

MATH 525

Section 1.8 - Weight and Distance

August 31, 2020

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August 31, 2020

1 / 3

Weight and Distance

Definition

Let $v \in K^n$. The **Hamming weight** (or just weight) of v , denoted by $\text{wt}(v)$, is the number of its nonzero components.

For example, $\text{wt}(0111001) = 4$.

Definition

Let $v, w \in K^n$. The **Hamming distance** (or just distance) between v and w , denoted by $d(v, w)$, is the number of positions in which they disagree.

For example, $d(010101, 101001) = 4$.

Note that $d(v, w) = \text{wt}(v + w)$. Hence,

$$\phi_p(v, w) = p^{n-\text{wt}(u)} \cdot q^{\text{wt}(u)}$$

where $u = v + w$.

Section 1.8

August 31, 2020

2 / 3

The Hamming distance is a **metric**, that is, for all $u, v, w \in K^n$, one has:

- ① $d(v, w) = 0 \iff v = w$ (reflexive).
- ② $d(v, w) = d(w, v)$ (symmetric).
- ③ $d(v, w) \leq d(v, u) + d(u, w)$ (triangle inequality).