ECE/CSE 576, Spring 2019 Homework 3: Content-Based Image Retrieval

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1 Algorithm

For each image, we performed k-means clustering with $k = 8$ for 32 iterations.[1] Connected components was then applied to segment the image into contiguous regions. For each region, the following features were computed: (1) the proportion of the image occupied the region, (2) the average red, green, and blue color levels scaled to lie in range $[0, 1]$, (3) the centroid, (4) the bounding box, and (5) a normalized gray-level co-occurence matrix (GLCM).

For the centroid and bounding box, coordinates were scaled to lie in range $[0, 1]$. The gray-levels were binned into 8 buckets each of size 32. The neighboring pixel of (r, c) was the diagonal pixel at $(r' = r + 1, c' = c + 1)$.

1.1 Distance 1

Distance 1 was simply the squared Euclidean distance over the 5 classes of features:

$$d_1(\mathbf{x}, \mathbf{y}) = \|\mathbf{x} - \mathbf{y}\|_2^2. \tag{1}$$

For the vectors in Equation 1, the first coordinate is the volume, the colors are the next 3 entries, the centroid are the next 2 entries in the vector, the top, right, bottom, and left of the bounding box make the next 4 entries, and the normalized GLCM are the last 64 entries for a total of 74 features.

1.2 Distance 2

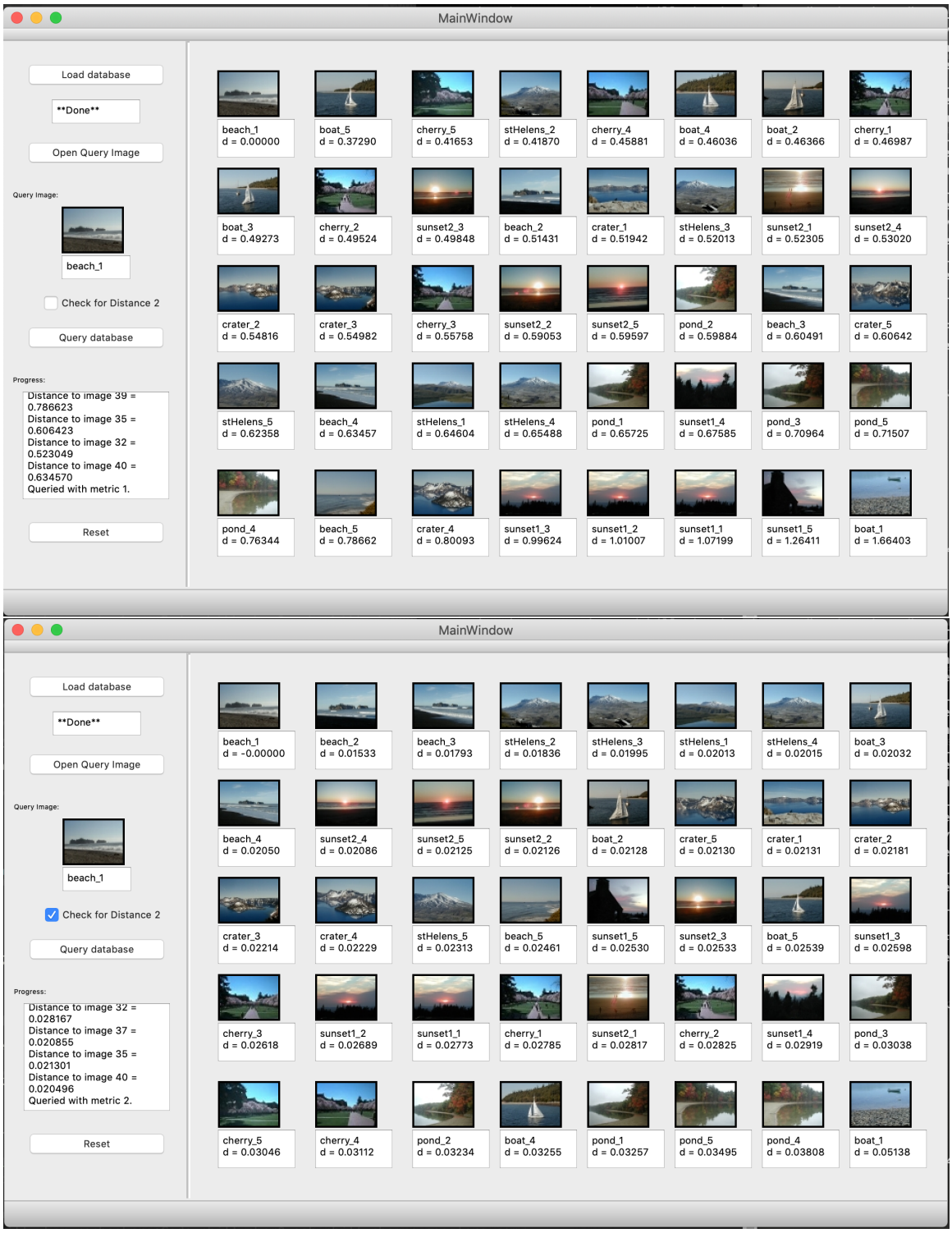
The secod distance function is more complex and uses several derived features.

$$d_2(\mathbf{x}, \mathbf{y}) = \tag{2}$$

[1] A random seed of 2020 was used for reproducibility.

2 Results

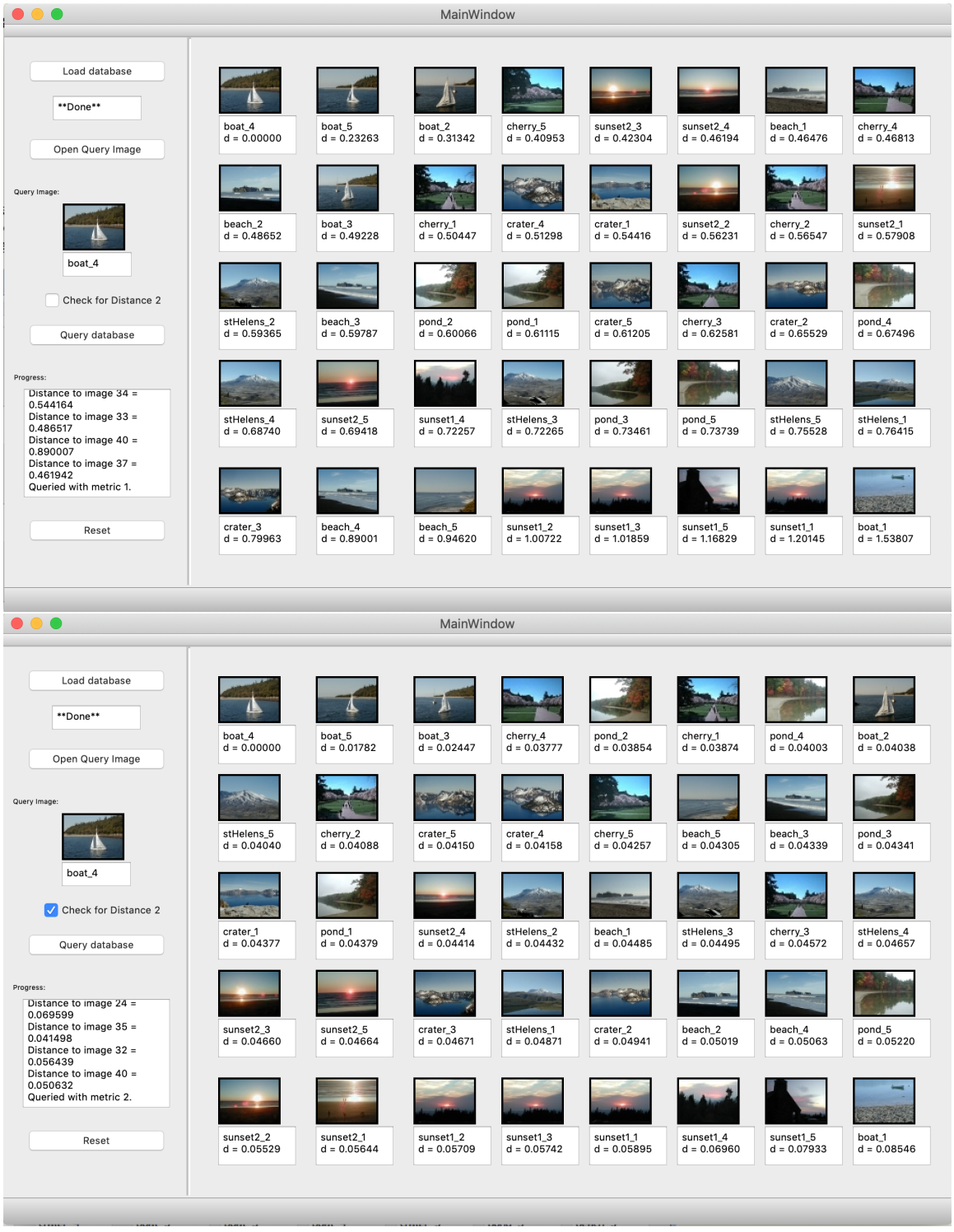
2.1 `Beach`



Query results for `beach_1.jpg`.

The beach queries proved challenging. Euclidean distance completely fails, while d_2 only manages to return 2/4 beach images.

2.2 Boat



Query results for `boat_4.jpg`.

d_1 and d_2 both return other boat images for their top two results. One might say that d_2 does slightly better since it has another boat result in the top row.

Appendix

All code used to generate these images can be found at `ppham27/cse576/hw3`. The embedded JPEG, PNG files, and the LaTeXcan be found in `ppham27/cse576/hw3/report`.