Euclidean Distance

The Euclidean distance is the vertical distance between two vectors of n-dimension, in n-space, where n is the number of components in the vector.

For example, vector is a 3-dimensional vector and is in 3-space. Each of the components in the vector determine the distance starting from the origin (the point *(0,0,0)*), on a Cartesian plane, and the tip of the vector lying on the point *(2,3,5)* The distance between two vectors is calculated using the Pythagorean Theorem, in n-space. In basic terms, it calculates the difference of each of the vector’s ith elements, squares them then sums them up. Once summed, the square-root of this value is the Euclidean distance. The formula for to calculate the Euclidean distance is:

**Example 1:** given two vectors **S** and **T**, where , the Euclidean distance is calculated as the following:

Two vectors (**S** and **T**), in any n-space, are said to be close when their Euclidean distance is close to 0. If , their Euclidean distance is 1. They lie in the same x-plane, the same y-plane, and only differentiate 1 unit in their z-plane.

cuACS and Euclidean Distance

In our cuACS matching algorithm, one of the components to determine how good a match, between a client and an animal is, is the Euclidean distance. Using the Euclidean distance, the algorithm calculates how far apart the two vectors lie, and uses the resulting figure, along with a number of other calculations and variables, to determine if it’s a good match.

As an example, each animal has a value for their attributes and each client has their own attribute values, both can be stored in a vector. In our cuACS algorithim, vectors using 14 elements are used in calculating the perfect match. For simplicity’s sake, let’s say we have an animal and a client with 5 attributes: *level of affection*; *level of fearfulness*; *level of energy*; *how it handles crowds* and; *level of messiness*. Each attribute is based off a 5-point scale, 1 being low and 5 being high. The resulting 5-demensional vector would lie in 5-space and would lie on 5 Cartesian planes. Here are our vectors for the animal **A** and client **C**.

The resulting Euclidean Distance is approximately 3.317 and suggests the animal-client pairing is a good match.

The resulting Euclidean Distance is approximately 7.000 and suggests the animal-client pairing is a **not** good match.

The perfect animal-client match would result in a Euclidean Distance of 0.000. This is the case when all the elements of 2 vectors are identical, regardless of the dimension size. Using the above 5-demensional vector, with values ranging from 1 to 5 for each vector element, the worst-case match would have a Euclidean Distance of approximately 8.944, it’s vectors are shown below.