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Suppose x = (1, 2, 3) and y = (2, 10, 6)

Q1. What is Euclidean length squared of x?

Q2. What is the value of x-y?

Q3. What is the dot product between x and y (xTy)?

Q4. What is the Euclidean length squared of x-y?

A1. 1**2 + 2**2 + 3**2 = 14

A2. (-1, -8, -3)

A3. 1*2 + 2*10 + 3*6 = 40

A4. x-y = (-1, -8 ,-3). ||x||**2 = -1**2 + -8**2 + -3**2

||x|| = sqrt(sum_i xi**2)

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u = (u1, u2, u3)

v = (v1, v2, v3)

||u – v||^2 = Σ_i (ui – vi)^2

A two dimensional matrix is a set of numbers organized in a two dimensional grid. For example

M shown below is a 2x3 matrix. The first number is the number of rows and second is number of columns.

3	4	10
2	20	19

We can multiply a nxm matrix by a mx1 vector as shown below. The answer will have dimensionality nx1. Below we have a 2x3 matrix multiplying a 3x1 vector and the answer will have dimensionality 2x1.

(3, 4, 10) (2) (3*2 + 4*4 + 10*5) (72)

(2, 20, 19) (4) = (2*2 + 20*4 + 19*5) = (179)

(5)

The transpose of a matrix is such that each row becomes a column. So if M is nxm then M^T is of dimension mxn. So the transpose of the matrix below

(3, 4, 10)

(2, 20, 19)

is given by

(3, 2)

(4, 20)

(19, 10)

The transpose of the matrix

(1, 2, 4, 1)

(1, 4, 6, 5)

(4, 5, 1, 5)

is

(1, 1, 4)

(2, 4, 5)

(4, 6, 1)

(1, 5, 5)

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w = (1, 2)

x = (x0, x1)

w0 = 4

$w^T x$ = (1, 2) * (x0) = 1*x0 + 2*x1 = x0 + 2x1

(x1)

Suppose the mean vector m = (m1, m2, m3)

Suppose x = (x1, x2, x3)

Then we can write the variance as $||x – m||^2 = \Sigma_i (xi – mi)^2$

Suppose we have four points in class 0

1 1

1 2

2 1

2 2

and four points in class 1

10 10

10 11

11 10

11 11

What are the means and variances of the two classes? For variance we need just the variance of each column.

m0 = (1.5, 1.5)

m1 = (10.5, 10.5)

v0 = (.25, .25)

v1 = (.25, .25)

These points below are in class 0.

-2 1

-1 1

0 1

1 1

2 2

And these are in class 1.

2 -2

1 -1

1 0

1 1

1 2

m0 = (0, 1.2)

m1= (1.2, 0)

v0 = (2, 0.16)

v1 = (0.16, 2)

Test data are

(-3, 1)

(1, 3)

To classify (-3, 1) calculate the weighted distance to each mean

Dist to m0 = (-3-0)**2/2 + (1-1.2)**2/0.16 = 9/2 + .04/0.16 = 4.5 + 1/4

Dist to m1 = (-3-1.2)**2/0.16 + (1-0)**2/2 = 16/0.16 + ½ = 100 + 1/2

Clearly distance to m0 is smaller but we can also reach this conclusion by ignoring the dimension with larger variance.

To classify (1, 3) calculate the weighted distance to each mean

Dist to m0 = (1-0)**2/2 + (3-1.2)**2/0.16 = 1/2 + 4/0.16 = .5 + 25

Dist to m1 = (1-1.2)**2/0.16 + (3-0)**2/2 = .04/0.16 + 9/2 = 1/4 + 4.5

Since distance to m1 is smaller we classify (1,3) as class 1. I can reach the same conclusion by ignoring the column with higher variance.