Week 17 Summary: Randomized, Parallel Algorithms, and Course Synthesis

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1. Randomized and Parallel Algorithmic Paradigms

Randomized algorithms (randomized Quicksort, Quickselect, Monte Carlo π estimation, Bloom filters) avoid adversarial worst cases or bound error with high probability. Parallel algorithms (Blelloch prefix scan) separate total work $W(n)$ from longest-path span/depth $D(n) = O(\log n)$.

2. Complete Z5007 Algorithm Selection Guide

Problem Regime	Recommended Structure / Algorithm	Complexity
Dynamic ordered dictionary	AVL Tree	$O(\log n)$ worst-case search/edit
Fast unordered key lookup	Hash table (chaining / linear probing)	$O(1)$ expected
Priority queue / stream top-k	Binary Heap	$O(\log n)$ push/pop, $O(n)$ build
Unweighted / weighted shortest path	BFS / Dijkstra ($w \geq 0$) / Bellman-Ford	$O(V+E)$ / $O((V+E)\log V)$ / $O(VE)$
Minimum spanning backbone	Kruskal (DSU) or Prim (Min-Heap)	$O(E \log E)$ / $O((V+E)\log V)$
Optimal subset / alignment	0/1 Knapsack, LCS, Edit Distance (DP)	$O(nW)$ / $O(mn)$