



SAPIENZA
UNIVERSITÀ DI ROMA

Arioli Liù 1812888

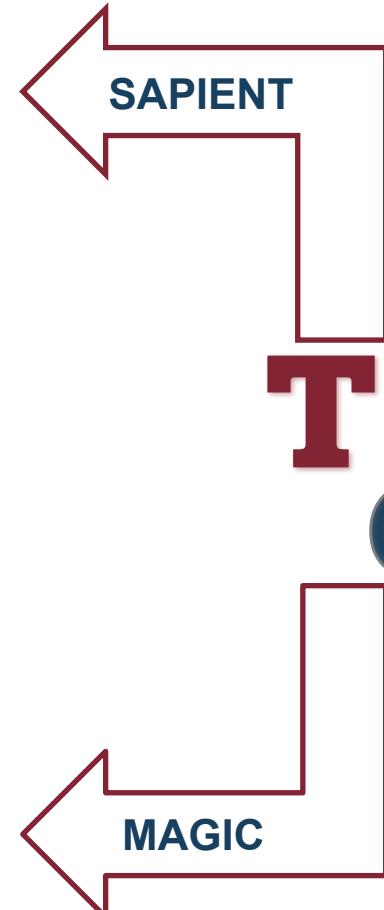
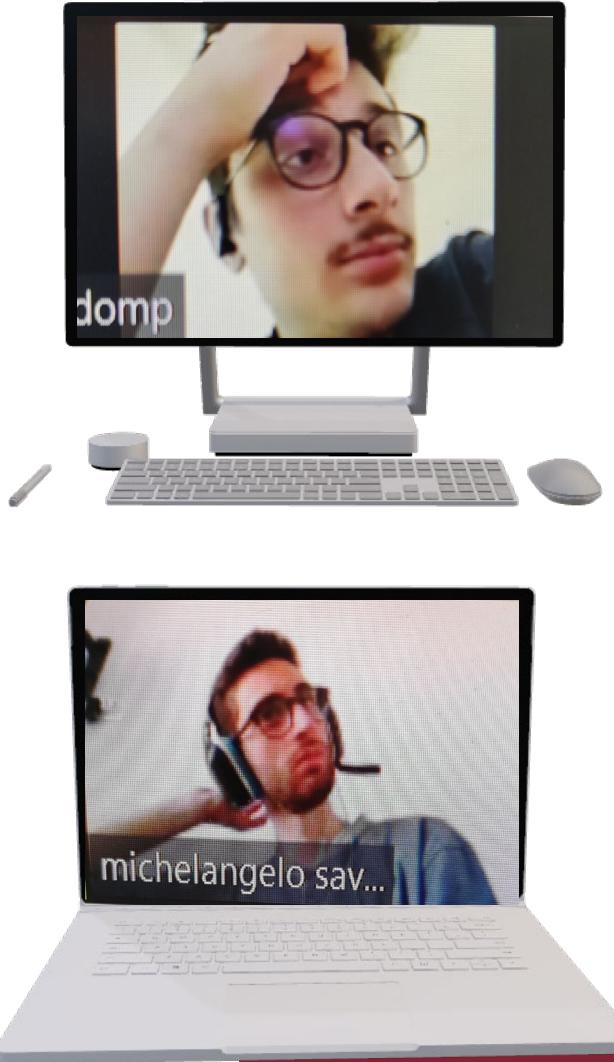
Calabrese Nicola 1797714

Cinque Domenico Mattia 1784965

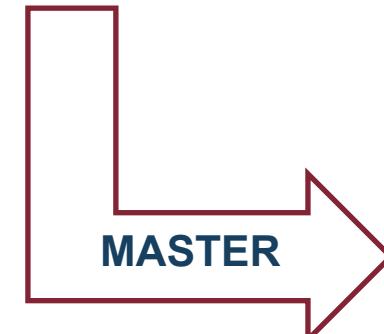
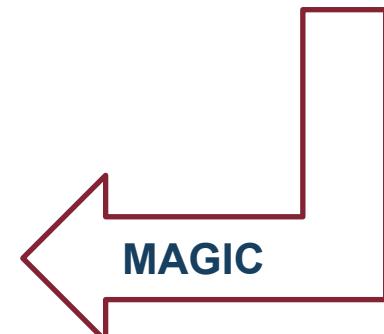
Saveriano Michelangelo 1823326

Age Classification

An IML approach



TEAM G 14





ABSTRACT



DIFFERENT AGE CLASSES

FACE IMAGE ANALYSIS

INTERPRETABLE MACHINE
LEARNING



DATA DESCRIPTION

UTK Face



20,000 face
images

[age]

Integer from 0 to 116

[gender]

0 if male
1 if female

[race]

0 if White
1 if Black
2 if Asian
3 if Indian
4 Others

[data not me]





DATA DESCRIPTION

Landmarks extraction for test images

For each image we have a text file with the landmarks of the faces in the format of a list of (x, y) values

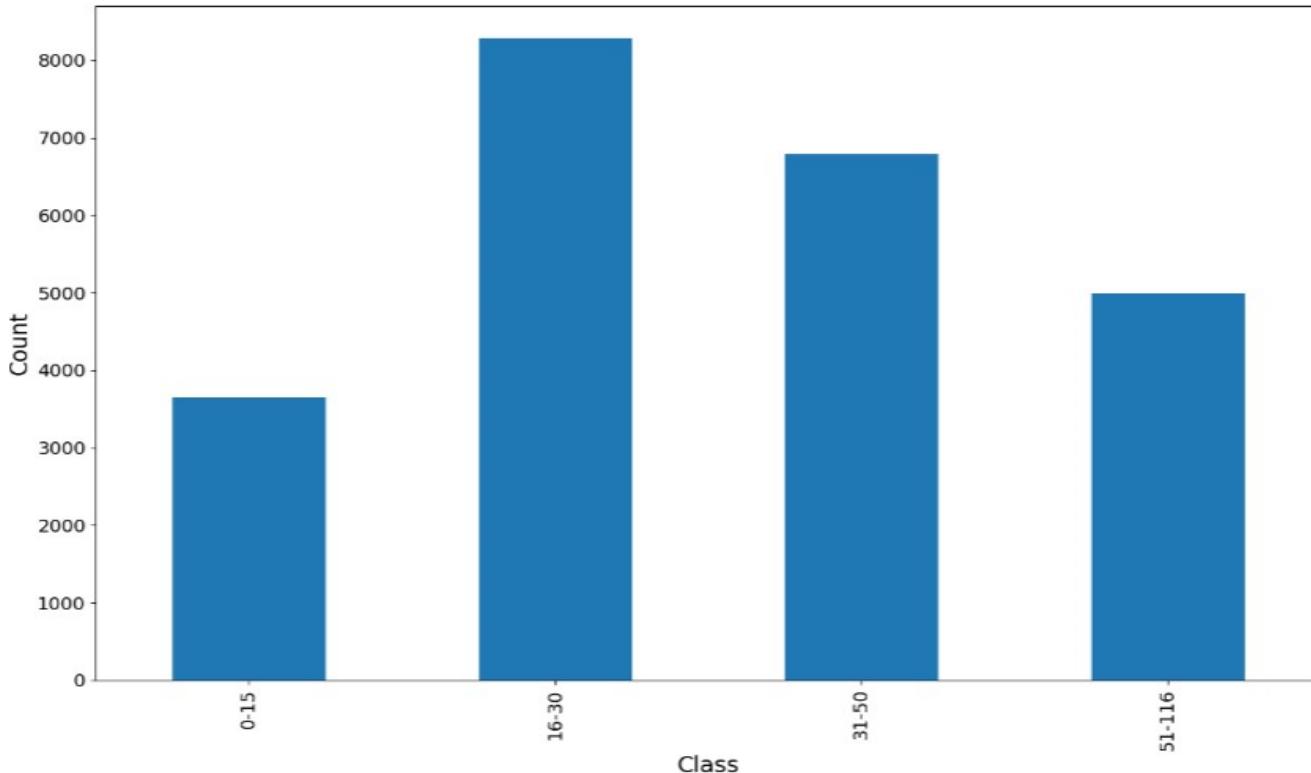


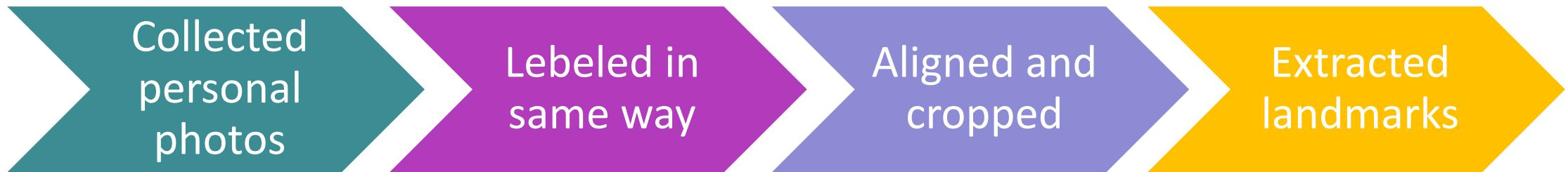
Figure 1: Classes distribution



IMPLEMENTATION

Pre-processing

For the Test we replicated the steps made on UTK Face dataset



(a) Original image



(b) Face cropping



(c) Landmarks





Feature Extraction

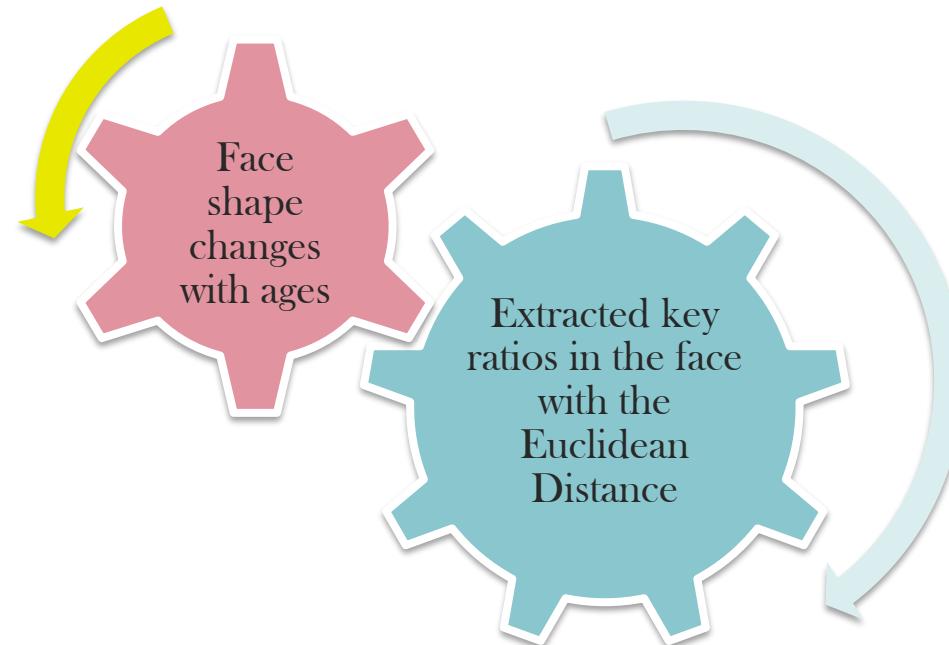
Face Anthropometry

$$\text{Ratio 1} = \frac{D(\text{Left Eye}, \text{Right Eye})}{D(\text{Middle of Eyes}, \text{Nose})}$$

$$\text{Ratio 2} = \frac{D(\text{Left Eye}, \text{Right Eye})}{D(\text{Middle of Eyes}, \text{Lip})}$$

$$\text{Ratio 3} = \frac{D(\text{Left Eye}, \text{Right Eye})}{D(\text{Middle of Eyes}, \text{Chin})}$$

$$\text{Ratio 4} = \frac{D(\text{Middle of Eyes}, \text{Nose})}{D(\text{Middle of Eyes}, \text{Lip})}$$



$$\text{Ratio 5} = \frac{D(\text{Middle of Eyes}, \text{Lip})}{D(\text{Middle of Eyes}, \text{Chin})}$$

$$\text{Ratio 6} = \frac{D(\text{Left Eye}, \text{Right Eye})}{D(\text{Top of Head}, \text{Chin})}$$

$$\text{Ratio 7} = \frac{D(\text{Left SoF}, \text{Right SoF})}{D(\text{Top of Head}, \text{Chin})}$$



Feature Extraction

Face Anthropometry

we computed the distances between every couple of a subset of landmarks

The number of these new feature is $\binom{10}{2} = 45$

Most of them are useless

SHAP

Distances are normalized

Dividing the x-coordinates by the width of the face

Dividing the y-coordinates by the height of the face

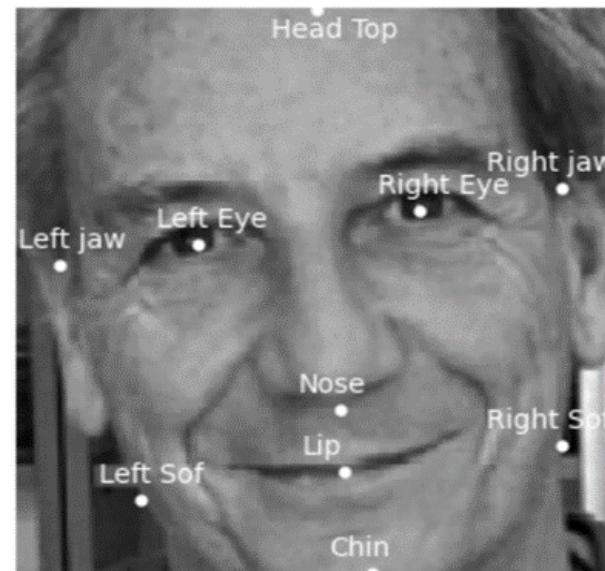


Figure 3: Main Landmarks



Feature Extraction

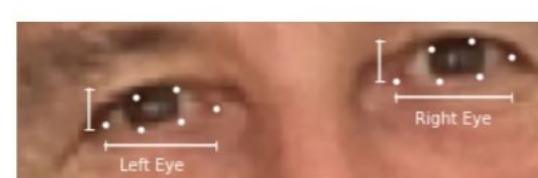
Face Anthropometry

We added a measure of the dispersion of the eyes and the lips

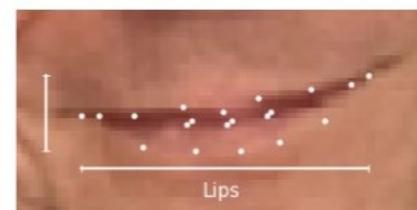


$$\text{Eye Dispersion}_x = \frac{s(\text{Left Eye Landmarks}_x) + s(\text{Right Eye Landmarks}_x)}{2}$$

$$\text{Eye Dispersion}_y = \frac{s(\text{Left Eye Landmarks}_y) + s(\text{Right Eye Landmarks}_y)}{2}$$



(a) Eyes



(b) Lips

Figure 4: *Dispersion*

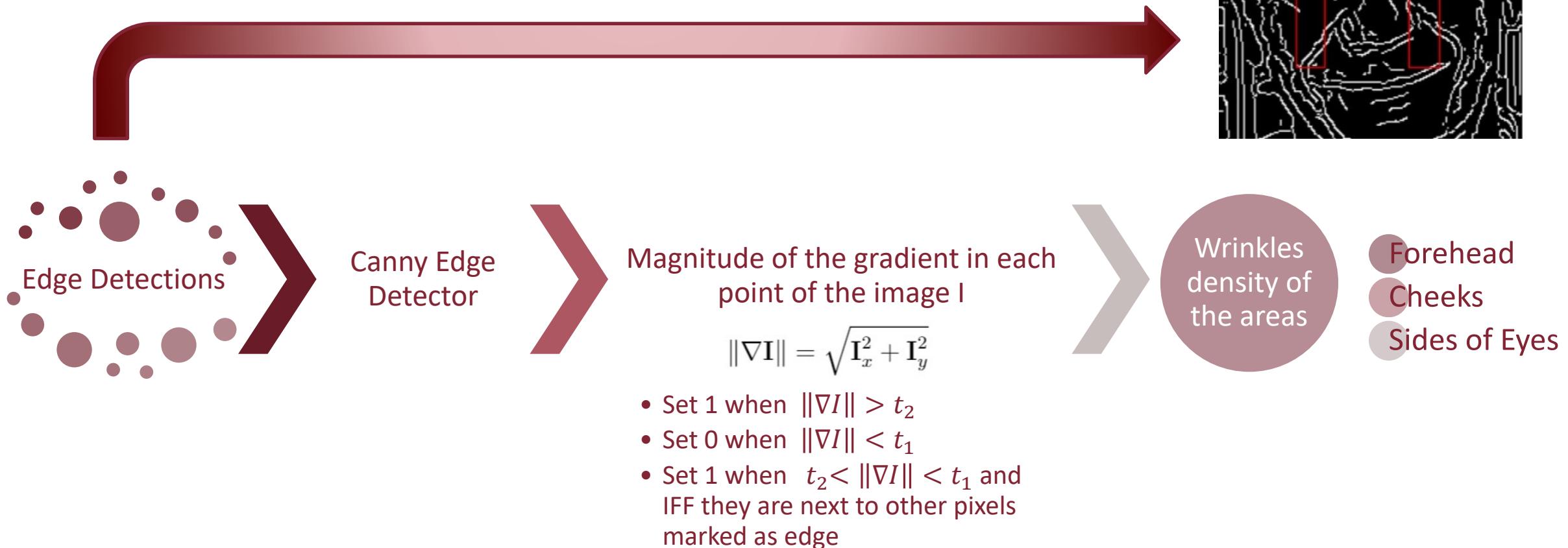
$$\text{Lip Dispersion}_x = s(\text{Lip Landmarks}_x) \quad \text{Lip Dispersion}_y = s(\text{Lip Landmarks}_y)$$

$s(\cdot) \rightarrow$ sample
standards
deviation



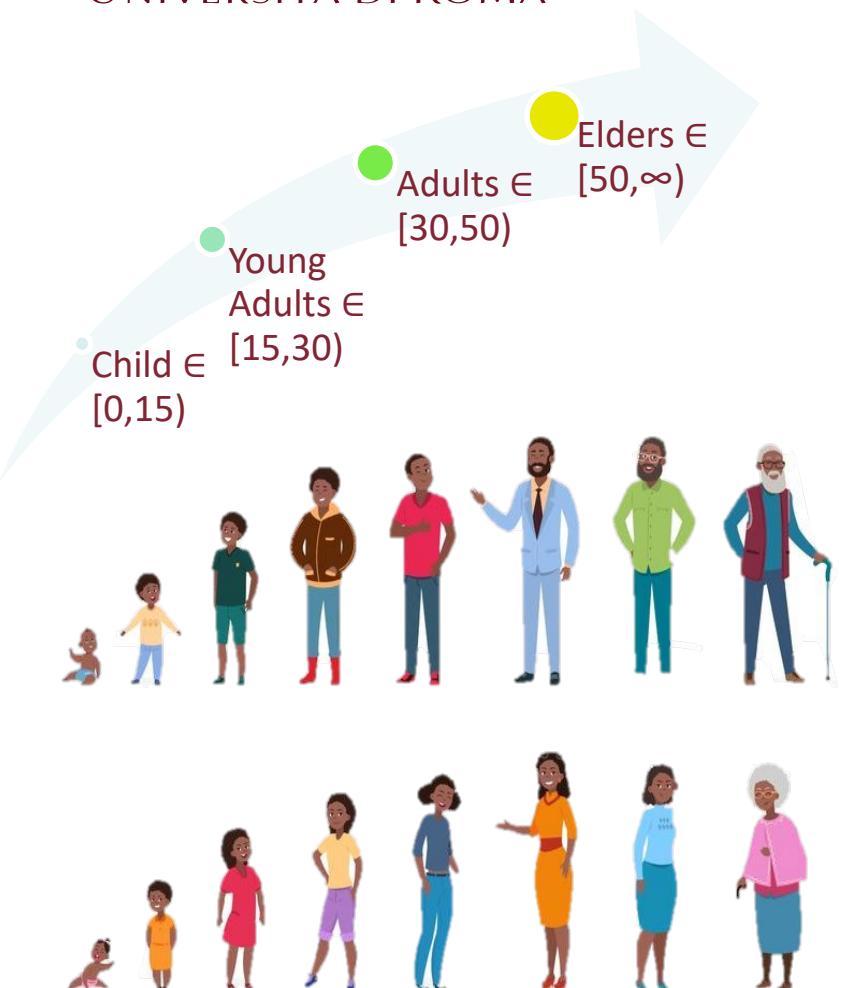
Feature Extraction

Wrinkles





RESULTS



The algorithm is a SVC with a rbf kernel
 $C=100$ and $\gamma = 1$

	Precision	Recall	Sample size
Children	0.82	0.70	1209
Young adults	0.61	0.73	2717
Adults	0.49	0.47	2232
Elders	0.70	0.58	1666

Table 1: Classification results on UTK

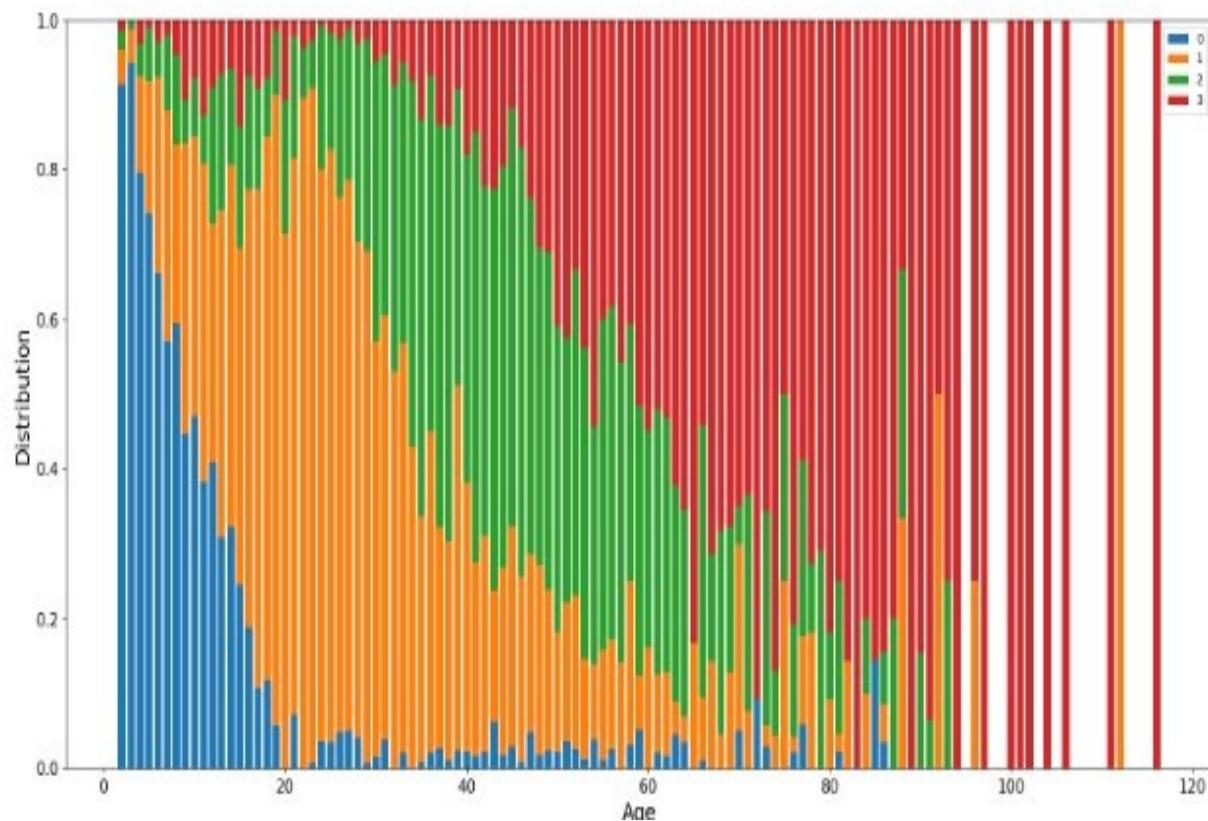
	Precision	Recall	Sample size
Children	0.25	1.00	16
Young adults	0.91	0.18	55
Adults	0.33	0.33	3
Elders	0.33	0.14	7

Table 2: Classification results on our Test set

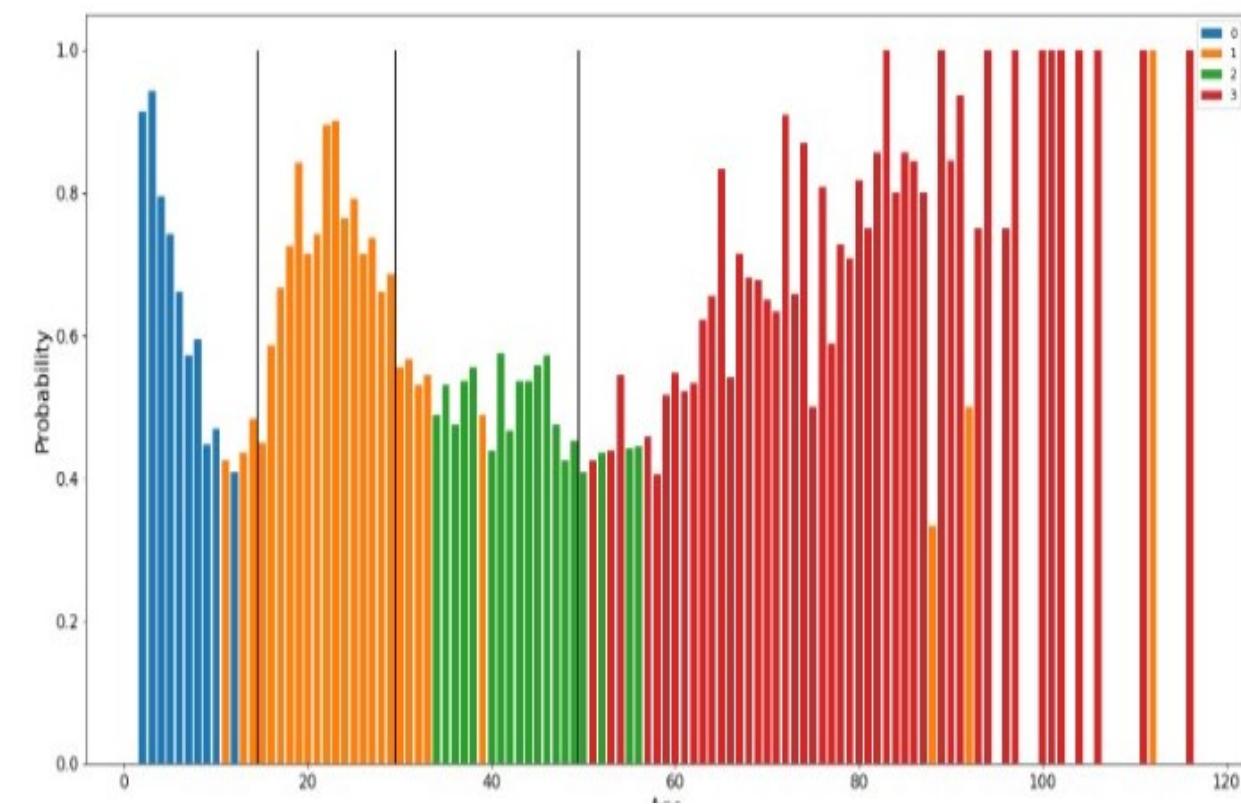


RESULTS

The predicted classes for each different age



The most likely class to be predicted with its value on the y-axis

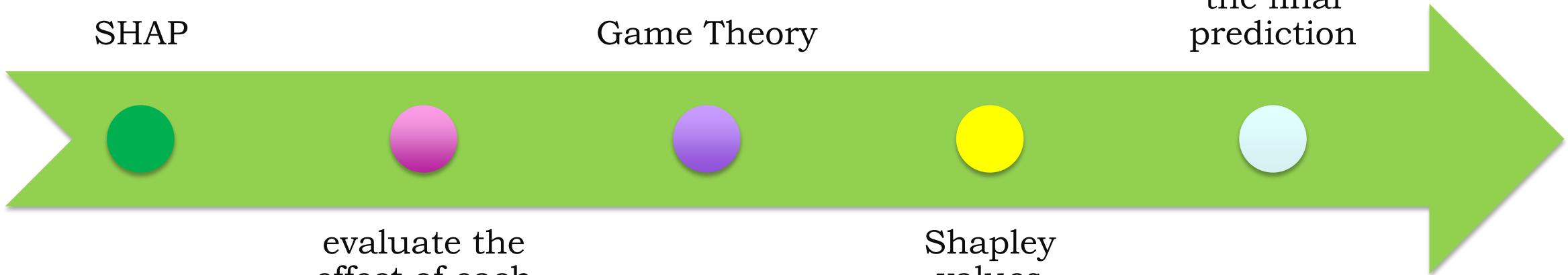




SHAP

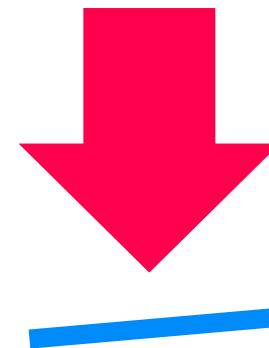
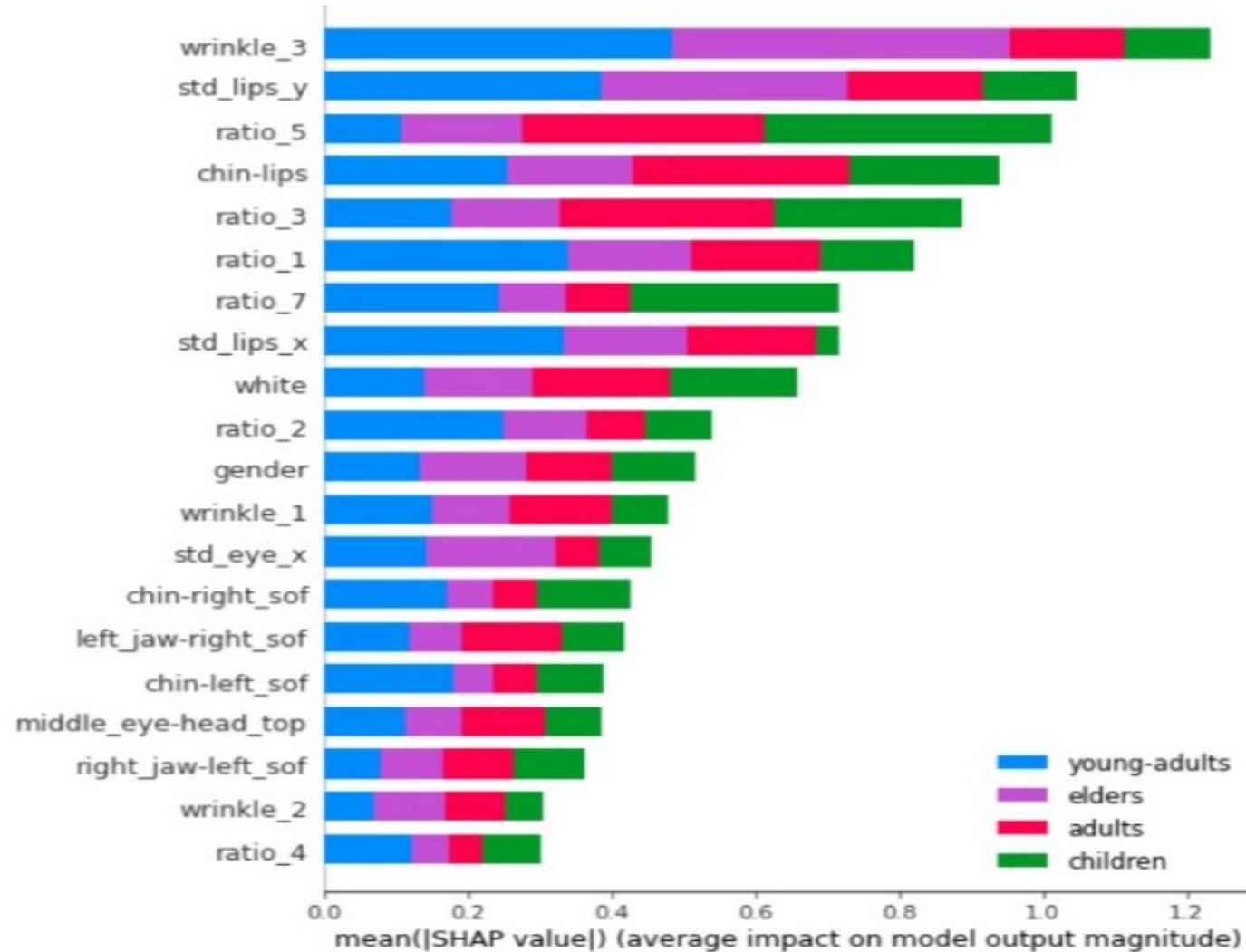
Game Theory

Each feature
influences
the final
prediction



evaluate the
effect of each
feature to the
prediction of
a particular
output

Shapley
values



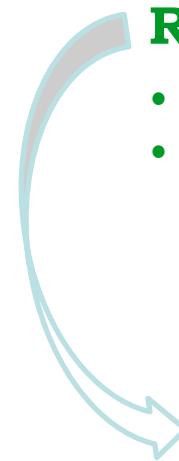
Wrinkle_3

- Elders
- Young Adults



Ratio_5

- Children
- Adults

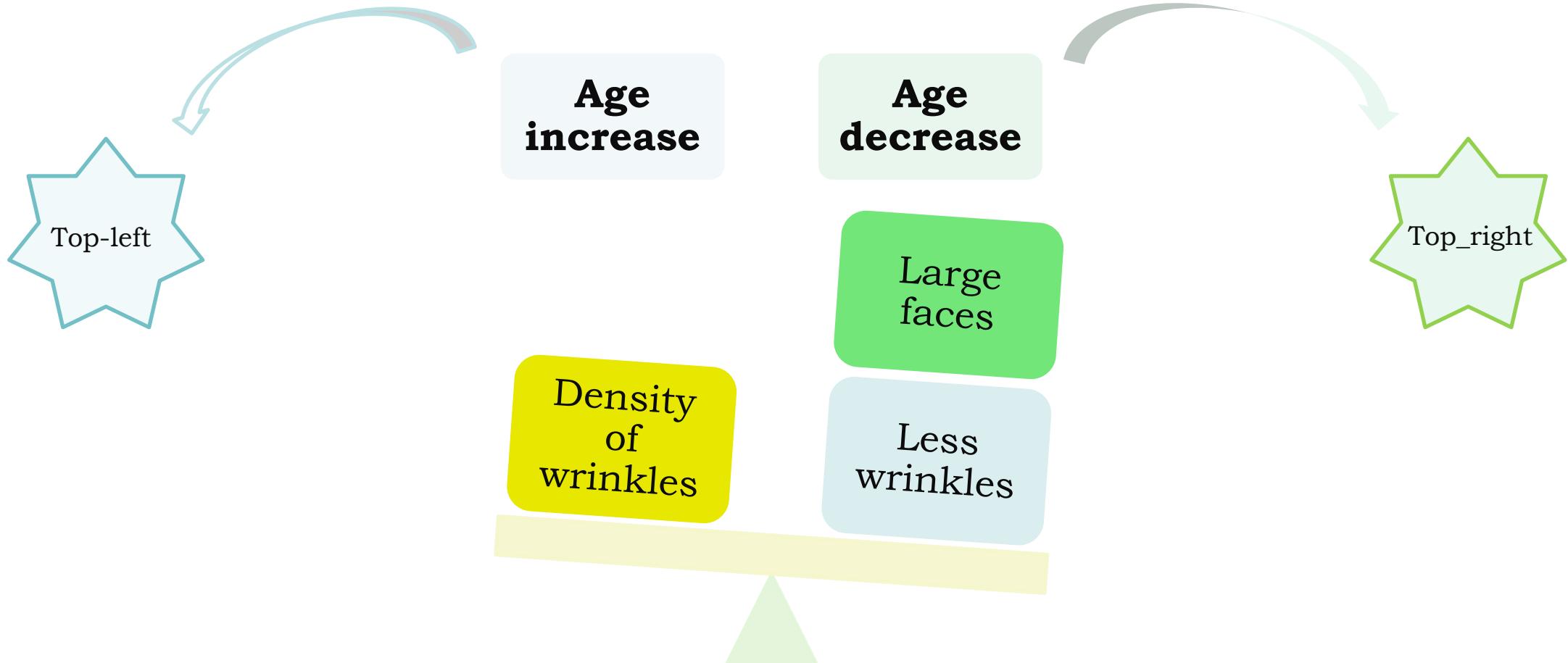


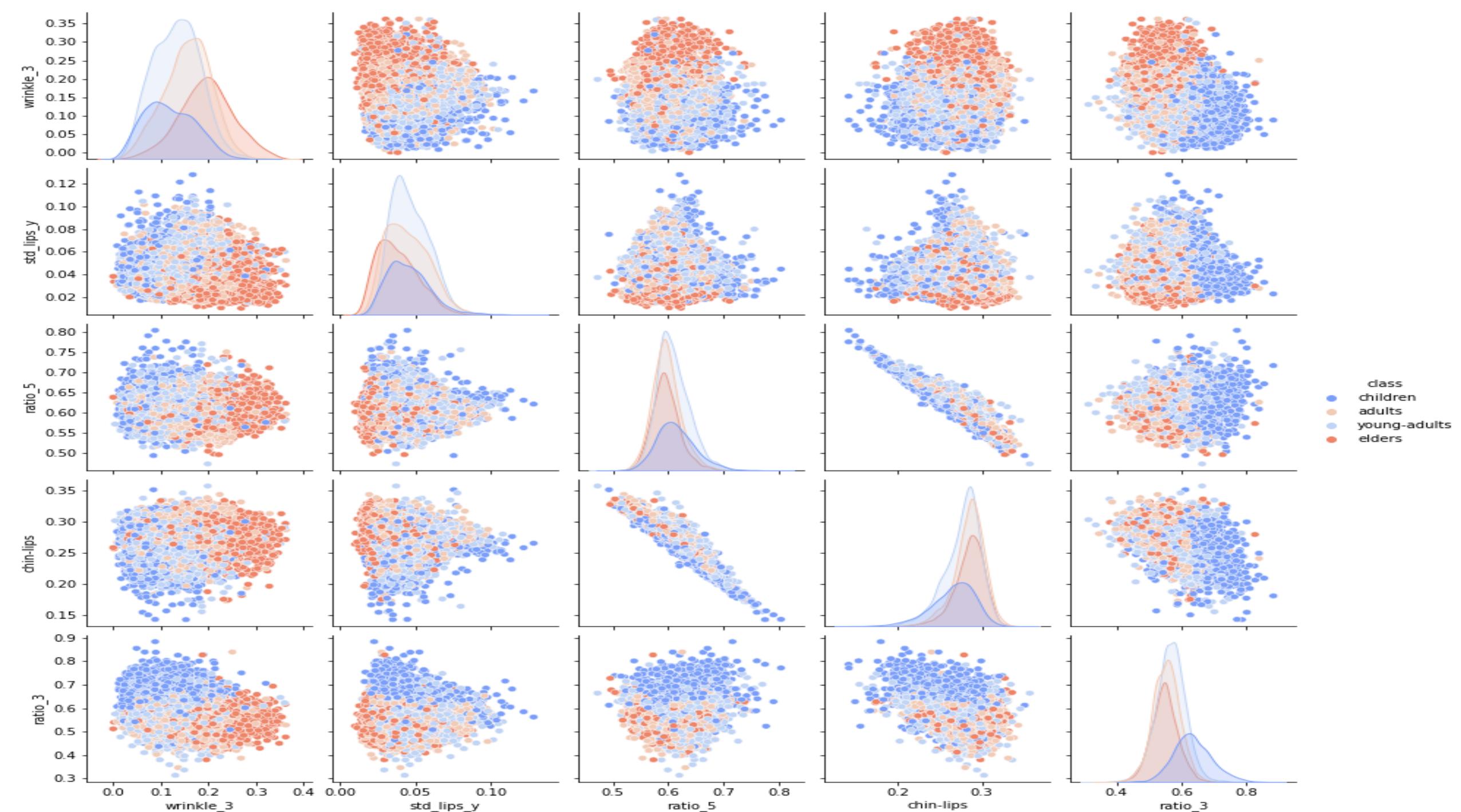
Roundness of the face

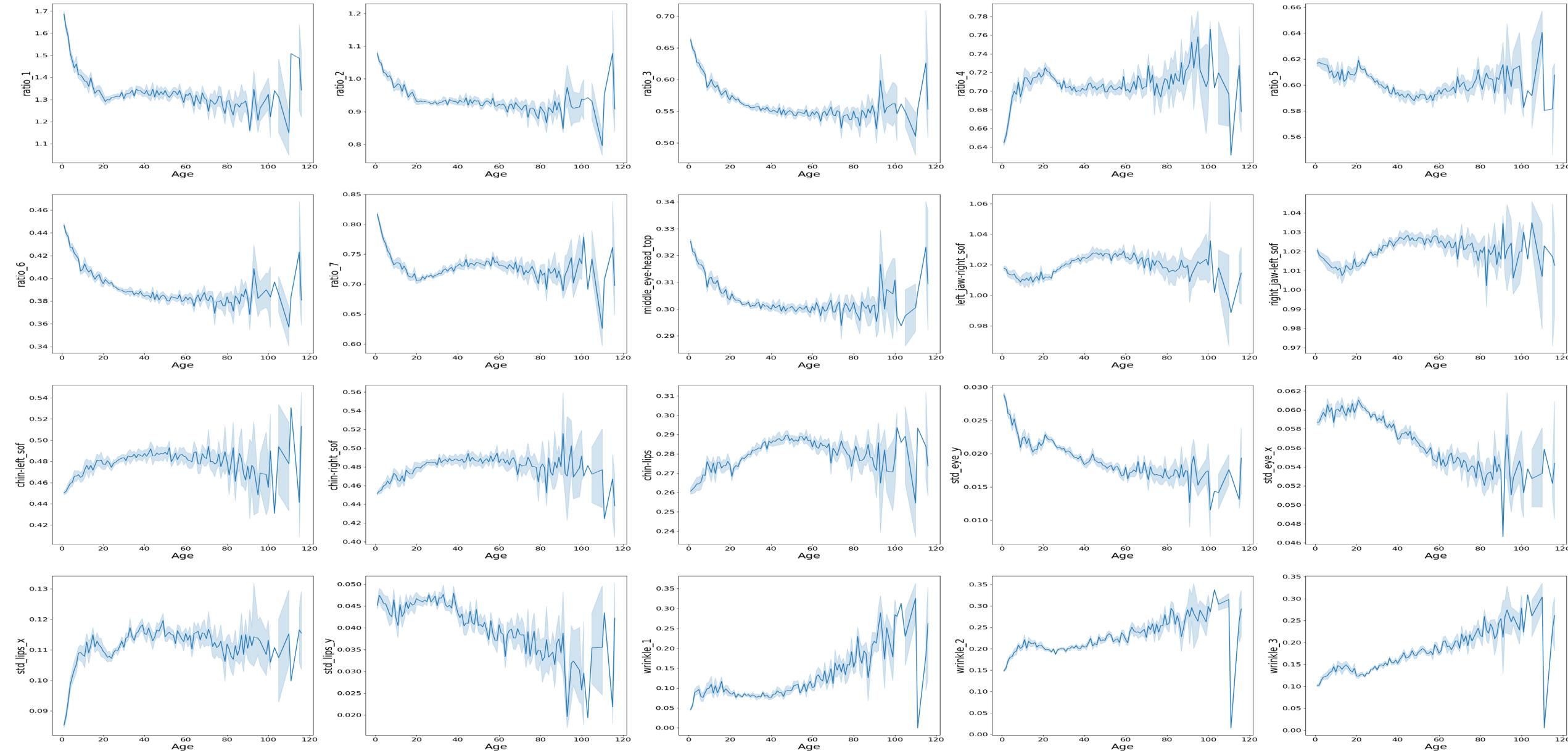


Pairplot of the 5 most important features

For example:





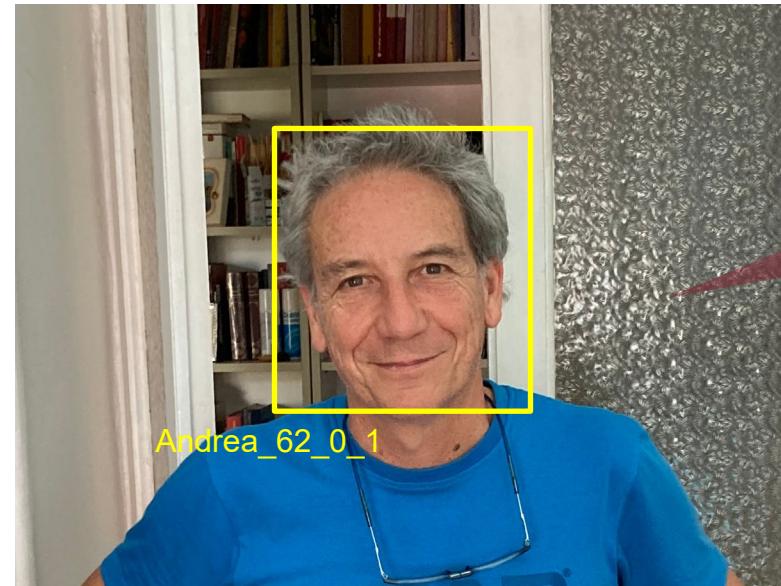




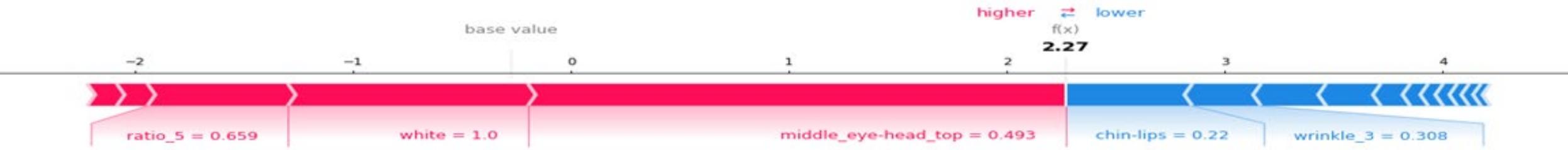
SHAP force-plot



ANDREA was classified correctly in the last class and we can see that the features that push most toward this class are wrinkle-3 and std-lips-y



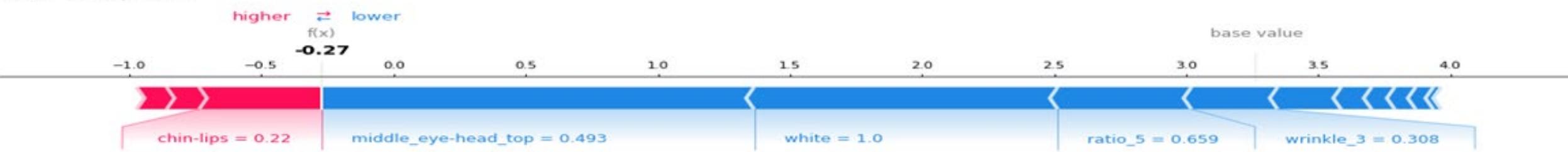
Class: 0-15, Child



Class: 16-30, Young Adult



Class: 31-50, Adult



Class: 51+, Elderly



YOUR ATTENTION



A detailed close-up of Yoda's face, showing his green skin, wrinkled forehead, and large, expressive eyes. A yellow rectangular frame highlights the area around his eyes and forehead.

YODA_900_0_5

THANK YOU FOR