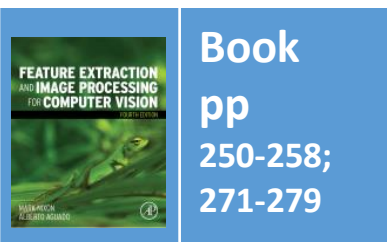


Lecture 10 Applications/Deep Learning

COMP3204 & COMP6223 Computer Vision

Where is feature extraction used these days?



Department of
Electronics and
Computer Science

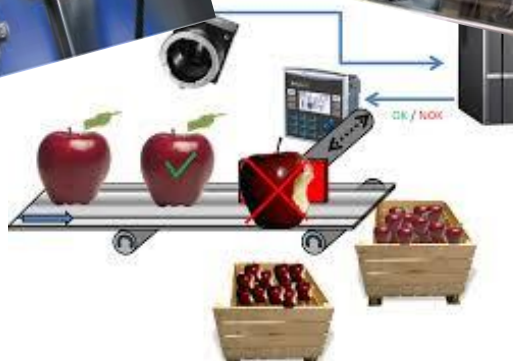
UNIVERSITY OF
Southampton
School of Electronics
and Computer Science

Content

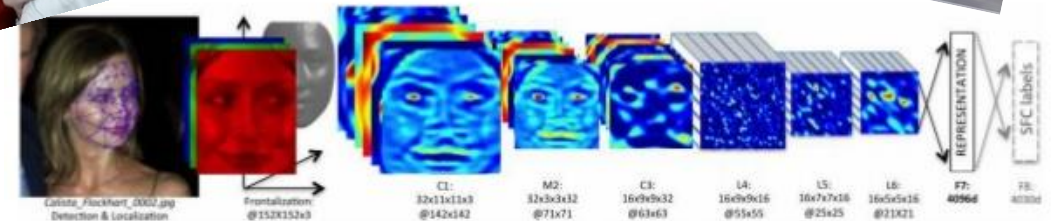
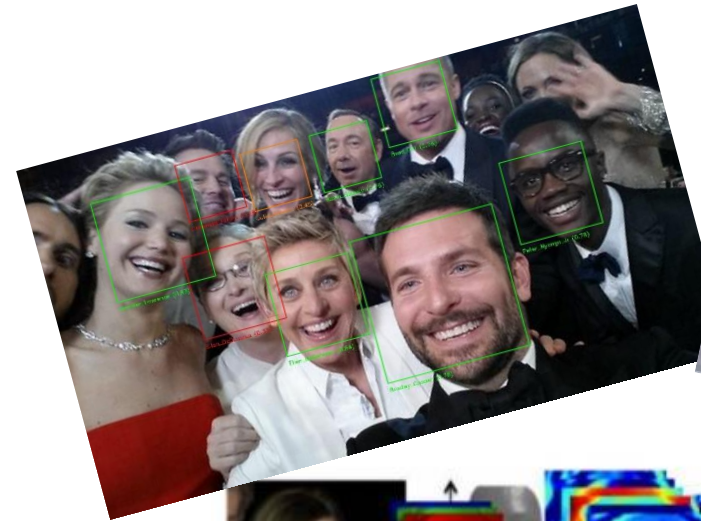
1. Where is computer vision going?
2. Where and how is it used?

Where is computer vision used?

What you see depends on the viewpoint you take

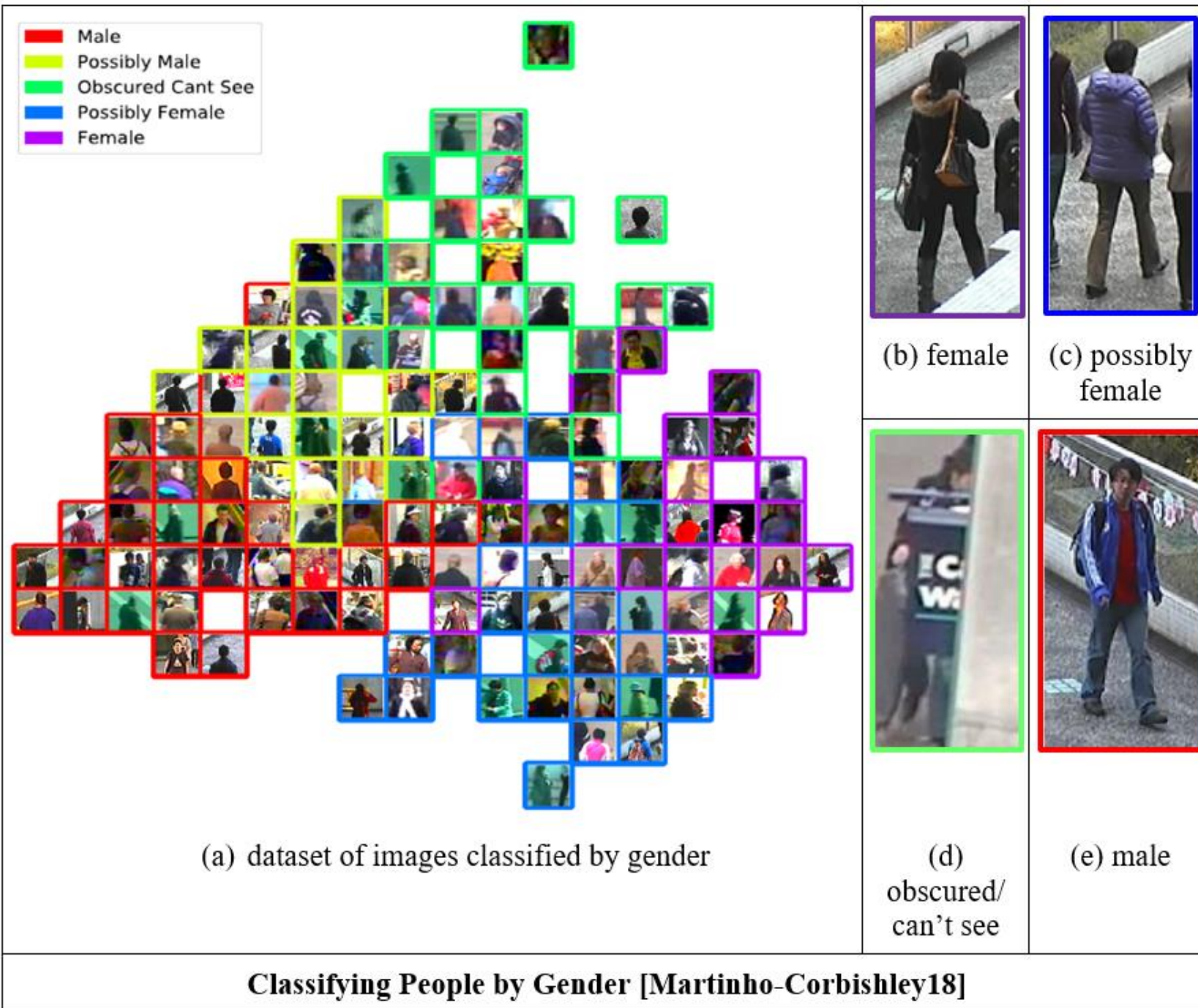


Industry

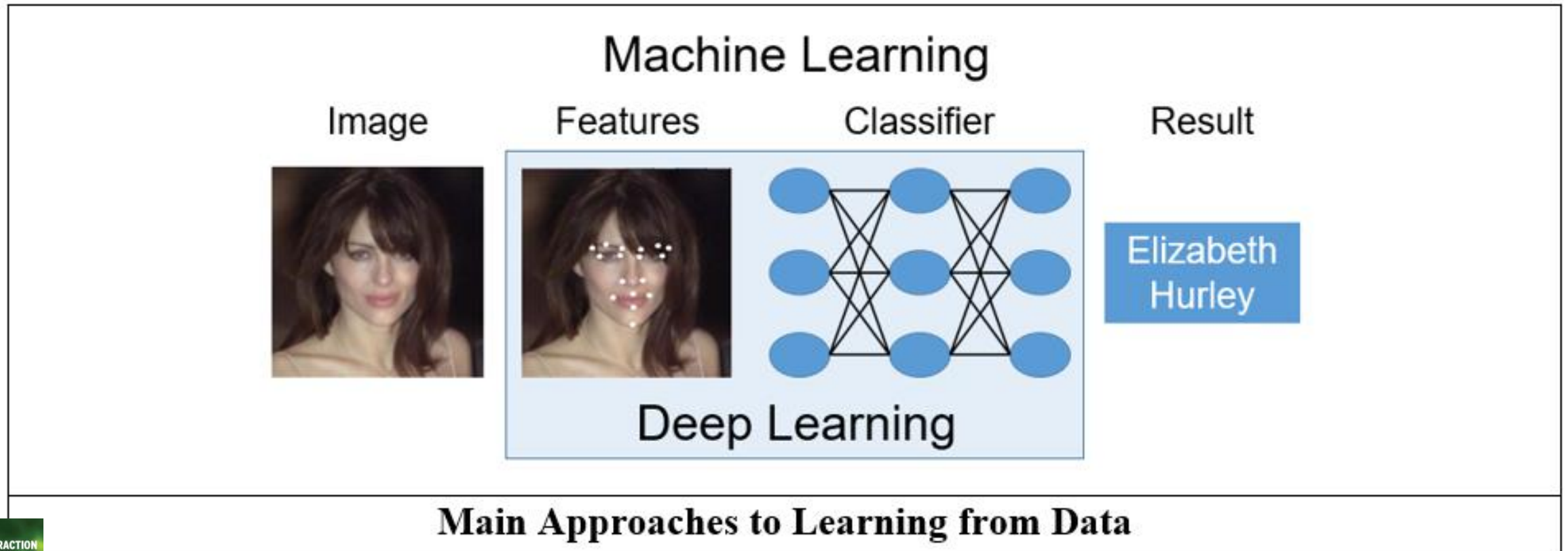


Academics,
but increasingly everyone

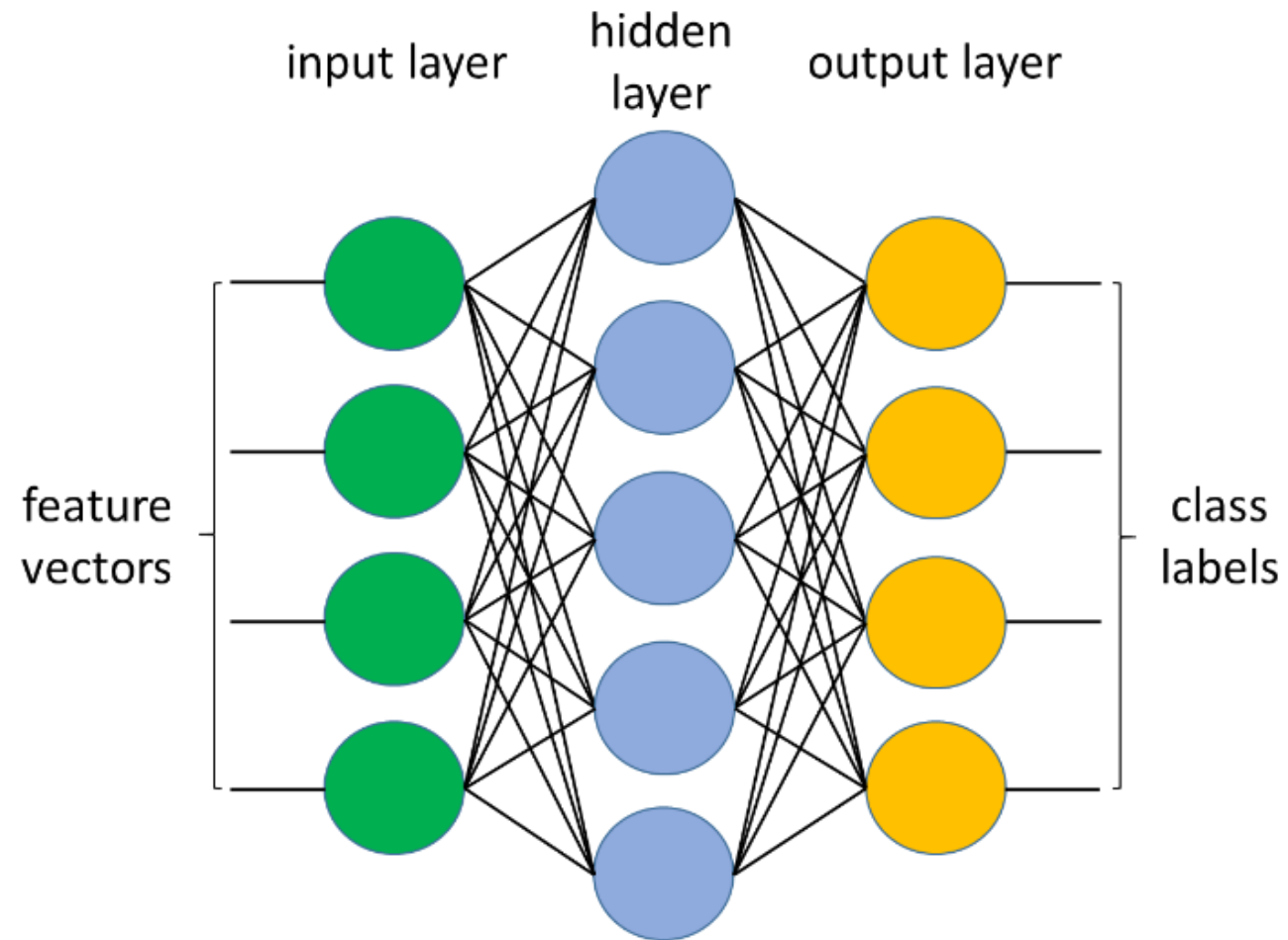




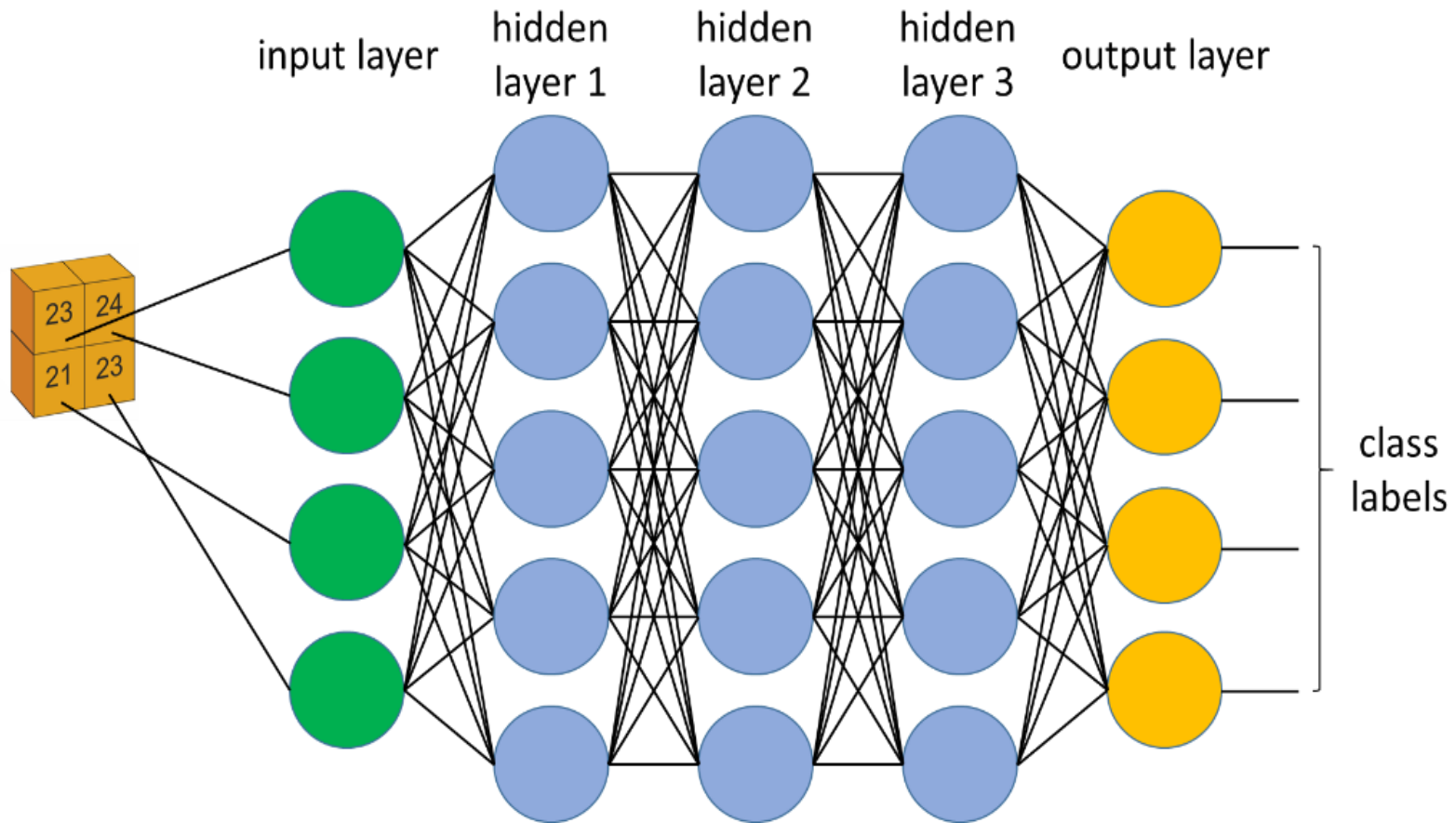
On learning



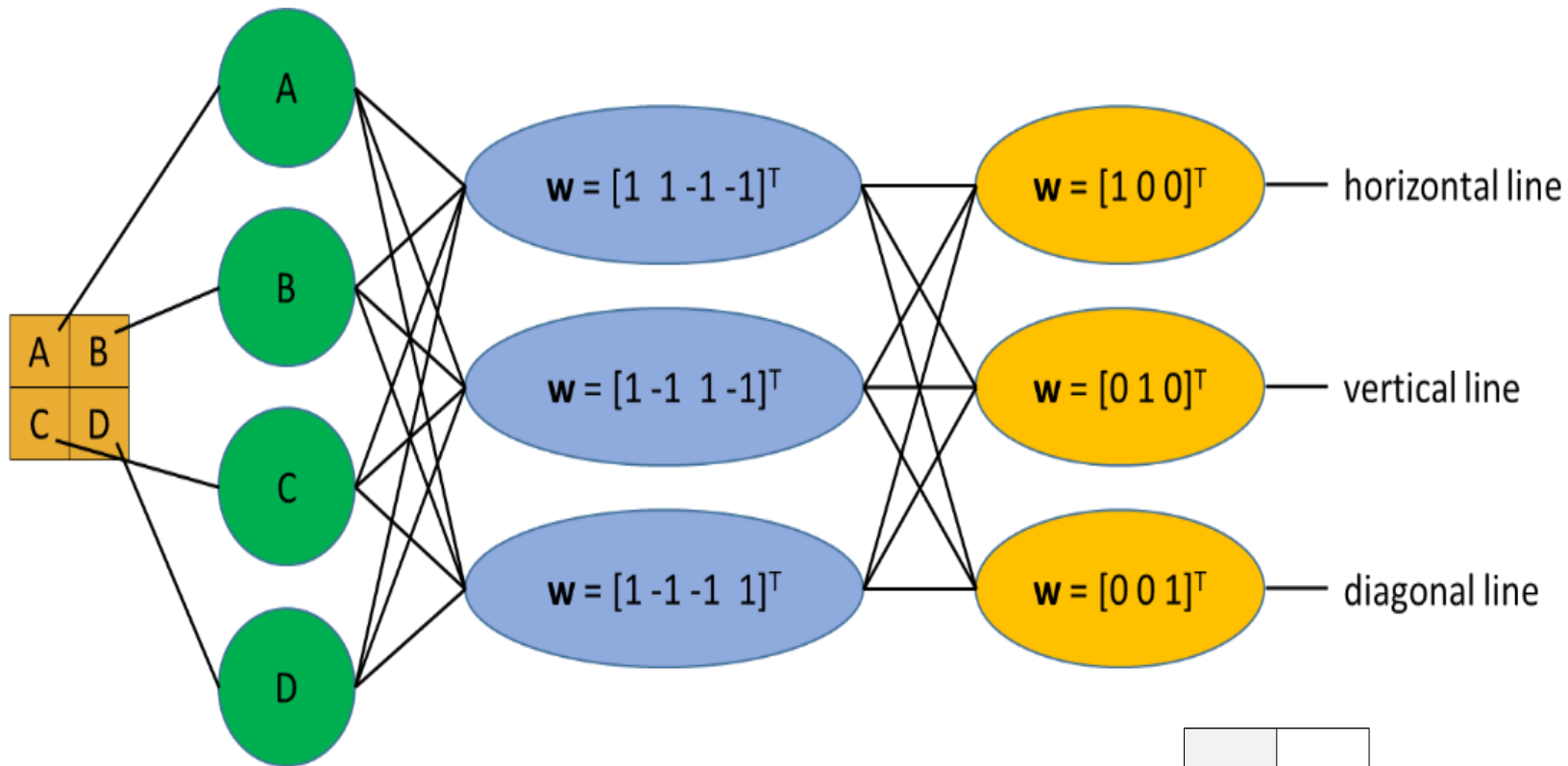
80's



Basis of a Deep Neural Network



Trained Example Neural Network

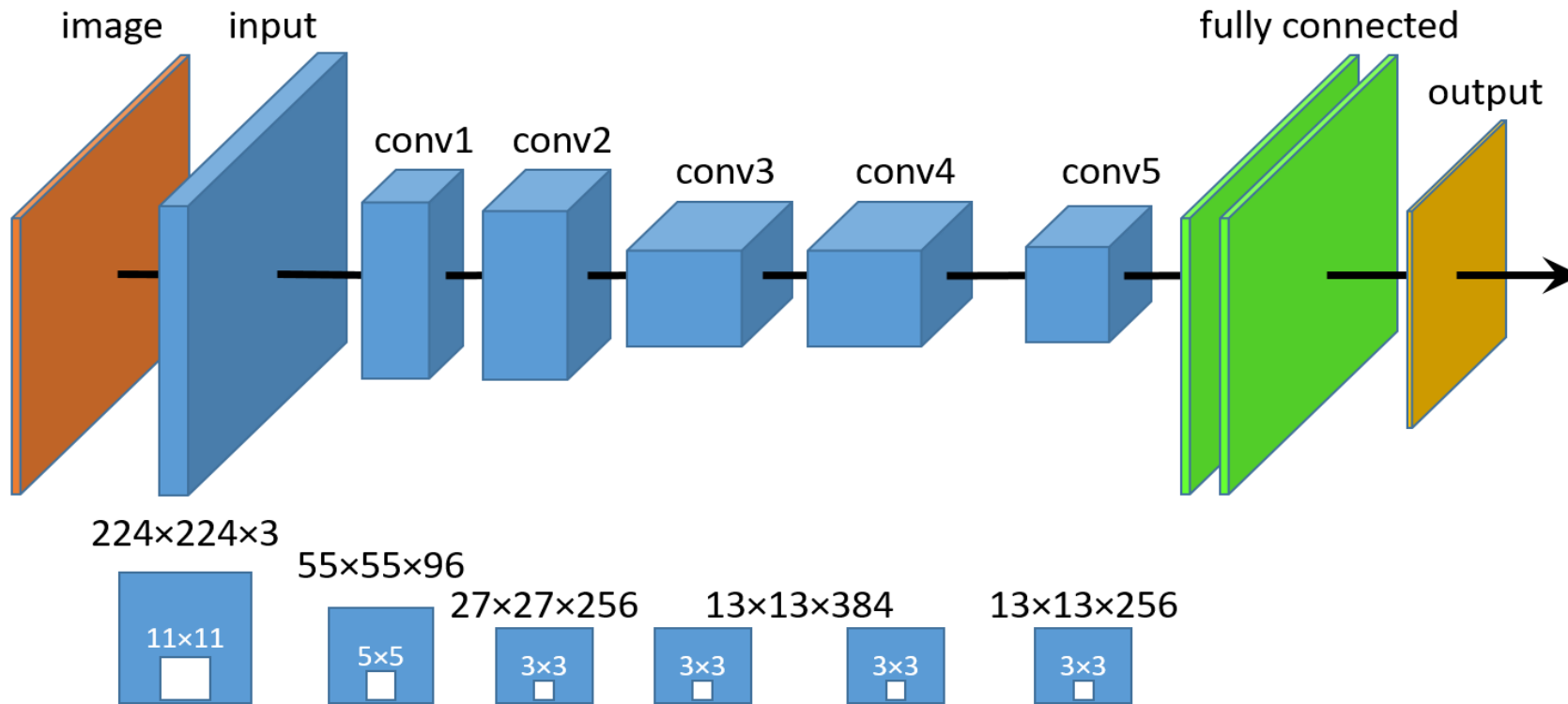


42	52	$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$
11	18	

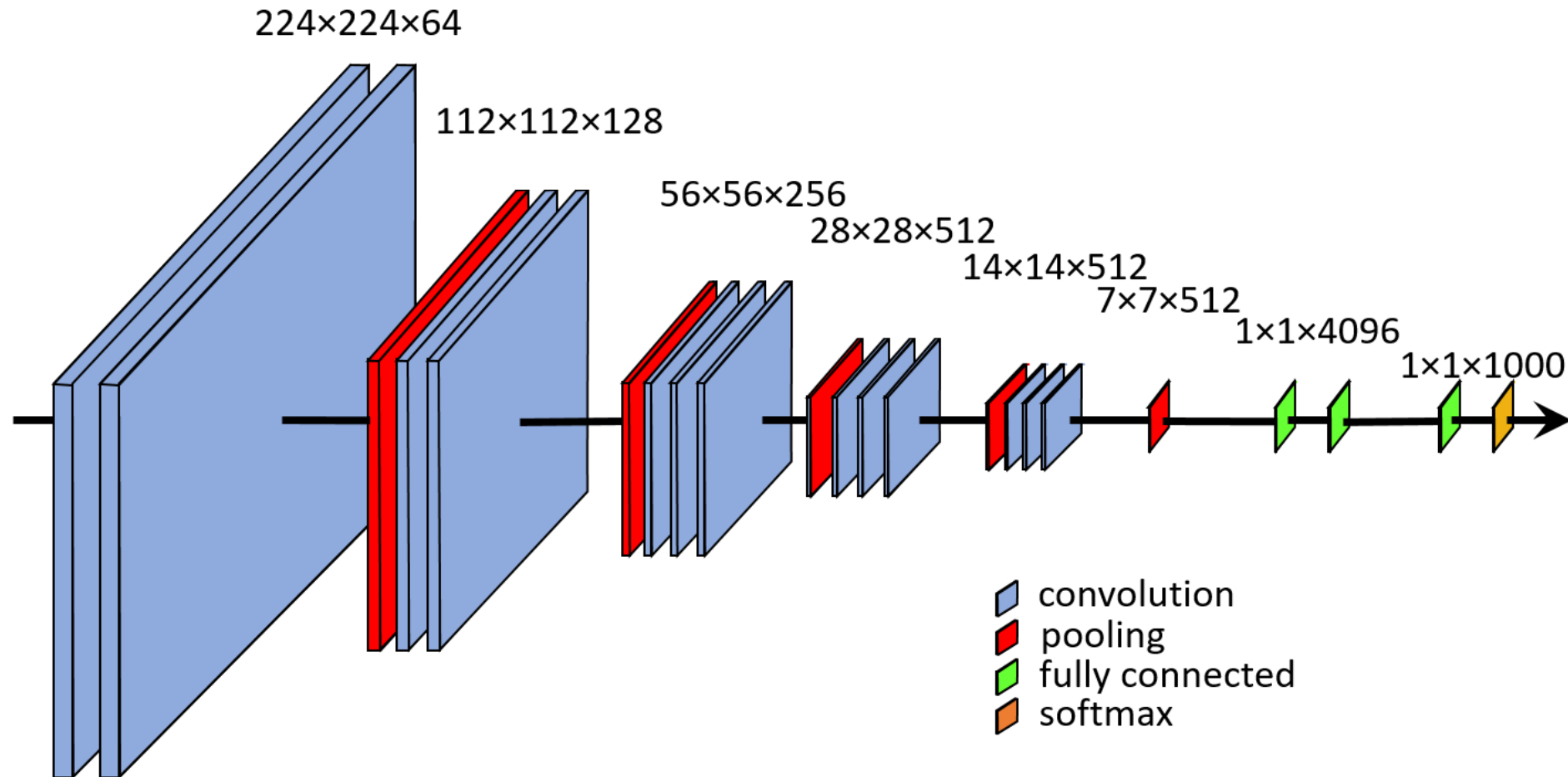
22	52	$\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$
11	48	

22	52	$\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$
45	24	

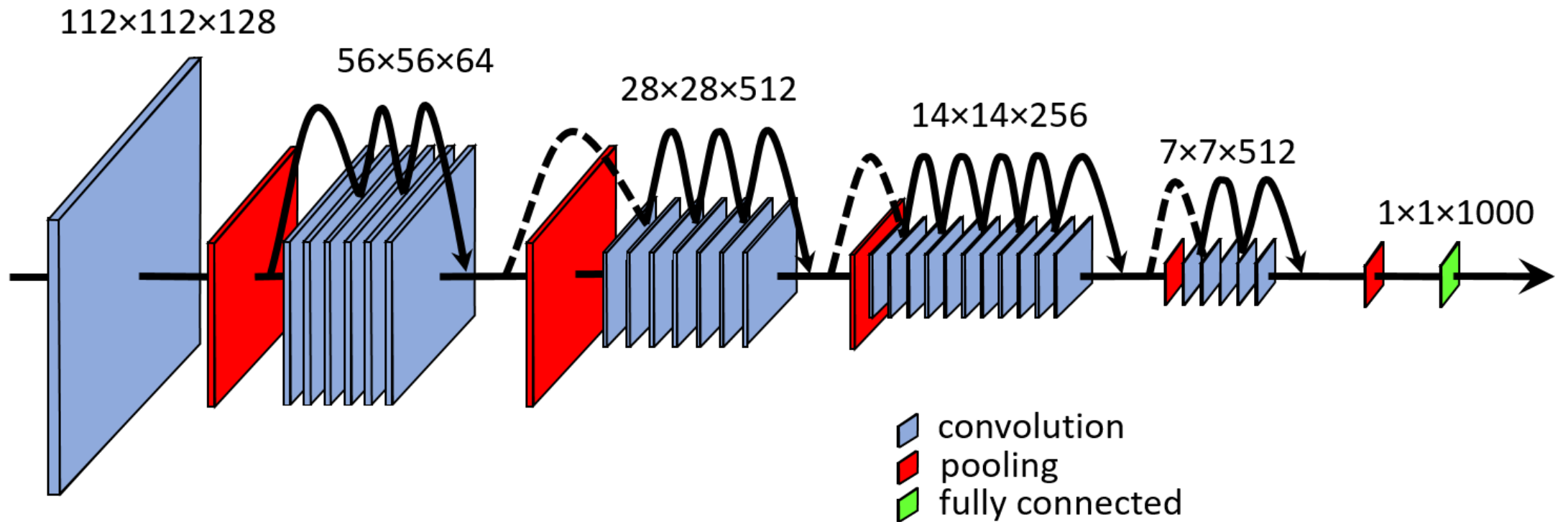
Alexnet architecture



VGG architecture



Resnet architecture

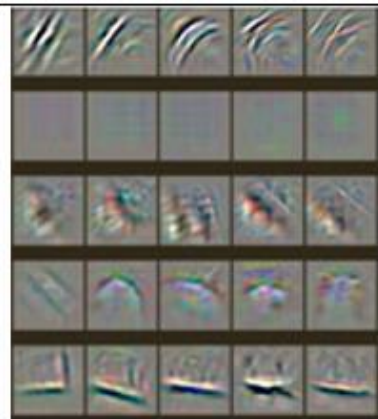




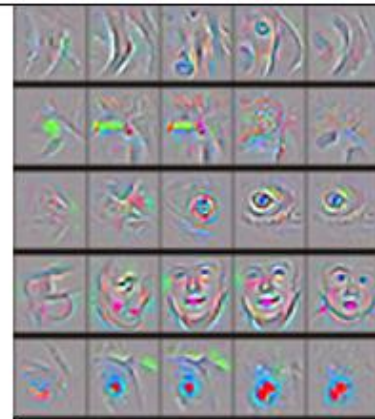
(a) part of a database of face images



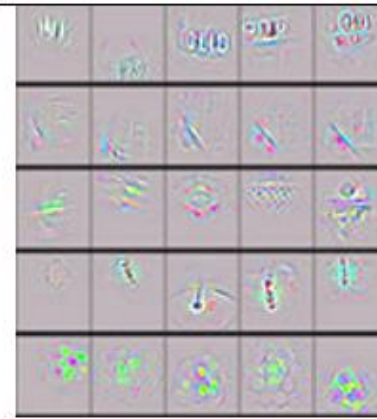
(b) level 1 features



(c) level 2 features



(d) level 3 features



(e) level 4 features

Features at Different Levels in Deep Learning





(a) full image



(b) ground truth



(c) by interpolation

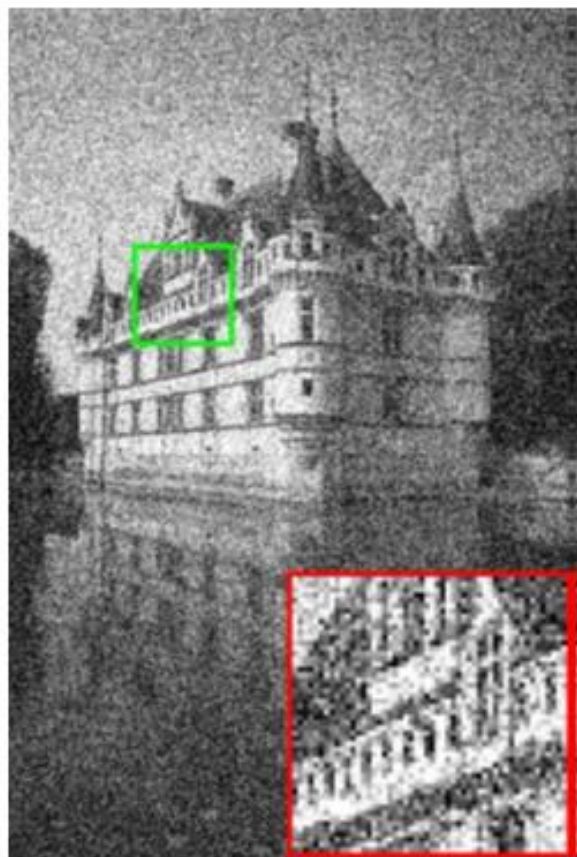


(d) by DRNN

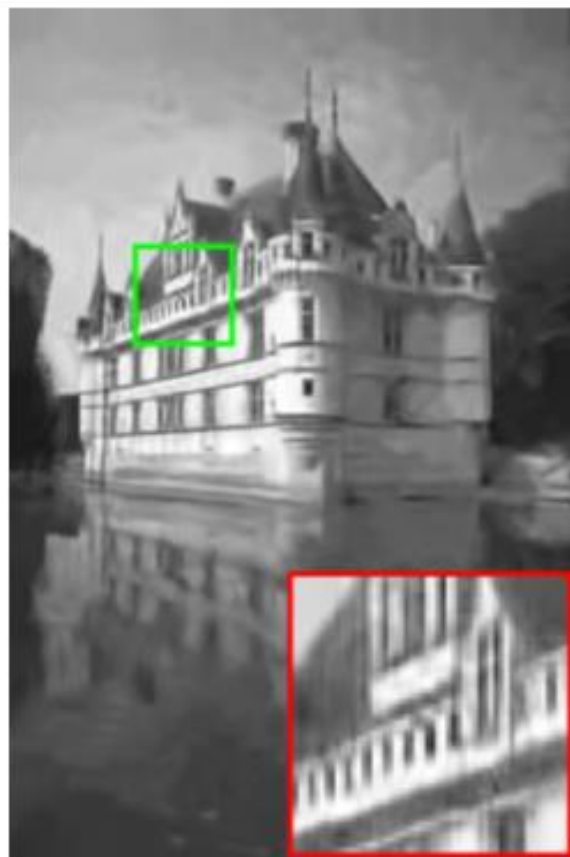


(e) by LFSR

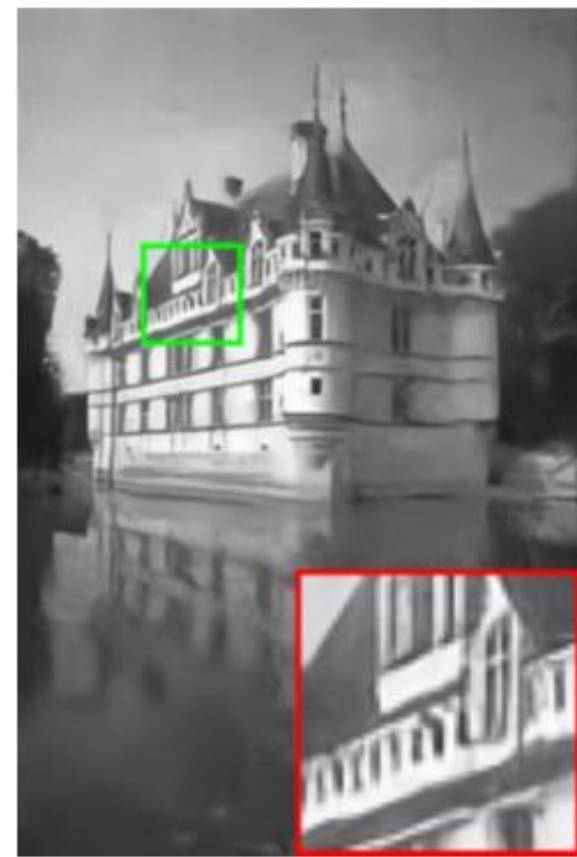
Lightfield Image Resizing [Gul18]



(a) image with added noise



(b) denoising by transform domain

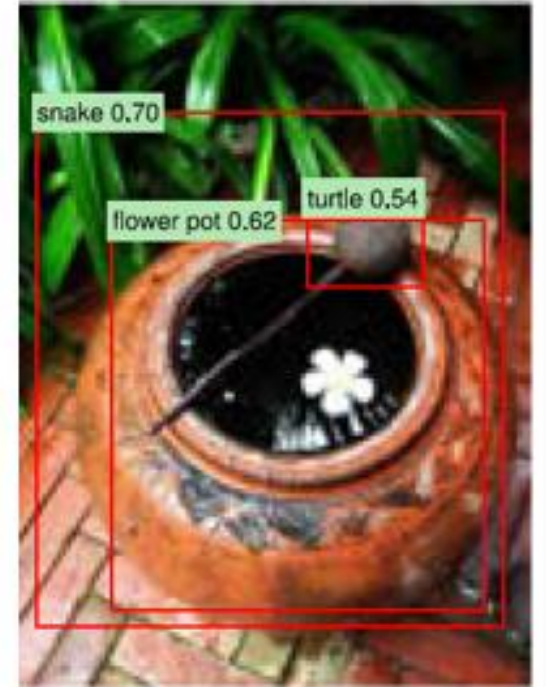
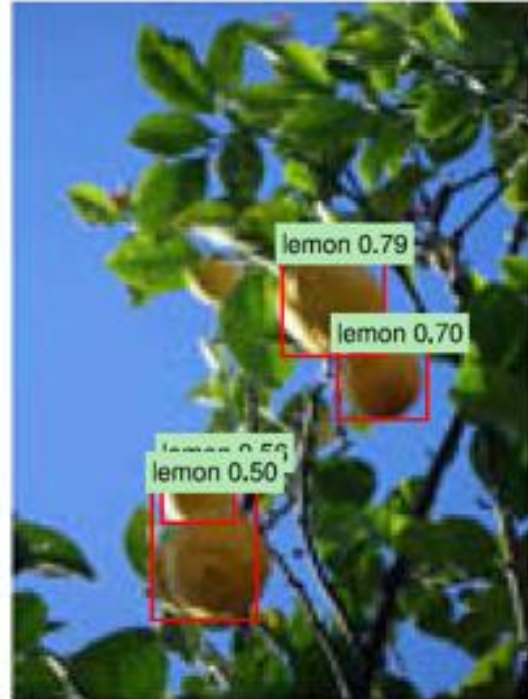


(c) denoising by modified VGG

Image Denoising [Zhang17]



(a) some of the top activations



(b) semantic segmentation

Object Extraction by Region-Based Convolutional Networks [Girshick16]

Motivation: Murder case in Australia 2014



Herald Sun
MELBOURNE 8C-15C

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flybe. The fastest way from A to B

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TRUE CRIME SCENE
New crimes, cold cases, latest investigations

Murdered jeweller Dermot O'Toole's widow Bridget says her husband would be alive if his killer Gavin Perry wasn't out on parole

PADRAIC MURPHY HERALD SUN JUNE 24, 2014 2:19PM

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Bridget O'Toole has described the impact of her husband's murder to the court.

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Automating eye witness statements

Eyewitness statement

“24 year old male average height wearing shirt”

Image of crime



Generate description

Subject	Gender	Age	Height	Nose W	Top
?	M	24	171	2.4	Shirt

Database of images




Generate descriptions

Subject	Gender	Age	Height	Nose W	Top
123456	M	25	172	2.3	Shirt
123457	F	36	156	2.2	Blouse
123458	M	58	182	1.2	T shirt

Database of descriptions

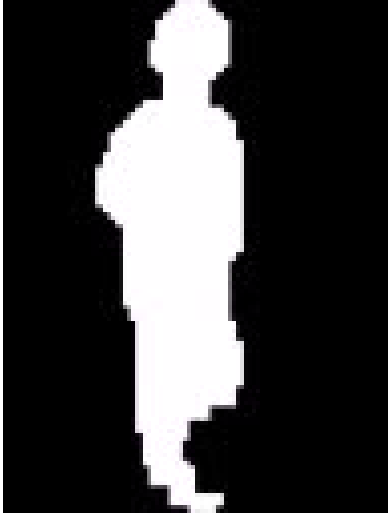
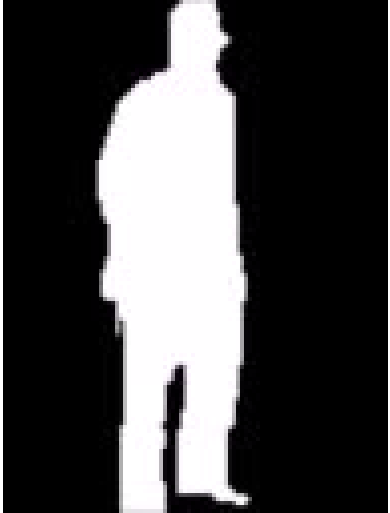
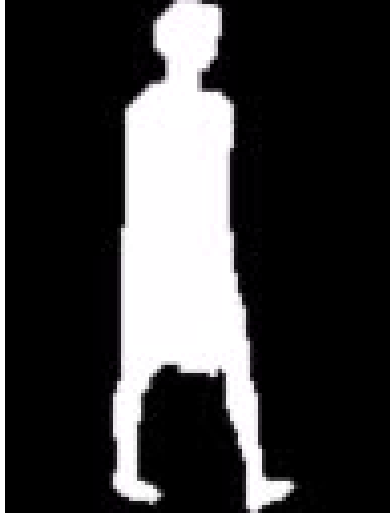
Gender estimation on PETA

- Gender?

Subject	1	2	3
PETA image			
PETA label	A B	A B	A. Male B. Female

Gait-based Age Estimation using a Whole-generation Gait Database

- How old is he/she?

Subject	1	2	3
Gait			
Age	A. 4 years old B. 14 years old C. 24 years old	A. 62 years old B. 72 years old C. 82 years old	A. 24 years old B. 34 years old C. 44 years old

Traits and terms

Body Features

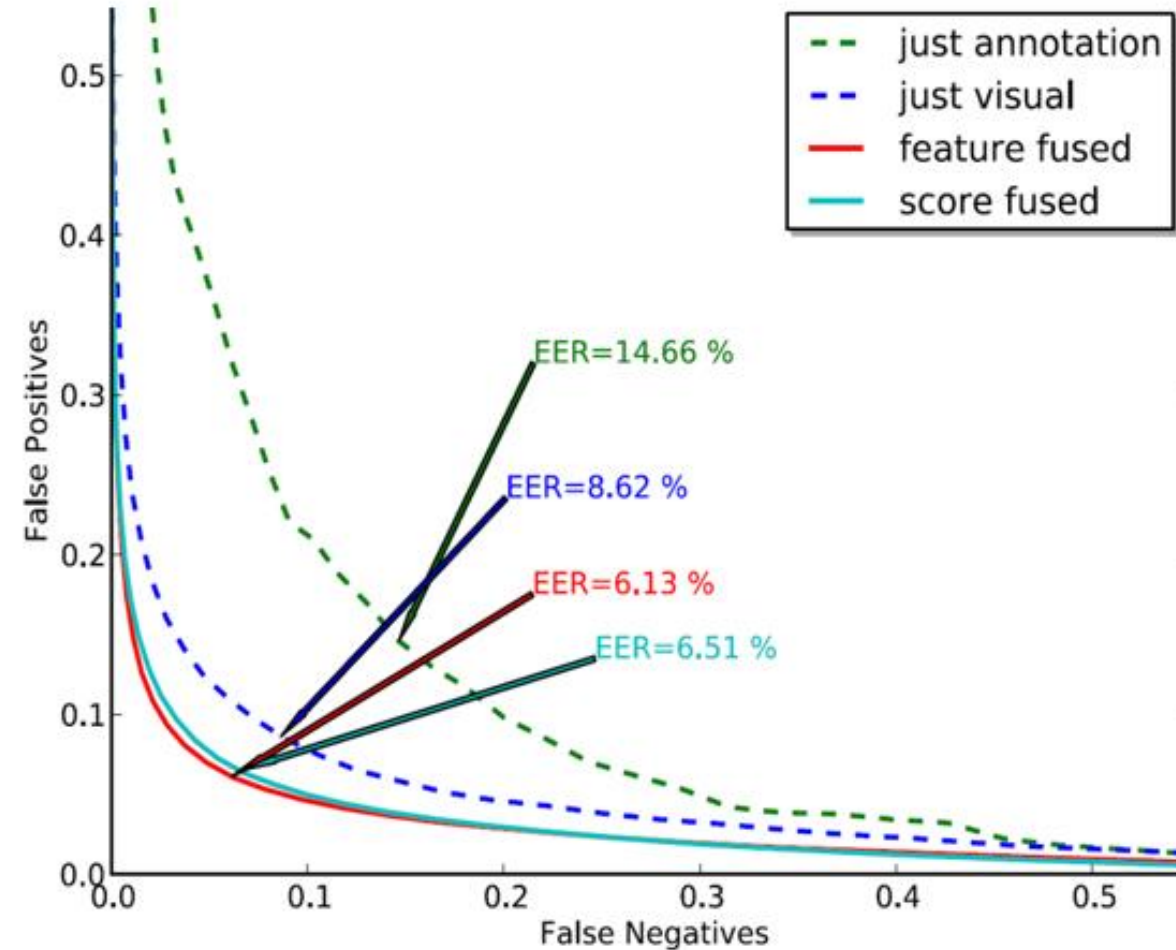
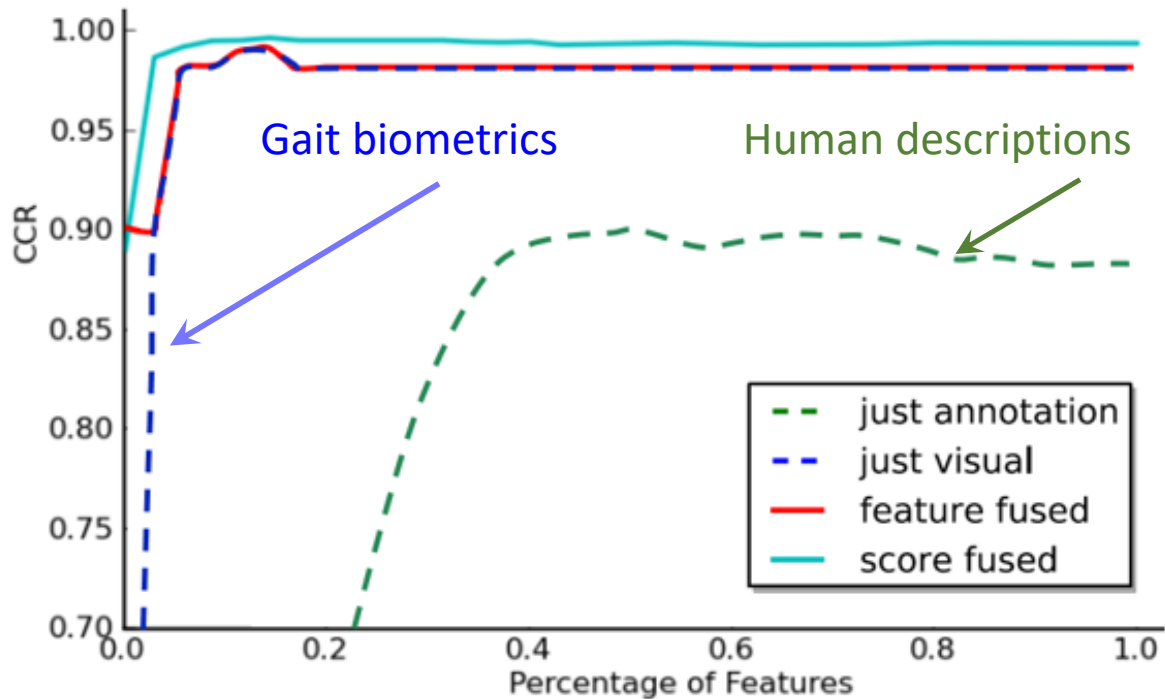
- Based on **whole body** description **stability** analysis by **MacLeod** et al.
 - Features showing **consistency** by different **viewers** looking at the same **subjects**
- Mostly comprised of **5 point** qualitative measures
 - e.g. very fat, fat, average, thin, very thin
- Most likely candidate for **fusion** with gait
- In biometrics, gender and sex are synonymous. 'Assigned sex' might be preferred to 'gender' in general use.

This changed

- Global
 - Sex
 - Ethnicity
 - Skin Colour
 - Age
- **Body Shape**
 - **Figure**
 - **Weight**
 - **Muscle Build**
 - **Height**
 - **Proportions**
 - **Shoulder Shape**
 - **Chest Size**
 - **Hip size**
 - **Leg/Arm Length**
 - **Leg/Arm Thickness**
- Head
 - Hair Colour
 - Hair Length
 - Facial Hair Colour/Length
 - Neck Length/Thickness




Human descriptions: recognition capability



First result

Comparative human descriptions

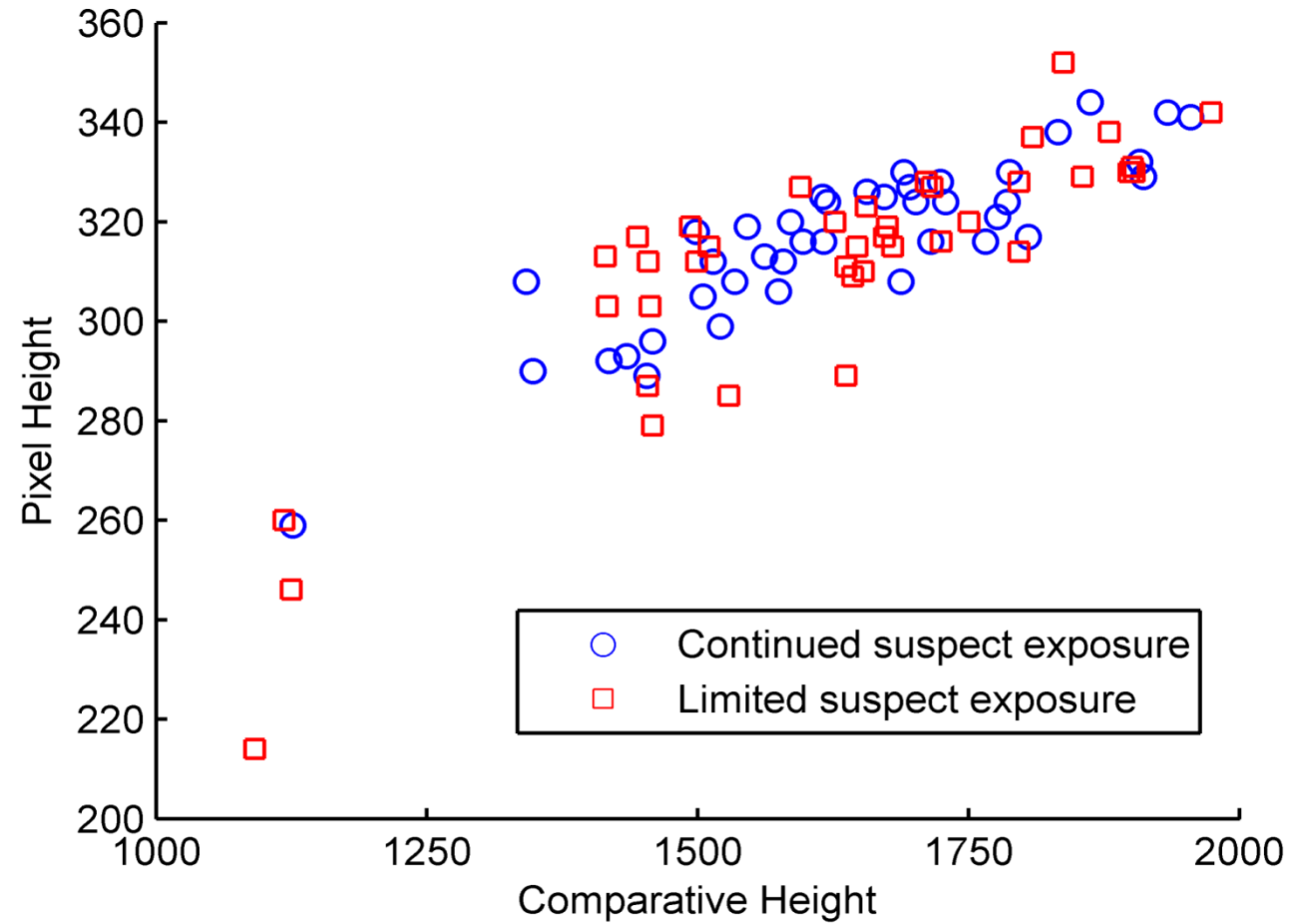
- Compare one subject's attribute with another's
- Infer continuous relative measurements



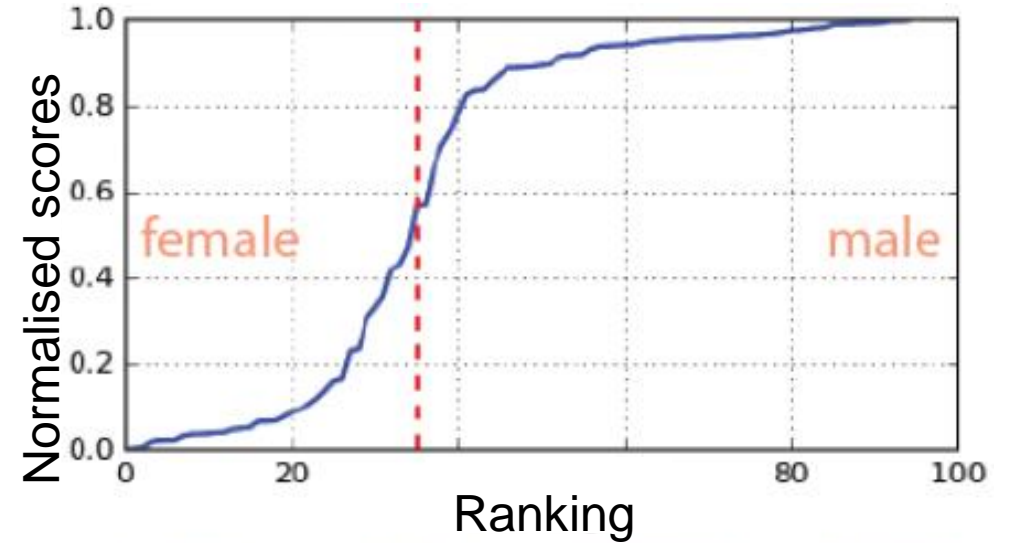
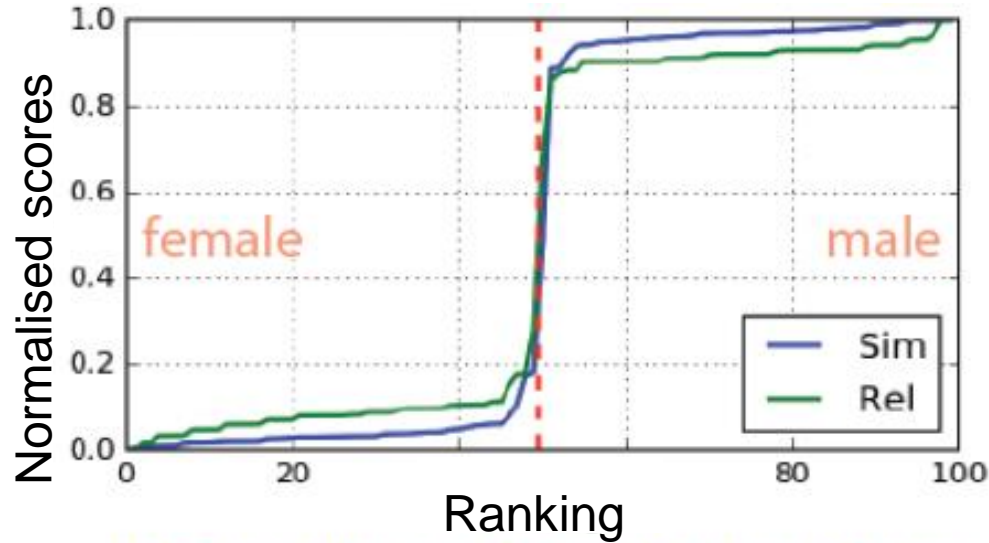
Please compare the subject in the lower video to the subject in the top video.
For example if the subject in the bottom video is taller than the subject

Attribute	Annotation
Age	Older
Bottom subject is OLDER than the top	
Hair Colour	Same
Subjects have roughly the SAME hair colour	
Hair Length	Longer
Bottom subject has LONGER hair than the top	
Height	Taller
Bottom subject is TALLER than the top	
Figure	Same
Subjects both have roughly the SAME figure	
Neck Length	Same
Subjects have roughly the SAME length neck	
Neck Thickness	Thinner
Bottom subject has a THINNER neck than the top	
Shoulder Shape	Same
Subjects have roughly the SAME shoulder shape	
Chest	Same
Subjects have roughly the SAME size chest	
Arm Length	Longer
Bottom subject has a LONGER arms than the top	

Height correlation (with time)



Pairwise similarity comparisons on PETA



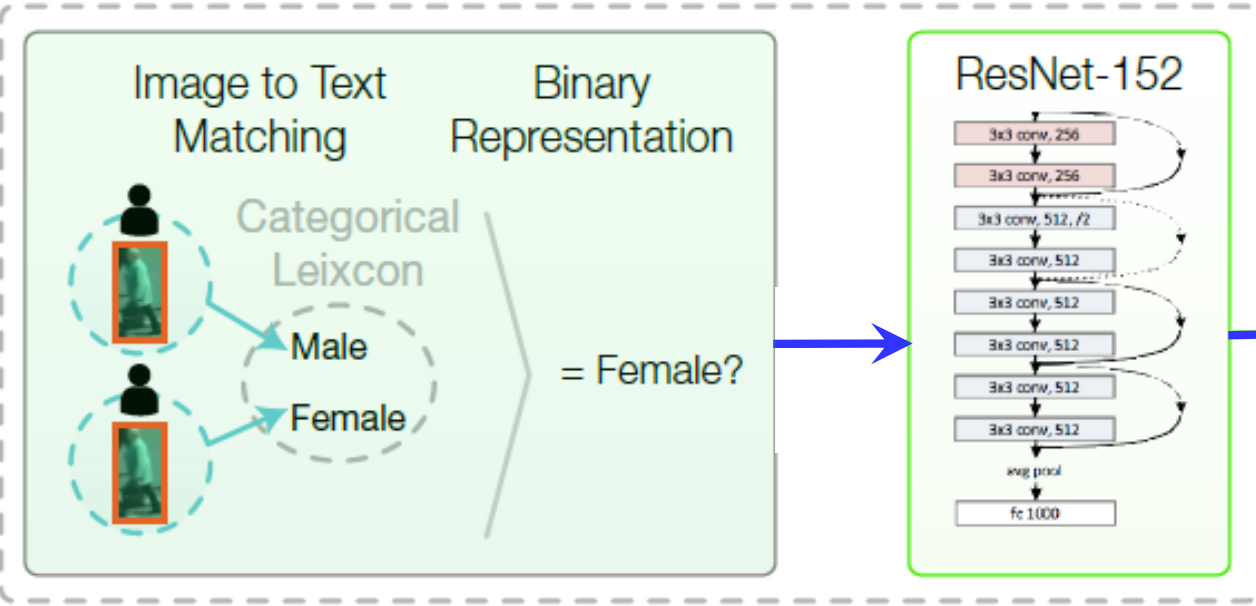
Relative	0.18	0.28	0.68	0.86	0.88
Similarity	0.17	0.18	0.47	0.89	0.89



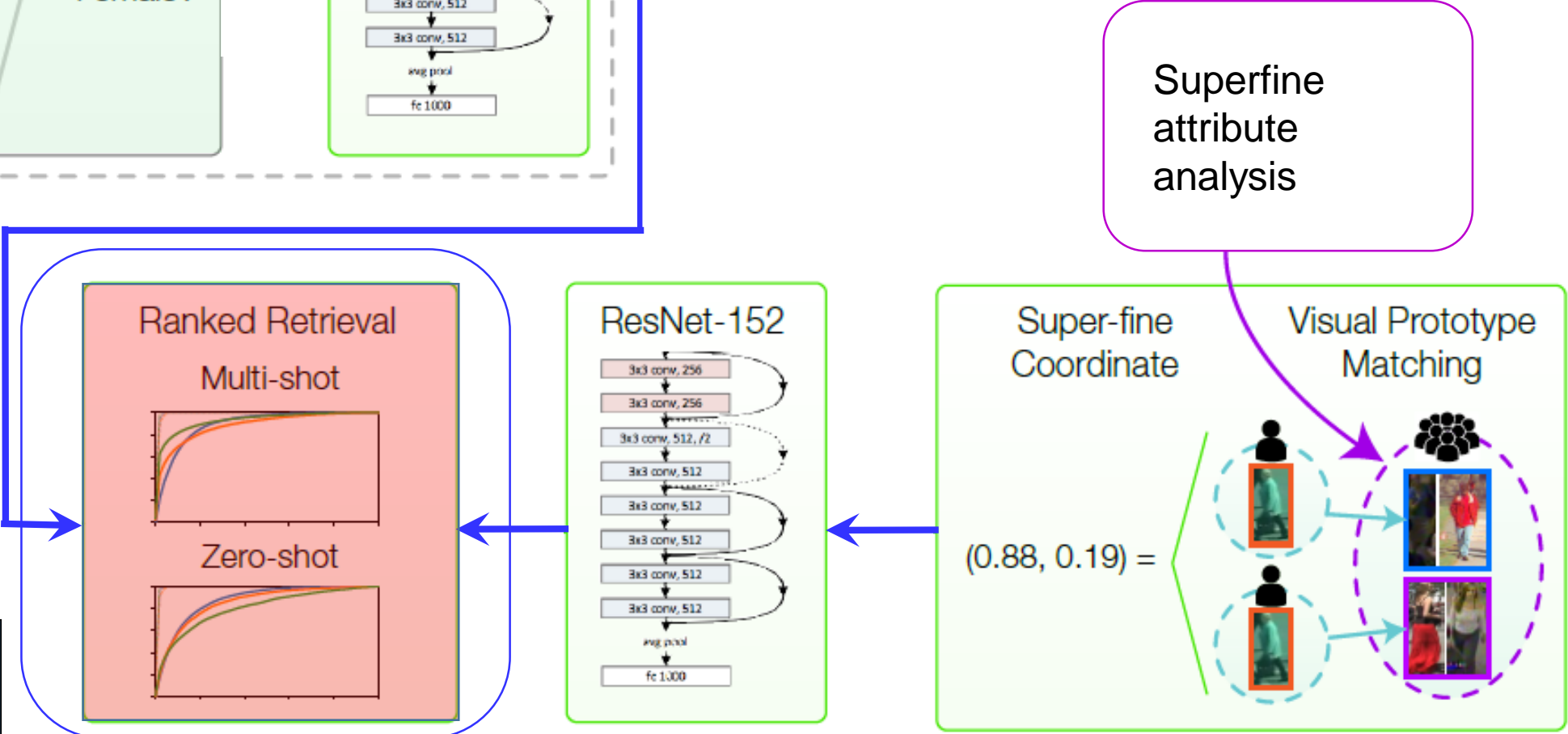
Binary	male	female	female	female
Similarity	0.47	0.57	0.83	0.95

Gender distribution not binary
Can measure confidence

Conventional attribute-based analysis

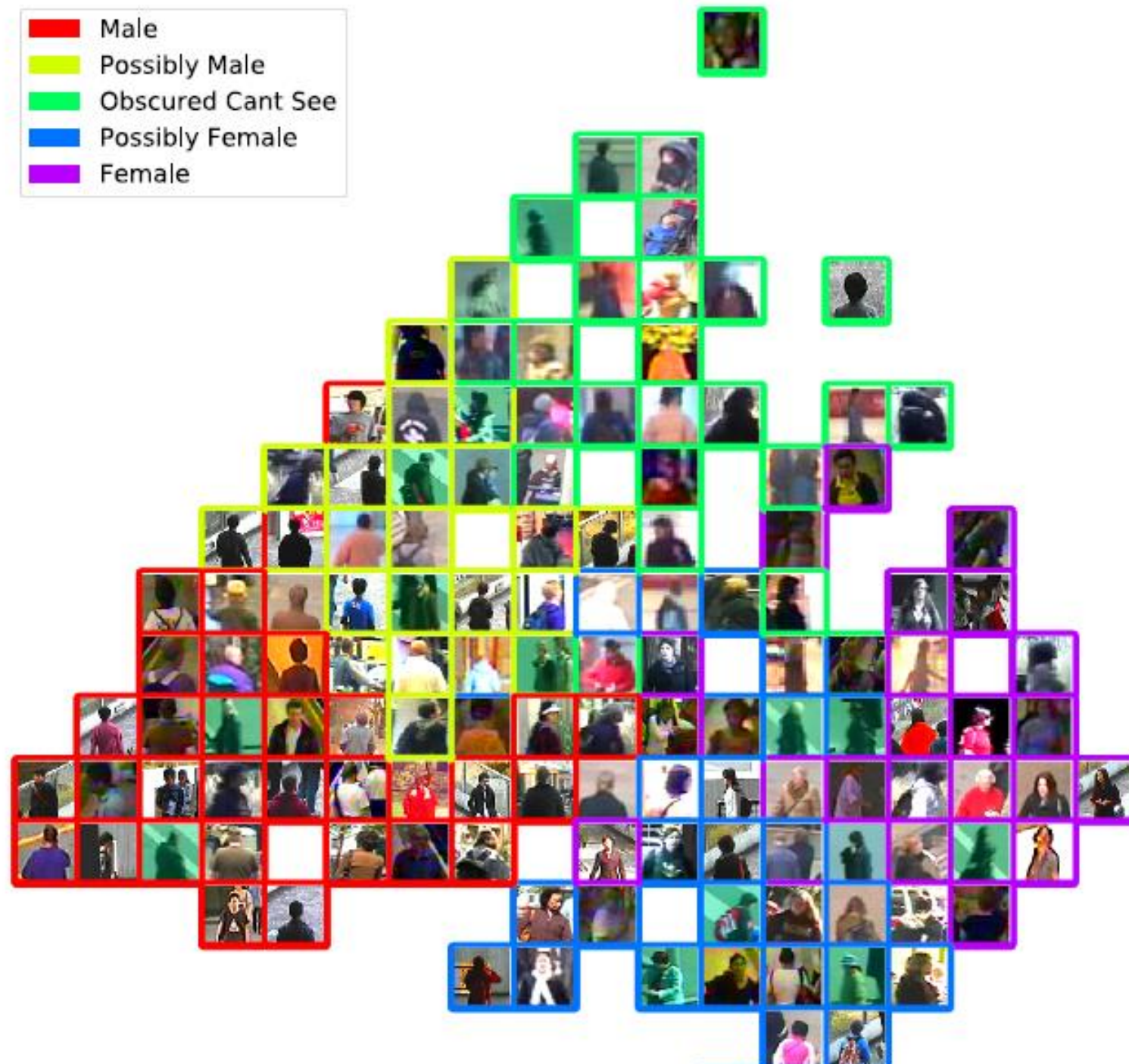


Retrieval architecture




Gender

- Male
- Possibly Male
- Obscured Cant See
- Possibly Female
- Female



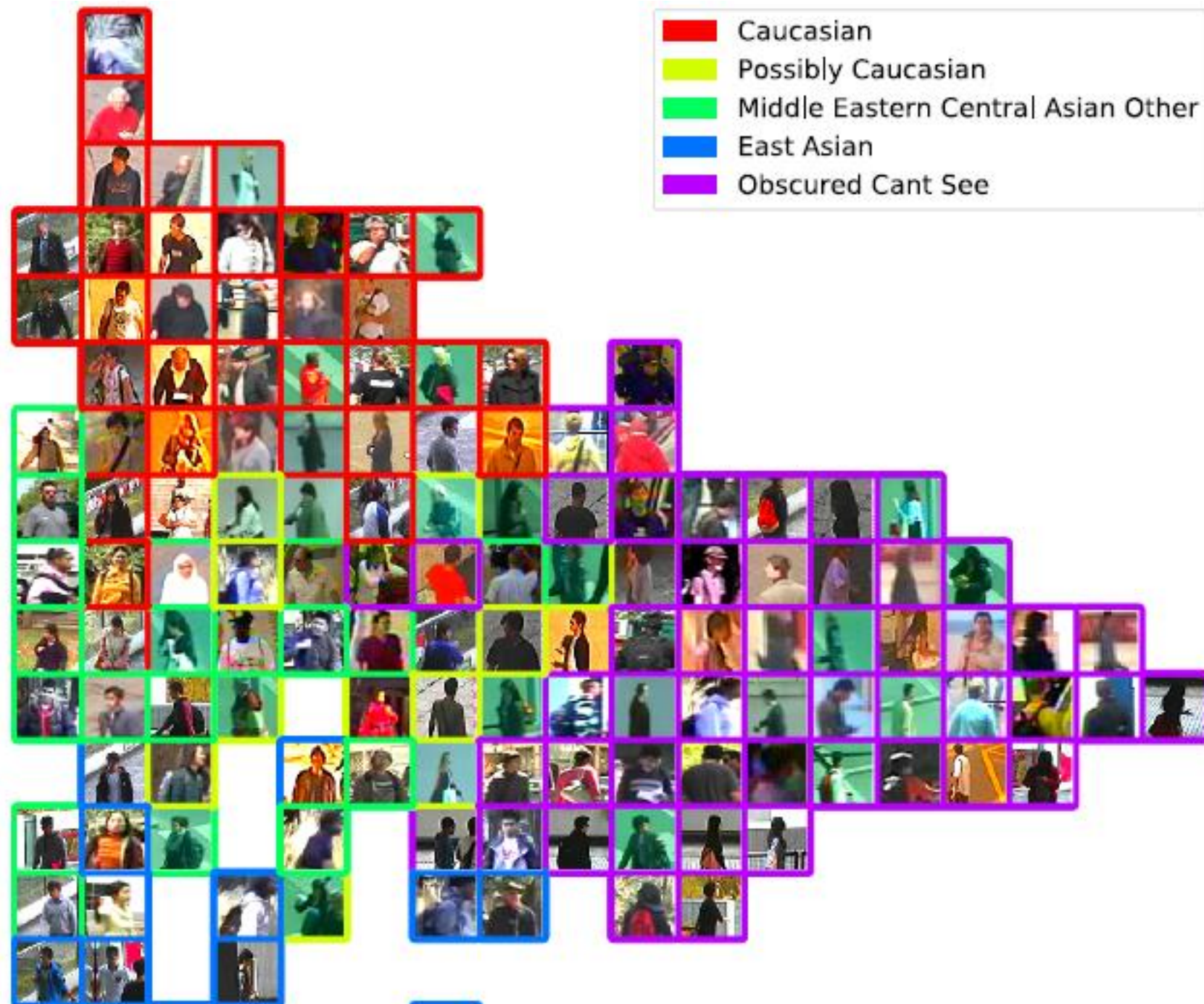
Analysing gender (??!!)

- Gender?

Subject	1	2	3
			
Gender			<p>A. Male B. Female</p>



Ethnicity



Takeaway time

- 1 – computer vision works and has a great future
- 2 – big difference between hand crafted and deep learning
- 3 – some parts are the same (group operators/ templates)
- 4 – what will happen in the future?

Jon Hare will happen in the **future**!

Beyond that, I can only speculate. Enjoy!

