

Python Interview Questions

Comprehensive Interview Guide: Beginner to Expert

1. Core Python & Memory Management

What is Python?

Python is a high-level, interpreted, and general-purpose programming language. It is known for its simple syntax, readability, and vast library support for Web Development, Data Science, and AI.

Difference between 'is' and '=='

- '==' checks for value equality (do the objects hold the same data?).
- 'is' checks for reference equality (do both variables point to the exact same memory location?).

Explain Mutable Default Arguments.

If a mutable object (like a list) is used as a default argument in a function, it is created only once when the function is defined. Subsequent calls reuse this object, leading to unexpected behavior (e.g., a list keeping values from previous calls).

Deep Copy vs Shallow Copy

- Shallow Copy: Creates a new object but inserts references into it to the objects found in the original.
- Deep Copy: Creates a new object and recursively adds copies of nested objects found in the original (using the `copy` module).

How is memory managed in Python?

Python uses a private heap space. Memory management is handled by the Python Memory Manager. It primarily uses Reference Counting (deallocating objects when references drop to zero) and a Cyclic Garbage Collector to handle reference cycles.

2. Advanced Data Structures

How does a Dictionary work internally?

Dictionaries use a Hash Table. Keys are hashed using a hash function to determine the index where the value is stored. In modern Python (3.7+), dictionaries are also ordered by insertion.

List Comprehension vs Generator Expression

- List Comprehension: Creates the entire list in memory immediately. Syntax: `[x for x in data]`.
- Generator Expression: Returns a generator object that yields items one by one (lazy evaluation), saving memory. Syntax: `(x for x in data)`.

What is the difference between List and Tuple?

- List: Mutable, slower, consumes more memory. Defined with `[]`.
- Tuple: Immutable, faster, hashable (can be used as dict keys). Defined with `()`.

Explain `zip()` and `enumerate()`

- `zip()`: Aggregates elements from multiple iterables into tuples.
- `enumerate()`: Adds a counter to an iterable and returns it as an enumerate object (index, value).

3. Object-Oriented Programming (OOP) - Deep Dive

What is MRO (Method Resolution Order)?

MRO determines the order in which Python searches for a method in a class hierarchy. Python uses the C3 Linearization algorithm. You can view it via `ClassName.__mro__`.

Difference between `@staticmethod` and `@classmethod`

- `@staticmethod`: Does not take `self` or `cls` as the first argument. Behaves like a regular function inside a class.

- `@classmethod`: Takes `cls` as the first argument. Can access and modify class state.

What is `__new__` vs `__init__`?

- `__new__`: A static method responsible for creating a new instance. It runs *before* `__init__`.
- `__init__`: An instance method responsible for initializing the created instance.

What are Abstract Base Classes (ABC)?

ABCs define a blueprint for other classes. They cannot be instantiated and often contain abstract methods that subclasses must implement. Used via the `abc` module.

What is the use of `__slots__`?

`__slots__` restricts the attributes an object can have to a fixed set. It saves memory by preventing the creation of a `__dict__` for each instance.

4. Advanced Python Concepts

Explain Context Managers and the `with` statement.

Context managers handle resource management (setup and teardown). The `with` statement ensures `__enter__` is called at the start and `__exit__` is called at the end, even if exceptions occur (e.g., closing files automatically).

What are Decorators?

Decorators are functions that take another function as an argument and extend its behavior without explicitly modifying it. They are applied using the `@` syntax.

What is the GIL (Global Interpreter Lock)?

The GIL is a mutex that allows only one thread to hold the control of the Python interpreter. This means CPU-bound multi-threaded programs may not run in parallel, though I/O-bound tasks still benefit.

Multithreading vs Multiprocessing

- Multithreading: Uses threads within a single process. Shared memory space. Limited by GIL.
- Multiprocessing: Uses separate processes. Separate memory space. Bypasses GIL, allowing true parallelism on multi-core CPUs.

What is Monkey Patching?

Monkey patching is the dynamic replacement of attributes or methods of a class/module at runtime. It is often used in testing to mock behavior.

5. General & Tricky Questions

What does `if __name__ == '__main__':` do?

It checks if the script is being run directly or imported as a module. If run directly, the code inside the block executes. If imported, it does not.

What are `*args` and `**kwargs`?

- `*args`: Allows passing a variable number of non-keyword arguments (tuple).
- `**kwargs`: Allows passing a variable number of keyword arguments (dictionary).

Difference between `.py` and `.pyc` files

`.py` contains the source code. `.pyc` contains compiled bytecode, which is generated to speed up loading times on subsequent runs.