**CS 513-A Midterm exam: Q1 and Q7**

**1. Measure the distance between (0, 0, 0) and (1, 1, 1) using the following distance formula. Is the following function a proper distance function? Why? Explain your answer.**

Solution

Refer to the distance function properties,

* Property 1: Distance is always non-negative
* Property 2: Commutative, distance from “A to B” is distance from “B to A”
* Property 3: Triangle inequality holds, distance from “A to C” must be less than or equal to distance from “A to B to C”

Let the given points be, A(x1, x2, x3) = A(0, 0 ,0) and B(y1, y2, y3) = B(1, 1, 1)

From the above distance formula,

d(A, B) = (0 – 1)3 + (0 – 1)3 + (0 – 1)3 = -3

d(B, A) = (1 – 0)3 + (1 – 0)3 + (1 – 0)3 = 3

As the results, **the given distance function is not a proper distance function** because it does not satisfy the distance function properties.

d(A, B) = -3 : The result is negative, it does not satisfy the distance function property 1.

d(A, B) ≠ d(B,A) : The result does not satisfy the distance function property 2

**7. A COVID test was administered to 1,000,000 individuals. The test correctly identified 95% of those who were sick (P[positive/sick] = 0.95) but also produced a positive result for 10% of those who were not sick (P[positive/not sick] = 0.10). If the prevalence of COVID in this population is 20%, what is the probability that an individual who tested positive is actually sick? What is the probability that an individual who tested negative is actually sick?**

Solution

From the question, P(positive/sick) = 0.95, P(positive/not sick) = 0.10, and P(sick) = 0.2

**1) What is the probability that an individual who tested positive is actually sick?**

P(positive) = P(positive/sick) \* P(sick) + P(positive/not sick) \* P(not sick)

= 0.95 \* 0.2 + 0.1 \* (1 – 0.2)

= 0.27

**P(sick/positive)** = P(positive/sick) \* P(sick) / P(positive)

= 0.95 \* 0.2 / 0.27

**= 0.704 …..(Answer)**

**2)** **What is the probability that an individual who tested negative is actually sick?**

P(negative) = 1 - P(positive)

= 1 – 0.27

= 0.73

**P(sick/negative)** = P(negative/sick) \* P(sick) / P(negative)

= (1 – 0.95) \* 0.2 / 0.73

**= 0.014 …..(Answer)**