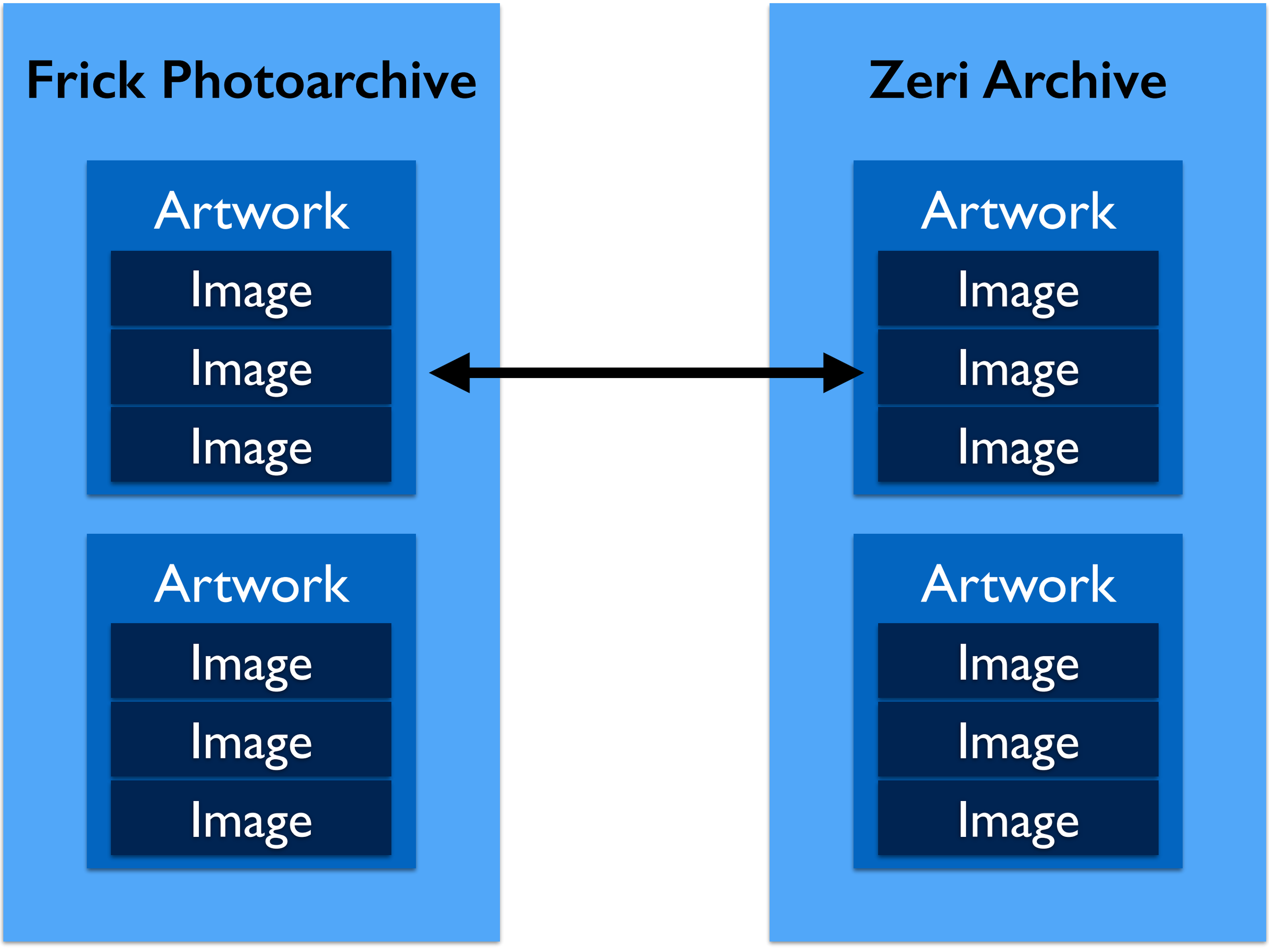
Same Piece, Similar Style

Same Piece, Similar Style

Similar/Copies

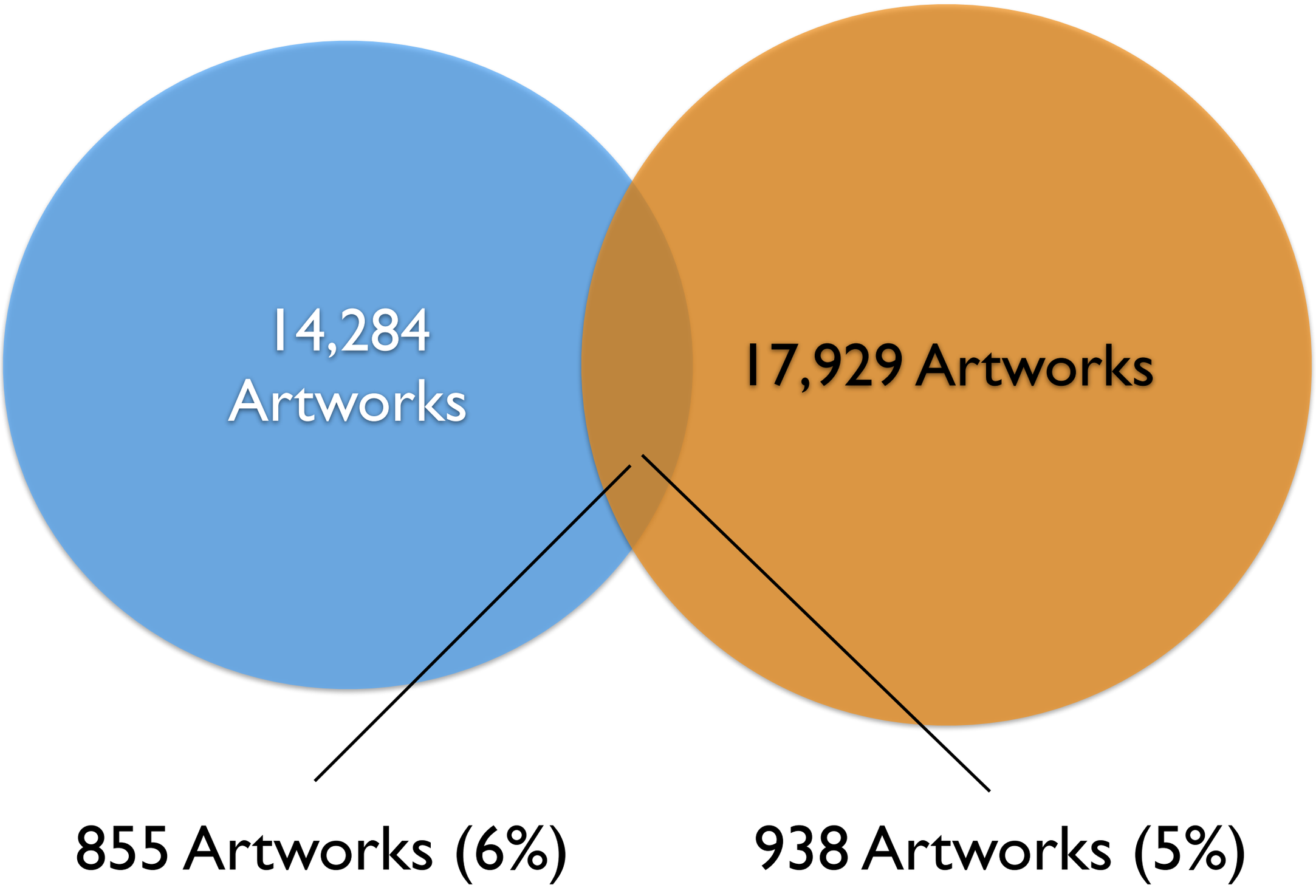
What Happens When We Combine Archives?

- Discover new relationships with the other archive
- Discover new relationships inside our own archive


Frick Photoarchive
Artwork
Image
Image
Image
Artwork
Image
Image
Image
Zeri Archive
Artwork
Image
Image
Image
Artwork
Image
Image
Image

Frick-Zeri Image Matches

Frick-Zeri Artwork Matches



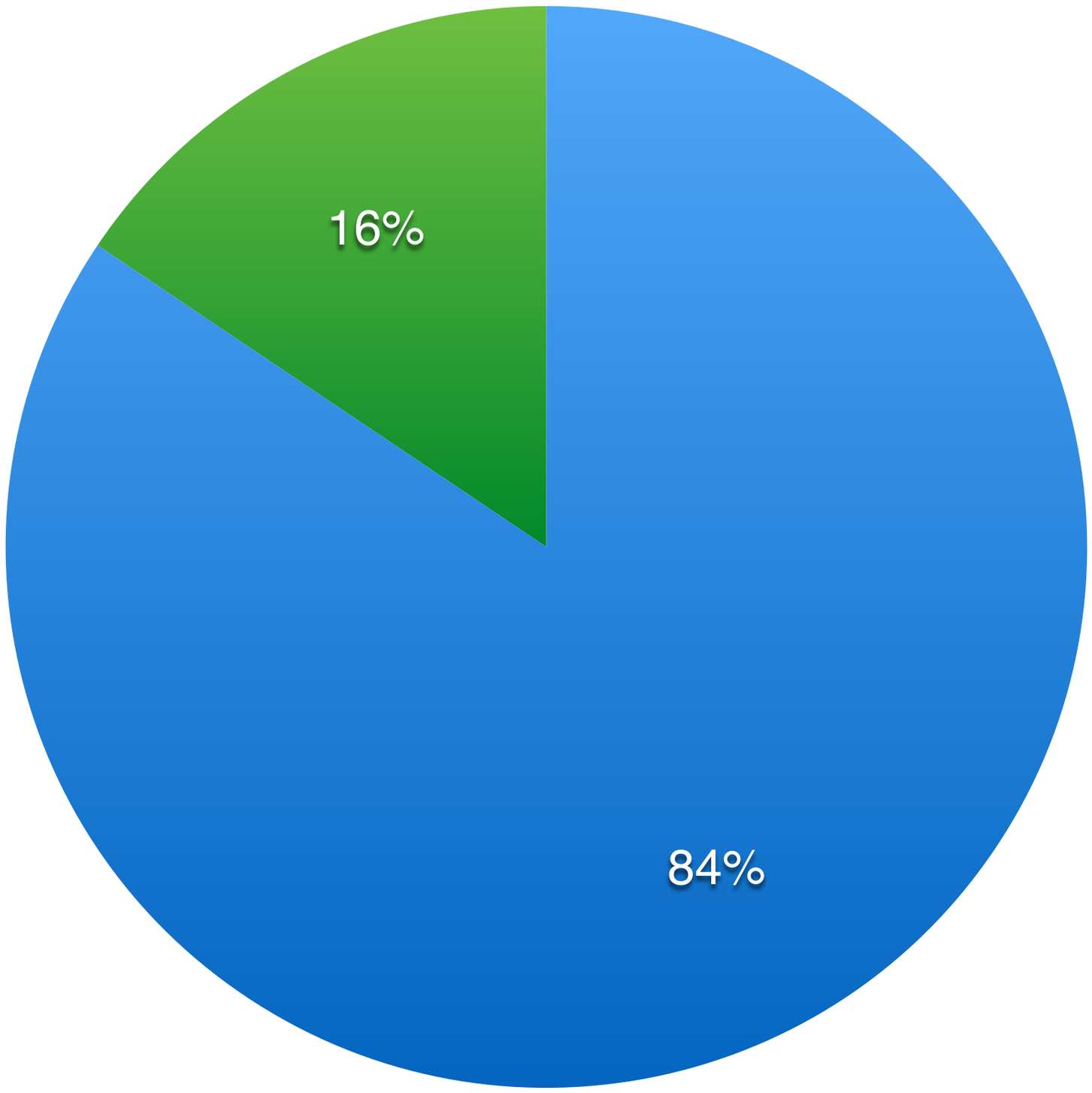
855 Artworks (6%)

938 Artworks (5%)

Merge Verification

- Previously, 77 artworks were manually matched by a researcher at the Zeri foundation
- Can use to verify the quality of the matches

Merge Verification



Lighting Differences

Tiny Details

Merging Works!

- 84% success confirming known relationships (with a small sample)
- Only 6% of computer-discovered matches were also found by a human.
  - (55 human matches vs. 938 computer matches)

Graph Analysis

Frick 420

420

?

Frick 417

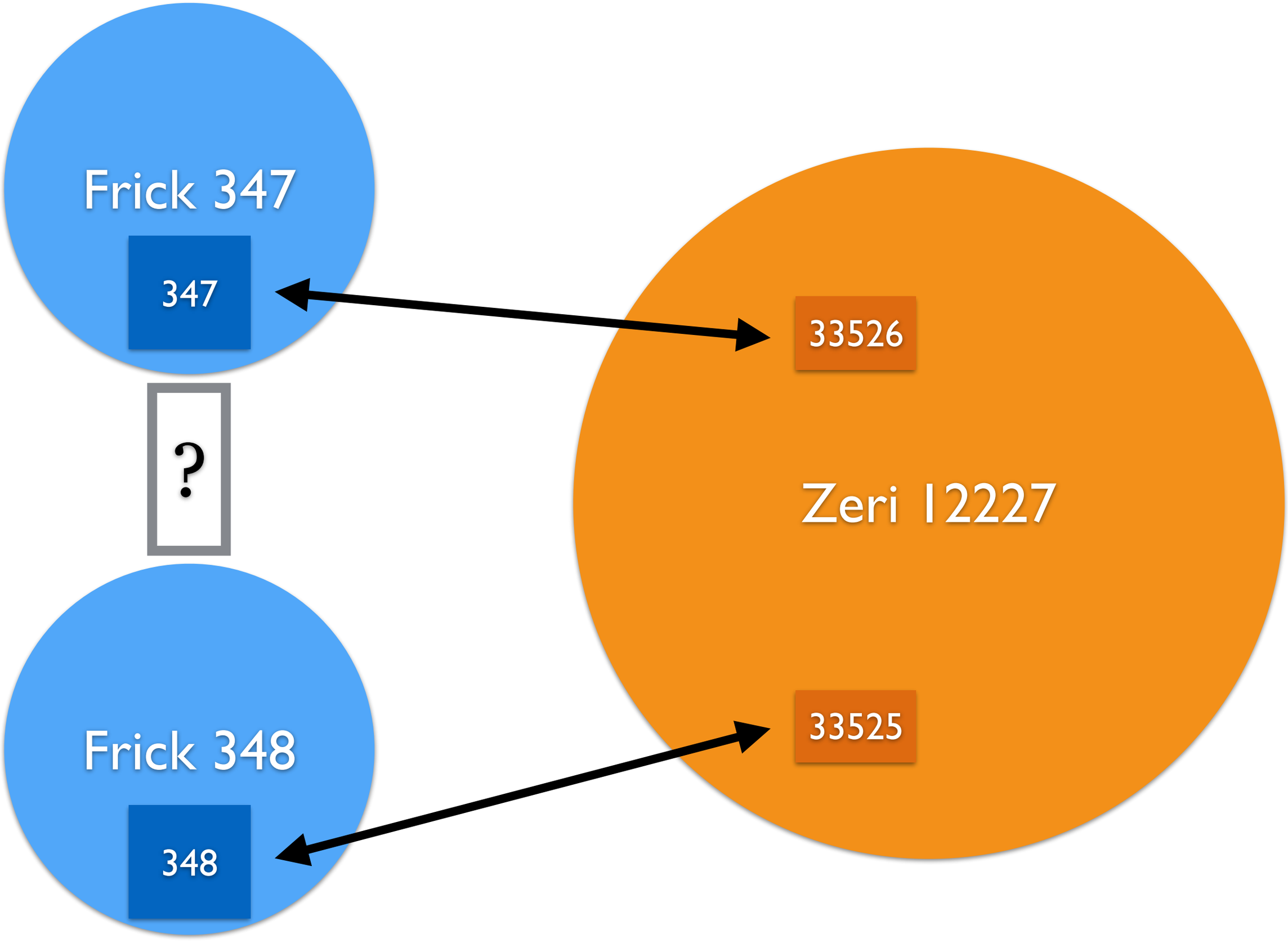
417

42090

Zeri 15836

Finding new Links

- Found 14 new Frick links via Zeri
- Found 236 new Zeri links via Frick


Frick 347
347
?
Frick 348
348
33526
Zeri 12227
33525

HOC OPVS FACTVM A.D. 1617

HOC OPVS FACTVM A.D. 1617

Frick 8131

8131a

8131

57130

Zeri 23405

57138

?

57129

Zeri 23402

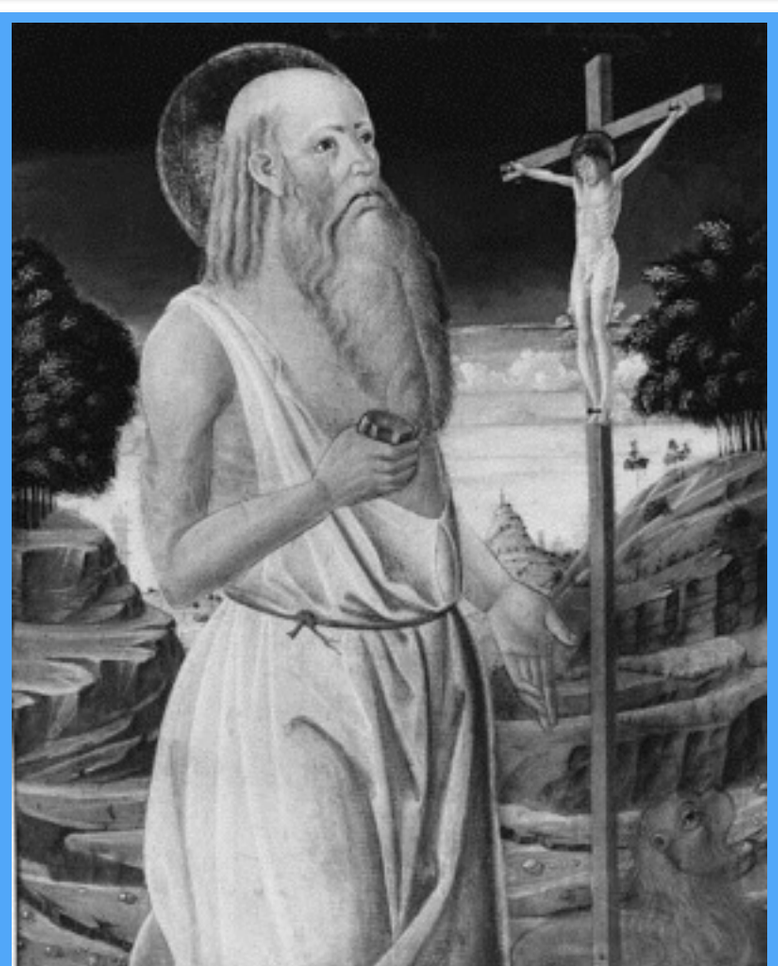
57134

8132a

8132

Frick 8132

ECCE AGNVS DEI



ECCE AGNVS DEI

Conclusion

- It becomes possible to merge photo archives, even though they're in different langauges.
- New relationships are discovered in the process.
- The synergy of combining multiple archives reveals even more information.
- All of this is completely automated!

Kress Foundation Grant

- Just received a Digital Resources grant from the Kress Foundation
- Will be used to support the creation of Open Source tools
- Reproduce all of the results shown here today - on your images!
- Coming: Later 2014.

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