#29: Graph Implementation
April 14 2021 · *G Carl Evans*

Graph Implementation #1: Edge List

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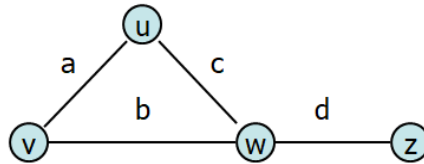
Data Structures:

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?

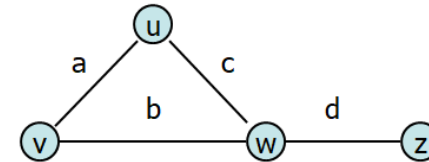incidentEdges(Vertex v):
- What needs to be done?

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	**v**	**w**	**z**
u			**a**	**u**				
v			**b**	**v**				
w			**c**	**w**				
z			**d**	**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?

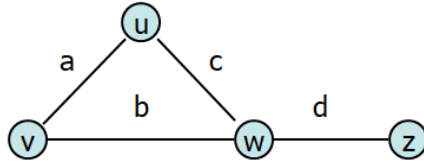incidentEdges(Vertex v):
- What needs to be done?

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
v
w
z

		a
		b
		c
		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	n²	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. lab_btree released this today; due on Sunday
2. mp_mazes released date on Monday, April. 26
3. POTD today!