tags: - cocubes - coding - dsa

Coding Pattern Catalog

1. Linear scan

Use when you need sum, min, max, count, existence or first position.

Time O(n), extra space O(1).

Examples: largest array element, count evens, sum of cards.

2. Frequency map

Use a hash map/dictionary for counts or matching values.

Time O(n) average, space O(n).

Examples: first non-repeating character, duplicate detection, two-sum, anagram check.

3. Sorting

Sort when order makes the problem simple.

Time usually O(n log n).

Examples: remove duplicates, merge intervals, two pointers on a sorted array, closest pair.

4. Two pointers

Usually one pointer at each end, or a slow/fast pair.

Examples:

- palindrome string;
- pair sum in sorted array;
- remove duplicates in sorted array;
- cycle detection in linked list using slow/fast pointers.

5. Sliding window

Maintain a contiguous range with left and right pointers.

Examples: maximum sum subarray of size k, longest substring with a constraint.

6. Prefix sum

Precompute cumulative sums so a range sum is O(1).

prefix[i] = sum of elements before i, depending on indexing convention.

Examples: range-sum queries, count subarrays with target sum plus frequency map.

7. Stack

Examples: balanced brackets, next greater element, expression evaluation.

For balanced brackets: push opens; on close, top must be matching open; stack must be empty at end.

8. Binary search

Use for sorted data or monotonic answer space.

Invariant method:

- maintain left/right valid bounds;
- calculate middle safely;
- decide which half cannot contain answer;
- update one bound, guaranteeing progress.

9. Recursion/backtracking

Use only if input limits are small or the problem naturally branches. Always write base case first.

10. Matrix/grid traversal

Use direction arrays for four neighbours. Check boundaries before accessing. BFS handles shortest unweighted grid paths; DFS handles exploration/components.

Pattern selection guide

Phrase in problem	First pattern to consider
count/frequency/duplicate	hash map
contiguous subarray/substring	sliding window or prefix sum
sorted array/pair	two pointers or binary search
matching brackets	stack
minimum/maximum repeatedly	heap

Phrase in problem	First pattern to consider
shortest steps in unweighted grid	BFS
simple numeric digits/power	modulo/cycle

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