
Families In the Wild (FIW): Large-Scale Kinship Image Database & Benchmarks

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Overview





Overview

Griffin Family

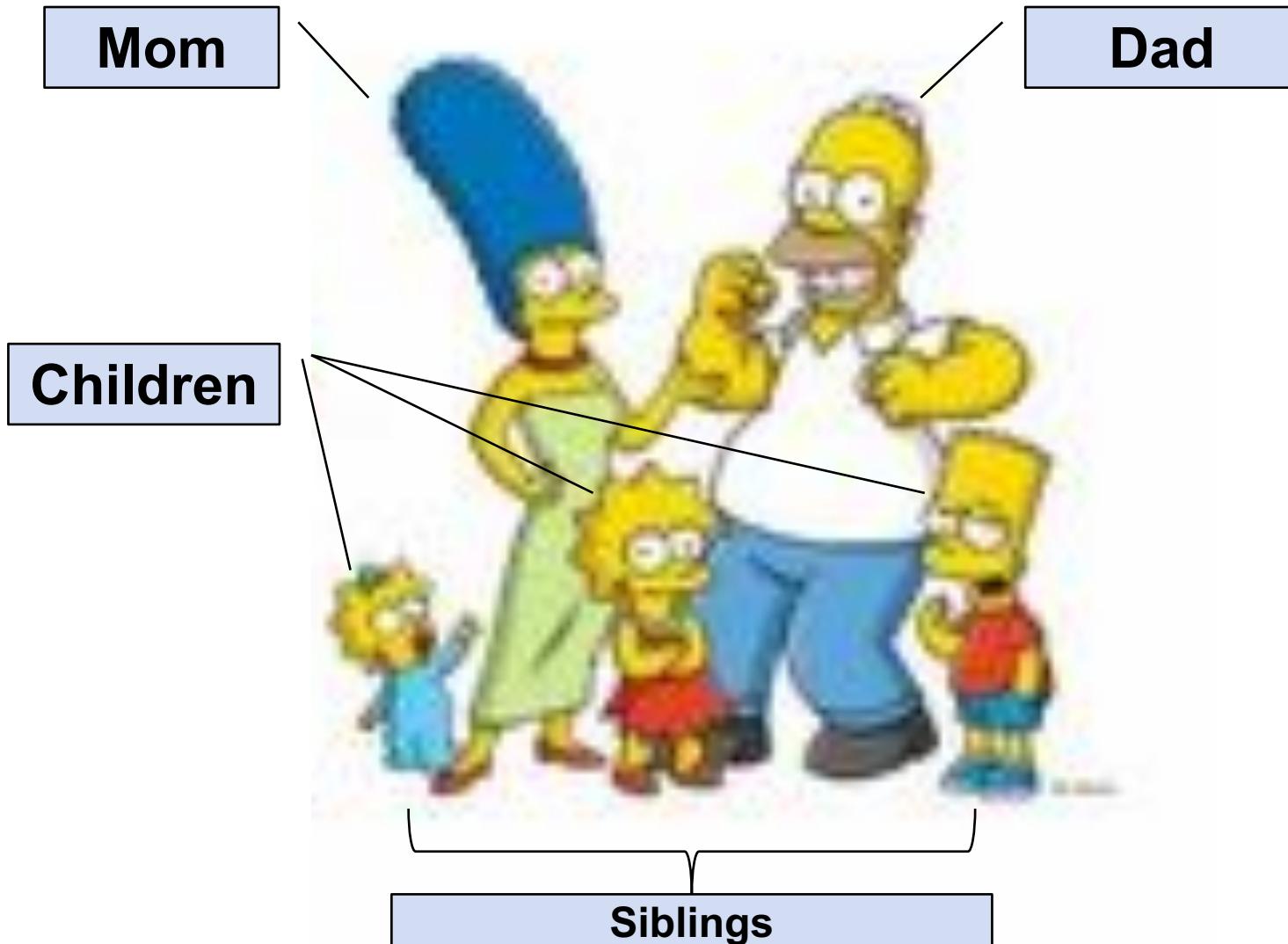


Simpson Family





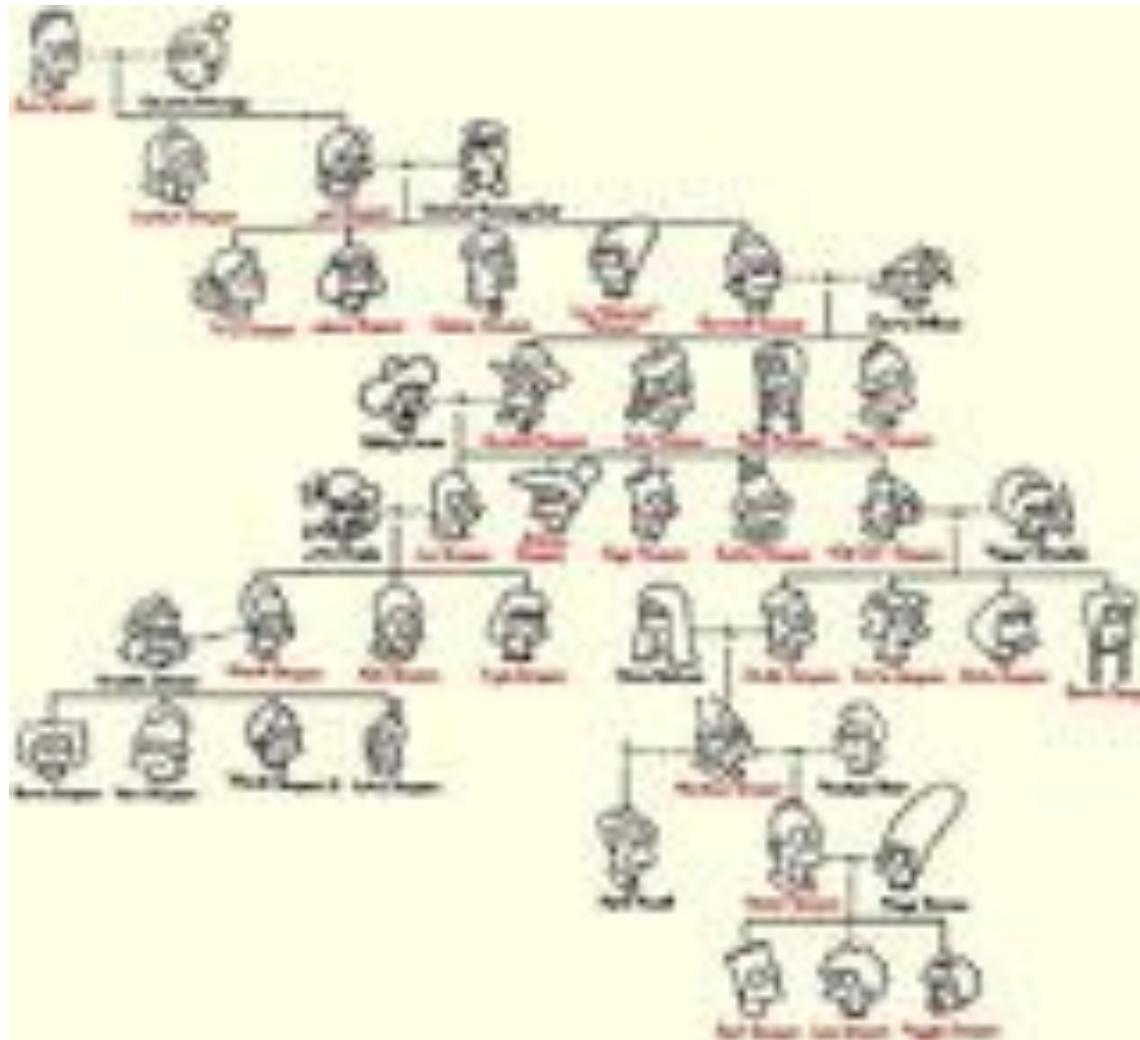
Overview





Overview

Simpson Family Tree





Overview

Motivation



Automatic Photo Album Organizer





Overview

Motivation



Social Media and Various Industries



Overview

Motivation



Missing Children



Search Investigations

Forensics



Overview

Motivation



Genealogical Studies



Overview

Objective

Problem Formulation

- Automatic kinship recognition is a challenging feat
- Pre-existing datasets do not properly represent true data distributions
 - Image quality is poor
 - Image quantity is lacking
 - Pair-wise samples do not properly reflect family tree structure
- Many factors are still undiscovered by the machine vision community
- Research has not yet reached reality

A Large-scale Kinship Dataset

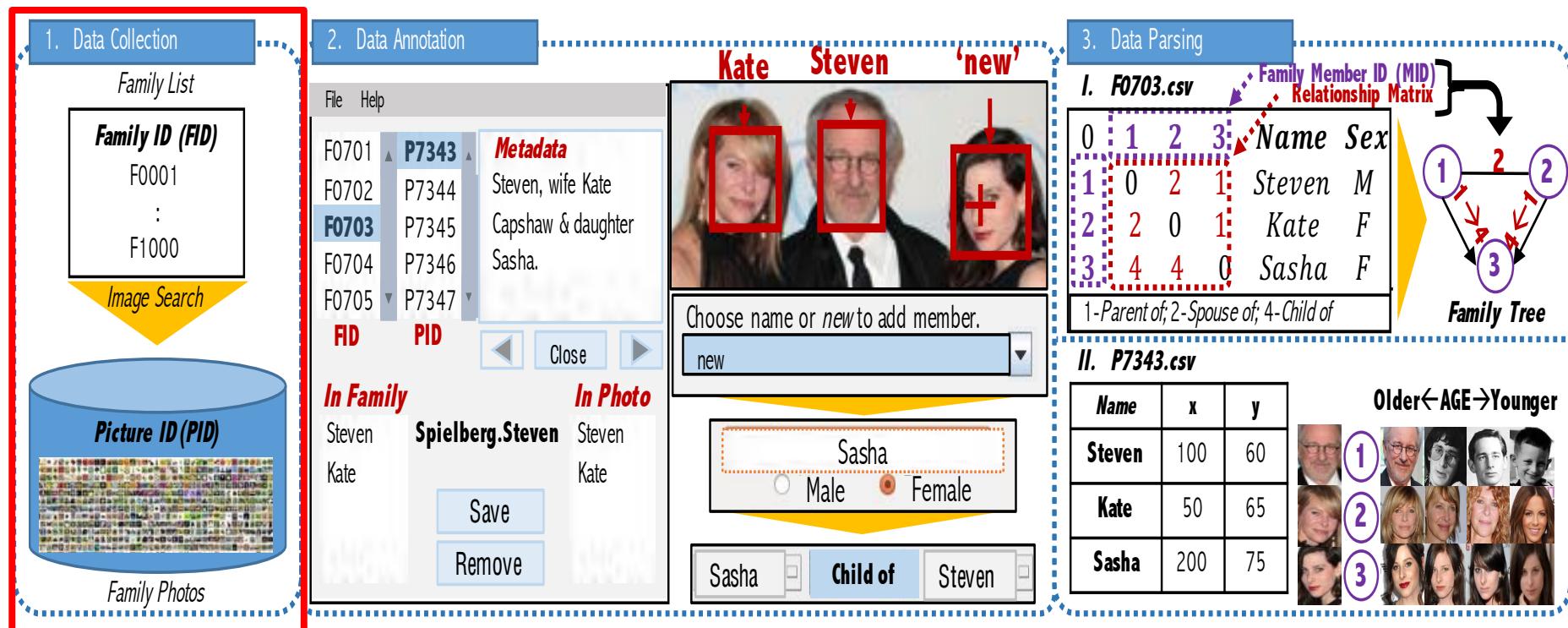


Progress Overview

Labelling Process

Process to build FIW:

Data Collection → Compiled list of candidate families and collected photos for each





Progress Overview

Labelling Process

1. Data Collection

Family List

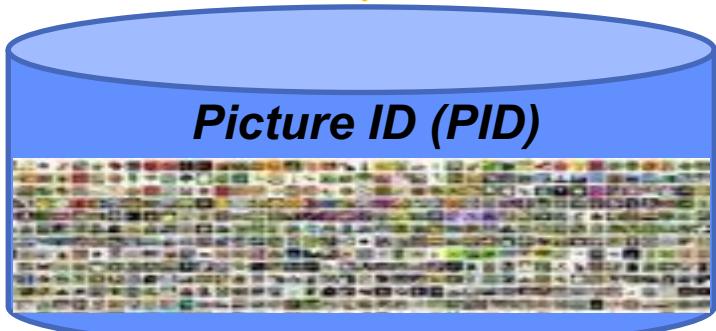
Family ID (FID)

F0001

:

F1000

Image Collection



Goal

- Collect family photos for 1,000 families from around the globe
- The following criteria must be met:
 - ~10 family photos
 - Min. of 3 family members



Progress Overview

Labelling Process

1. Data Collection

Family List

Family ID (FID)

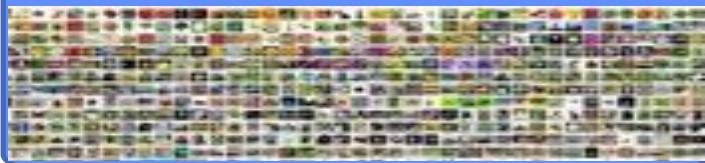
F0001

:

F1000

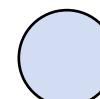
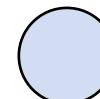
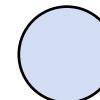
Image Collection

Picture ID (PID)



Family Photos

| | |
|-------|------------------|
| F0001 | Einstein, Albert |
| F0002 | Lee, Bruce |



| | |
|-------|----------------------|
| F0999 | Jackson, Michael |
| F1000 | Spanish Royal Family |



FIW Database



Disney



Freeman



Zardari



British
Royal



Lee



Spanish
Royal



Einstein



Japanese
Royal



McGwire



Jackson 5



Affleck



King of
Thailand



Gronkowski



Nicholas II



Roosevelt



FIW Database



Disney



Freeman



Zardari



British
Royal



Lee



Spanish
Royal



Einstein



Japanese
Royal



McGwire



Jackson 5



Affleck



King of
Thailand



Gronkowski



Nicholas II

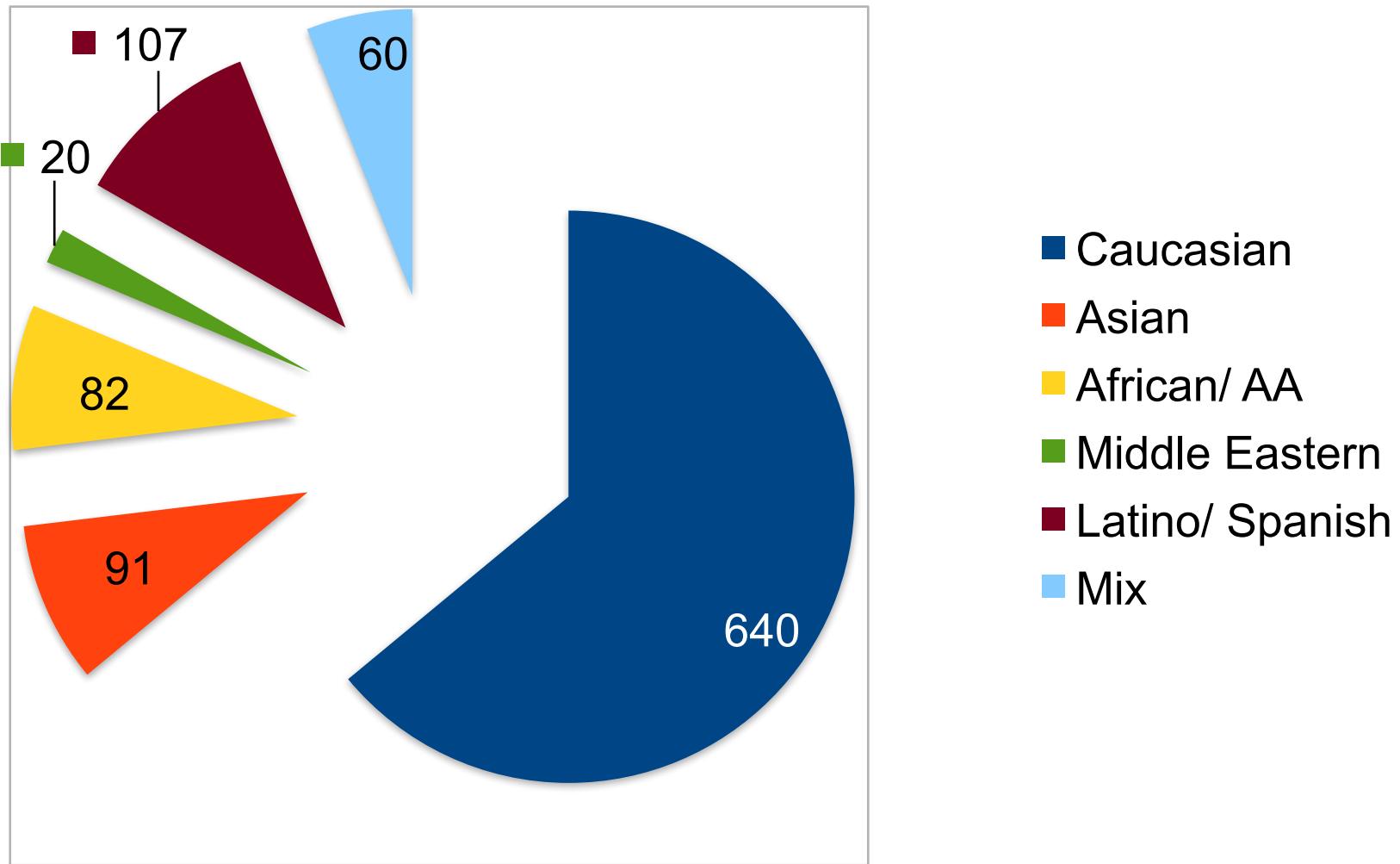


Roosevelt



FIW Database

Ethnicity Distribution





Progress Overview

Labelling Process

1. Data Collection

Family List

Family ID (FID)

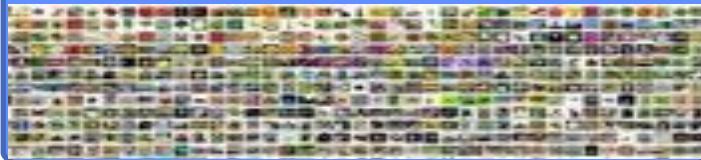
F0001

:

F1000

Image Collection

Picture ID (PID)



Family Photos



Progress Overview

Sample Family: Gronkowski





Progress Overview

Sample Family: Gronkowski





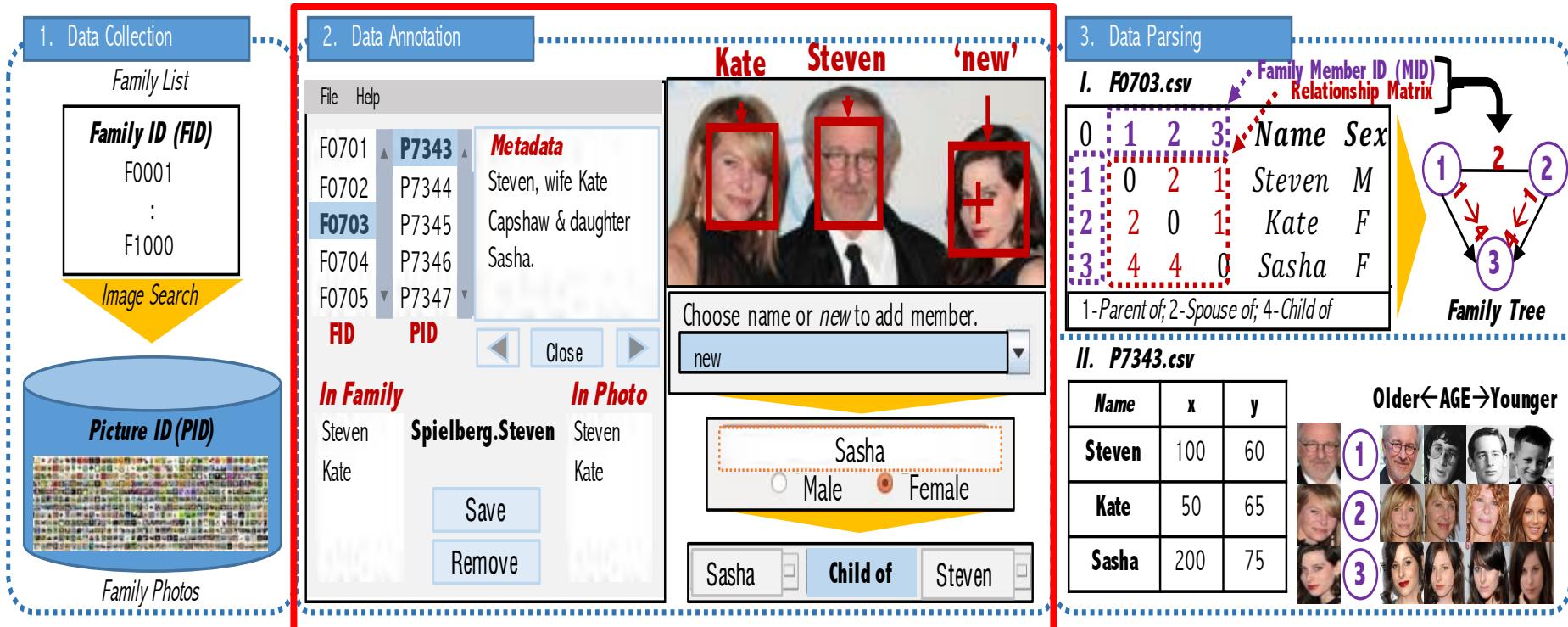
Progress Overview

Labelling Process

Process to build FIW:

Data Collection → Compiled list of candidate families and collected photos for each

Data Annotation → Marked complex relationships for 1,000 families using labeling tool





Progress Overview

Labelling Process

2. Data Annotation

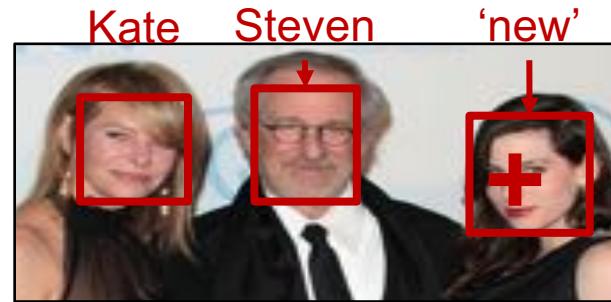
FID PID ◀ ▶ Close

In Family *In Photo*

| FID | PID | In Family | In Photo |
|--------------|--------------|-----------|------------------|
| F0701 | P7343 | Steven | Spielberg Steven |
| F0702 | P7344 | Kate | Steven Kate |
| F0703 | P7345 | | |
| F0704 | P7346 | | |
| F0705 | P7347 | | |
| F0706 | P7348 | | |

Save Remove

Metadata
Steven, wife Kate
Capshaw & daughter
Sasha.



(a)

Choose name or *new* to add
new

(b)

Sasha
 Male Female

(c)

Sasha Child of Steven

(d)



Progress Overview

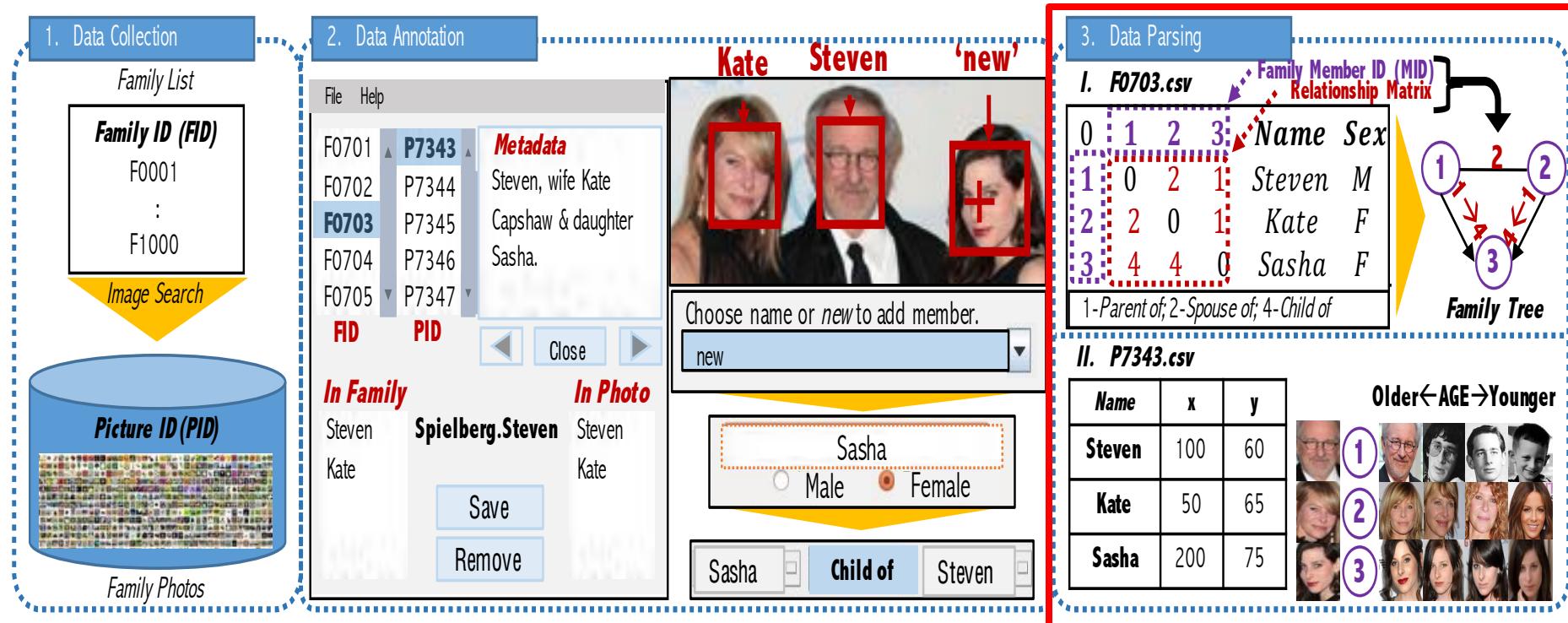
Labelling Process

Process to build FIW:

Data Collection → Compiled list of candidate families and collected photos for each

Data Annotation → Marked complex relationships for 1,000 families using labeling tool

Data Parsing → Parsed 2 label types generated by tool for 2 tasks, verification & recognition





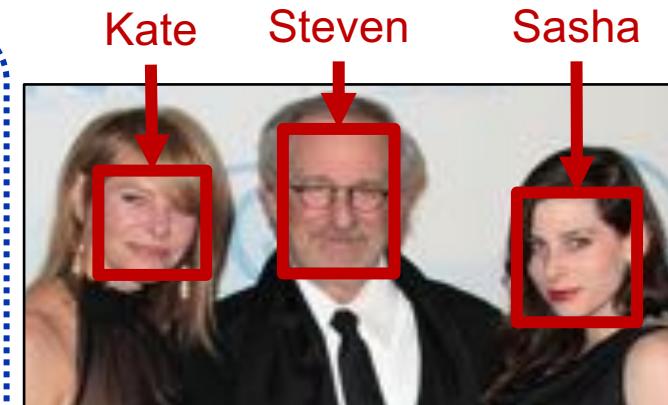
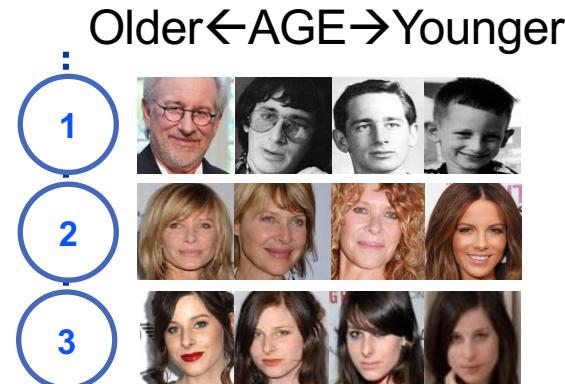
Progress Overview

Labelling Process

3. Data Parsing

I. P7343.csv

| Name | x | y |
|--------|-----|----|
| Steven | 100 | 60 |
| Kate | 50 | 65 |
| Sasha | 200 | 75 |





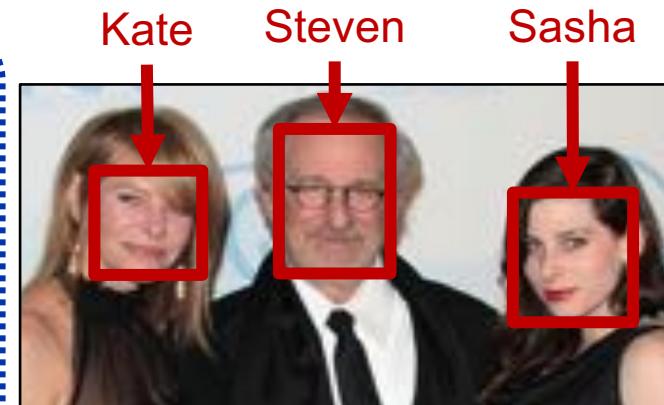
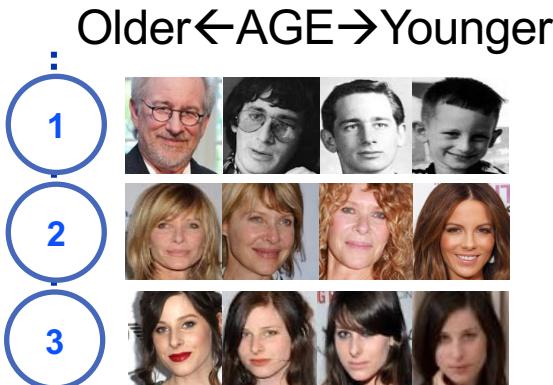
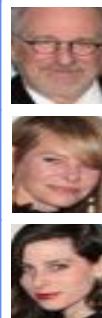
Progress Overview

Labelling Process

3. Data Parsing

I. P7343.csv

| Name | x | y |
|--------|-----|----|
| Steven | 100 | 60 |
| Kate | 50 | 65 |
| Sasha | 200 | 75 |

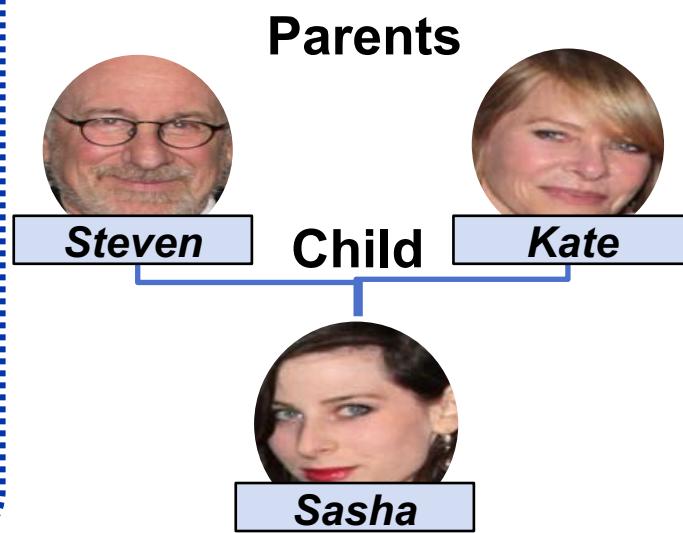
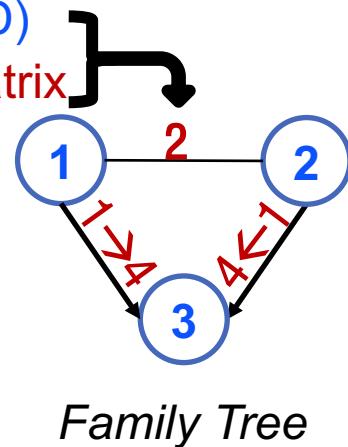


II. F0703.csv

| Member ID (MID) | | | Name | Sex |
|-----------------|---|---|--------|-----|
| 1 | 2 | 3 | Steven | M |
| 2 | 0 | 1 | Kate | F |
| 3 | 4 | 0 | Sasha | F |

1-Parent of; 2-Spouse of; 4-Child of

Relationship Matrix

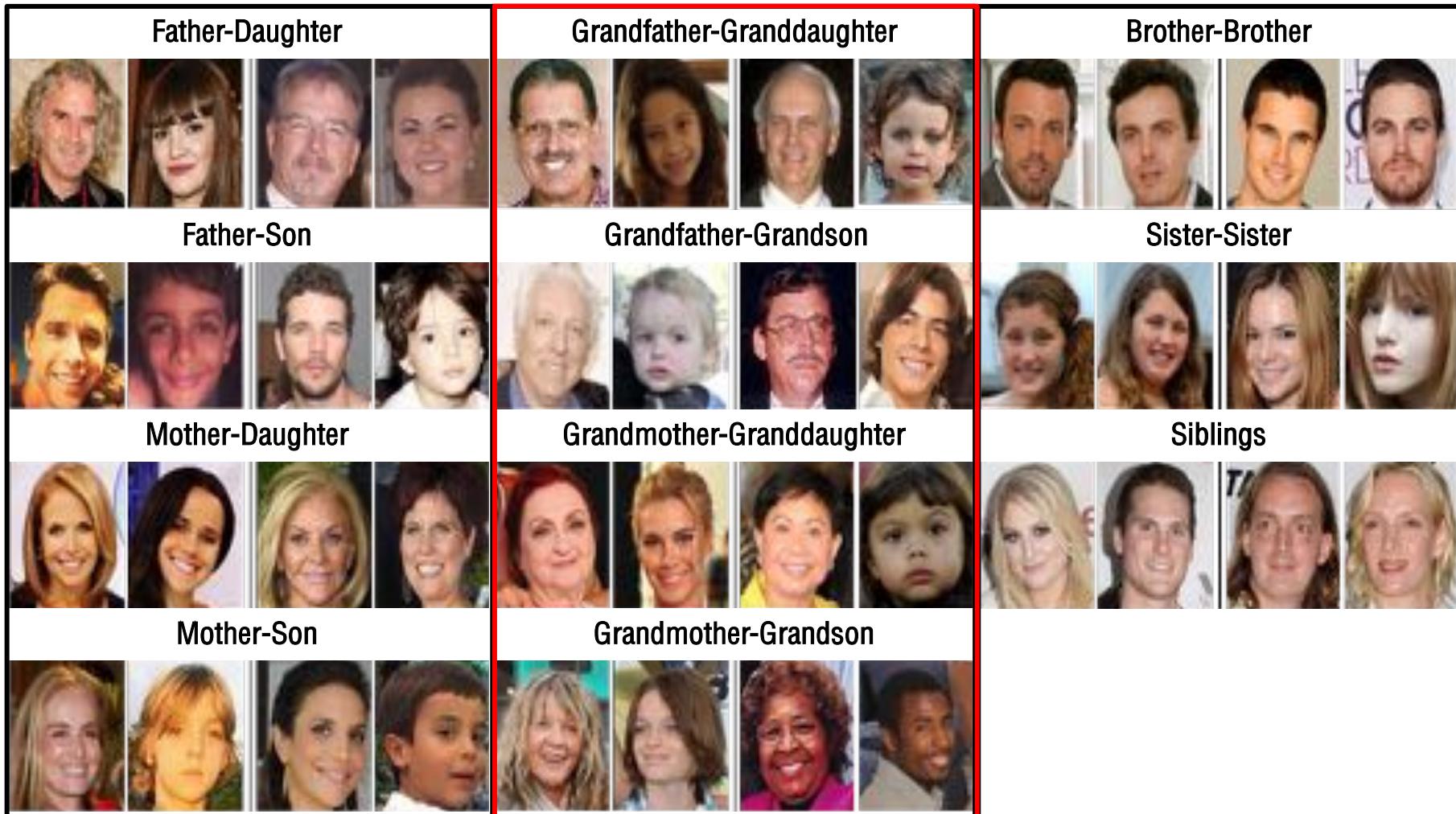




FIW Database

Pair-wise Types

Sample pairs of the 11 relationship types provided by FIW.

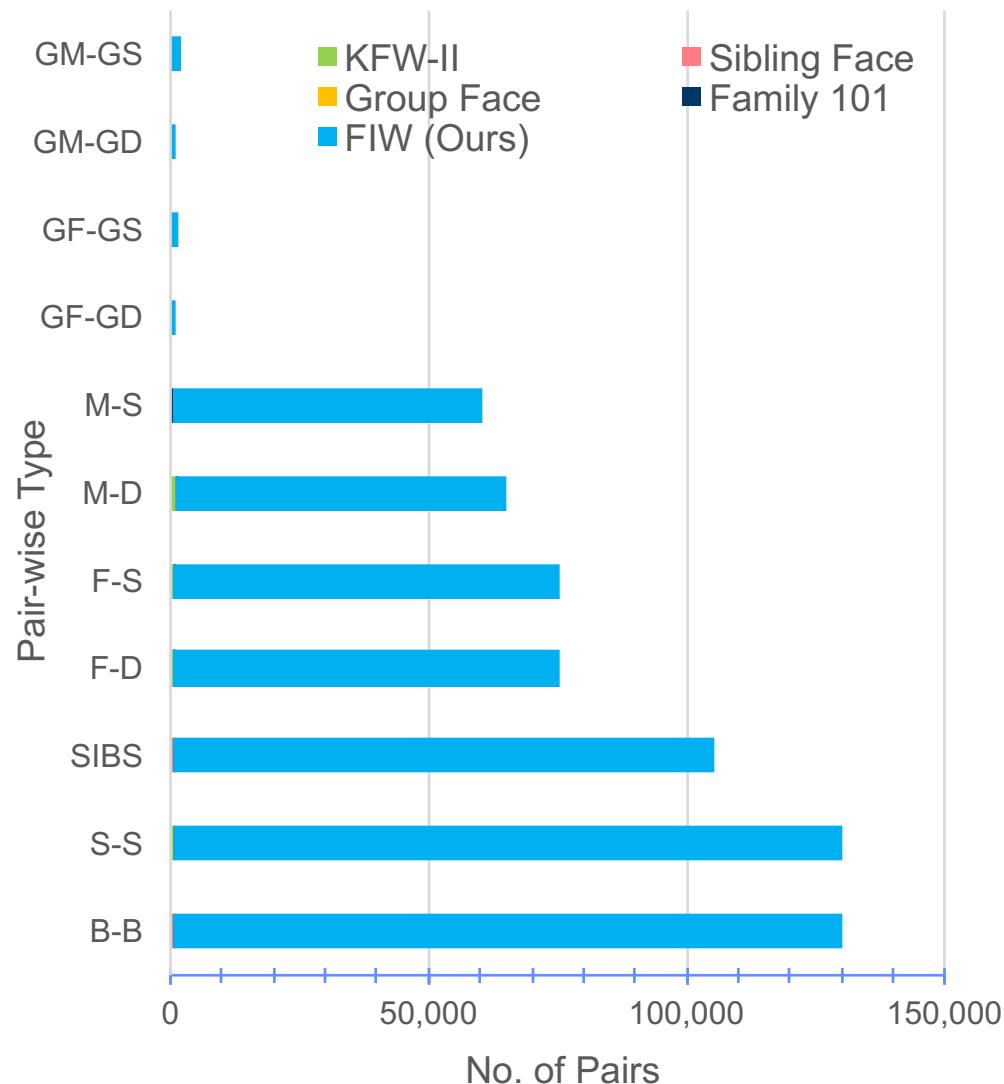




FIW Database

Pair-wise Types

| Type | KFW-II | Sibling Face | Group Face | Family 101 | FIW (Ours) |
|-------|--------|--------------|------------|------------|----------------|
| B-B | -- | 232 | 40 | -- | 130,000 |
| S-S | -- | 211 | 32 | -- | 130,000 |
| SIBS | -- | 277 | 53 | -- | 105,000 |
| F-D | 250 | -- | 69 | 147 | 75,000 |
| F-S | 250 | -- | 69 | 213 | 75,000 |
| M-D | 787 | -- | -- | 148 | 64,000 |
| M-S | 101 | -- | 70 | 184 | 60,000 |
| GF-GD | -- | -- | -- | -- | 1,000 |
| GF-GS | -- | -- | -- | -- | 1,350 |
| GM-GD | -- | -- | -- | -- | 950 |
| GM-GS | -- | -- | -- | -- | 2,000 |
| Total | 1,000 | 720 | 395 | 607 | 644,300 |

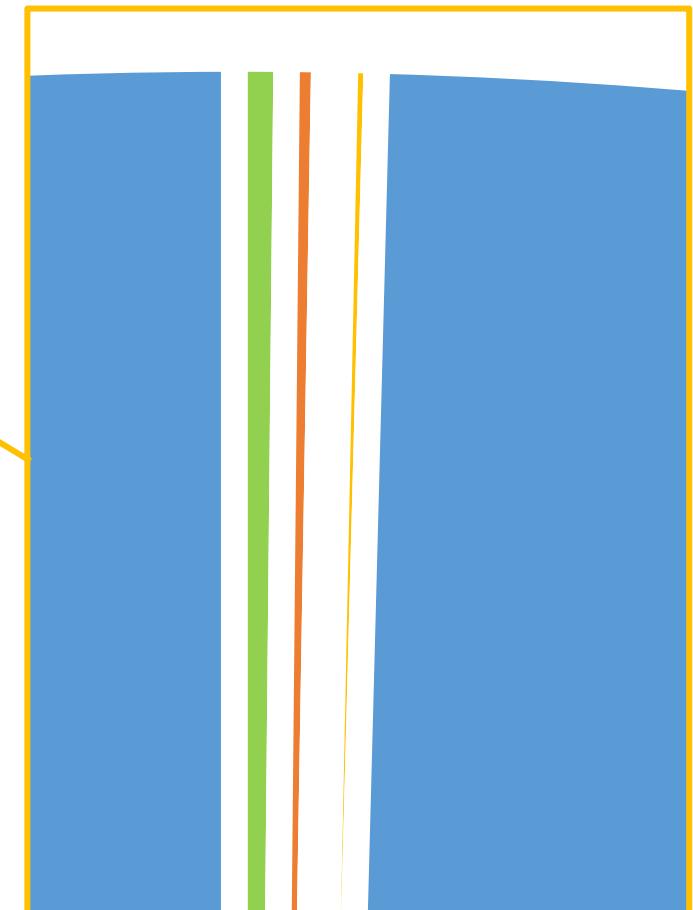
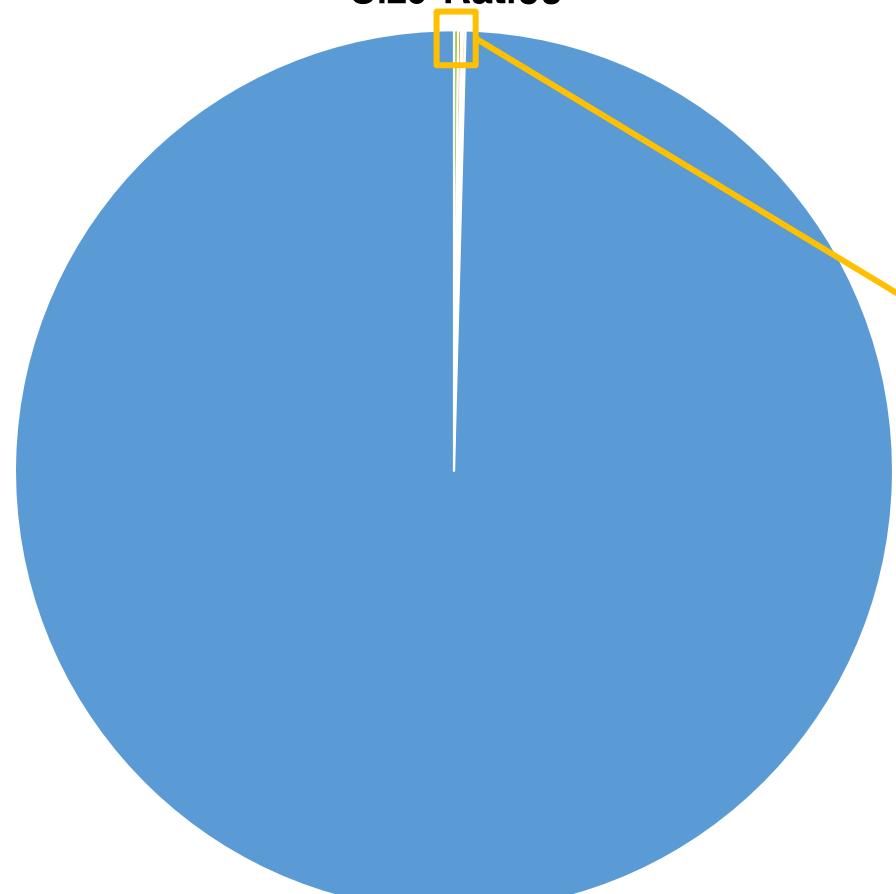




FIW Database

Pair-wise Types

Size Ratios



■ KFW-II

■ Sibling Face

■ Group Face

■ Family 101

■ FIW (Ours)



FIW Database

Pair-wise Types

| Dataset | No. Family | No. People | No. Faces | Age Varies | Family Structure | Highlights |
|-------------------|--------------|---------------|---------------|------------|------------------|--|
| CornellKin [5] | 150 | 300 | 300 | No | No | Parent-child pairs. |
| UB KinFace-I [8] | 90 | 180 | 270 | Yes | No | Parent-child pairs. Parents' 139 images at various ages. |
| UB KinFace-II [8] | 200 | 400 | 600 | Yes | No | Parent-child pairs. Parents' 139 images at various ages. |
| KFW-I [6] | — | 1,066 | 1,066 | No | No | Parent-child pairs. |
| KFW-II [6] | — | 2,000 | 2,000 | No | No | Parent-child pairs. |
| TSKinFace [9] | 787 | 2,589 | — | Yes | Yes | Two parents-child pairs for tri-verification. |
| Family101 [7] | 101 | 607 | 14,816 | Yes | Yes | Family structured, variations in age and ethnicity. |
| FIW(Ours) | 1,000 | 10,676 | 30,725 | Yes | Yes | 1,000 family trees that provides both depth and breadth, along with multi-task evaluation offerings. |



Experimental

Convolutional Neural Network: VGG-Face

Specs

- Very Deep Architecture
 - Trained weights on LFW (~2.6M faces, 2,622 IDs)
- Network Details
 - “Very small” convolution filters (i.e., 3x3)
 - Convolutional stride of 1
 - ReLu non-linearity
 - 3 Fully-Connected Layers





Experimental

Convolutional Neural Network: Fine-Tuned VGG-Face

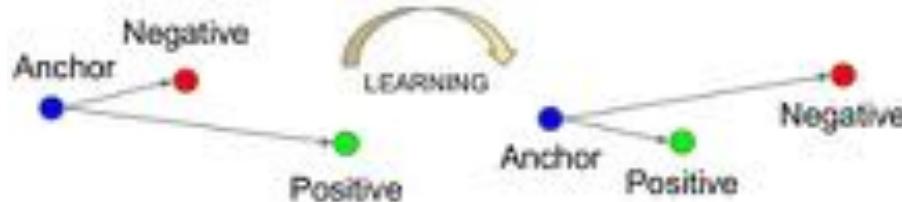
Kinship Verification

Triplet-loss

- Replaced topmost layer w triplet-loss



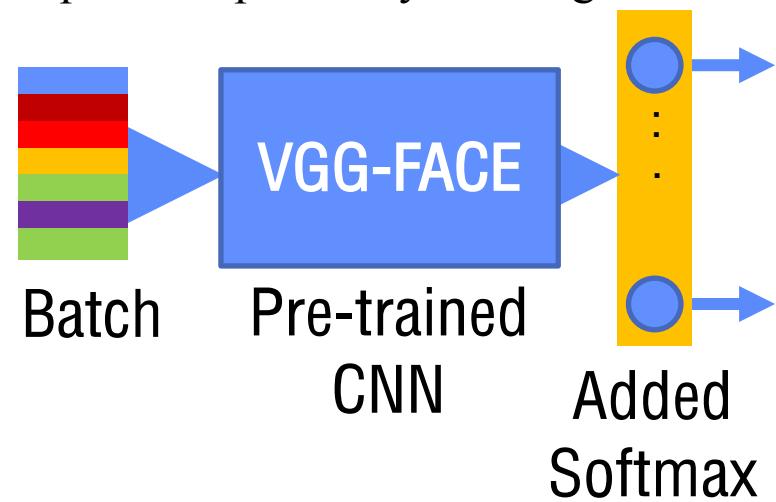
$$L = \sum_i^N \left[\|f(x_i^a) - f(x_i^p)\|_2^2 - \|f(x_i^a) - f(x_i^n)\|_2^2 + \alpha \right]_+$$



Family Classification

Softmax

- Replaced topmost layer to target 316 families



$$P(y = j | x) = \frac{e^{x^T w_j}}{\sum_{k=1}^K e^{x^T w_k}}$$

Top accuracies for each task resulted from fine-tuning the VGG-Face model.



Experimental

Verification Benchmarks

- Given a pair of faces → kin or non-kin ?
- No family overlap between folds.

Table 4 Verification scores for 5-fold experiment on FIW.

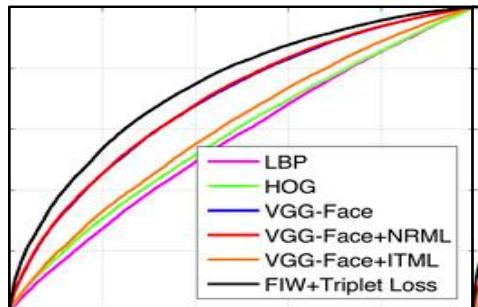
| | F-D | F-S | M-D | M-S | SIBS | B-B | S-S | GF-D | GF-S | GM-D | GM-S | Avg. |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| HOG | 56.2 | 56.9 | 56.8 | 55.7 | 59.3 | 50.3 | 57.8 | 62.4 | 58.9 | 59.5 | 57.7 | 57.4 |
| HOG PCA | 56.1 | 56.5 | 56.4 | 55.3 | 58.7 | 50.3 | 57.4 | 59.3 | 66.9 | 60.4 | 56.9 | 57.7 |
| LBP | 55.0 | 55.2 | 55.4 | 56.0 | 57.1 | 57.0 | 55.9 | 59.0 | 56.0 | 55.8 | 60.3 | 56.6 |
| LBP PCA | 55.0 | 55.3 | 55.4 | 55.9 | 57.1 | 56.8 | 55.8 | 58.5 | 59.1 | 55.6 | 60.1 | 56.8 |
| VGG-Face | 64.3 | 63.3 | 66.4 | 64.2 | 73.2 | 71.4 | 70.6 | 66.1 | 61.1 | 64.9 | 60.4 | 66.0 |
| VGG-Face PCA | 64.4 | 63.4 | 66.2 | 64.0 | 73.2 | 71.5 | 70.8 | 64.4 | 68.6 | 66.2 | 63.5 | 66.9 |
| Fine-Tuned | 67.8 | 66.6 | 66.7 | 68.2 | 72.3 | 70.8 | 70.3 | 69.5 | 68.3 | 69.5 | 63.5 | 68.5 |
| Fine-Tuned PCA | 69.4 | 68.2 | 68.4 | 69.4 | 74.4 | 73.0 | 72.5 | 72.9 | 72.3 | 72.4 | 68.3 | 71.0 |



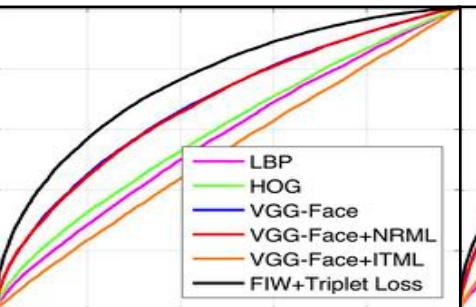
Progress Overview

Experimental

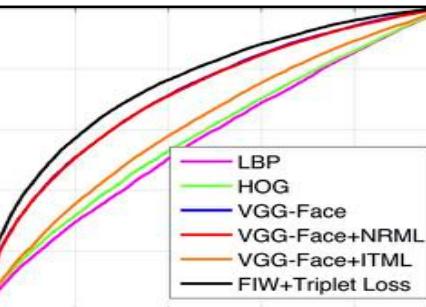
F-D



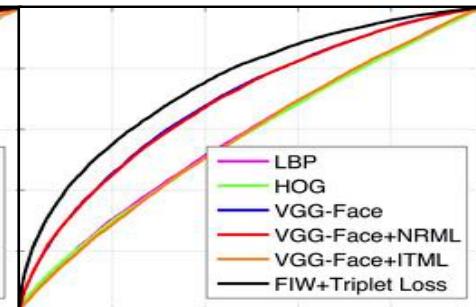
F-S



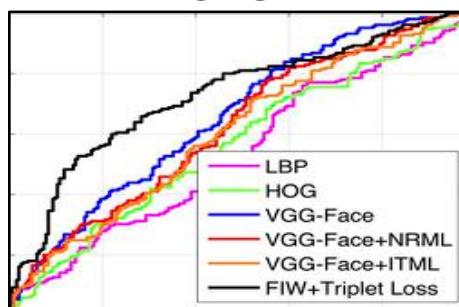
M-D



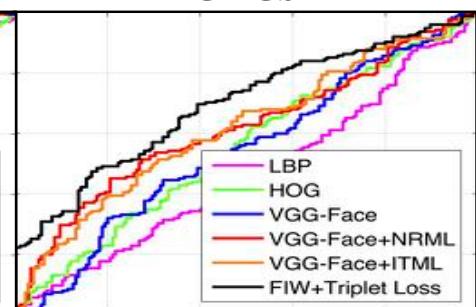
M-S



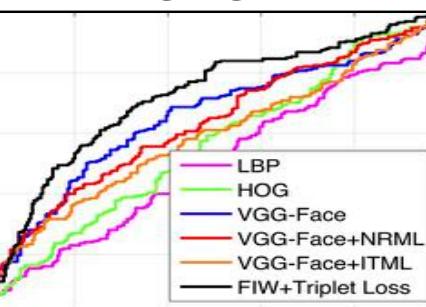
GF-GD



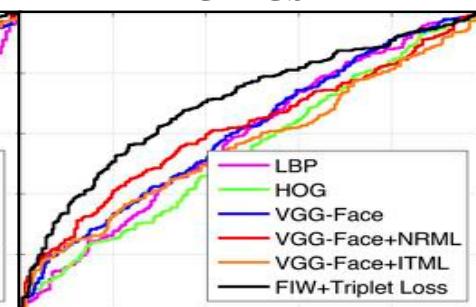
GF-GS



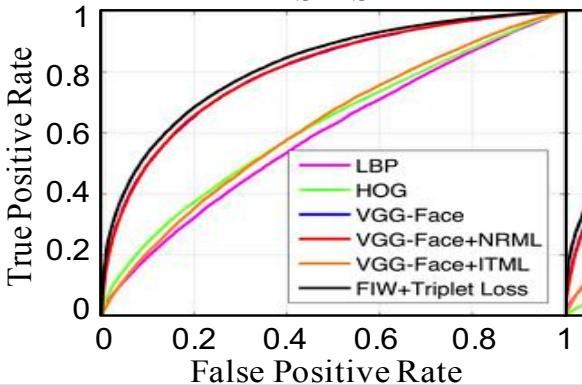
GM-GD



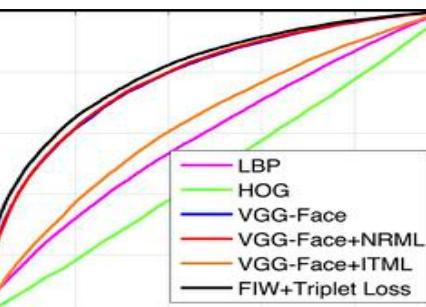
GM-GS



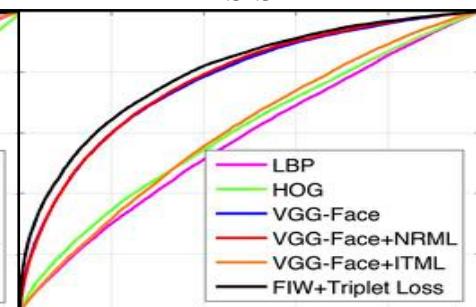
SIBS



B-B



S-S





Experimental

Family Classification Benchmarks

- Families with 5+ members, each with 5+ face samples → 316 Families
- Leave 1 member out for testing, train on rest (5-Fold)

Table 5 Classification accuracy scores for FIW.

| Fold | VGG-Face | VGG-Face (fine-tuned) |
|------|----------|--------------------------|
| 1 | 9.6 | 10.9 |
| 2 | 14.5 | 14.8 |
| 3 | 11.6 | 12.5 |
| 4 | 12.7 | 14.8 |
| 5 | 13.1 | 13.5 |
| Avg. | 12.3 | 13.3 |

Note: random = 0.3%



Experimental

Family Classification Benchmarks



Query

Top Ranked (10)



Conclusion

What's Next

Upcoming Challenge

- Organize kinship recognition into challenge; support additional tasks.

The screenshot shows a dark-themed website for "FAMILIES IN THE WILD". At the top, there is a navigation bar with links: Home, Contact, About Us, Collaborations, News, Media, and Get Involved. Below the navigation, the word "Challenges" is prominently displayed in white. Underneath "Challenges", there are three buttons: "MISSING PERSON SEARCH & RETRIEVAL" (highlighted in light gray), "KINSHIP VERIFICATION", and "FAMILY CLASSIFICATION".

<http://smile-fiw.weebly.com/>



Conclusion

What's Next

Upcoming Challenge

- Organize kinship recognition into challenge; support additional tasks.

Extend FIW Database

- Add more data to the 1,000 families using more clever labeling scheme.

Experimental

- Improve models and perform more intensive analysis.

Families in the Wild Dataset





Conclusion

In summary

- Much larger, spanning with depth and breadth (i.e., multi-generations and multiple samples per subject)
- Quality family photos captured *in the wild* (i.e., unconstrained)
- 1,000 full family trees containing many more pairs than existing datasets (i.e., far outdoes predecessors)
- Serves multi-task purposes supported by laboratory style evaluations and benchmarked results

Families in the Wild Dataset





Thank you!

