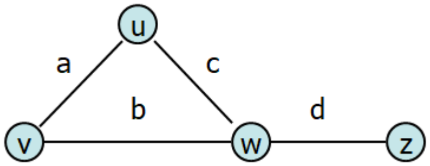
CS 225

#34: Graph Implementation

November 14 2018 · *Wade Fagen-Ulmschneider*

Graph Implementation #1: Edge List

Vert.	Edges		
u			**a**
v			**b**
w			**c**
z			**d**



Data Structures:

Vertex Collection:

Edge Collection:

Operations on an Edge List implementation:

insertVertex(K key):
- What needs to be done?

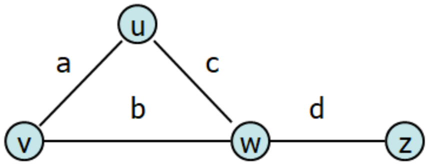
removeVertex(Vertex v):
- What needs to be done?

incidentEdges(Vertex v):
- What needs to be done?

areAdjacent(Vertex v1, Vertex v2):
- Can this be faster than **`G.incidentEdges(v1).contains(v2)`**?

insertEdge(Vertex v1, Vertex v2, K key):
- What needs to be done?

Graph Implementation #2: Adjacency Matrix



Vert.	Edges			Adj. Matrix				
u			**a**	▨	**u**	**v**	**w**	**z**
v			**b**	**u**				
w			**c**	**v**				
z			**d**	**w**				
				z				

Data Structures:

Operations on an Adjacency Matrix implementation:

insertVertex(K key):
- What needs to be done?

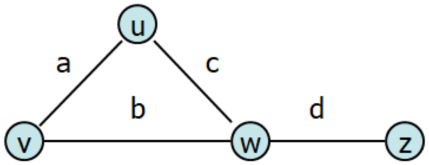
removeVertex(Vertex v):
- What needs to be done?

incidentEdges(Vertex v):
- What needs to be done?

areAdjacent(Vertex v1, Vertex v2):
- Can this be faster than **`G.incidentEdges(v1).contains(v2)`**?

insertEdge(Vertex v1, Vertex v2, K key):
- What needs to be done?

Graph Implementation #3: Adjacency List



Vertex List	Edges		
u			a
v			b
w			c
z			d

Operations on an Adjacency Matrix implementation:

insertVertex(K key):

removeVertex(Vertex v):

incidentEdges(Vertex v):

areAdjacent(Vertex v1, Vertex v2):

insertEdge(Vertex v1, Vertex v2, K key):

Running Times of Classical Graph Implementations

	Edge List	Adj. Matrix	Adj. List
Space	n+m	n^2	n+m
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))

Q: If we consider implementations of simple, connected graphs, what relationship between n and m?

- On connected graphs, is there one algorithm that underperforms the other two implementations?

Q: Is there clearly a single best implementation?

- Optimized for fast construction:

- Optimized for areAdjacent operations:

CS 225 – Things To Be Doing:

1. **Programming Exam C is different than usual schedule:**
   Exam: Sunday, Dec 2 – Tuesday, Dec 4
2. lab_dict released this week; due on Tuesday, Nov. 27
3. MP6 EC+5 due tonight; final due date on Monday, Nov. 26
4. Very special POTD today!