Master in
Computer Vision
Barcelona

Module 3: Machine learning for computer vision

Project: Bag of Visual Words Image Classification

Lecturer: Ramon Baldrich, ramon.baldrich@uab.cat

Credit to Marçal Rossinyol

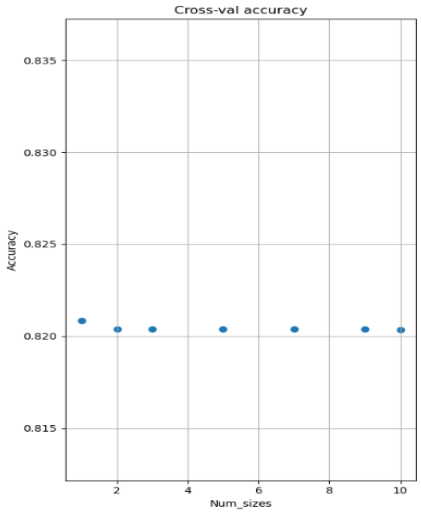
Tasks to do

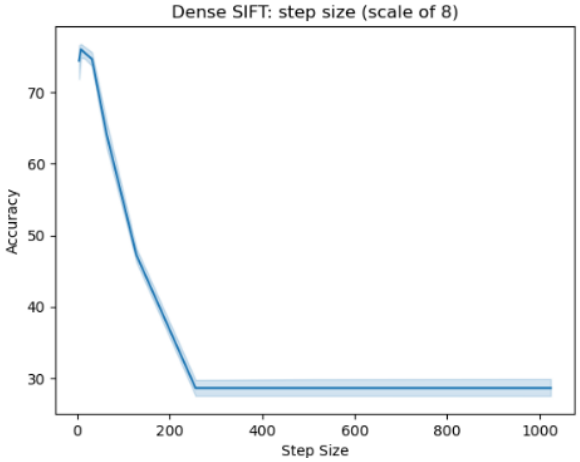
Improve the BoVW code with:

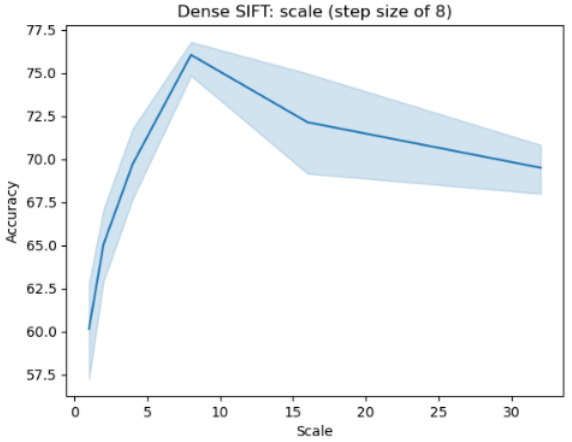
- Dense SIFT (with tiny steps and different scales!)
- L2-norm - power norm
- SVM classifier
- Scalers (norms)
- Cross-validation
- Linear, RBF and histogram intersection kernels
- Spatial Pyramids
- Fisher Vectors (OPTIONAL)

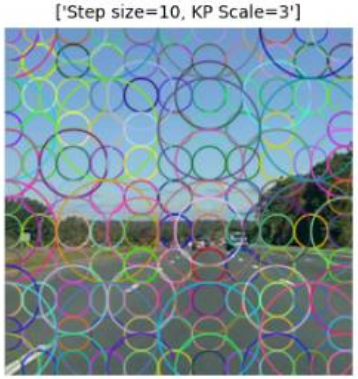
Step size & scale

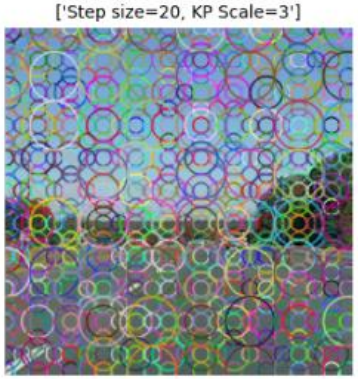
Small up to a certain limit

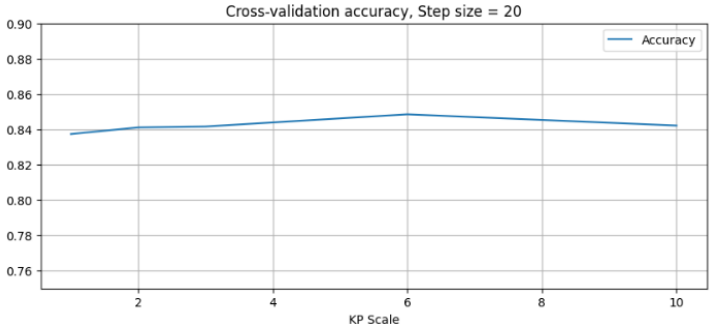




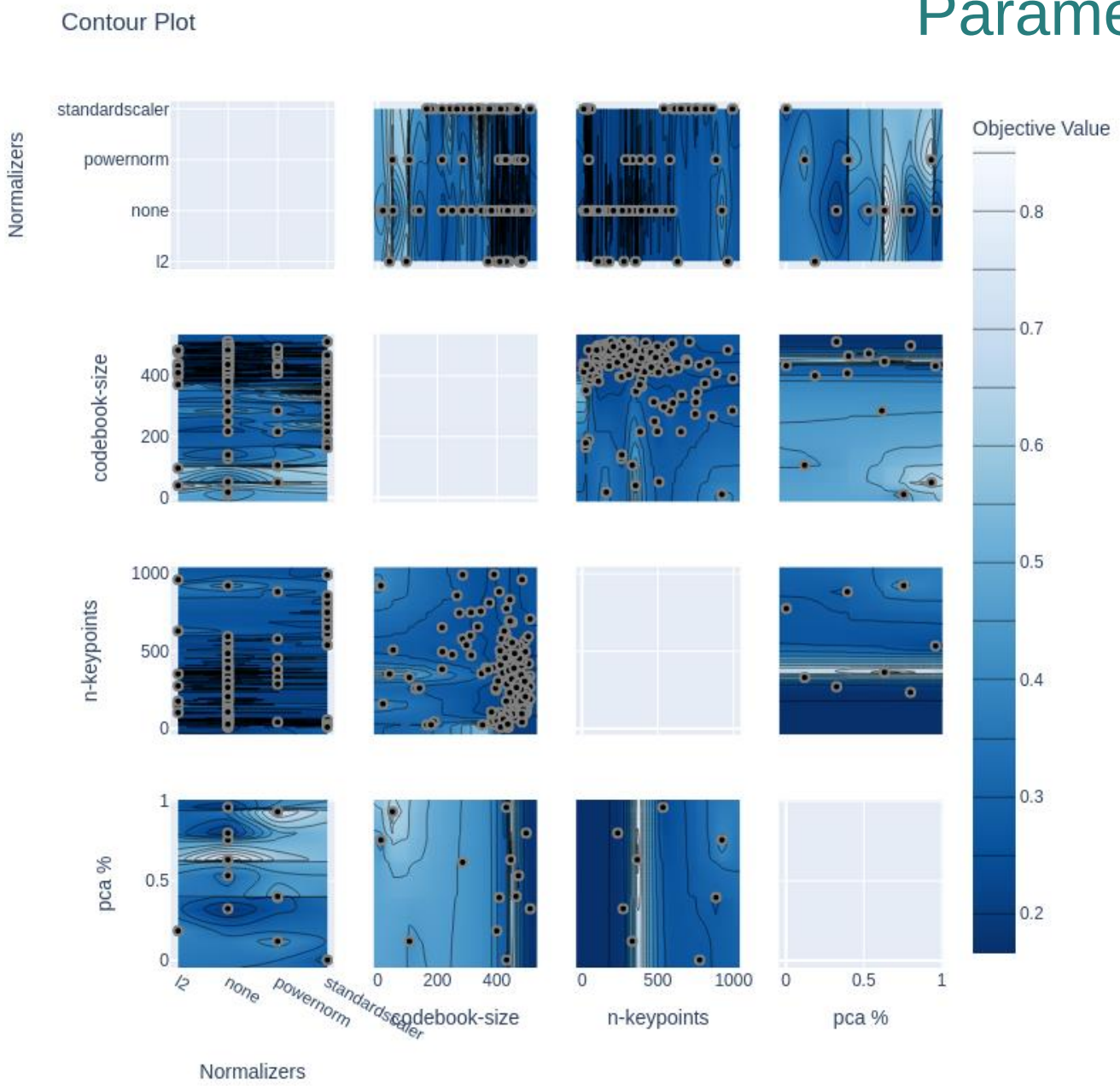




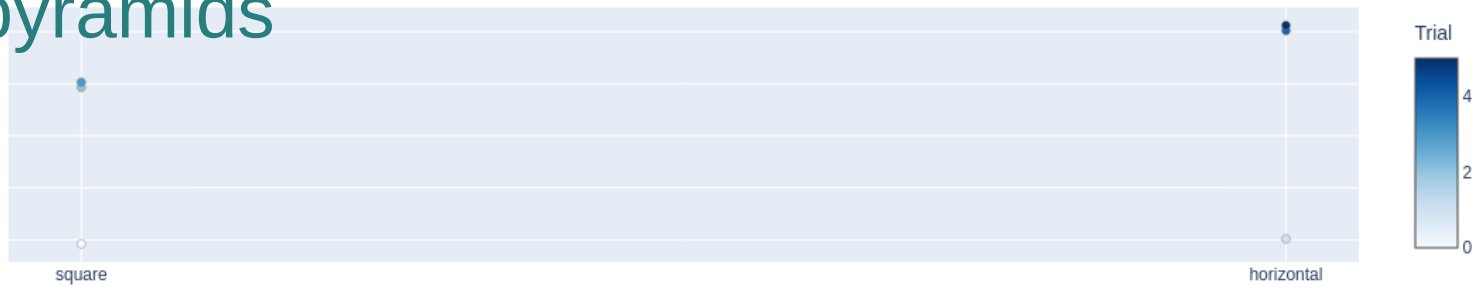


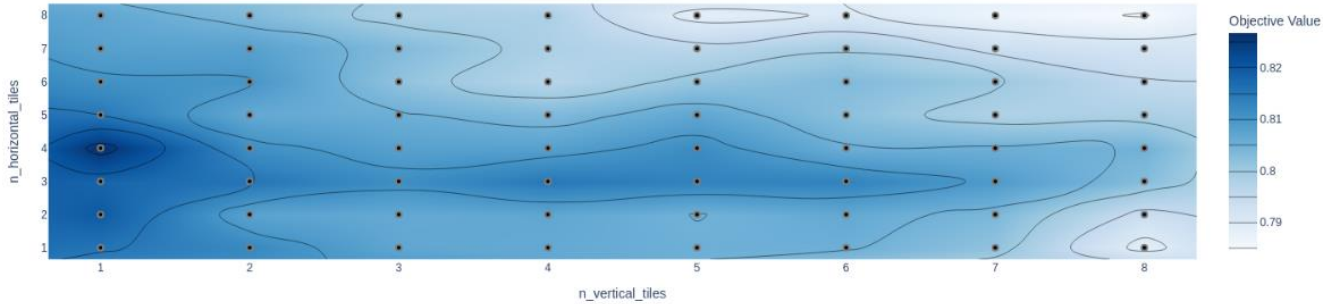


Parameter selection

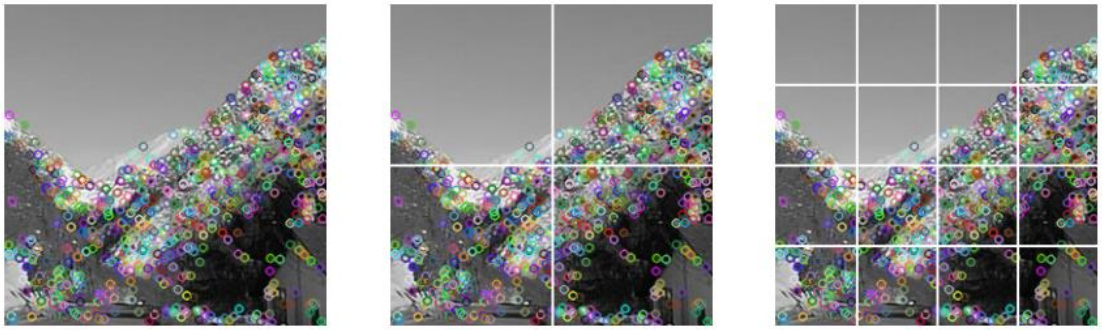


Spatial pyramids



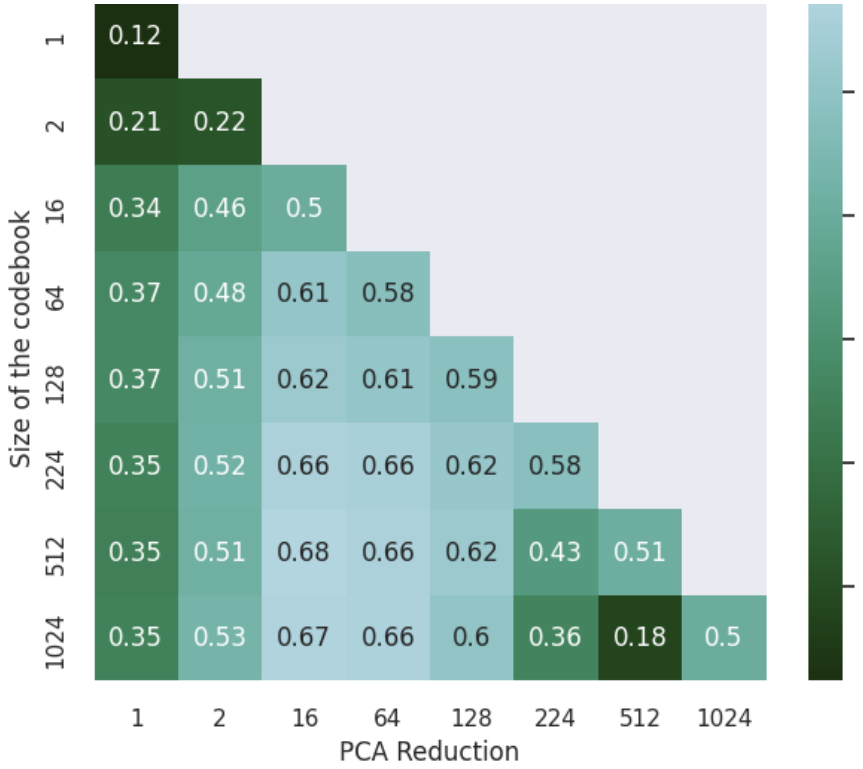


Spatial pyramid divisions with keypoints

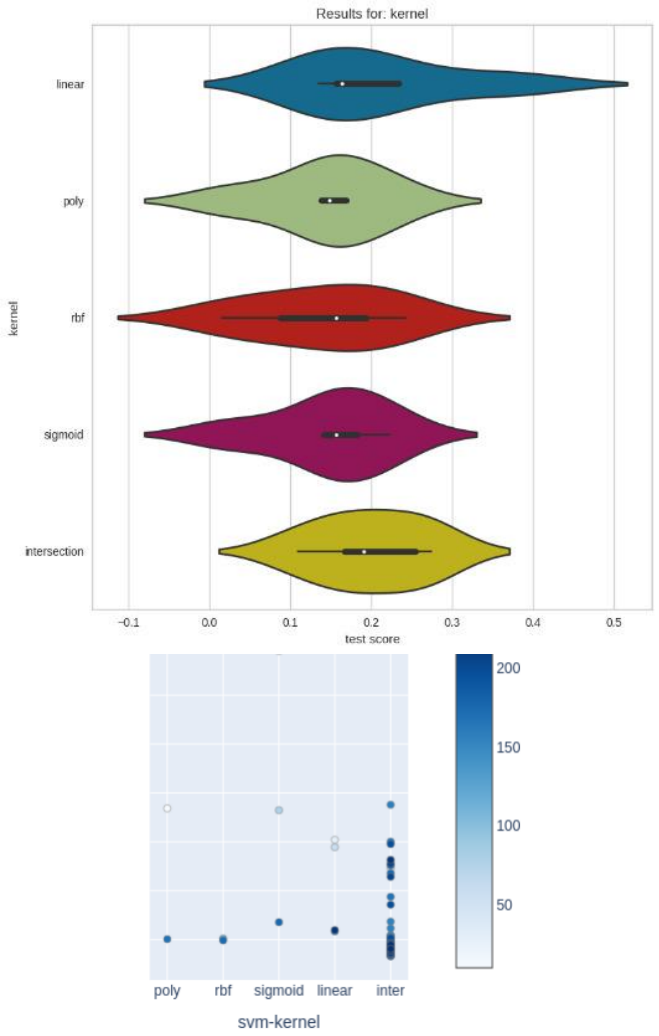


SP => dense

Pca

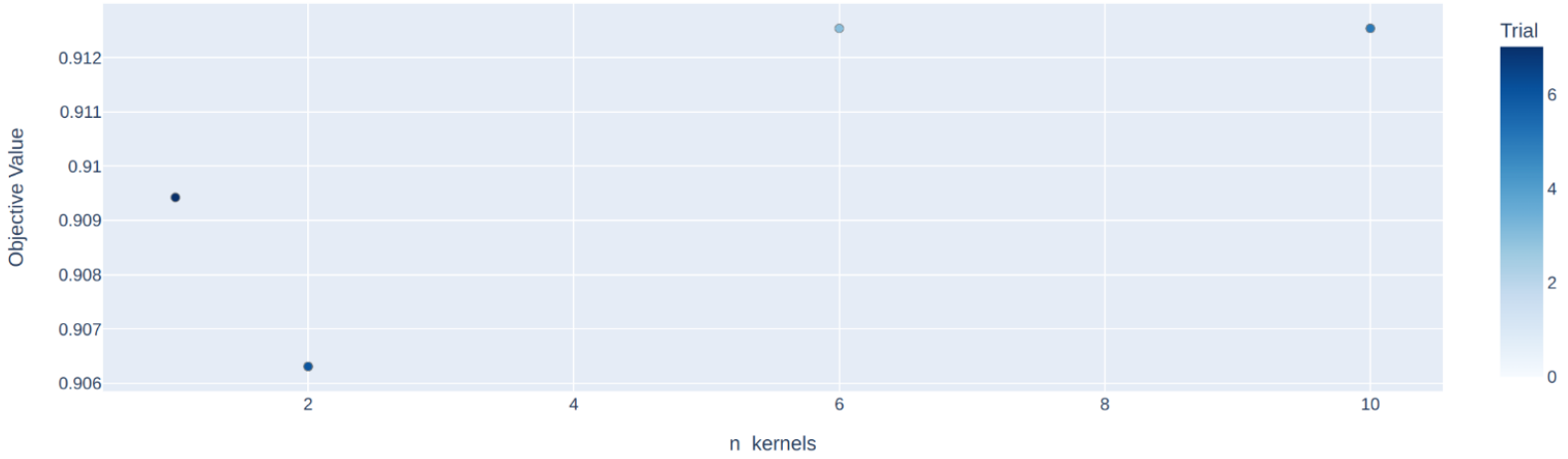

Size of the codebook
1
2
16
64
128
224
512
1024
0.12
0.21 0.22
0.34 0.46 0.5
0.37 0.48 0.61 0.58
0.37 0.51 0.62 0.61 0.59
0.35 0.52 0.66 0.66 0.62 0.58
0.35 0.51 0.68 0.66 0.62 0.43 0.51
0.35 0.53 0.67 0.66 0.6 0.36 0.18 0.5
1 2 16 64 128 224 512 1024
PCA Reduction

Svm kernel & others

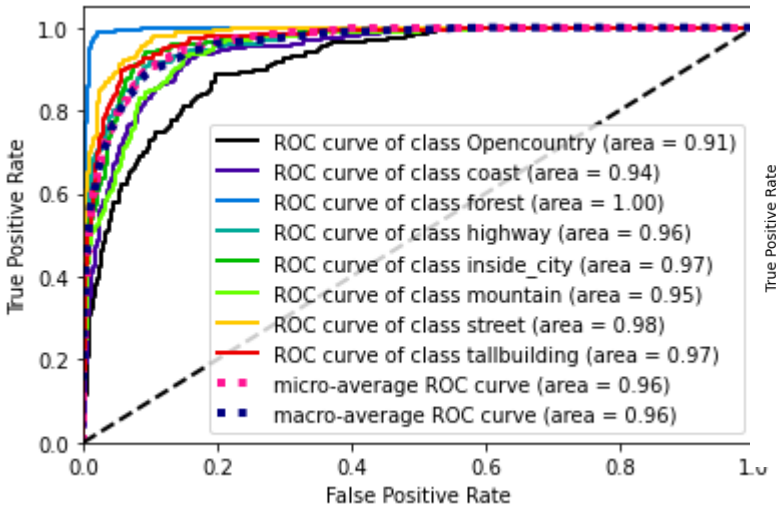


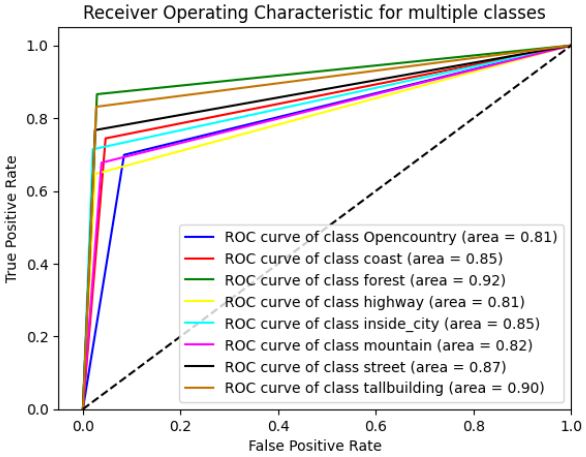
Classifier	Test Accuracy	Accuracy STD	Fit Time
SVM	0.738969	0.008270	16.453848
KNN	0.677299	0.012100	16.475282
Logistic	0.689527	0.021052	16.384468
Random Forest	0.717172	0.014285	16.590544
Naive Bayes	0.620415	0.027716	17.176783

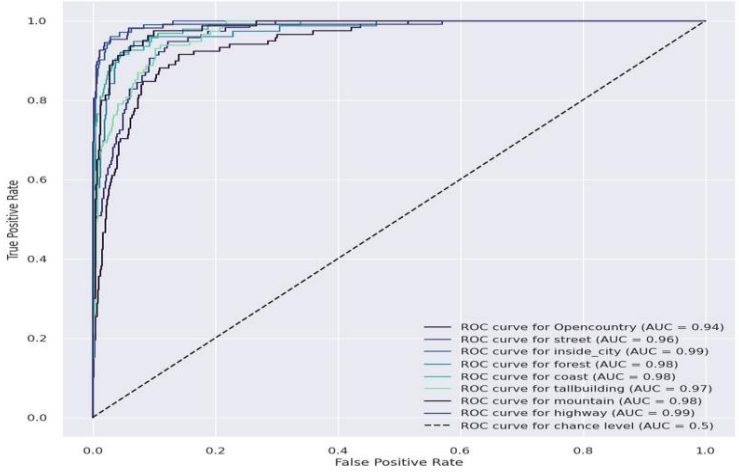
Fisher vectors



On accuracy some hot 90ies but reported 83.5


True Positive Rate
False Positive Rate
ROC curve of class Opencountry (area = 0.91)
ROC curve of class coast (area = 0.94)
ROC curve of class forest (area = 1.00)
ROC curve of class highway (area = 0.96)
ROC curve of class inside_city (area = 0.97)
ROC curve of class mountain (area = 0.95)
ROC curve of class street (area = 0.98)
ROC curve of class tallbuilding (area = 0.97)
micro-average ROC curve (area = 0.96)
macro-average ROC curve (area = 0.96)


Receiver Operating Characteristic for multiple classes
True Positive Rate
False Positive Rate
ROC curve of class Opencountry (area = 0.81)
ROC curve of class coast (area = 0.85)
ROC curve of class forest (area = 0.92)
ROC curve of class highway (area = 0.81)
ROC curve of class inside_city (area = 0.85)
ROC curve of class mountain (area = 0.82)
ROC curve of class street (area = 0.87)
ROC curve of class tallbuilding (area = 0.90)


True Positive Rate
False Positive Rate
ROC curve for Opencountry (AUC = 0.94)
ROC curve for street (AUC = 0.96)
ROC curve for inside_city (AUC = 0.99)
ROC curve for forest (AUC = 0.98)
ROC curve for coast (AUC = 0.98)
ROC curve for tallbuilding (AUC = 0.97)
ROC curve for mountain (AUC = 0.98)
ROC curve for highway (AUC = 0.99)
ROC curve for chance level (AUC = 0.5)

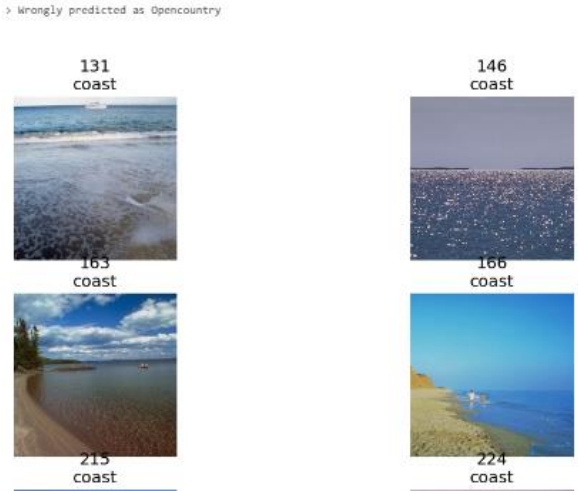
Other issues

representation??

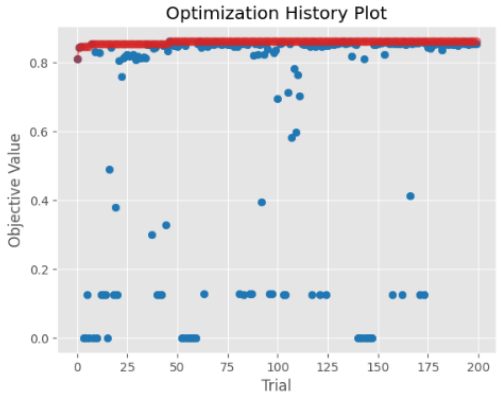
No way

Hard cases …

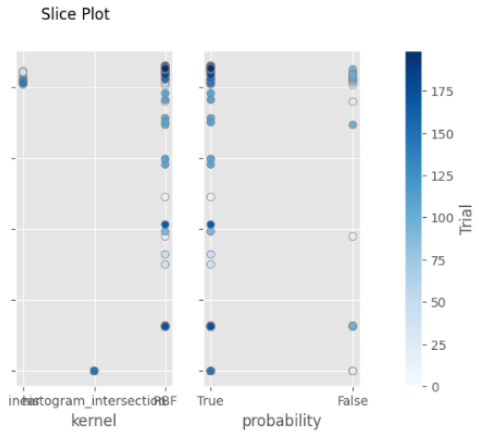
But, not so hard ☹



History (slice) not very informative



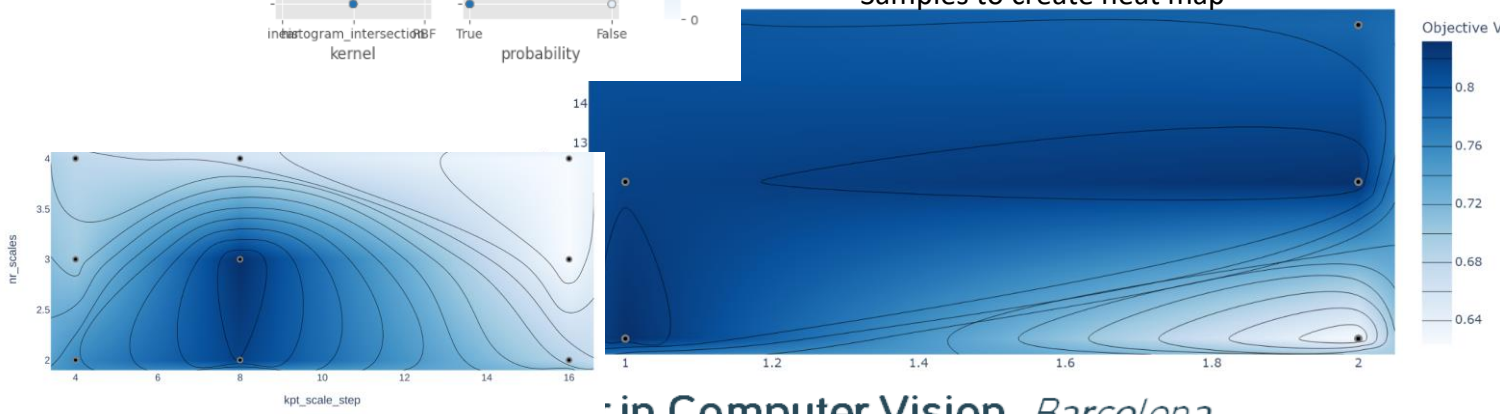
	label	accuracy	f1_score
0	Opencountry	0.912020	0.687225
1	coast	0.925651	0.767442
2	forest	0.966543	0.877828
3	highway	0.951673	0.715328
4	inside_city	0.962825	0.836957
5	mountain	0.944238	0.792627
6	street	0.975217	0.868421
7	tallbuilding	0.957869	0.844037
8	OVERALL	0.796248	0.796536



No need to get all the performance in all cases ALWAYS

Distance metric	Base Accuracy	PCA Accuracy	LDA Accuracy	Computing time
Euclidean	78.69%	76.46%	84.01%	30.26s
Manhattan	80.05%	75.34%	84.01%	31.18s
Chebyshev	59.85%	73.73%	84.39%	31.32s
Minhowski	78.69%	78.07%	84.01%	31.51s
Hamming	37.30%	14.13%	14.13%	31.35s
Canberra	62.70%	75.84%	82.65%	32.19s
Braycurtis	80.05%	76.70%	84.51%	31.35s

Samples to create heat map



Group	grade
1	10
2	8
3	5
4	6
5	*
6	10
7	8
8	7
9	9
10	10

* No figures shown