Quiz 2 Review

Scope

- Quiz 1 material fair game but explicitly **not emphasized**
- 6 lectures on graphs, L09-L14, 3 Problem Sets, PS5-PS7

Graph Problems

- Graph exploration, count connected components via Full BFS or Full DFS
- Topological sort / Cycle detection via DFS
- Negative weight cycle detection via Bellman-Ford
- Single Source Shortest Paths (SSSP) via relaxation framework

Restrictions		SSSP Algorithm		
Graph	Weights	Name	Running Time $O(\cdot)$	How it works
DAG	Any	DAG Relaxation	$\lvert V\rvert + \lvert E\rvert$	Relax in topological order
General	Unweighted	BFS	$\lvert V\rvert + \lvert E\rvert$	Relax level by level
General	Nonnegative	Dijkstra	$\lvert V\rvert \log \lvert V\rvert + \lvert E\rvert$	Relax in priority order
General	Any	Bellman-Ford	$\lvert V\rvert\lvert E\rvert$	Relax in $\lvert V\rvert$ rounds

- All Pairs Shortest Paths (APSP)
  - Run a SSSP algorithm $|V|$ times
  - Johnson's solves APSP with negative weights in $O(|V|^2 \log |V| + |V||E|)$ time

Graph Problem Strategies

- Be sure to **explicitly describe a graph** in terms of problem parameters
- Convert problem into finding a shortest path, cycle, topo. sort, conn. comps., etc.
- May help to duplicate graph vertices to encode additional information
- May help to add auxiliary vertices/edges to graph