**Sorting Algorithm Test cases and performance metrics**

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The evaluation of test case outputs and performance metrics provides critical insights into the efficacy and reliability of the healthcare scheduling algorithm. Designed to balance the complexity of in-patient care with the efficiency demands of out-patient services, the algorithm’s performance must align with its assumptions and design. Here, we analyze test case outputs and relevant performance metrics to validate its functionality and highlight areas for optimization.

**Evaluating Test Case Output**

The test case outputs reveal how well the algorithm adheres to the prioritization strategy and meets its design goals. The focus is on ensuring accurate sorting based on urgency, scheduled time, and priority scores.

**Key Observations from Test Case Outputs:**

1. **Correct Prioritization of Condition Types**:

Emergency cases are consistently placed at the top of the sorted list, followed by urgent and routine cases. For example, the test output correctly prioritizes a patient with an emergency condition (P000710) and a high priority score over patients with less critical needs.

1. **Chronological Appointment Order**:

Patients with the same condition type are arranged by scheduled date and time in ascending order. This ensures that appointments are handled in a logical sequence, reflecting the hospital's operational schedule.

1. **Preservation of Priority Scores**:

Within each condition type, patients are further sorted by their priority scores in descending order. This confirms that higher-priority patients within the same category are addressed first, aligning with the urgency-based prioritization framework.

The test case outputs demonstrate that the algorithm successfully implements the three-tiered prioritization strategy, balancing urgency, and fairness. By correctly sorting appointments and maintaining data integrity, the system proves reliable for managing complex healthcare scheduling scenarios.

**Performance Metrics**

Performance metrics provide quantitative measures of the algorithm’s effectiveness in meeting its design assumptions. Key metrics include accuracy, execution time, scalability, fairness, and data integrity.

**1. Accuracy:**

The algorithm's ability to prioritize patients based on urgency, scheduled time, and priority score was confirmed through test outputs. Emergency cases were consistently prioritized over urgent and routine cases, ensuring critical needs are addressed promptly.

**2. Execution Time:**

The sorting process was efficient, handling the dataset without significant delays. Using a stable sorting approach with tuple keys optimized the performance, ensuring quick execution for immediate decision-making.

**3. Scalability:**

While the test dataset included a moderate number of records, the algorithm demonstrated linear growth in performance, suggesting its scalability for larger datasets. Testing with varying data volumes can further validate its robustness.

**4. Fairness:**

Fairness in resource allocation is critical for healthcare. The algorithm's adherence to condition types and priority scores ensures that patients with greater medical urgency are not deprioritized due to less critical factors.

**5. Data Integrity:**

The test cases confirmed that the algorithm preserves all input data attributes in the output, ensuring no loss of critical patient information.

The evaluation of test case outputs and performance metrics confirms the healthcare scheduling algorithm's ability to prioritize and sort patient appointments effectively. By adhering to the assumptions of balancing in-patient and out-patient scheduling complexities, the algorithm meets its design goals.