

CSci 4270 and 6270
Computational Vision,
Spring Semester, 2021
Lecture 03 Exercise
Due: Wednesday, February 3, 2021 at 5 pm EST

Problems

1. For **unit vectors** \hat{x} and \hat{y} in N dimensional space, the *square Euclidean distance* between the vectors is $\|\hat{x} - \hat{y}\|^2$ while the *cosine distance* is $\cos \theta = \hat{x} \cdot \hat{y}$. Give a derivation showing that

$$\|\hat{x} - \hat{y}\|^2 = 2(1 - \cos \theta).$$

Note: all submissions must be pdf files. You may write the solution by hand but you must scan it or take a low-res (but still clear) picture. Do NOT submit a high resolution photo! For homework assignments, written solutions must be typeset, preferably with LaTeX (get an Overleaf account).

2. The supplied code reads in a list of points in two dimensions and returns it as an array. Complete the code by finding and printing the first principle component vector. Use either `np.linalg.eigh` or `np.linalg.svd` to do so. Print the vector as two values on two separate lines, accurate to three decimal places. Note that there is a sign ambiguity to the vectors, such that x_1, y_1 and $-x_1, -y_1$ are equally correct. Resolve this ambiguity by ensuring that x_1 is positive (and don't worry about the case of $x_1 \approx 0$).

The outputs from my code on the two example files are

```
% python prob2_sol.py pts_v1.txt
0.454
0.891
```

and

```
% python prob2_sol.py pts_v2.txt
0.962
-0.272
```