

CSC373 Worksheet 4 Solution

August 4, 2020

1. • Calculating out-degree

Let $G = (V, E)$ be a directed graph. Let $[v_1, \dots, v_n]$ be a list of vertices in graph G .

I need to calculate the outdegree of every vertex using adjacency list.

We know that in addition to counting each v_i in adjacency list where $i = 1, \dots, n$, we are also counting $|Adj[v_i]|$ edges.

Since there are $|V| = n$ many vertices, we can write that the total count is $|V| + \sum_{i=1}^n |Adj[v_i]| = |V| + |E|$, which is $\mathcal{O}(|V| + |E|)$.

• Calculating In-degree

The outdegree of a vertex is indegree of another vertex.

Using this fact, we can conclude the running time of computing indegree of every vertex is $\mathcal{O}(|V| + |E|)$.

Notes:

• **Vertex**

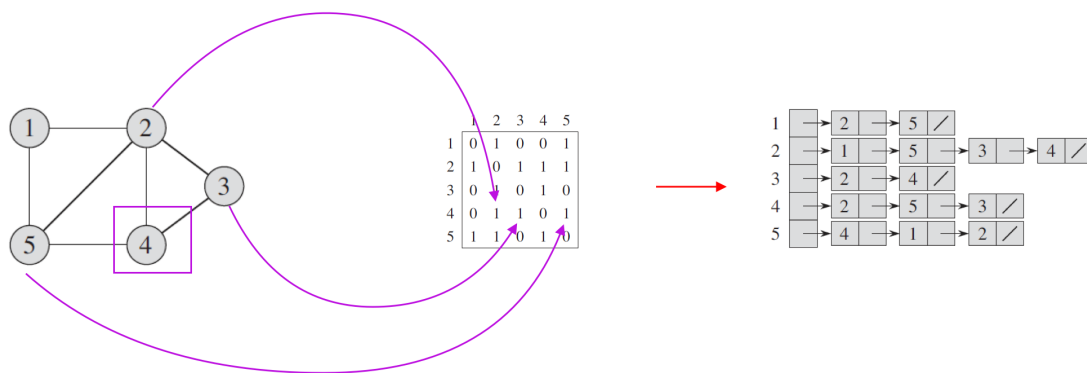
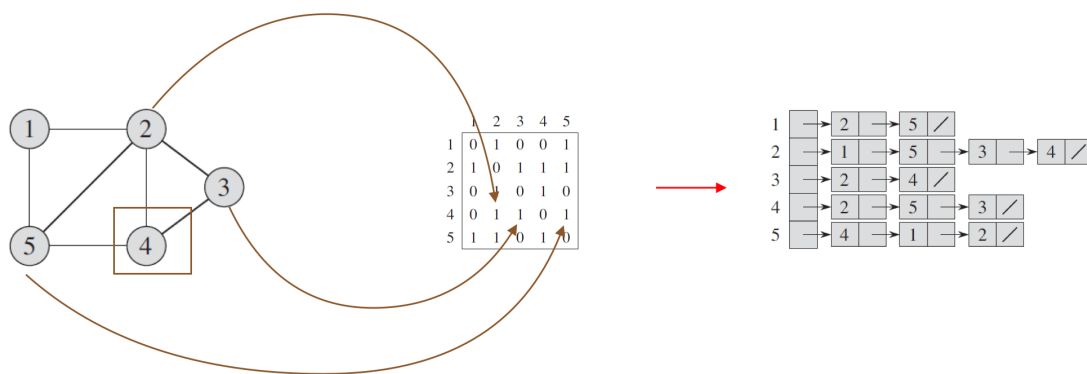
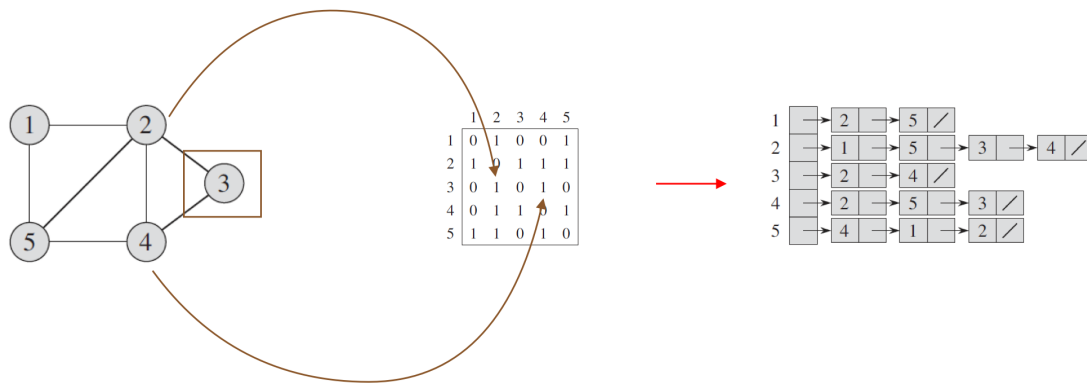
- Is a fundamental unit of which graphs are formed
- Also means node



• Adjacency-list Representation

- Associates each vertex in a graph with the collection of its neighbouring vertices or edges
- Is represented by $Adj[v]$
 - * Means all vertices that are neighbour to vertex v
 - * In a directed graph, $Adj[v]$ are all out-degree vertices of vertex v
 - * $|Adj[v]|$ means the total number of outdegree of vertex v







• Directed graph

- Is a graph that is made up of a set of vertices connected by edges, where the edges have a direction associated with them



• Out-degrees

- For a directed graph $G = (V(G), E(G))$ and a vertex $x_1 \in V(G)$, the Out-Degree of x_1 refers to the number of arcs incident from x_1 . That is, the number of arcs directed away from the vertex x_1 .

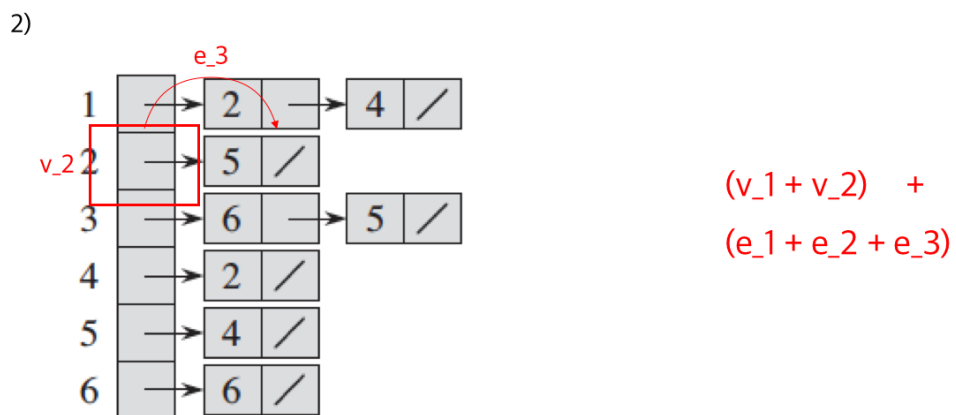


• In-degrees

- For a directed graph $G = (V(G), E(G))$ and a vertex $x_1 \in V(G)$, the In-Degree of x_1 refers to the number of arcs incident to x_1 . That is, the number of arcs directed towards the vertex x_1 .



- Computing the outdegree of every vertex using adjacency list



3)



$$(v_1 + v_2 + v_3) + (e_1 + e_2 + e_3 + e_4 + e_5)$$

3)



$$(v_1 + v_2 + v_3) + (e_1 + e_2 + e_3 + e_4 + e_5)$$

4)



$$(v_1 + v_2 + v_3 + v_4) + (e_1 + e_2 + e_3 + e_4 + e_5)$$

4)



$$(v_1 + v_2 + v_3 + v_4) + (e_1 + e_2 + e_3 + e_4 + e_5)$$

6)



$$(v_1 + v_2 + v_3 + v_4 + v_5 + v_6) + (e_1 + e_2 + e_3 + e_4 + e_5 + e_6 + e_7 + e_8)$$

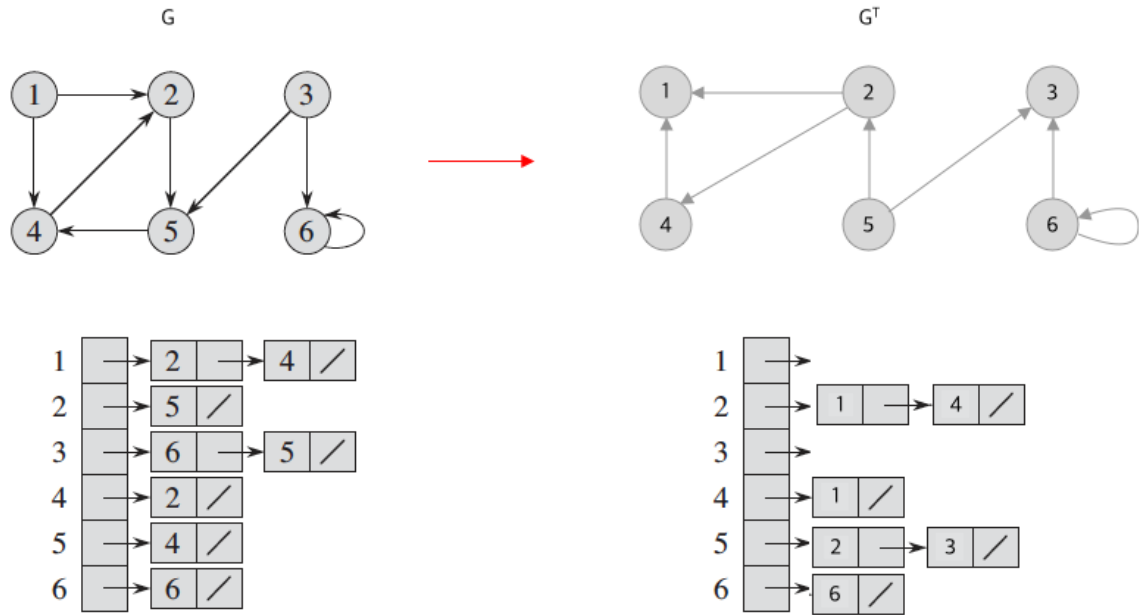
So it has $\mathcal{O}(V + E)$

- Computing the outdegree of every vertex using adjacency list

The outdegree of a vertex is indegree of another vertex.

Using this fact, we can conclude the running time of computing indegree of every vertex is $\mathcal{O}(V + E)$.

- Computing G^T from G in Adjacency List



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1  COMPUTE-G-TRANSPOSE-ADJ-LIST(Adj, V)
2      Let Adj' be a new adjacency list containing keys  $v_1 \dots v_n$ 
3
4      for i = 1 to |V|
5          for every vertex w in Adj[ $v_i$ ]
6              Insert(Adj'[w],  $v_i$ )
7

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- Computing G^T from G in Adjacency-Matrix