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In computer science, standardized mathematical systems for storing data are essential for linking bits—individual zeroes and ones—to meaningful concepts; throughout the 20th century, data structures were developed to realize this goal. Assuming they succeed in this objective, a data structure’s performance is typically evaluated according to two types of efficiency—time efficiency refers to its timeliness whereas space efficiency refers to the maximum number of bits it uses at one time. One of the most prolific data structures in the field is the Dictionary.

The Dictionary—often implemented as the HashMap—is a data structure that maps each element of one particular set of data, or keys, to an element of another, or values. For example, a Dictionary of grocery prices may associate, or map, “apple” to “\$5,” and “banana” to “\$4.” Importantly, while a Dictionary can simultaneously map both “orange” and “grapefruit” to “\$7,” it cannot associate “orange” to both “\$7” and “\$8.” This reflects the Dictionary’s fundamental design principle that each key corresponds to a single, unique value. The Dictionary is so powerful that its average lookup time remains roughly constant, regardless of the size of its key–value collection.

Computer scientists sometimes jokingly claim that the solution to all data-structure problems is simply to use a Dictionary. This contention arises from the fact that it can abstract away many other common types of data structures. For one, take the Set, an unordered collection of items that is useful for querying if a particular item is contained. Similarly, a Pair—two ordered values—can be reduced to a Dictionary by assigning keys such as “1” and “2” to the first and second elements, respectively.

Dictionaries are not perfect constructions. For one, they are not useful in many circumstances that other data structures are better suited for. Take, for instance, an interconnected social network. While a Dictionary could technically be molded to suit this purpose, other structures, like the Graph, more naturally and efficiently capture the relationships between nodes. Additionally, the Dictionary as used for its intended purpose still has inherent problems. It works by assigning each key a unique position in memory. If the computer runs out of memory, or the algorithm cannot provide a unique position, a “hash collision” occurs, which severely hinders efficiency. Indeed, it is often the case that a programmer needs to consider the tradeoffs between space and time efficiency before implementing their Dictionary. Nevertheless, despite these limitations, Dictionaries serve as a foundational data structure underlying many technologies that are now taken for granted.

1. The primary purpose of the passage is to:
 - a. Describe the technical details of the Dictionary data structure
 - b. Explain the advantages and limitations of Dictionaries in computer science.
 - c. Argue that dictionaries are superior to most other data structures.
 - d. Show that Graphs are more efficient than Dictionaries in some cases.
 - e. Explain how hash collisions occur

2. As used in the passage, the phrase “abstract away” (second sentence of the third paragraph) most nearly means:
 - a. eliminate the need to understand
 - b. replace in every possible circumstance
 - c. serve the same function as
 - d. make more difficult to interpret
 - e. obscure the purpose of

3. Which of the following represents the author’s attitude towards the Dictionary data structure?
 - a. The author views the Dictionary as a flawless and universally applicable tool.
 - b. The author considers the dictionary to be an important but imperfect data structure with practical limitations.
 - c. The author is skeptical about the usefulness of the Dictionary compared to other data structures.
 - d. The author believes the Dictionary will eventually come to replace all other types of data structures.
 - e. The author regards the Dictionary as purely theoretical with no applications in modern computing..

4. According to the passage, which of the following would be an example of an invalid Dictionary?
 - a. A Dictionary that maps unique student IDs to their (not necessarily unique) names
 - b. A Dictionary that maps each ISBN to a single book
 - c. A dictionary that maps "B+" to "Michael"
 - d. A dictionary that maps "Jordan" to both "delivery driver" and "barista"
 - e. A dictionary that maps "1" to "1"

5. Which of the following is most analogous to the function of a Dictionary?
 - a. A phone book that lists people's names alongside their phone numbers
 - b. A recipe book that groups ingredients by meal type
 - c. A calendar that schedules appointments by date and time
 - d. A filing cabinet that stores folders without labels
 - e. A map showing routes between multiple cities

6. Why does the author discuss Sets and Pairs in the third paragraph?
 - a. To show that all data structures can be represented as Dictionaries.
 - b. To argue that Sets and Pairs are unnecessary.
 - c. To argue that Dictionaries are inherently more useful than Sets and Pairs.
 - d. To describe the role of keys and values in the Dictionary.
 - e. To illustrate how Dictionaries can simulate other data structures.

Answers

1. b

2. c

3. b

4. d

5. a

6. e