

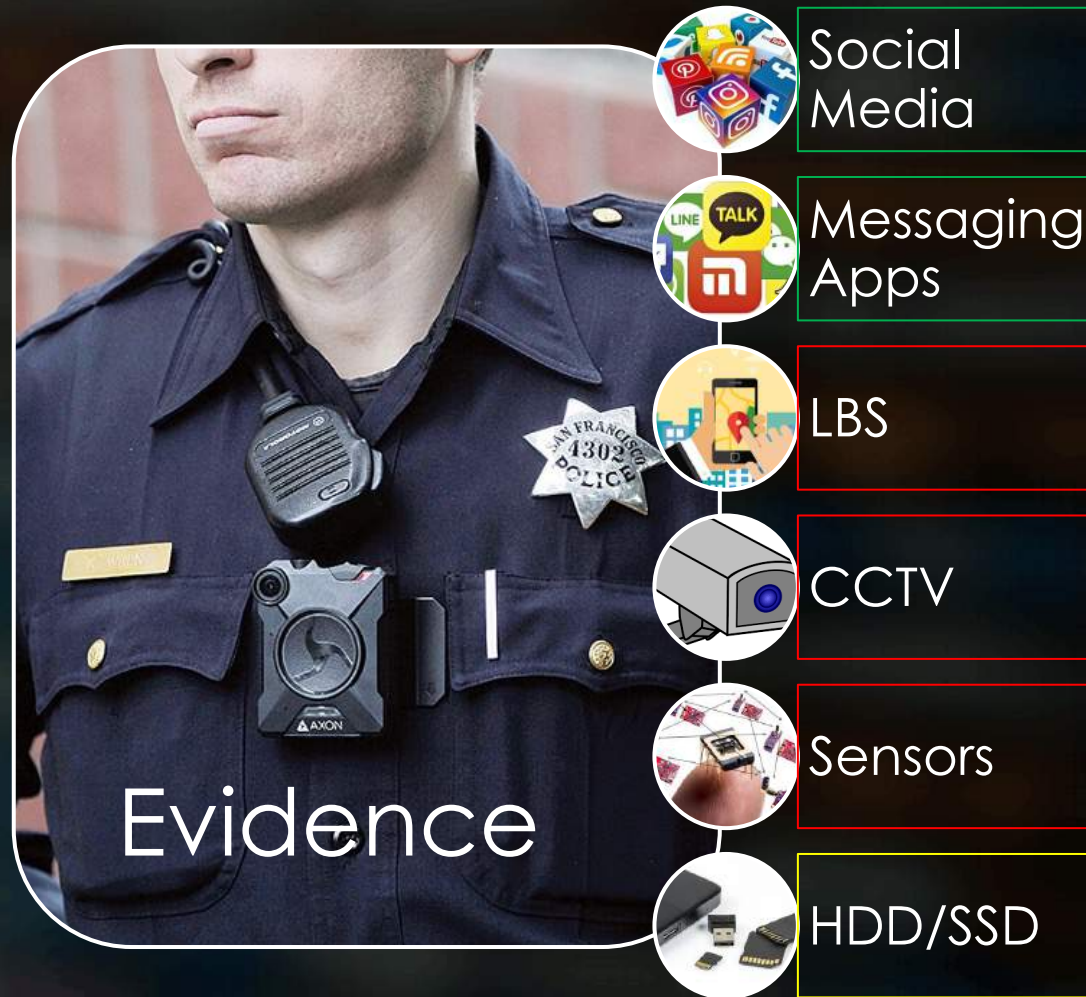
DeepUAge: Improving Underage Age Estimation Accuracy to Aid CSEM Investigation

FELIX ANDA, NHIEAN-AN LE-KHAC AND MARK SCANLON

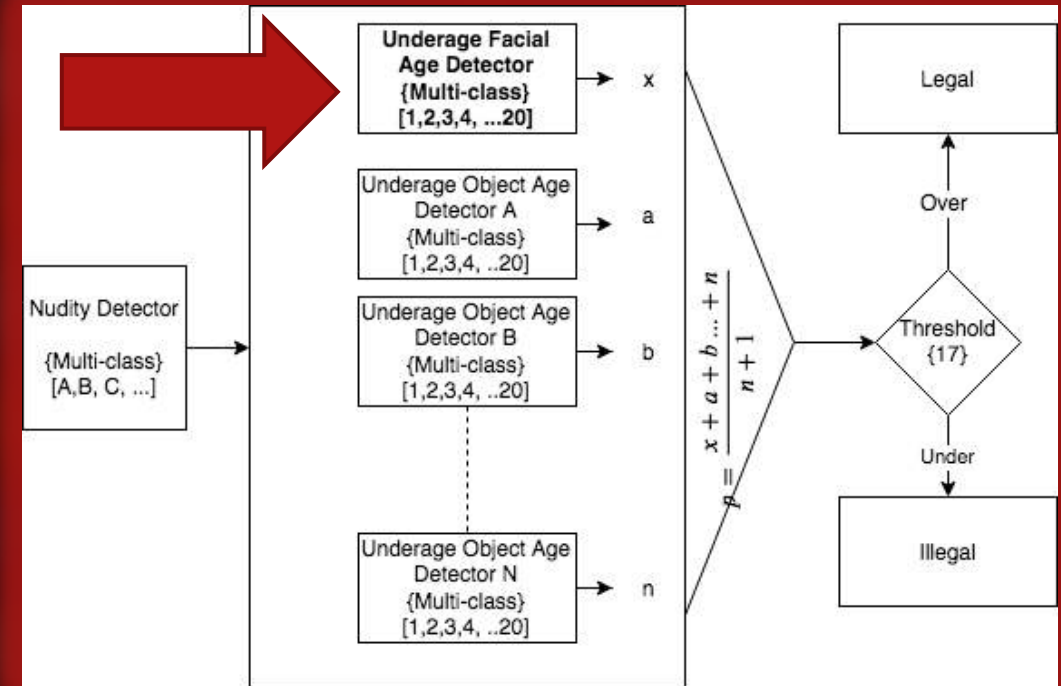


UCD Forensics and
Security Research Group

What is Digital Forensics Backlog?



What can be done?



Age Estimation

4



Validate and
Test (MAE)



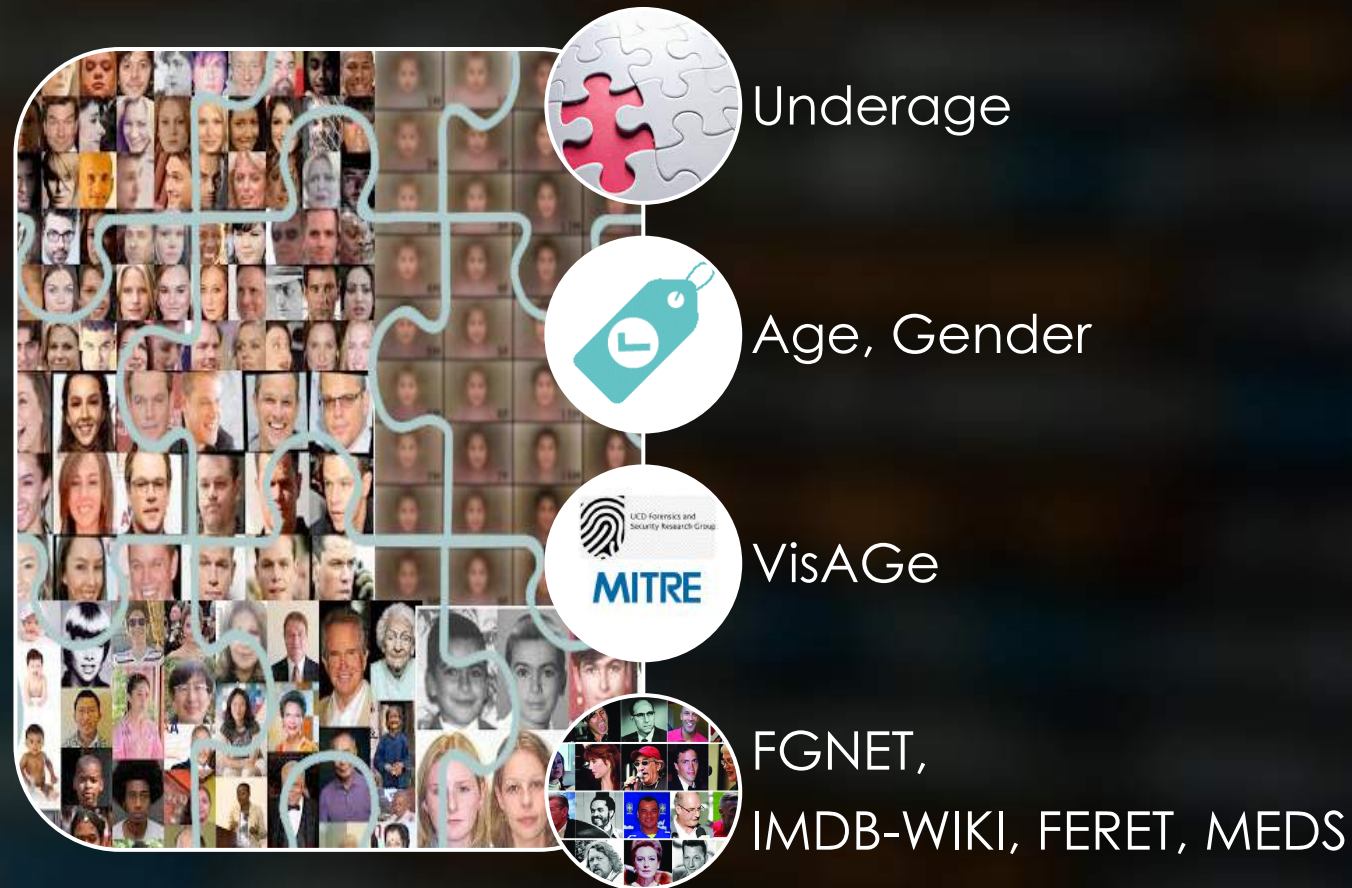
Age Estimation approaches

5

- ▶ Anthropometric approaches
 - ▶ measure sizes and proportions of human faces.
 - ▶ (Ramanathan and Chellappa, 2006)
- ▶ Biologically Inspired Features
 - ▶ (Guo et al. , 2009)
 - ▶ Improve when manifold learning uses BIF
- ▶ Standard Linear SVM
 - ▶ (Eidenger et al., 2014)
 - ▶ age and gender estimation using SVM
- ▶ VGG16
 - ▶ (Rothe et al. , 2016)
 - ▶ Deep learning , IMDB-WIKI (3.25 years)
- ▶ Humans
 - ▶ 2.07 – 8.62
 - ▶ Own Age, Age and Difference



Datasets

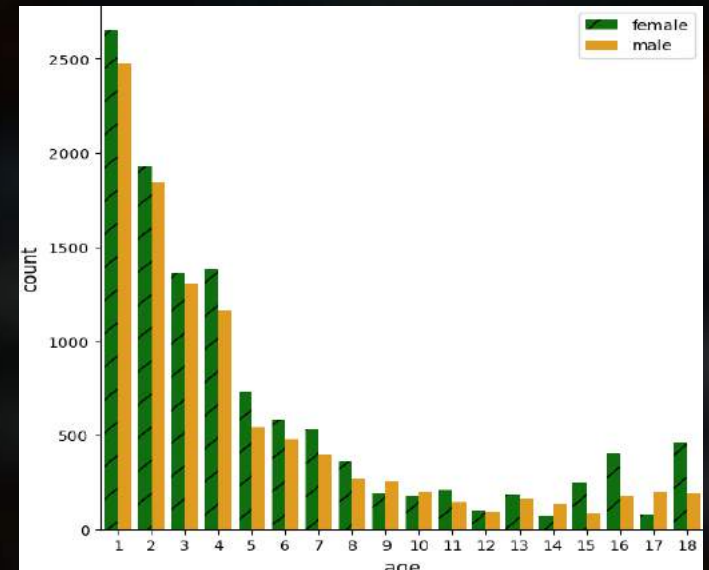
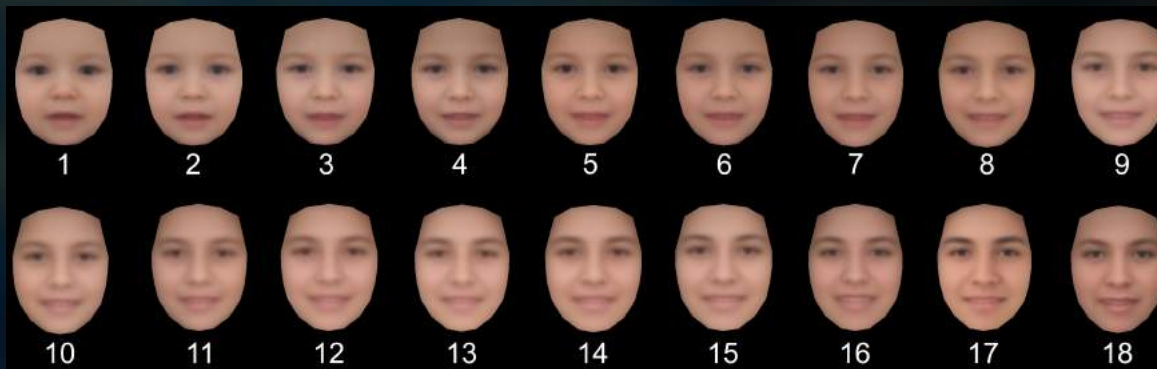


- 16K Images.
- [80, 20]% Training & Validation.
- 1K for Testing (UTKFace and Dataset generator Anda et al., 2018).

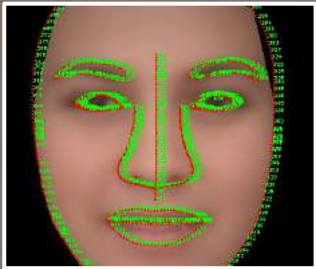


VisAGe

- ▶ Age and Gender annotations by Voting System.
- ▶ Underage Dataset [1 -18] y/o.
- ▶ Flickr Creative Commons (CC) Images
- ▶ > 19,446 Images
- ▶ Humans estimate



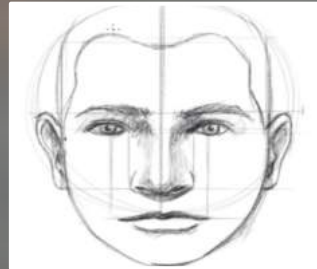
DCA Contour Technique



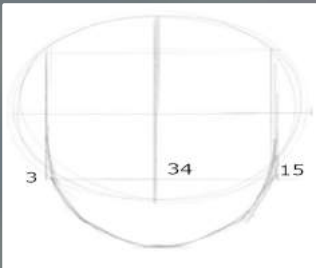
FACE ++
1k facial key points



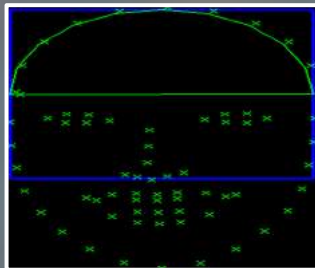
DLIB/STASM
68 / 84



Loomis



Dlib Contour Artistic
Approach



Contour reconstruction

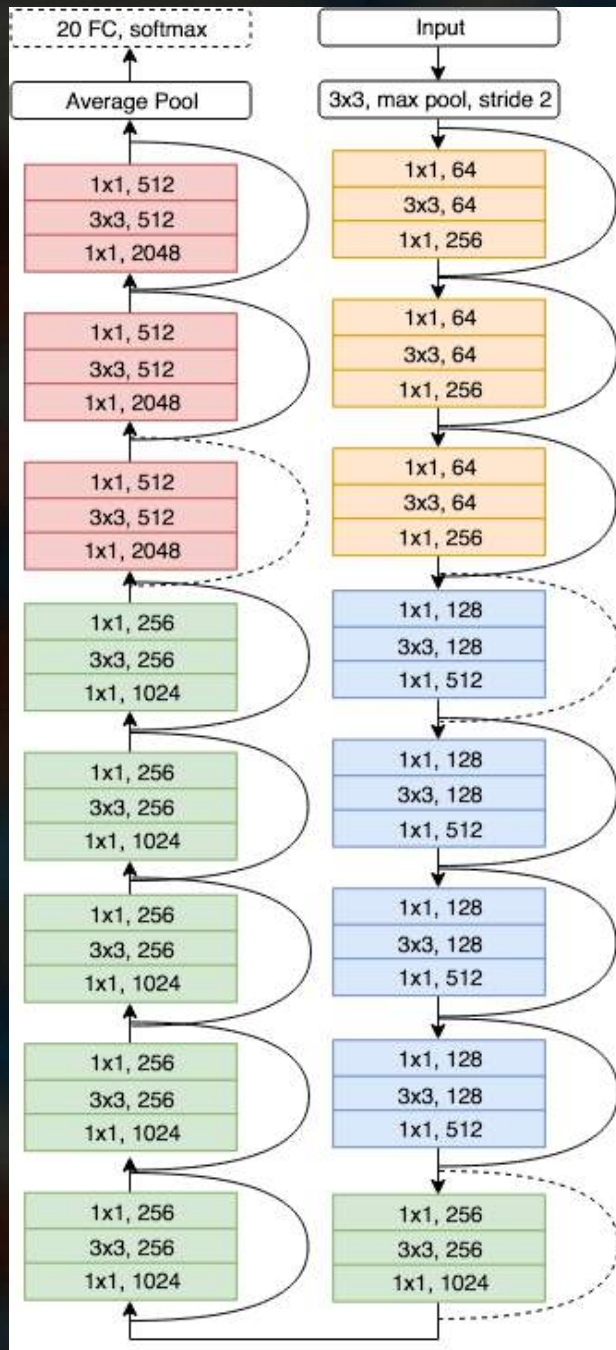


DCA Contour

Align
Warp



ResNet50



- ▶ Hyper/parameters
 - ▶ Frozen layers
 - ▶ Categorical Cross Entropy
Logarithmic loss function
 - ▶ Batch size 64
 - ▶ Epochs 100 (Early Stopping)
 - ▶ Softmax activation function
 - ▶ SGD: momentum-> 0.9 , LR -> 0.1
 - ▶ 224x224 pixels
 - ▶ MAE

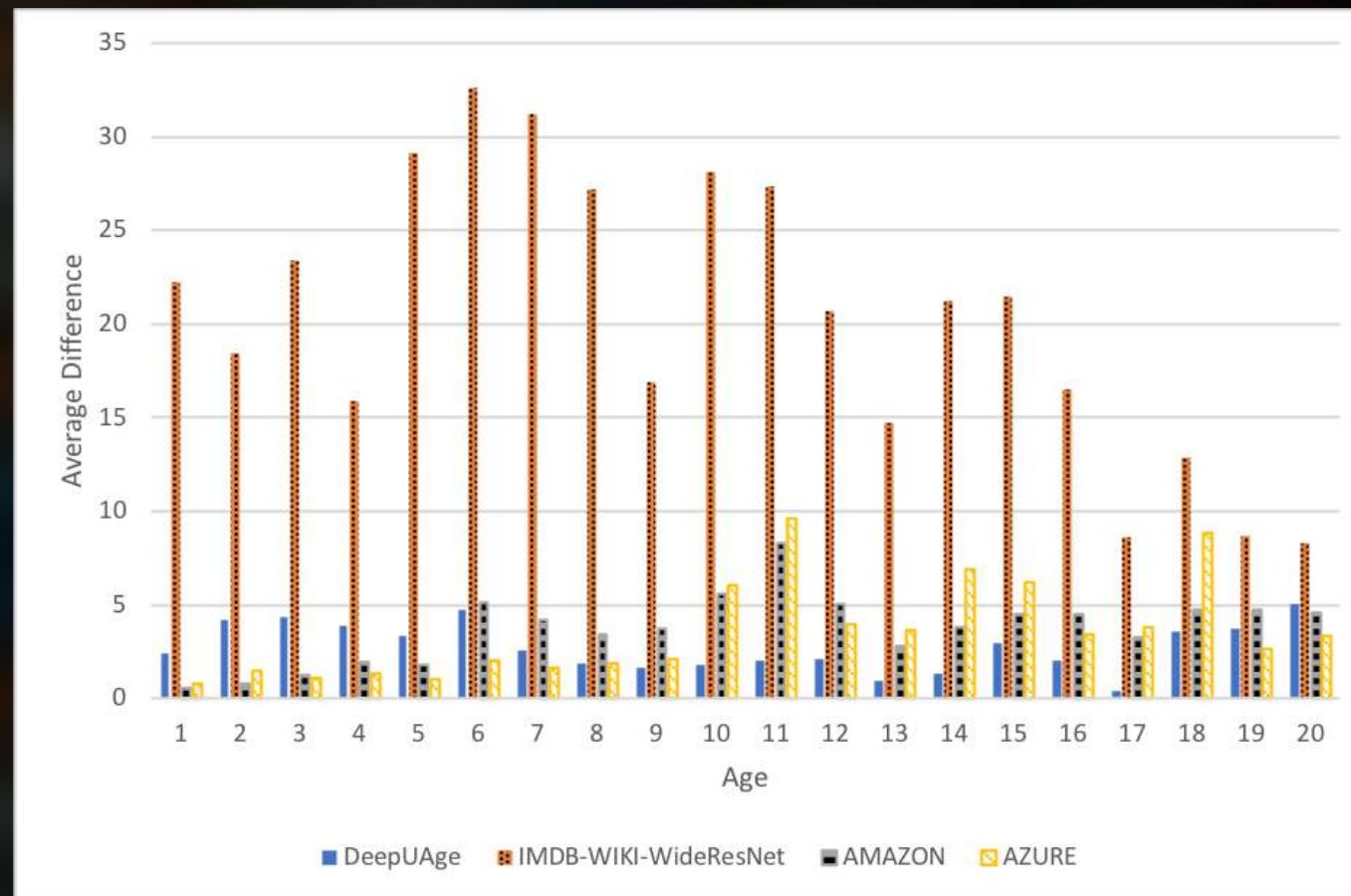
Results

Preprocessing Techniques

Approach	MAE
DCA	2.73
Face++ contour	2.79
Dlib contour aligned	4.01
Dlib contour non-aligned	4.28
Dlib cropped	5.31
Non-processed	5.71

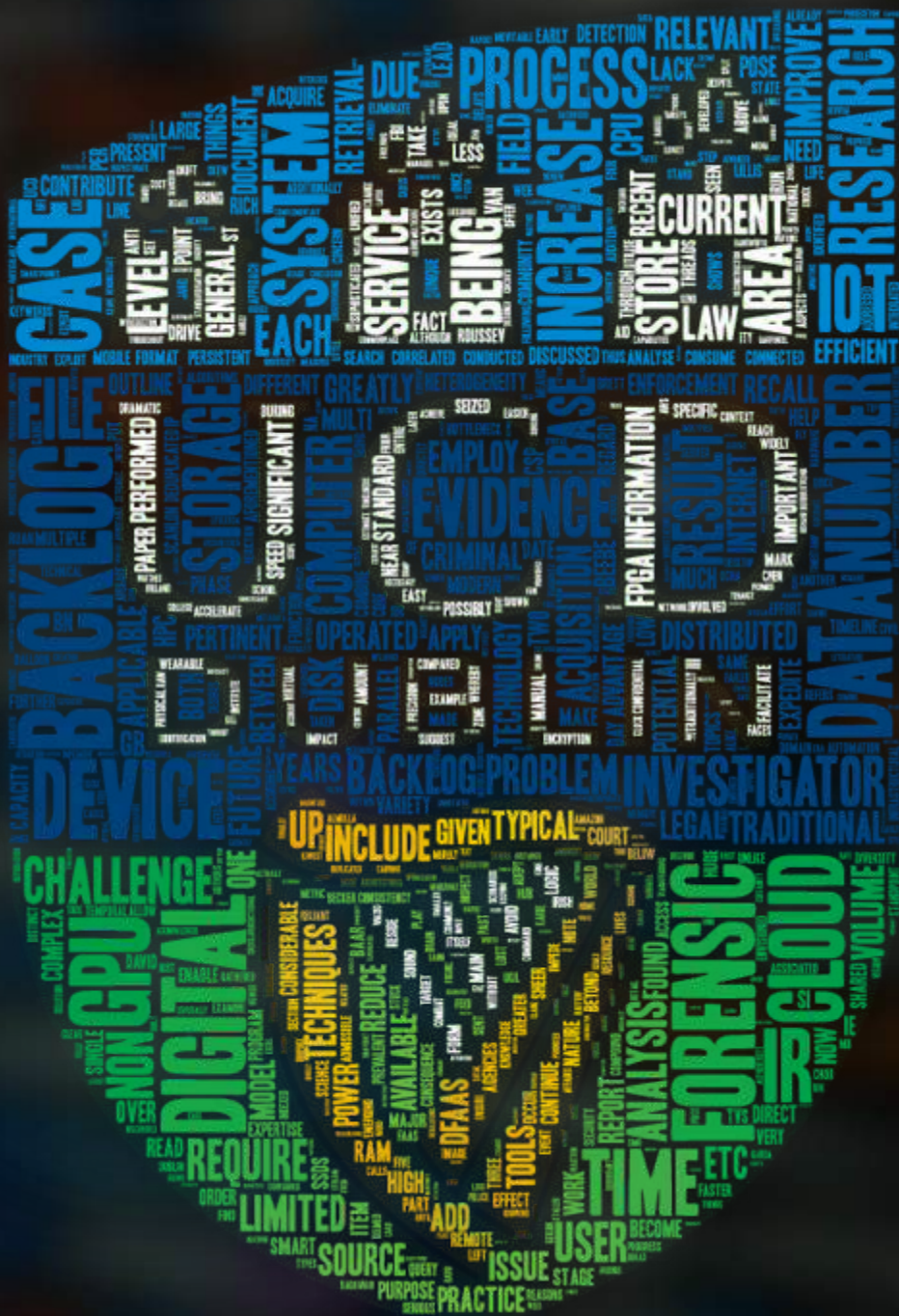
Age Estimators

Approach	MAE
DeepUAge Validation	1.53
DeepUAge Test	2.73
Microsoft Azure Face API	3.60
Amazon Rekognition	3.74
Dummy estimator (All assumed 10 y/o)	5.00
Face++	18.21
IMDB-WIKI WideResNet [9]	20.43



Conclusion

- ▶ Impact accuracy of DL models
 - ▶ Validation of data
 - ▶ Reduction of unnecessary features
 - ▶ Small problem
- ▶ Guidelines for underage age estimation
 - ▶ Balanced Images
 - ▶ Preprocessing
 - ▶ Background Noise elimination



THANK YOU



FELIX.ANDABASABE@UCD.IE



WWW.FORENSICSANDSECURITY.COM



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UCD Forensics and Security Research Group