CSci 4270 and 6270
Computational Vision,
Spring Semester, 2021
Lecture 03 Exercise
Due: Saturday, January 22, 2022 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 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
   ```