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**DATA STRUCTURES USED IN OPERATING SYSTEMS**

**Introduction**

An Operating System (OS) acts as a bridge between the hardware of a computer and its users. To perform tasks like memory management, process scheduling, and file organization efficiently, it uses various data structures. These structures are crucial for the internal operation of the OS and help in organizing and managing system resources effectively.  
  
Some of the most commonly used data structures in operating systems include queues, stacks, trees, hash tables, and linked lists. Each plays a vital role in ensuring smooth and efficient functioning of different OS components.

**Common Data Structures and Their Applications in OS**

**1. Queue**

Used in: Process Scheduling (e.g., Round-Robin Scheduling)  
Description: A queue follows the First In First Out (FIFO) method. Tasks waiting to be processed are added at the end and executed in the order they were added.  
Example: Ready queue in CPU scheduling holds all the processes that are ready to execute.

**2. Stack**

Used in: Handling system calls and recursive function calls  
Description: A stack follows the Last In First Out (LIFO) method. It's used to keep track of function calls and return addresses.  
Example: The call stack stores function calls and local variables.

**3. Linked List**

Used in: Managing memory (like free space and process queues)  
Description: Linked lists help in dynamically allocating and deallocating memory, making them suitable for memory management.  
Example: Maintaining the list of free memory blocks or active processes.

**4. Tree**

Used in: File systems, device management  
Description: Hierarchical data structures like trees help in organizing data in a tree-like fashion.  
Example: Directory structures in a file system are maintained using tree data structures.

**5. Hash Table**

Used in: File systems, address translation  
Description: A hash table allows fast data retrieval using a key.  
Example: Page tables in memory management use hashing for quick page lookups.

**6. Bitmap**

Used in: Disk management  
Description: A bitmap uses bits to keep track of memory or disk blocks. It provides a compact and efficient way to manage resources.  
Example: Keeping track of used and free disk sectors.

**Real-Time Example: Process Scheduling using Queues**

In multitasking operating systems, multiple processes are executed in parallel. To manage which process should run and when, the OS uses a ready queue. Here’s how it works:  
  
1. Process Arrival: A new process is created and enters the ready queue.  
  
2. Scheduler Selection: The CPU scheduler selects a process from the queue based on a scheduling algorithm.  
  
3. Execution: The selected process runs, while others wait.  
  
4. Re-entering Queue: If not completed, the process re-enters the queue after a fixed time.  
  
This system ensures fair and efficient CPU utilization, thanks to the queue data structure.

**Conclusion**

Data structures are essential to the design and functioning of operating systems. From managing memory to scheduling processes and organizing files, every critical OS operation relies on efficient data structures. Understanding these helps in grasping how operating systems perform complex tasks quickly and reliably.

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