

Time Complexity

Adjacency Lists

Pros

- Space-efficient when a graph is sparse
- Can be modified to support many graph variants
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Complexity

Space $\Theta(V^2)$

Time $\Theta(1)$

Checking if an edge $(u, v) \in G$ takes $\Theta(1)$

Listing all neighbors of a vertex takes $\Theta(V)$

Listing all edges takes $\Theta(V^2)$

| | Space | Edge Check | List all neighbors | List all edges |
|------------------|-----------------|-----------------------|----------------------------|-----------------|
| Adjacency List | $\Theta(E + V)$ | $O(\text{degree}(u))$ | $\Theta(\text{degree}(u))$ | $\Theta(E + V)$ |
| Adjacency Matrix | $\Theta(V^2)$ | $\Theta(1)$ | $\Theta(V)$ | $\Theta(V^2)$ |

Adjacency list representation is suited to sparse graphs ($E \ll V^2$)

Adjacency matrix representation is suited to dense graphs $E \approx V^2$