**Free Distance:**

The term "free distance" typically refers to the free distance of a linear code. The free distance is an important parameter that characterizes the error-correcting capability of a linear code.

**Free Distance of a Linear Code:**

Definition:

The free distance, denoted as df of a linear code is the minimum Hamming distance between any two distinct codewords in the code, excluding the all-zero codeword. In other words, it is the minimum number of bit positions in which two codewords can differ while still being considered distinct.

Importance:

The free distance is a crucial parameter in determining the error correction capability of a linear code. A larger free distance generally implies better error-correcting properties. It indicates the ability of the code to correct a certain number of errors or detect a greater number of errors in a received codeword.

**Error Correction:**

The free distance is related to the code's ability to correct errors. Specifically, if the free distance is

**Relationship with Minimum Distance:**

The free distance is always less than or equal to the minimum distance

The minimum distance includes the possibility of the all-zero codeword, while the free distance specifically excludes it.

**Applications:**

Understanding the free distance is crucial in the design and analysis of error-correcting codes. It helps code designers make informed decisions about the code's parameters, such as code rate and minimum distance, based on the desired error correction capabilities for a specific communication channel.

The free distance of a linear code is a measure of the minimum Hamming distance between non-zero codewords, providing valuable insights into the code's ability to correct errors in a noisy communication environment.

**Active Distance:**

In information theory and coding theory, the commonly used terms are "Hamming distance," "weight," and "distance."

Hamming Distance:

The Hamming distance between two equal-length strings of symbols is the number of positions at which the corresponding symbols differ. In the context of linear codes, the minimum Hamming distance is the smallest Hamming distance between any two distinct codewords in the code. It is a key parameter indicating the error-detecting and error-correcting capabilities of a code.

Weight of a Codeword:

The weight of a codeword in a linear code is the number of nonzero elements (symbols) in the codeword. There are different types of weights, such as Hamming weight and Manhattan weight, depending on the context. In Hamming weight, the weight is the number of non-zero components in the codeword.

Weight Distance:

The term "weight distance" is not a standard term in information theory or coding theory. However, there is a concept related to weights called "minimum weight," which refers to the smallest weight among all nonzero codewords in a linear code. The minimum weight is closely related to the minimum Hamming distance. The Hamming distance and weights of codewords are essential concepts. The minimum Hamming distance is a key parameter for error correction, and the weight of a codeword provides information about its structure.

weight enumerators and path enumerators are tools used to analyze and describe the properties of codes, especially linear block codes.