

Python Interview Topics and Coding Problems

1. Data Structures and Algorithms (DSA)

- Arrays/Lists: Find the missing number in a list of size $n-1$ containing distinct numbers from 1 to n .
- Strings: Check if a string is a palindrome, ignoring non-alphanumeric characters and case.
- Dictionaries (Hash Maps): Find the first non-repeating character in a string using a dictionary.
- Sets: Return the list of unique elements from two lists (union and intersection).
- Linked Lists: Detect if a linked list has a cycle (Floyd's cycle detection).
- Stacks: Implement a stack that supports push, pop, top, and retrieving the minimum element in constant time.
- Queues: Implement a queue using two stacks.
- Trees: Given a binary tree, return its inorder traversal without recursion.
- Graphs: Find if a path exists between two nodes in an undirected graph (using BFS).
- Sorting Algorithms: Implement merge sort on an array.
- Searching Algorithms: Perform binary search on a sorted array to find a target.
- Dynamic Programming: Climbing stairs: How many distinct ways to climb n stairs?

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2. Basic Python Fundamentals

- Data Types: Swap the keys and values in a dictionary.
- Operators: Count how many numbers between 1 and 100 are divisible by both 3 and 5.
- Control Flow: FizzBuzz from 1 to 100.
- Functions: Function accepting *args and **kwargs and printing them.
- List and Dictionary Comprehensions: Square all even numbers in a list.
- Mutability vs. Immutability: Show mutability with a list inside a function.
- Scope: Use nonlocal to modify a variable in the enclosing scope.
- Error Handling: Safe division with try/except block.
- File Handling: Read file and count lines containing a keyword.

3. Object-Oriented Programming (OOP)

- Classes and Objects: Create a Dog class with name and breed attributes.
- Methods: Add a bark() method to Dog class.
- Inheritance: Create a GuideDog subclass of Dog with guide() method.

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- Polymorphism: Define move() method in Car and Boat classes.
- Encapsulation: Use private attributes with getters/setters.
- __init__ Method: Initialize Dog object with constructor.

4. Common Python Libraries

- Pandas: Load CSV and return top 5 rows where a column value > threshold.
- NumPy: Create 3x3 random integer matrix between 0-10.
- String Manipulation (re): Extract email addresses using regex.
- Collections: Count word frequencies using collections.Counter.
- Itertools: Generate all possible pairs of a list.

5. Concurrency and Parallelism

- Threads vs Processes: Example of when to use threading vs multiprocessing.
- threading module: Create 3 threads printing numbers 1-10.
- multiprocessing module: Parallelize square numbers 1-100.
- Synchronization Primitives: Synchronize shared counter with Lock.

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- Race Conditions and Deadlocks: Demonstrate and fix with Lock.
- Asynchronous Programming: Async fetch data using asyncio and aiohttp.

6. System Design Basics

- Scalability (Horizontal vs Vertical): Scale web app serving 1M users.
- Load Balancing: Design simple load balancer between 2 servers.
- Caching: Build in-memory cache with 5 min invalidation.
- API Design (RESTful): CRUD operations for a task manager.