

# Rock Paper Scissors

## Gesture Recognition



# Goal of the Project

The goal of this project is to develop a classifier able to correctly recognize the gesture among the three of the famous rock paper scissor game. The input is an image

It would be interesting to apply the techniques used in this project for a more noble purpose, for example the recognition of sign language gestures

# Raw Dataset



**Paper**  
712 Images



**Scissors**  
750 Images



**Rock**  
726 Images

All the hand in the images are pointing in the same direction, the background is green and the light is always the same; there isn't much variability

The dataset is not fully balanced but is very close to it

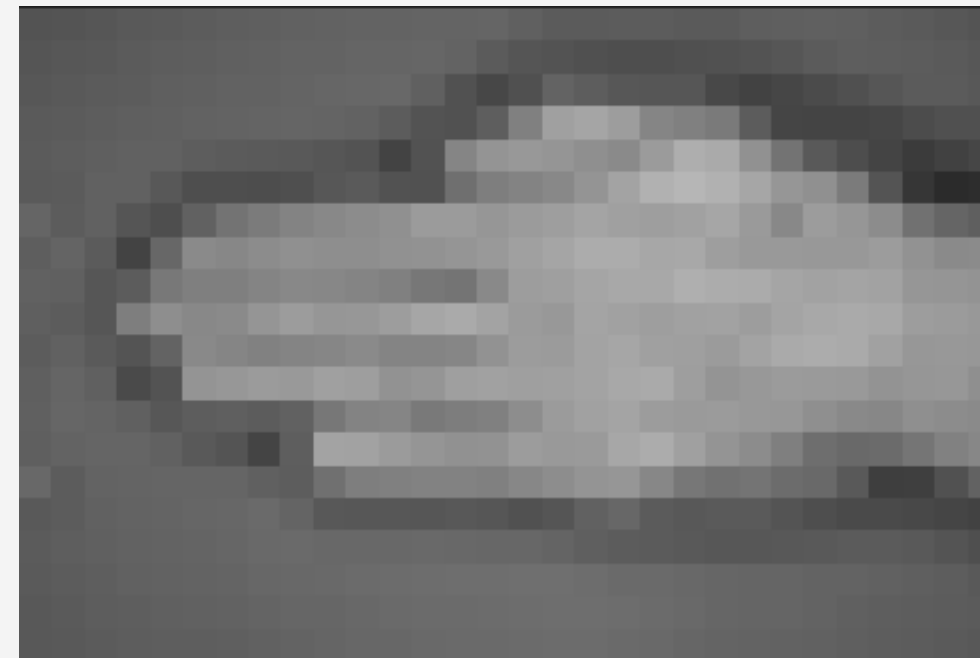
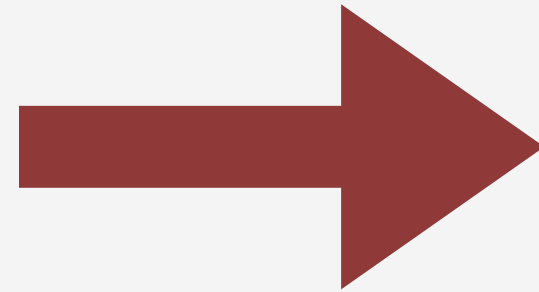
Source: [www.kaggle.com/drgfreeman/rockpaperscissors](https://www.kaggle.com/drgfreeman/rockpaperscissors)

# Data Transformation

- Pixel Values as features



200x300 pixels



20x30 pixels

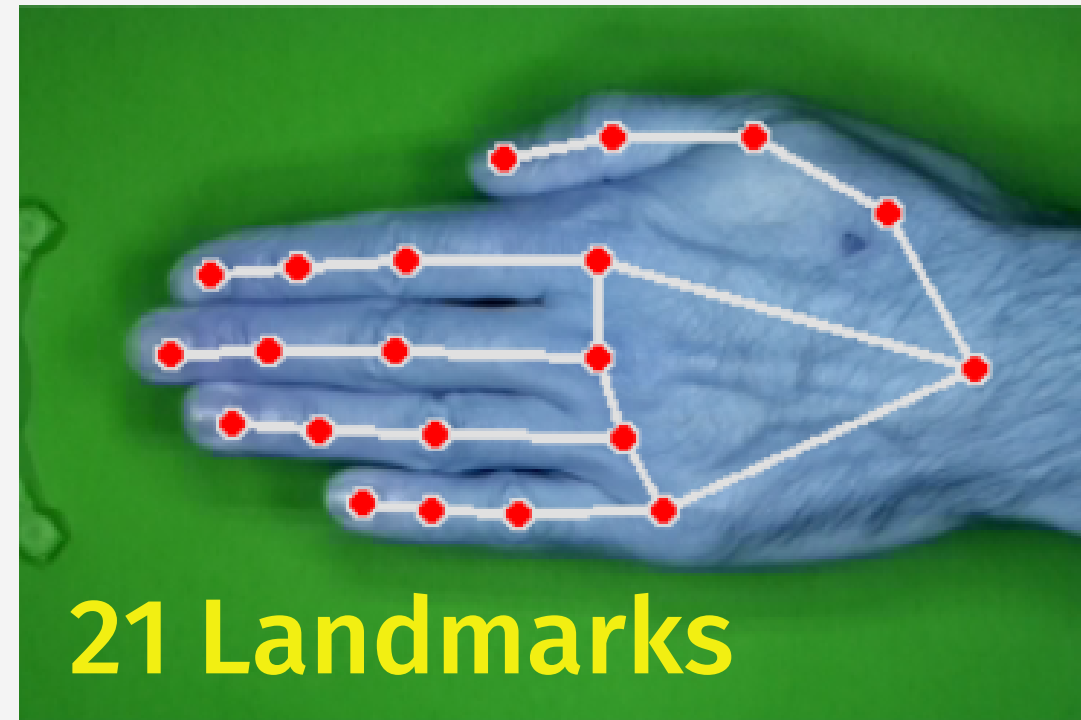
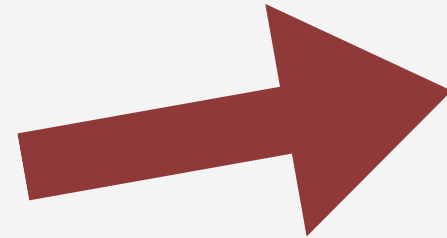
Records: 2188

Features: 600



# Data Transformation

- Landmarks as features



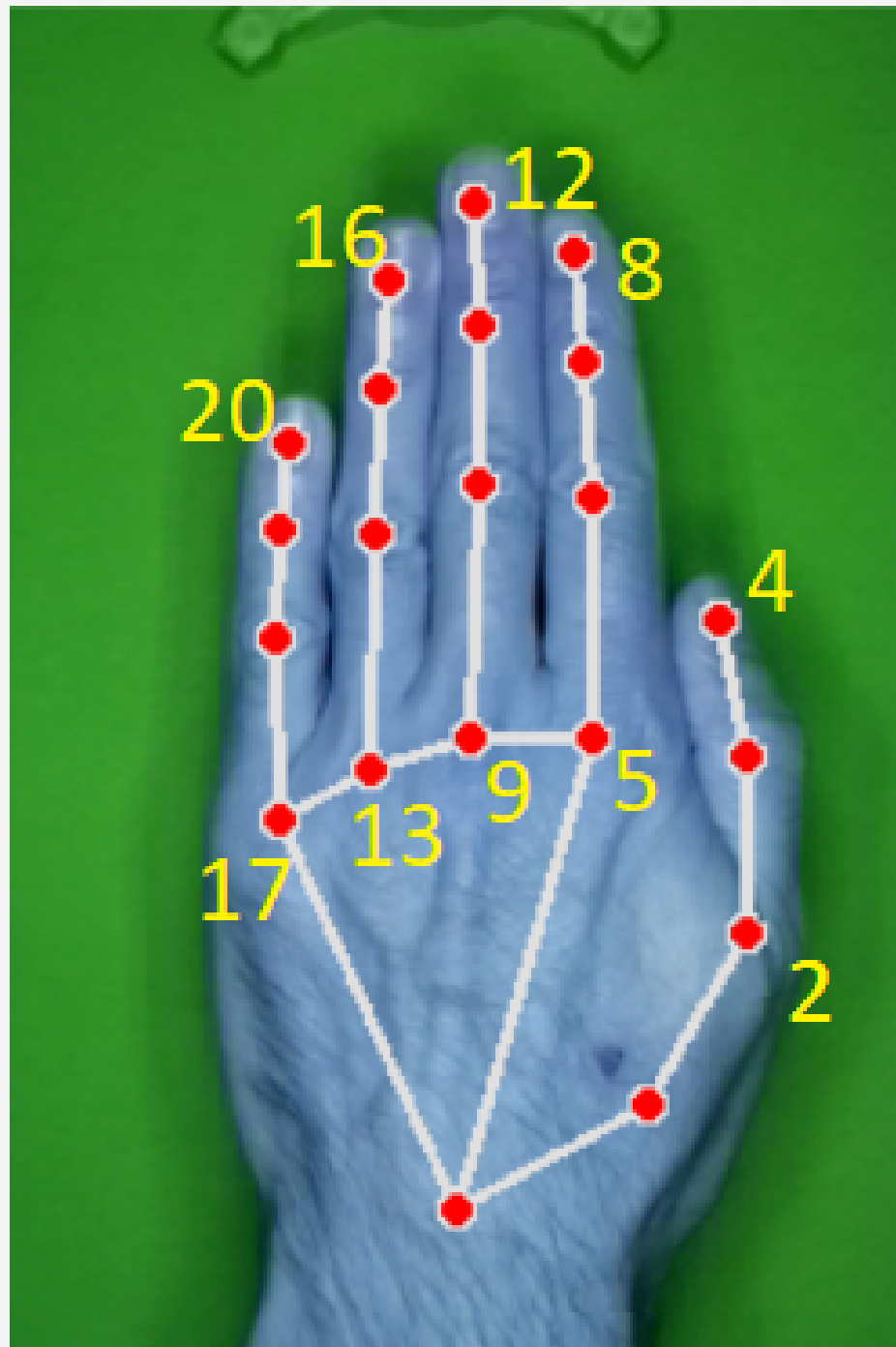
At each Landmark are associated 3 values that is the coordinates of the Landmark itself. Since all hand are placed at the same distance from the camera I discarded the third coordinate which indicates the depth.

Records: 2091

Features: 42

# Data Transformation

- Distances as features



Euclidian Distance between the landmarks:

(4, 2) (5, 8) (9, 12) (13, 16) (17, 20)

Records: 2091

Features: 5

# Data Augmentation

The dataset created with the distances is unaffected by the fact that all the hand, in the images, point in the same direction

A classifier trained on ones of the other two datasets, probably will not be able to correctly classify an image where the hand is directed in a different way





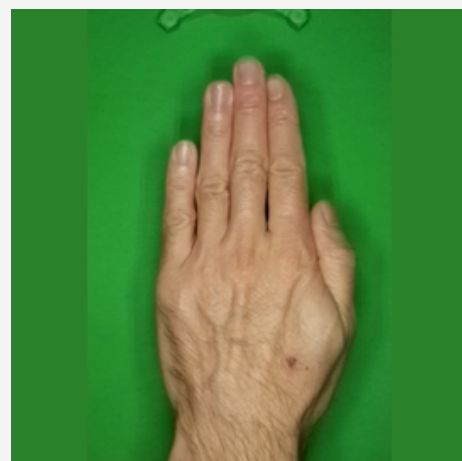
# Data Augmentation



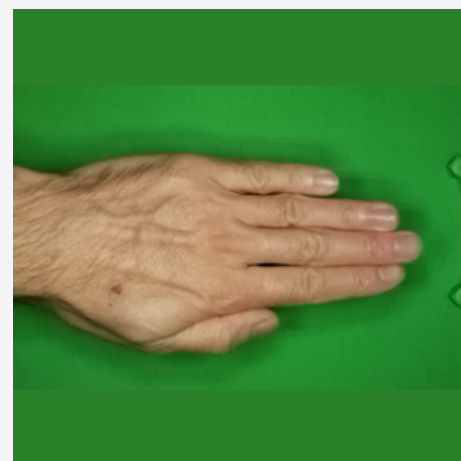
→  
Padding



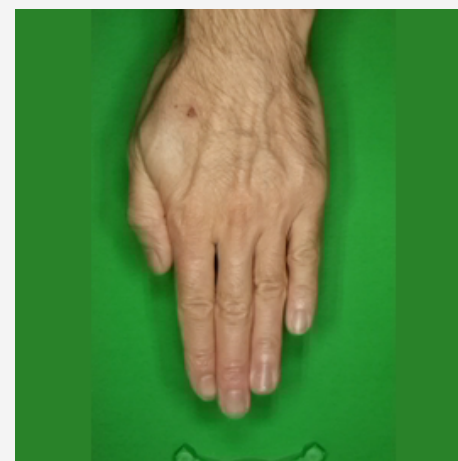
300x300



Rotation  
→



Rotation  
→



**Pixels**

Records: 2188  
Features: 600



Records: 8752  
Features: 625

**Landmarks**

Records: 2091  
Features: 42



Records: 4219  
Features: 42



# Data Augmentation

## Pixels

Records: 2188  
Features: 600

## Landmarks

Records: 2091  
Features: 42

## Distances

Records: 2091  
Features: 5



Data Augmentation



## Aug. Pixels

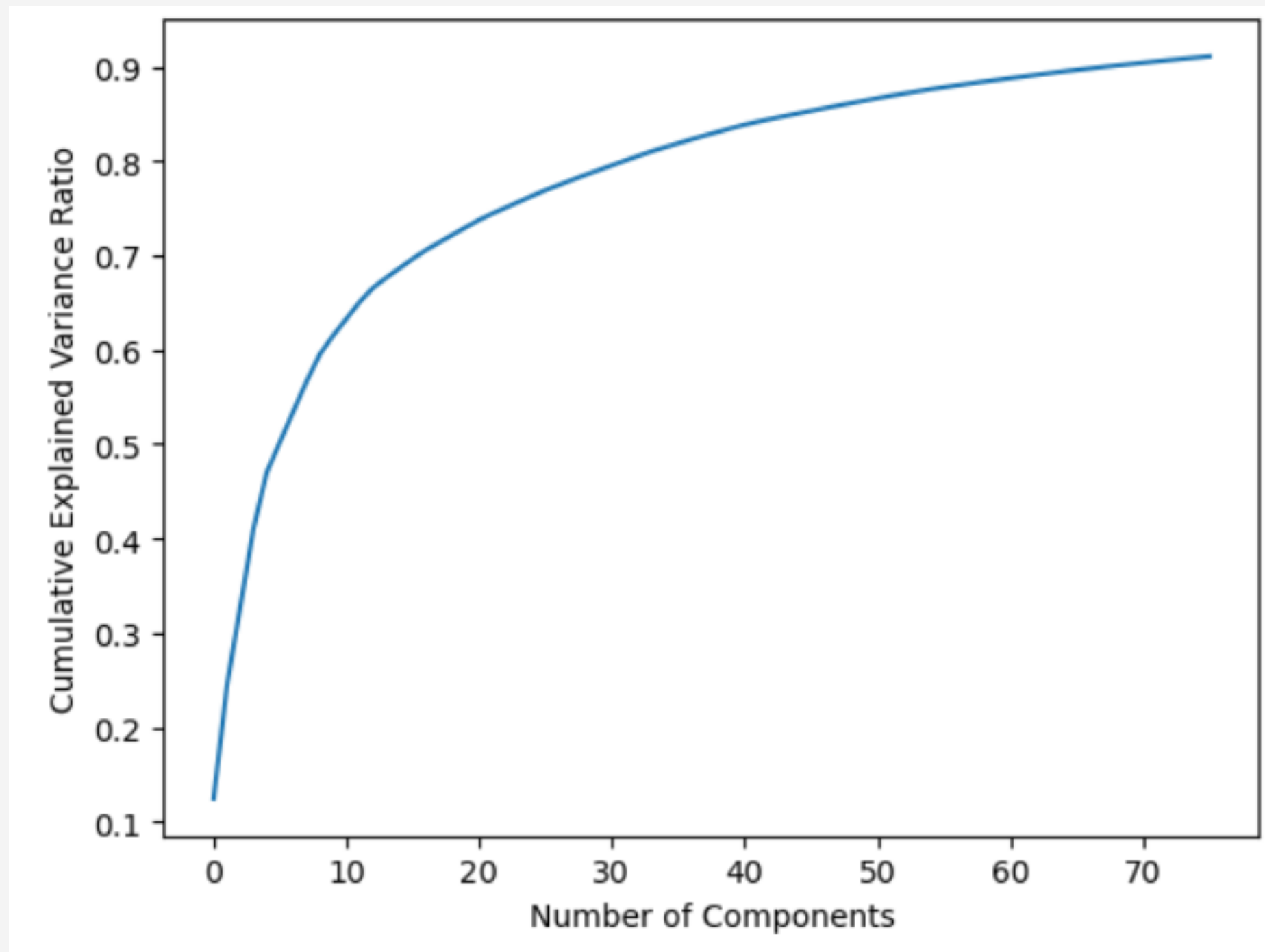
Records: 8752  
Features: 625

## Aug. Landmarks

Records: 4219  
Features: 42

# PCA

In the dataset that have the pixel values as features, the number of features is too high. I decide to performe Principal Component Analysis in order to reduce it



625 Features



70 Features

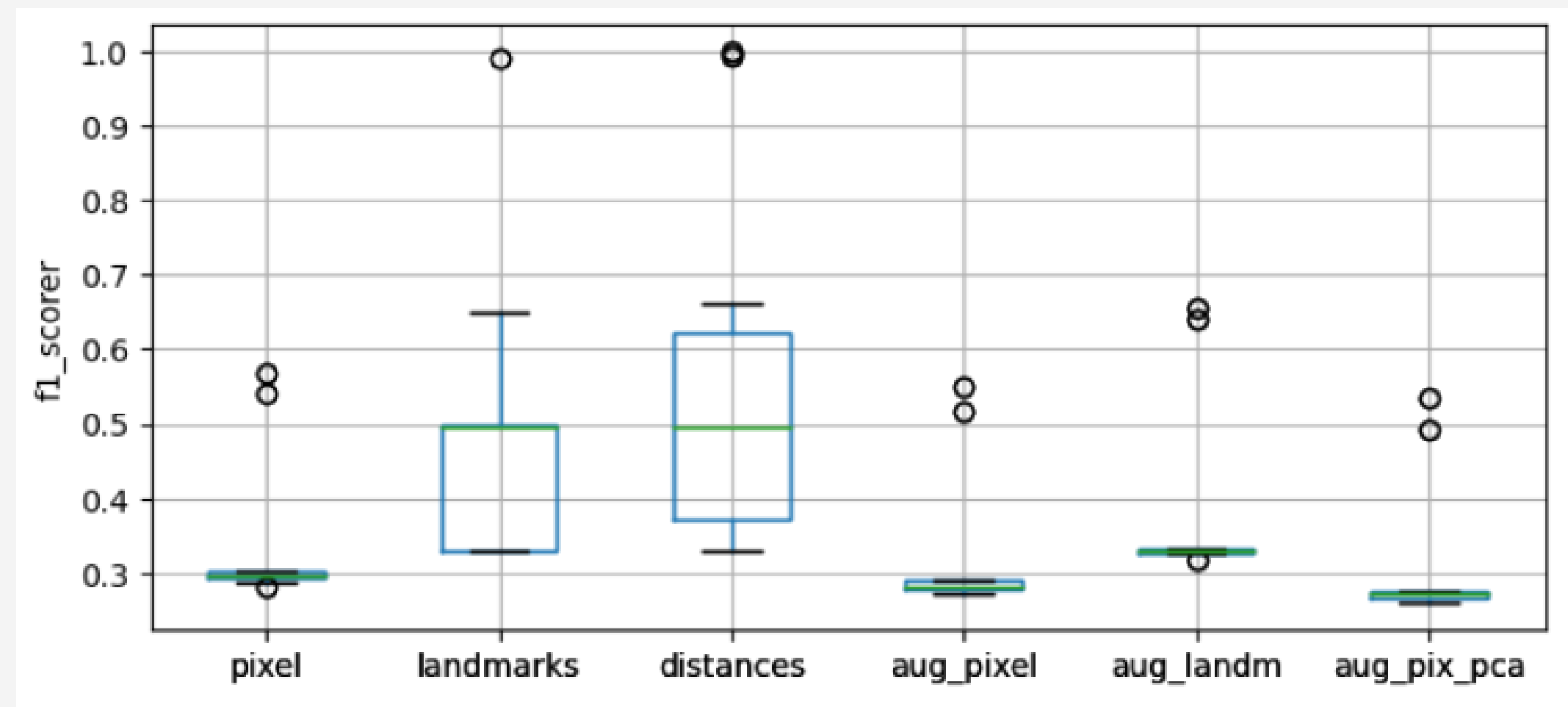
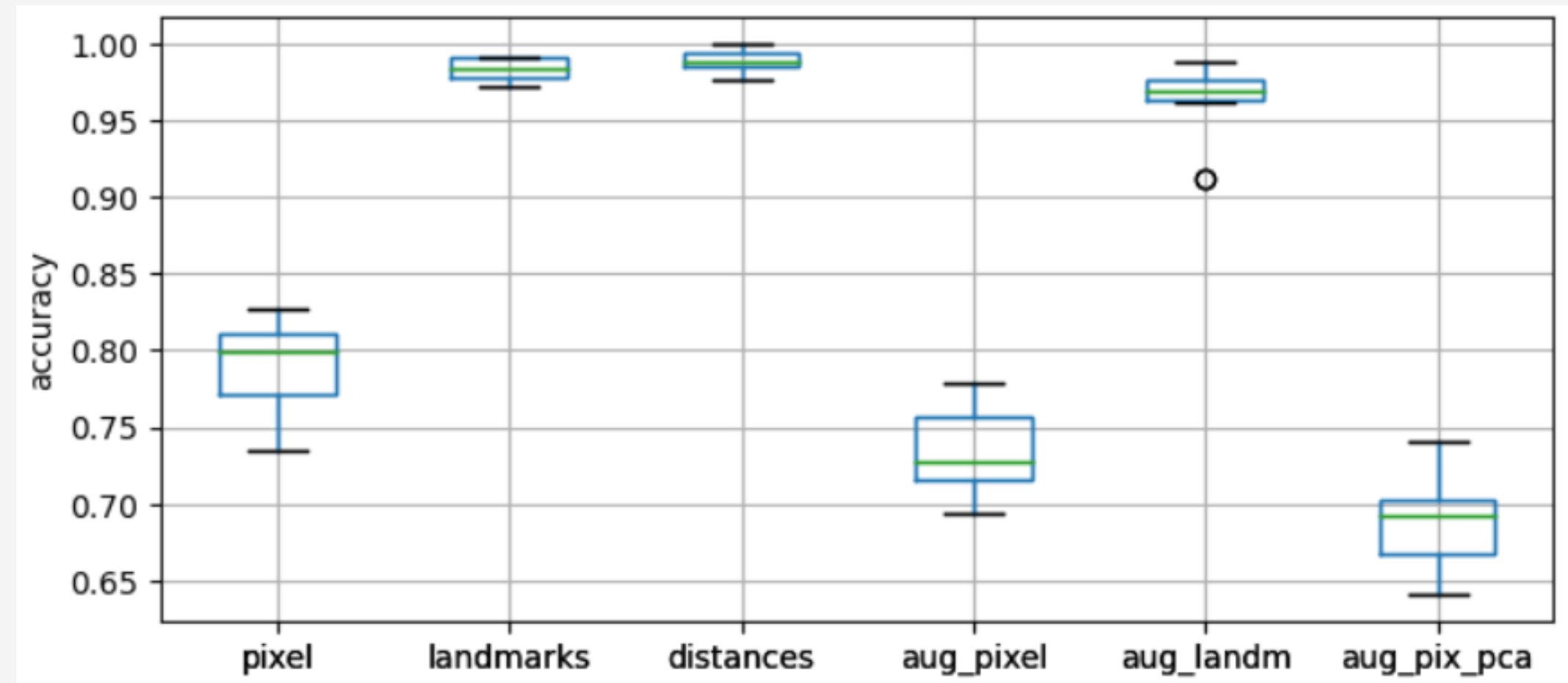


# Classification

## Decision Tree (criterion: gini)

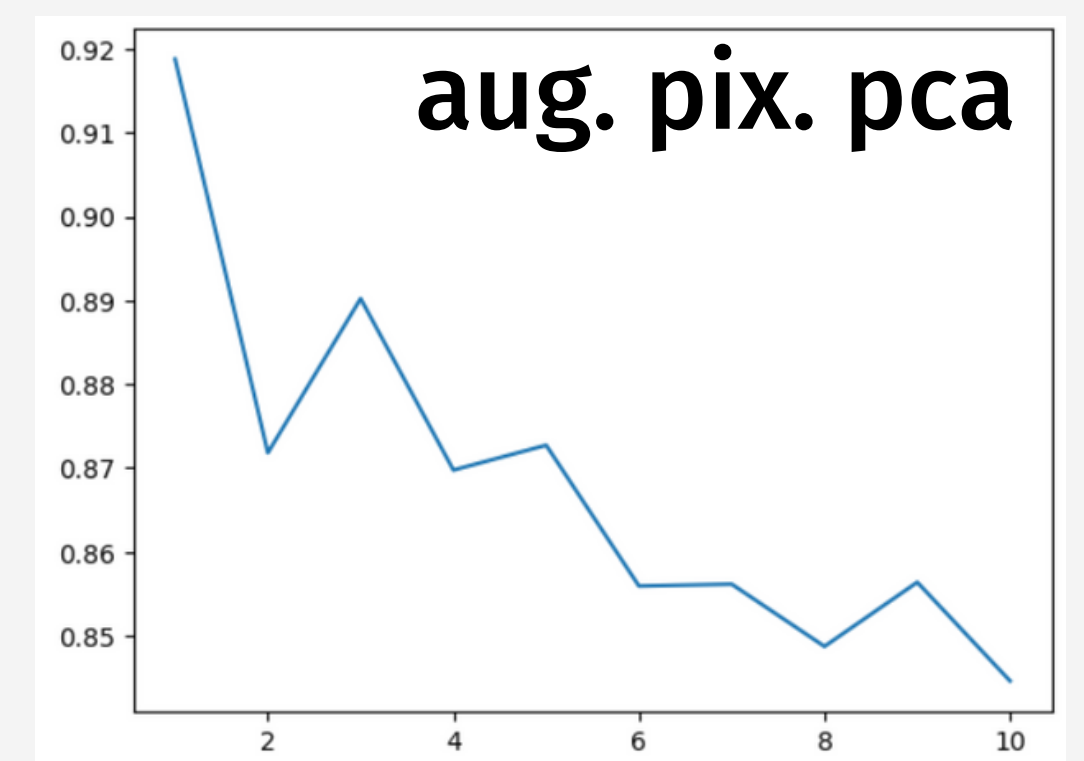
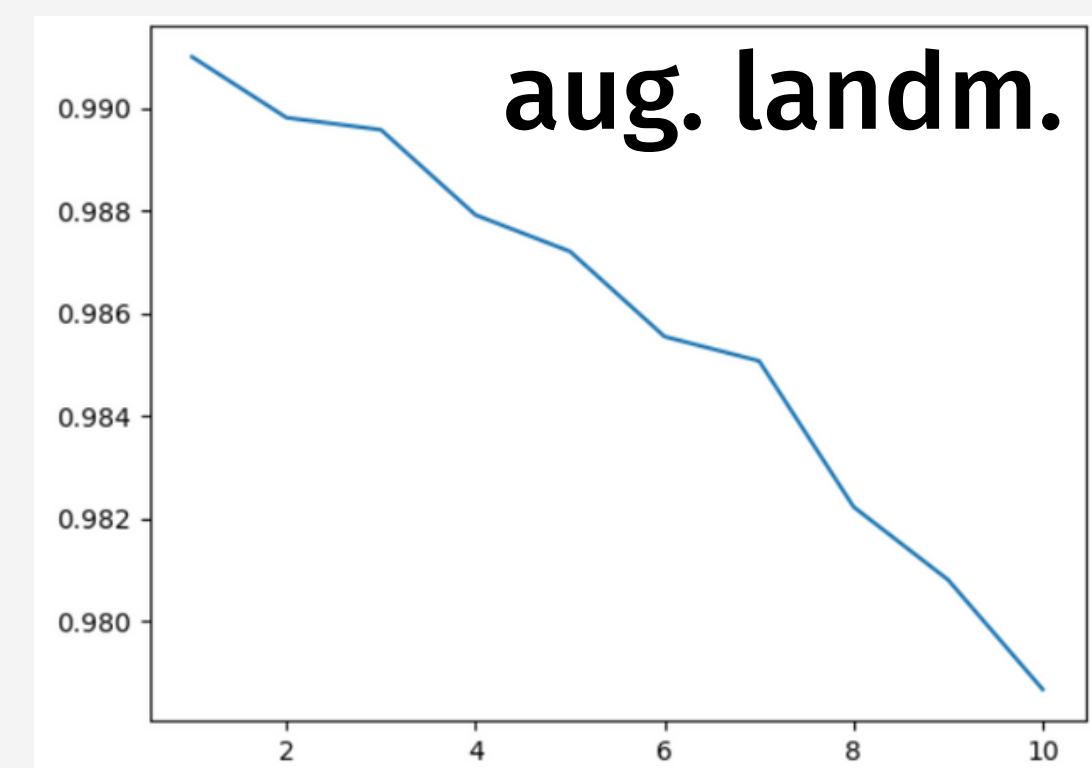
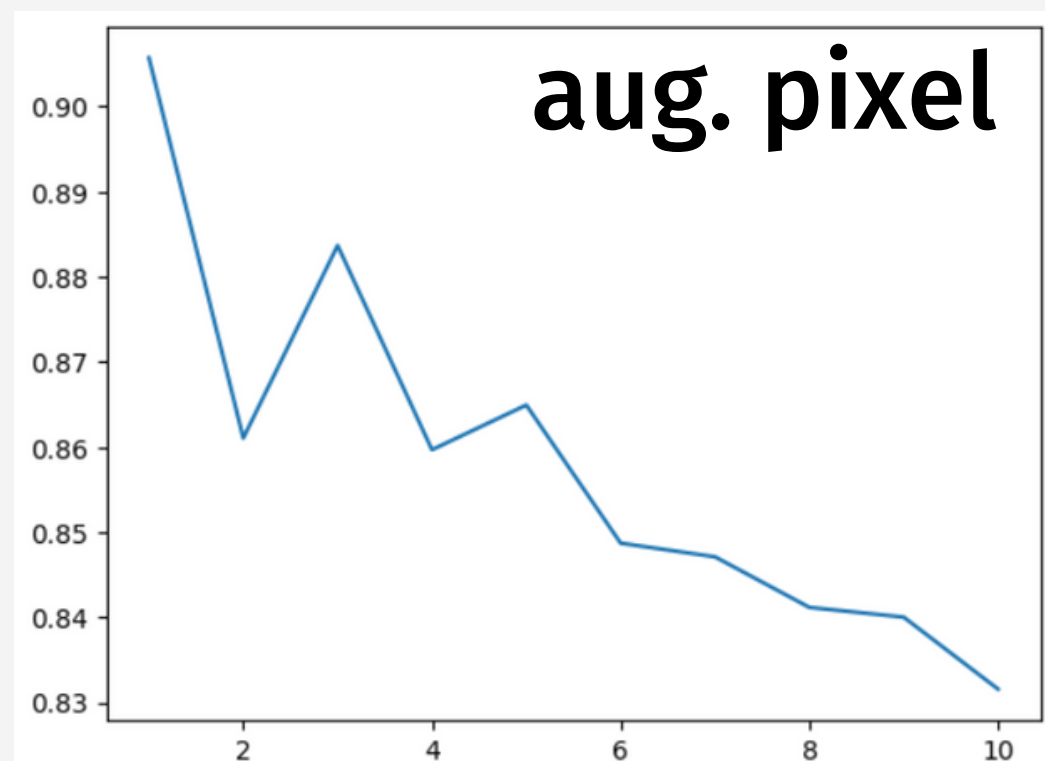
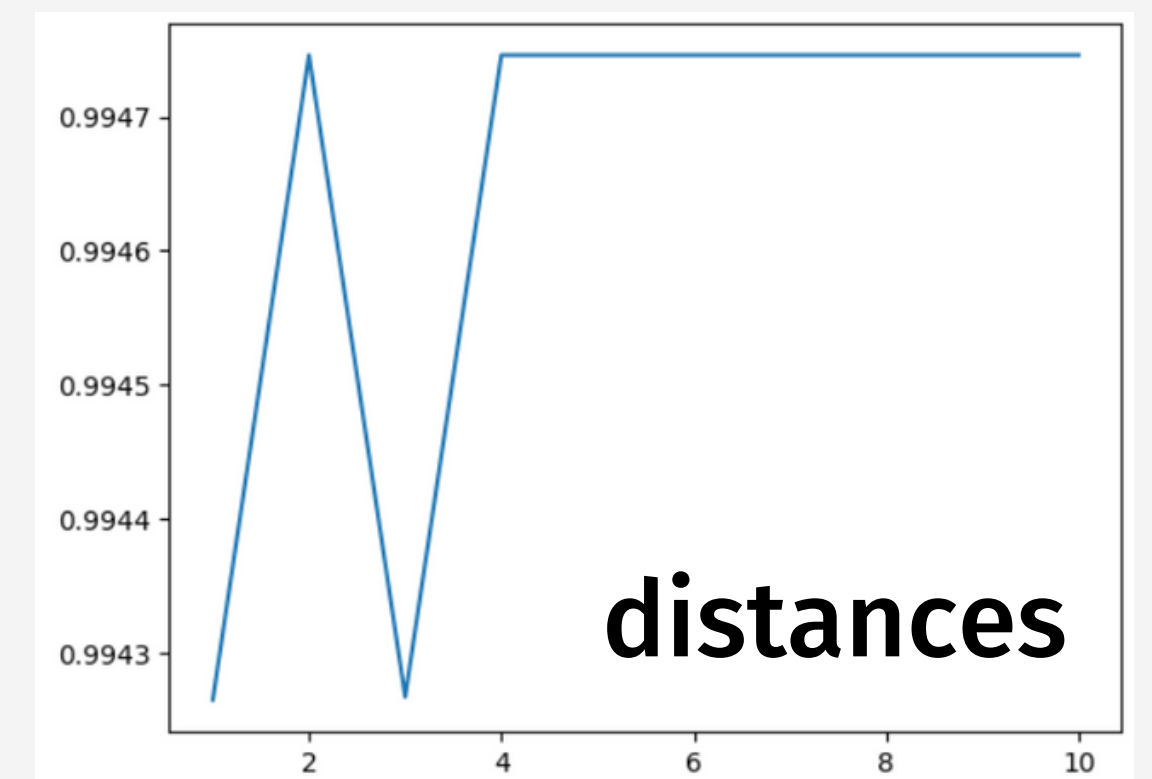
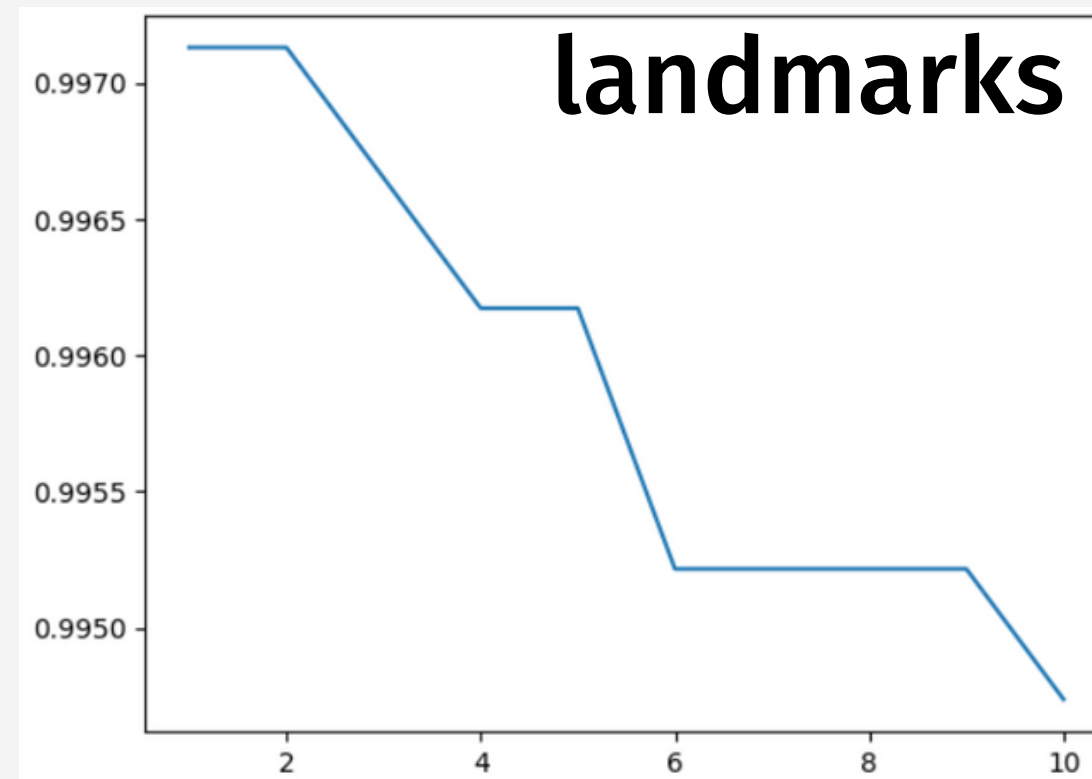
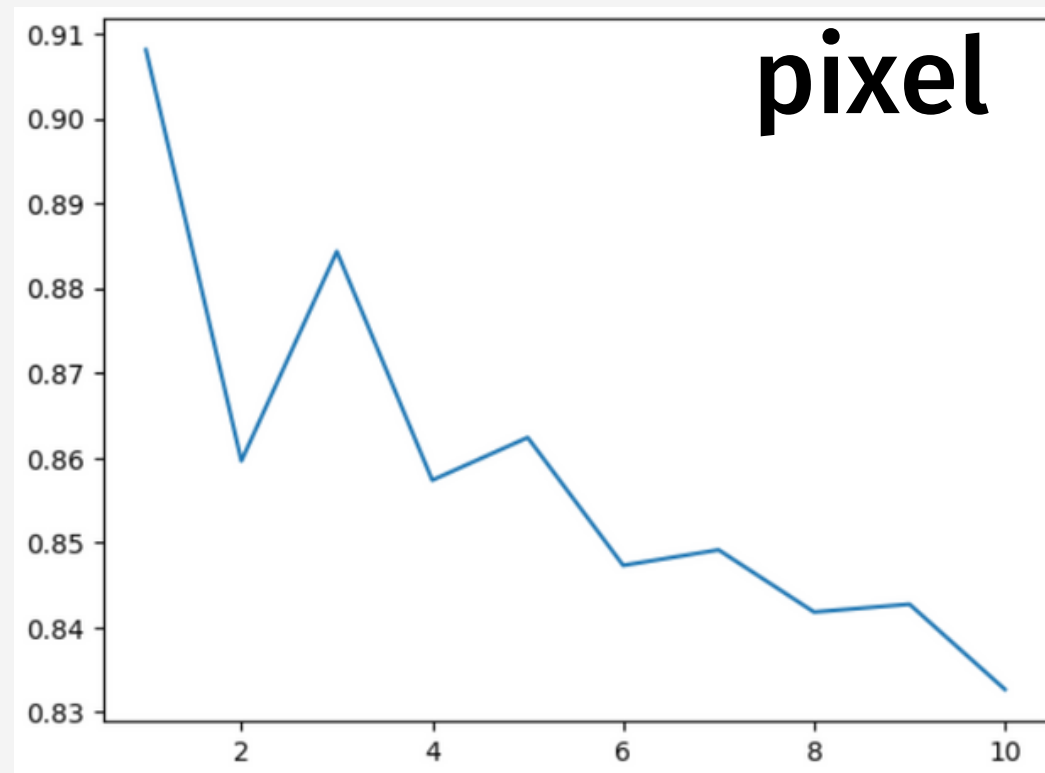
### Confusion Matrix:

paper	683	5	4
rock	5	680	1
scissors	6	1	706
	paper	rock	scissors



# Classification

K-Nearest Neighbor ( $k = 1 \div 10$ )



# Classification

## Pixel

Classifier
Decision Tree (gini)
Decision Tree (entropy)
K-Nearest Neighbor
Naive Bayesian
Random Forest (50)
Random Forest (100)

Accuracy	F1	Score time
0.791	0.346	0.0197
0.797	0.348	0.0205
0.908	0.394	0.1922
0.763	0.335	0.0410
0.902	0.377	0.0420
0.914	0.380	0.0555

## Landmarks

Accuracy	F1	Score time
0.983	0.494	0.0107
0.985	0.528	0.0086
0.997	0.798	0.0484
0.944	0.531	0.0116
0.994	0.664	0.0253
0.993	0.698	0.0402

# Classification

## Distances

## Aug. Pixel

Classifier
Decision Tree (gini)
Decision Tree (entropy)
K-Nearest Neighbor
Naive Bayesian
Random Forest (50)
Random Forest (100)

Accuracy	F1	Score time
0.989	0.563	0.0096
0.989	0.578	0.0226
0.994	0.714	0.0375
0.991	0.564	0.0109
0.992	0.647	0.0239
0.992	0.664	0.0389

Accuracy	F1	Score time
0.732	0.331	0.0344
0.735	0.332	0.0356
0.905	0.394	2.4051
0.649	0.299	0.0986
0.894	0.375	0.0792
0.903	0.377	0.1212



# Classification

Aug. Landmarks

Classifier
Decision Tree (gini)
Decision Tree (entropy)
K-Nearest Neighbor
Naive Bayesian
Random Forest (50)
Random Forest (100)

Accuracy	F1	Score time
0.966	0.391	0.0104
0.968	0.408	0.0096
0.990	0.614	0.1582
0.793	0.348	0.0141
0.985	0.530	0.0281
0.985	0.630	0.0408

Aug. Pixel PCA

Accuracy	F1	Score time
0.687	0.318	0.0624
0.681	0.314	0.0543
0.918	0.381	0.5829
0.693	0.316	0.0680
0.857	0.364	0.0850
0.865	0.366	0.1196