Hash Tables

1. Give us super fast lookup.
   1. Useful in Spell Checkers
      1. Can quickly look up a word amongst tens of thousands of words in a second
   2. Building dictionaries
      1. Quickly look up a word and find its translation in another language.
   3. Compilers
      1. Compilers use hash tables to quickly look up the address of functions and variables.
   4. Code Editors
   5. **Used literally anywhere you want to look up an item super fast.**
2. Most if not all programming languages have support for Hash Tables but under different names
   1. Java = HashMap
   2. JavaScript = Object
   3. C# & Python = Dictionaries
3. Key/Value Pairs
   1. At a very high level, we use them to store key/value pairs.
   2. Example:
      1. List of employees and we want to quickly look up an employee by employee number.
      2. Each employee has a unique employee number, so we use the employee number as the key.
4. Hash Function
   1. HashTable takes the employee number
   2. Passes it to a Hash Function
   3. Hash Function tells where the employee object should be stored in memory.
   4. To look up the employee by their employee number
      1. Hash Table passes the number to the Hash Function to figure out where the employee object is stored.
   5. Hash Functions are Deterministic
      1. Deterministic means every time we give it the same input, it will return the same value.
      2. This is why we can use it for both storing and looking up objects.
5. Internally, a HashTable uses an array to store objects
6. Operations
   1. Insert – O(1)
   2. Lookup – O(1)
   3. Delete – O(1)
7. Null keys and null values (Sometimes they ask this in interviews)
   1. Hash Tables do allow for null keys and values although there isn’t really an application for this.