

I ILLINOIS

Graph Implementation

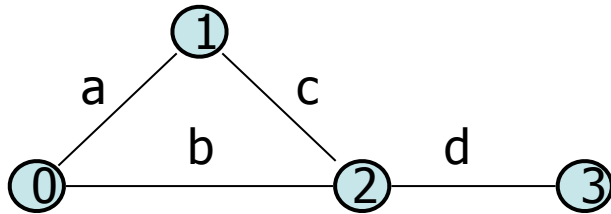
Learning Objectives

1. Compare and Contrast when to use different Graph Implementations



Graph Implementation - Edge List

$G = (V, E), |V| = n, |E| = m$



0	0	1	a
1	0	2	b
2	1	2	c
3	2	3	d

insertVertex(K key); - $O(1)$

insertEdge(Vertex v1, Vertex v2, K key); - $O(1)$

removeVertex(Vertex v); - $O(m)$

removeEdge(Vertex v1, Vertex v2); - $O(m)$

incidentEdges(Vertex v); - $O(m)$

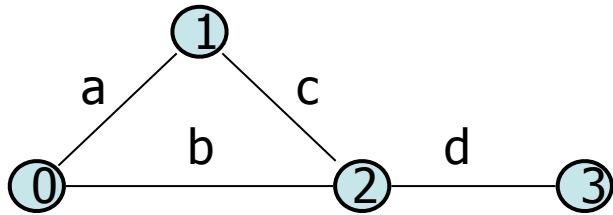
areAdjacent(Vertex v1, Vertex v2); - $O(m)$

Vertices Edges



Graph Implementation - Adjacency Matrix

$$G = (V, E), |V| = n, |E| = m$$



0
1
2
3

0	1	a
0	2	b
1	2	c
2	3	d

	0	1	2	3
0				
1				
2				
3				

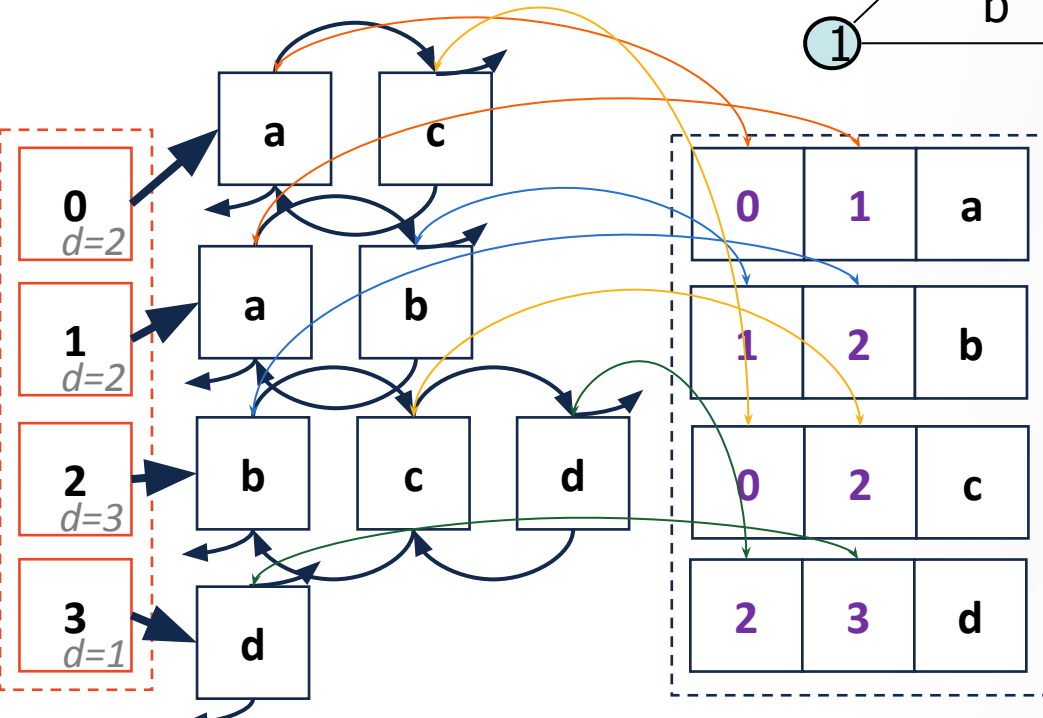
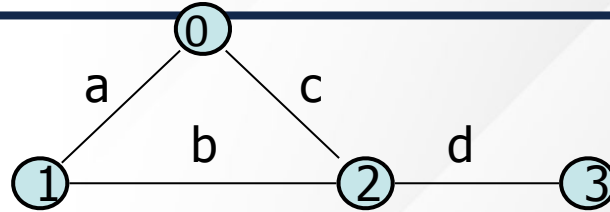
insertVertex - $O(n)$
insertEdge - $O(1)$
removeVertex - $O(n)$
removeEdge - $O(1)$
incidentEdges - $O(n)$
areAdjacent - $O(1)$

Vertices Edges



Graph Implementation - Adjacency List

$G = (V, E), |V| = n, |E| = m$



insertVertex - $O(1)$

insertEdge - $O(1)$

removeVertex - $O(\deg(v))$

removeEdge - $O(\min(\deg(v1), \deg(v2)))$

incidentEdges - $O(\deg(v))$

areAdjacent - $O(\min(\deg(v1), \deg(v2)))$



Summary

	EdgeList	AdjacencyMatrix	Adjacency List
Space	$O(n+m)$	$O(n^2 + m)$	$O(n+m)$
InsertVertex	$O(1)$	$O(n)$	$O(1)$
InsertEdge	$O(1)$	$O(1)$	$O(1)$
RemoveVertex	$O(m)$	$O(n)$	$O(\deg(v))$
RemoveEdge	$O(m)$	$O(1)$	$O(\min(\deg(v1), \deg(v2)))$
incidentEdges	$O(m)$	$O(n)$	$O(\deg(v))$
AreAdjacent	$O(m)$	$O(1)$	$O(\min(\deg(v1), \deg(v2)))$
Applications	Storing	Static, Connected	Traversals

