Monotonic Queue / Deque Pack — Cheat Sheet

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Files:
  1) sliding_window_max.py — classic O(n) sliding maximum with a decreasing deque.
  2) shortest_subarray_at_least_k.py — prefix sums + increasing deque to get shortest subarray ≥ K.
  3) constrained_subsequence_sum.py — DP with window-k max via decreasing deque.
  4) monotonic_queue_template.py — reusable class for sliding extremes patterns.

Core Patterns:
  • Decreasing deque (max): pop back while new >= back; front is the maximum.
  • Increasing deque (min or prefix): pop back while new <= back; front is the minimum.
  • Window management: drop front if it falls out of range (index ≤ i - k).
  • Prefix-sum trick: shortest subarray with sum ≥ K uses increasing P[i].

Complexity:
  • All listed algorithms are O(n) time, because each index/value enters and leaves the deque at most once.
  • Space is O(k) for fixed windows, O(n) for prefix-based scans.

Tips:
  • Store indices when you need window eviction or to map back to values.
  • Store (value, index) pairs when building DP-based monotonic queues.
  • Guard popping conditions carefully to avoid off-by-one errors.