

1. What are data structures, and why are they important?

Answer: Data structures are specific ways of organizing and storing data in a computer to allow for efficient access and modification. They are critical because they dictate the performance, memory usage, and scalability of software applications.

2. Explain the difference between mutable and immutable data types with examples.

Answer: Mutable data types can be modified after they are created (e.g., lists and dictionaries), whereas immutable data types cannot be changed once defined (e.g., strings and tuples).

3. What are the main differences between lists and tuples in Python?

Answer: Lists are mutable, meaning you can add, remove, or change elements, and are defined with square brackets []. Tuples are immutable, meaning their content cannot change, and are defined with parentheses () .

4. Describe how dictionaries store data.

Answer: Dictionaries store data in key-value pairs, where each unique key maps to a specific value.

5. Why might you use a set instead of a list in Python?

Answer: You would use a set to ensure all elements are unique and to perform fast membership testing or mathematical set operations like unions and intersections.

6. What is a string in Python, and how is it different from a list?

Answer: A string is a sequence of characters used to represent text. The primary difference is that strings are immutable, while lists are mutable.

7. How do tuples ensure data integrity in Python?

Answer: Tuples ensure data integrity because they are immutable; once data is stored in a tuple, it cannot be accidentally changed or overwritten during the execution of a program.

8. What is a hash table, and how does it relate to dictionaries in Python?

Answer: A hash table is the underlying data structure used by Python dictionaries to map keys to values efficiently, allowing for very fast data retrieval.

9. Can lists contain different data types in Python?

Answer: Yes, Python lists are heterogeneous, meaning they can contain a mix of different data types like integers, strings, and floats within the same list.

10. Explain why strings are immutable in Python.

Answer: Strings are immutable to ensure consistency in memory, improve performance through string interning, and provide security when strings are used as keys in dictionaries or for system resources.

11. What advantages do dictionaries offer over lists for certain tasks?

Answer: Dictionaries offer significantly faster data retrieval when you have a specific identifier, as they do not require iterating through the entire collection like a list does.

12. Describe a scenario where using a tuple would be preferable over a list.

Answer: A tuple is preferable for storing fixed data that should never change, such as the coordinates of a location (latitude, longitude) or a set of constant configuration settings.

13. How do sets handle duplicate values in Python?

Answer: Sets automatically remove or ignore duplicate values; every element in a set must be unique.

14. How does the "in" keyword work differently for lists and dictionaries?

Answer: For lists, the in keyword checks every element one by one (linear search), while for dictionaries, it checks if a key exists using a hash table, which is much faster.

15. Can you modify the elements of a tuple? Explain why or why not.

Answer: No, you cannot modify elements of a tuple because they are immutable by design to protect data integrity.

16. What is a nested dictionary, and give an example of its use case?

Answer: A nested dictionary is a dictionary where the values are themselves dictionaries. A use case is a database of students where each student's name is a key, and the value is another dictionary containing their grades and attendance.

17. Describe the time complexity of accessing elements in a dictionary.

Answer: The average time complexity for accessing an element in a dictionary is generally O(1), or constant time.

18. In what situations are lists preferred over dictionaries?

Answer: Lists are preferred when the order of elements matters, when you need to store duplicate values, or when you simply need a sequential collection of items.

19. Why are dictionaries considered unordered, and how does that affect data retrieval?

Answer: Historically, dictionaries were considered unordered because they prioritized mapping keys to values via hashing rather than maintaining a specific sequence. This means data is retrieved by its key rather than its position in the structure.

20. Explain the difference between a list and a dictionary in terms of data retrieval.

Answer: Data in a list is retrieved using a numerical index (position), whereas data in a dictionary is retrieved using a unique key.