CV Project - Plankton as Biosensor (task 2)
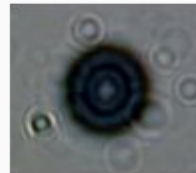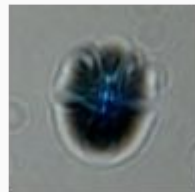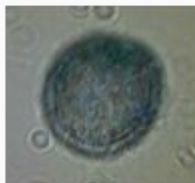
Riccardo Rorato

1. Design descriptors and features
2. Train anomaly detectors with them on 5 plankton classes
3. Feature selection
4. Future use?

The dataset

- Volvox
- Paramecium Bursaria
- Didinium Nasutum
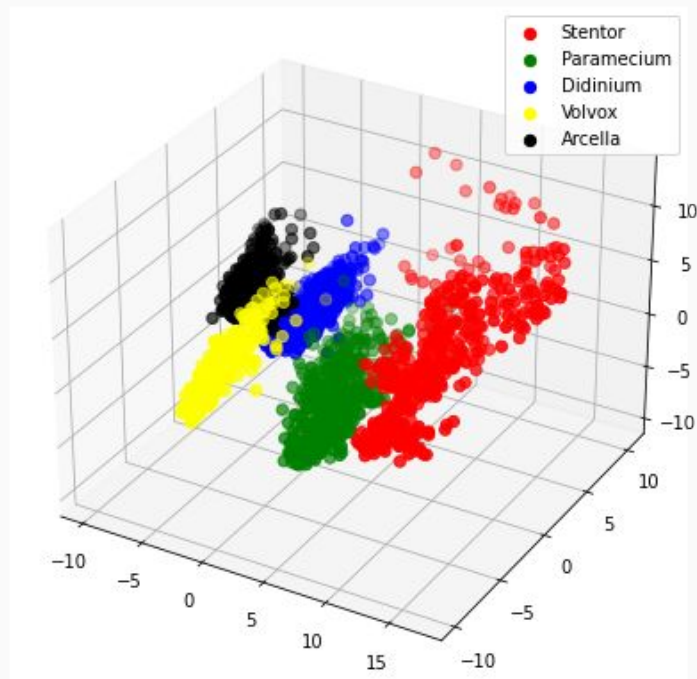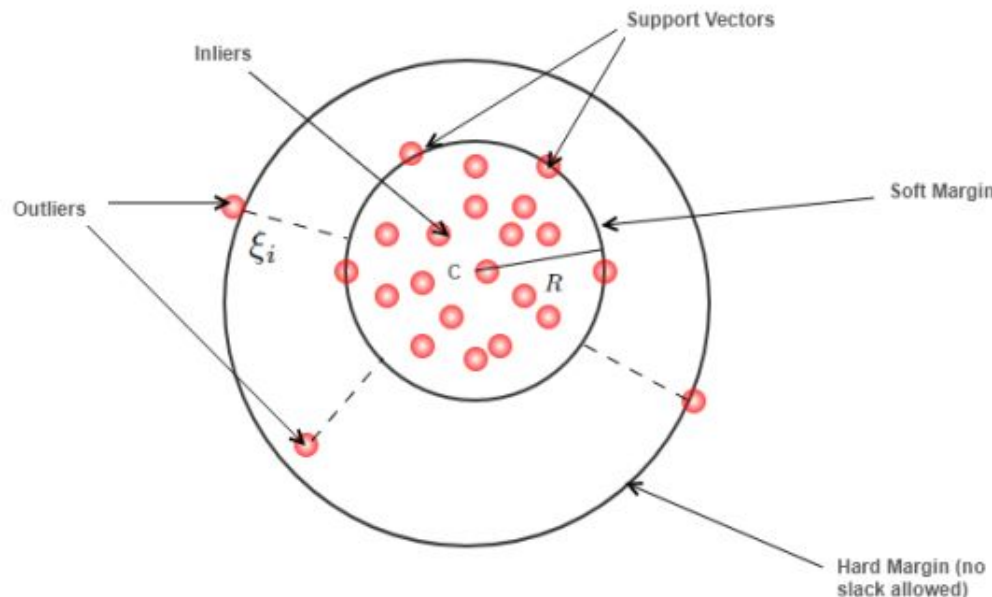- Arcella Vulgaris
- Stentor Coeruleus

Features

- 6 Minimum enclosing rectangle
- 3 Minimum enclosing ellipse
- 7 Hu moments
- 25 Zernike moments
- 5 Histogram features
- 3 Color ratios
- 13 Haralick/GSCM features
- 54 Local Binary Pattern features

116 total

PCA

One-class SVM

Support Vectors

Inliers

Outliers

ξ_i

Soft Margin

C

R

Hard Margin (no slack allowed)

Anomaly detection on Stentor:
On positive class (0): 0.9 ac
On negative class (1): 1.0 ac
On negative class (2): 0.474
On negative class (3): 0.998
On negative class (4): 0.634

Anomaly detection on Parameci
On negative class (0): 1.0 ac
On positive class (1): 0.898
On negative class (2): 1.0 ac
On negative class (3): 1.0 ac
On negative class (4): 1.0 ac

Anomaly detection on Didinium
On negative class (0): 0.638
On negative class (1): 1.0 ac
On positive class (2): 0.9 ac
On negative class (3): 1.0 ac
On negative class (4): 0.116

Anomaly detection on Volvox:
On negative class (0): 1.0 ac
On negative class (1): 1.0 ac
On negative class (2): 1.0 ac
On positive class (3): 0.9 ac
On negative class (4): 1.0 ac

Anomaly detection on Arcella:
On negative class (0): 0.666
On negative class (1): 1.0 ac
On negative class (2): 0.098
On negative class (3): 1.0 ac
On positive class (4): 0.902

Anomaly detection on Stentor:
On positive class (0): 0.8214285
On negative class (1): 1.0 accur
On negative class (2): 0.4714285
On negative class (3): 1.0 accur
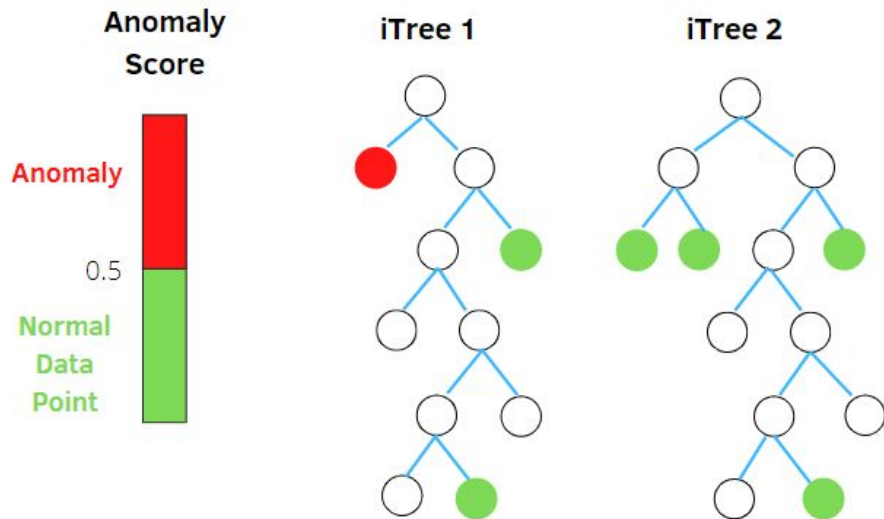On negative class (4): 0.6785714

Anomaly detection on Paramecium:
On negative class (0): 1.0 accur
On positive class (1): 0.4 accur
On negative class (2): 1.0 accur
On negative class (3): 1.0 accur
On negative class (4): 1.0 accur

Anomaly detection on Didinium:
On negative class (0): 0.6 accur
On negative class (1): 1.0 accur
On positive class (2): 0.9214285
On negative class (3): 1.0 accur
On negative class (4): 0.15 accu

Anomaly detection on Volvox:
On negative class (0): 1.0 accur
On negative class (1): 1.0 accur
On negative class (2): 1.0 accur
On positive class (3): 0.2928571
On negative class (4): 1.0 accur

Anomaly detection on Arcella:
On negative class (0): 0.5714285
On negative class (1): 1.0 accur
On negative class (2): 0.0428571
On negative class (3): 1.0 accur
On positive class (4): 0.8857142

Isolation Forest

Anomaly Score

Anomaly

0.5

Normal Data Point

iTree 1 **iTree 2** ...

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Anomaly detection on Stentor          Anomaly detection on Stentor:
On positive class (0): 0.936          On positive class (0): 0.8285714285714
On negative class (1): 1.0 a          On negative class (1): 1.0 accuracy
On negative class (2): 1.0 a          On negative class (2): 1.0 accuracy
On negative class (3): 1.0 a          On negative class (3): 1.0 accuracy
On negative class (4): 1.0 a          On negative class (4): 1.0 accuracy

Anomaly detection on Paramec          Anomaly detection on Paramecium:
On negative class (0): 1.0 a          On negative class (0): 1.0 accuracy
On positive class (1): 0.958          On positive class (1): 0.8 accuracy
On negative class (2): 0.982          On negative class (2): 0.9714285714285
On negative class (3): 1.0 a          On negative class (3): 1.0 accuracy
On negative class (4): 1.0 a          On negative class (4): 1.0 accuracy

Anomaly detection on Didiniu          Anomaly detection on Didinium:
On negative class (0): 1.0 a          On negative class (0): 1.0 accuracy
On negative class (1): 1.0 a          On negative class (1): 1.0 accuracy
On positive class (2): 0.978          On positive class (2): 0.8857142857142
On negative class (3): 1.0 a          On negative class (3): 1.0 accuracy
On negative class (4): 1.0 a          On negative class (4): 1.0 accuracy

Anomaly detection on Volvox:          Anomaly detection on Volvox:
On negative class (0): 1.0 a          On negative class (0): 1.0 accuracy
On negative class (1): 1.0 a          On negative class (1): 1.0 accuracy
On negative class (2): 1.0 a          On negative class (2): 1.0 accuracy
On positive class (3): 0.94           On positive class (3): 0.9214285714285
On negative class (4): 1.0 a          On negative class (4): 1.0 accuracy

Anomaly detection on Arcella          Anomaly detection on Arcella:
On negative class (0): 1.0 a          On negative class (0): 1.0 accuracy
On negative class (1): 1.0 a          On negative class (1): 1.0 accuracy
On negative class (2): 1.0 a          On negative class (2): 1.0 accuracy
On negative class (3): 1.0 a          On negative class (3): 1.0 accuracy
On positive class (4): 0.934          On positive class (4): 0.9142857142857
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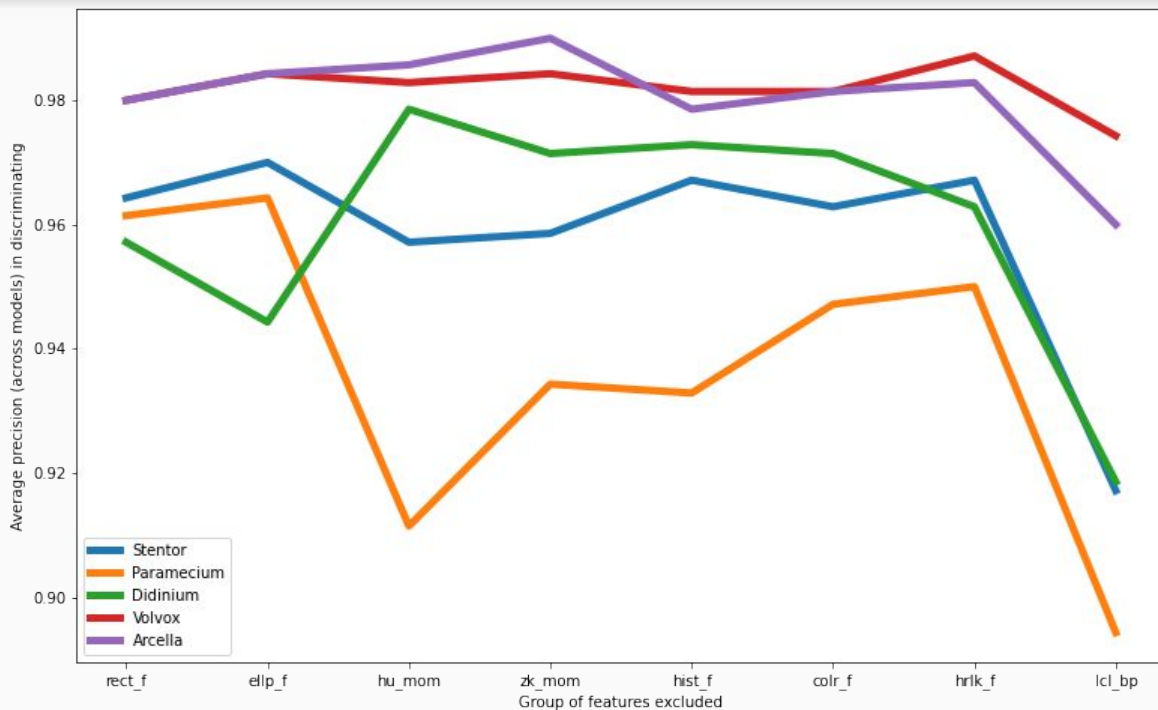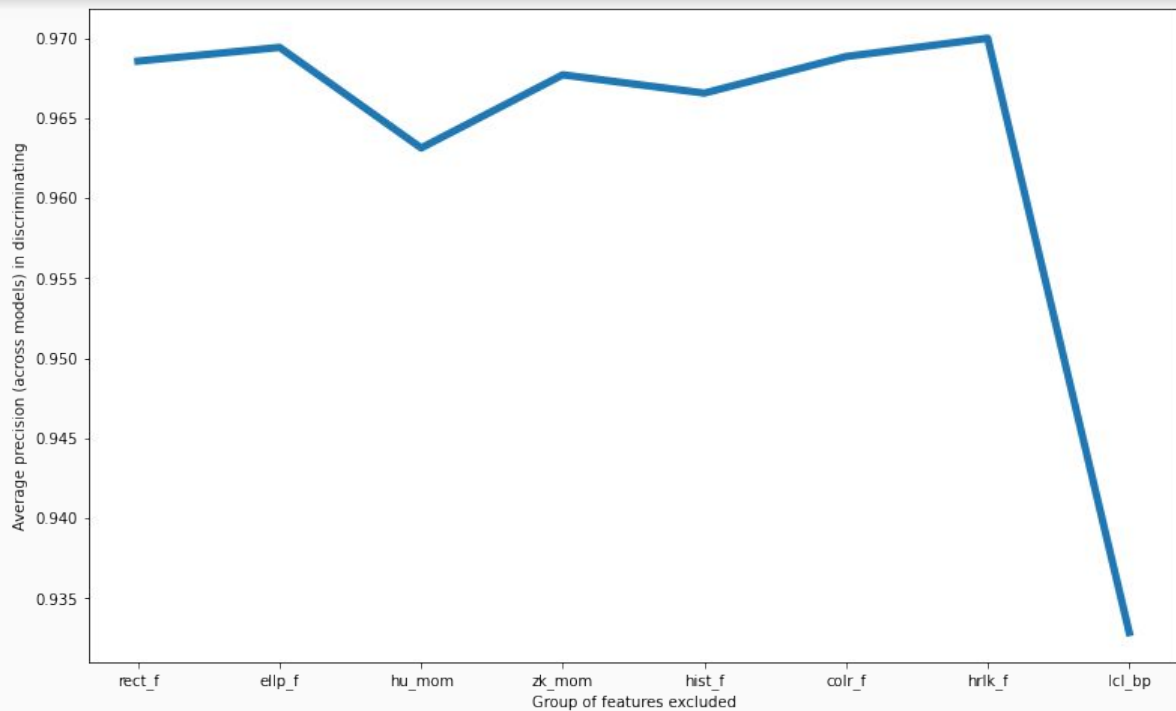
Feature selection: precision if deleting a group of features, averaging across models

Average again across species

Normalized by feature group size