

Online Algorithms

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1. Definition

- Algorithms that must make decisions sequentially, processing input piece by piece, without knowledge of future input.

2. Contrast with Offline Algorithms

- Offline algorithms have access to the entire input in advance and can plan optimally; online algorithms must commit to decisions immediately.

3. Competitive Analysis

- Measures how an online algorithm's performance compares to the optimal offline algorithm, expressed as a "competitive ratio."

4. Classic Examples

- **Caching/paging algorithms:** deciding which items to evict from limited cache memory without knowing future access patterns.
- **The Ski Rental Problem:** deciding whether to rent or buy equipment without knowing how long it will be needed.

5. Real-World Relevance

- Online algorithms model many practical situations: stock trading decisions, real-time resource allocation, and web caching, where future information simply isn't available.

6. Why It Matters

- Since real systems rarely have complete future information, understanding online algorithms is essential for designing practical, real-time systems.