#34: Graph Implementation

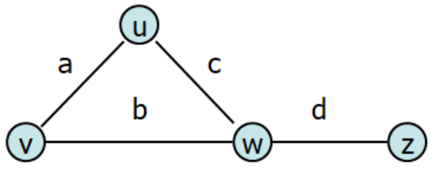
April 10 2019 · *Fagen-Ulmschneider, Zilles*

Graph Implementation #1: Edge List

Vert. | **Edges**

u
v
w
z

		a
		b
		c
		d



Data Structures:

Vertex Collection:

Edge Collection:

Operations on an Edge List implementation:

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

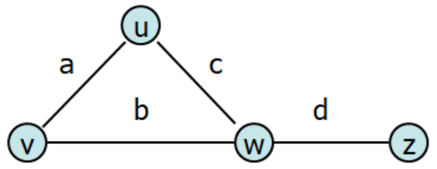
removeVertex(Vertex v):
- What needs to be done?

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

		a
		b
		c
		d

▨	**u**	**v**	**w**	**z**
u				
v				
w				
z				

Data Structures:

Operations on an Adjacency Matrix implementation:

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

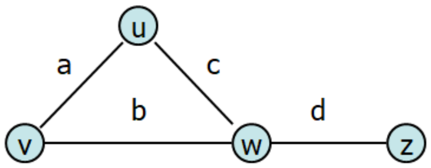
removeVertex(Vertex v):
- What needs to be done?

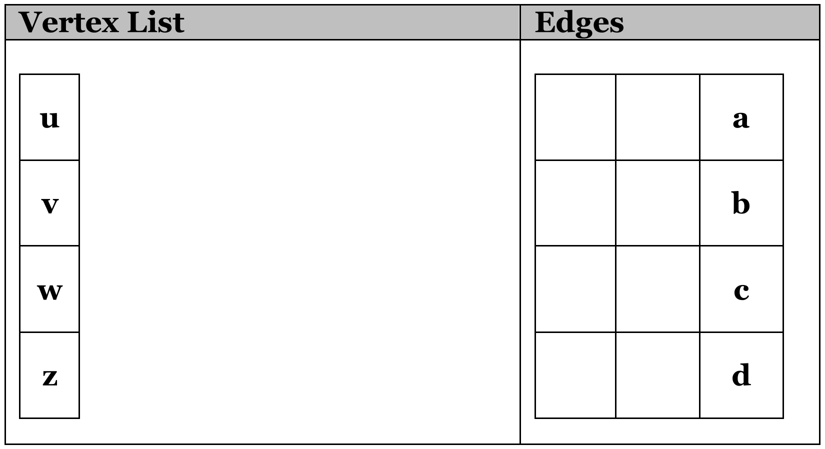
incidentEdges(Vertex v):
- What needs to be done?

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





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. **Optional Exam:** Thursday, April 11 – Sunday, April 14
2. lab_dict released this week; due on Sunday.
3. MP6 EC+5 due tonight; final due date on Monday, April. 15
4. Very special POTD today!