What is a Hash Function?

A hash function takes an input (or "key") and produces a fixed-size string of bytes that appears random. This output is usually a number, and it's called a hash code or hash value. The primary goal of a hash function is to map data to a specific location in a data structure (like a dictionary) where it can be quickly accessed.

How Does a Hash Function Work in a Dictionary?

1. **Mapping Keys to Indexes:**

   o When you insert a key-value pair into a dictionary, the hash function computes a hash value for the key.

   o This hash value determines the index (or position) in an underlying array where the key-value pair will be stored.

2. **Handling Collisions:**

   o Sometimes, two different keys can produce the same hash value (this is called a collision).

   o To handle collisions, dictionaries use techniques such as:

      ▪ **Chaining:** Each array index points to a linked list of key-value pairs. If multiple keys hash to the same index, they are stored in the linked list.

      ▪ **Open Addressing:** When a collision occurs, the algorithm searches for the next available slot in the array according to a probing sequence (like linear probing or quadratic probing).

3. **Retrieving Values:**

   o When you need to retrieve a value, the dictionary uses the hash function to compute the index for the given key.

   o It then searches at that index (and possibly in the linked list or through probing) to find the corresponding value.