CS 225

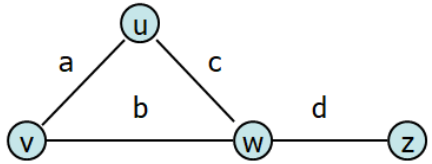
#34: Graph Implementation

April 13 2018 · *Wade Fagen-Ulmschneider*

Graph Implementation #1: Edge List

- HashTable storage of our vertex set
- List storage of our edge set
- O(1) runtime: insertVertex
- O(m) runtime: removeVertex, areAdjacent, and incidentEdges

Graph Implementation #2: Adjacency Matrix



Vert.	Edges	Adj. Matrix

u
v
w
z

		a
		b
		c
		d

	u	v	w	z
u				
v				
w				
z				

Operations on an Adjacency Matrix:

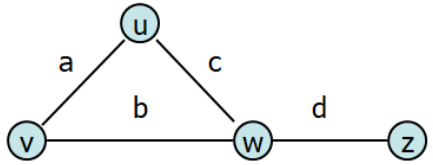
insertVertex(K key):

removeVertex(Vertex v):

areAdjacent(Vertex v1, Vertex v2):

incidentEdges(Vertex v):

Graph Implementation #3: Adjacency List



Vertex List	Edges

u
v
w
z

		a
		b
		c
		d

Operations on an Adjacency List:

insertVertex(K key): O(1)

removeVertex(Vertex v): O(deg(v))

areAdjacent(Vertex v1, Vertex v2): min(deg(v1), deg(v2))

incidentEdges(Vertex v): O(deg(v))

Running Times of Classical Graph Implementations

	Edge List	Adj. Matrix	Adj. List
Space	**n+m**	~~**n+m**~~ n^2	~~**n²**~~ m+n
insertVertex	**1**	**n**	**1**
removeVertex	**m**	**n**	**deg(v)**
insertEdge	**1**	**1**	**1**
removeEdge	**1**	**1**	**1**
incidentEdges	**m**	**n**	**deg(v)**
areAdjacent	**m**	**1**	**min(deg(v), deg(w))**

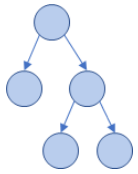
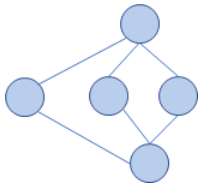
How do the algorithms compare?

...is one always better?

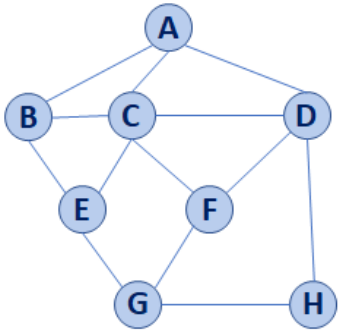
Graph Traversal

Objective: Visit every vertex and every edge in the graph.
Purpose: Search for interesting sub-structures in the graph.

We've seen traversal before – this is only slightly different:

BST	Graph
	

BST Graph Traversal



Expressed as O(f)	Edge List	Adjacency Matrix	Adjacency List
Space	n+m	~~n+m~~ n^2	~~n²~~ n + m
insertVertex(v)	1	n	1
removeVertex(v)	m	n	deg(v)
insertEdge(v, w, k)	1	1	1
removeEdge(v, w)	1	1	1
incidentEdges(v)	m	n	deg(v)
areAdjacent(v, w)	m	1	min(deg(v), deg(w))

CS 225 – Things To Be Doing:

1. Topic list for Programming Exam C available; starts Tuesday 4/17
2. lab_puzzles ongoing; due Sunday, April 15th
3. MP6 due on Monday, April 16th
4. Daily POTDs are ongoing!