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

Data structures are specialized formats for organizing, processing, and storing data. They enable efficient data access and modification, which is crucial for optimizing performance in software development and data analysis.

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

Property	Mutable	Immutable
Definition	Can be changed after creation	Cannot be changed after creation
Examples	Lists ([]), Dictionaries ({}), Sets ({})	Tuples (()), Strings (" "), Integers (1)
Use Cases	When data needs to be modified	When data should remain constant

Mutable types allow in-place modifications, while immutable types require creating new objects for changes.

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

Feature	List	Tuple
Syntax	[]	()
Mutability	Mutable	Immutable
Duplicates	Allowed	Allowed
Performance	Slower due to mutability	Faster due to immutability
Use Cases	When data needs to change	When data should remain constant

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4. Describe how dictionaries store data.

Dictionaries in Python store data as key-value pairs. Each key is unique and maps to a corresponding value. Dictionaries are implemented using hash tables, allowing for fast lookups, insertions, and deletions.

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

Use a set when:

- You need to ensure all elements are unique.
- Order doesn't matter.
- You require efficient membership tests and set operations (union, intersection, etc.)

Sets are implemented using hash tables, providing average-case constant time complexity for lookups.

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

A string is an immutable sequence of characters, whereas a list is a mutable collection of items. Strings support operations like slicing and indexing but do not allow modification of individual characters. Lists allow modification of elements, addition, and removal of items.

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7. How do tuples ensure data integrity in Python?

Tuples are immutable, meaning once created, their contents cannot be changed. This immutability ensures that data stored in tuples remains constant, providing data integrity, especially when used as keys in dictionaries or elements in sets.

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

A hash table is a data structure that maps keys to values using a hash function. Dictionaries in Python are implemented using hash tables, allowing for average-case constant time complexity for lookups, insertions, and deletions.

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9. Can lists contain different data types in Python?

Yes, lists in Python can contain elements of different data types, including integers, strings, and other lists. This flexibility allows for the creation of complex data structures.

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10. Explain why strings are immutable in Python.

Strings are immutable to ensure data integrity and performance optimization. Immutability allows strings to be stored in a way that can be shared safely across different parts of a program without the risk of unintended modifications.

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

Dictionaries provide:

- Fast lookups by key.
- Efficient insertion and deletion of key-value pairs.
- Ability to associate values with unique keys, making data retrieval more intuitive.

These features make dictionaries preferable when you need to map relationships between data.

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

Use a tuple when:

- The data should remain constant and not be modified.
- The data will be used as keys in a dictionary or elements in a set.
- Performance is a concern, as tuples are faster than lists due to their immutability.

For example, representing geographic coordinates as tuples ensures the data cannot be altered accidentally.

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13. How do sets handle duplicate values in Python?

Sets automatically remove duplicate values. If you attempt to add a duplicate item, the set will ignore it, ensuring that all elements are unique.

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

In a list, the `in` keyword checks for the presence of an element. In a dictionary, it checks for the presence of a key.

Example:

python

```
my_list = [1, 2, 3]
my_dict = {'a': 1, 'b': 2}

print(2 in my_list)   # True
print('a' in my_dict) # True
```

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

No, tuples are immutable. Once a tuple is created, its elements cannot be changed, added, or removed. This immutability ensures data integrity and allows tuples to be used as keys in dictionaries or elements in sets.

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

A nested dictionary is a dictionary where the value associated with a key is another dictionary. This structure allows for the representation of hierarchical data.

Example:

Python

```
student = {
    'name': 'Anamika',
    'grades': {'math': 90, 'science': 85}
}
```

Use case: Storing student information, where each student has a name and a set of grades.

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

Accessing elements in a dictionary by key has an average-case time complexity of O(1), meaning it takes constant time. This efficiency is due to the underlying hash table implementation.

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18. In what situations are lists preferred over dictionaries?

- The order of elements matters.
- You need to store multiple items, possibly of different types.
- You require indexing and slicing operations.

For example, storing a sequence of events in chronological order would be best represented by a list.

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

Dictionaries are considered unordered because, prior to Python 3.7, the insertion order of key-value pairs was not guaranteed. However, starting from Python 3.7, dictionaries maintain insertion order. This means that while the order of keys is preserved, dictionaries are still optimized for fast lookups by key rather than by position.

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

In a list, data is retrieved by index, which is an integer representing the position of an element. In a dictionary, data is retrieved by key, which can be of any immutable data type.

Example:

Python

```
my_list = [10, 20, 30]
my_dict = {'a': 10, 'b': 20, 'c': 30}

print(my_list[1])     # 20
print(my_dict['b'])   # 20
```