ADVANCED ALGORITHM ANALYSIS

Re-MID SEMESTER ASSIGNMENT

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Q1. Analyze Insertion Sort for Best Case? (10 Marks)

Baset Case

1	**2**	**3**	**4**	**5**	**6**	**7**

J 1

J 2

J 3

.

.

J= n1

= Ω Best Case Analysis

In Best Case i.e., when the array is already sorted, tj = 1

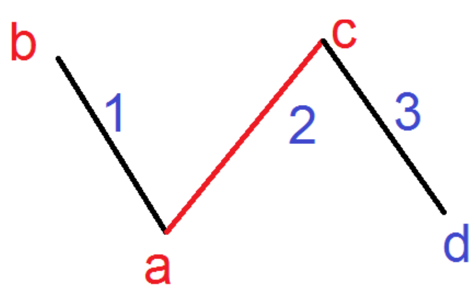
Therefore,T(n) = C1 * n + (C2 + C3) * (n - 1) + C4 * (n - 1) + (C5 + C6) * (n - 2) + C8 * (n - 1)

which when further simplified has dominating factor of n and gives T(n) = C * (n) or O(n) (n).

Q2. Explain briefly each of the following term with a supporting Graph. (10 Marks)

I. Adjacent Edges

Two edges are said to be adjacent if they are incident to a common vertex. Look at the image below.



There are three edges (1 & 2) in this graph on 4 vertices a,b, cand d.

The edge 1 connects **a** and **b**.

The edge 2 connects **a** and **c**.

The edge 3 connects **c** and **d**.

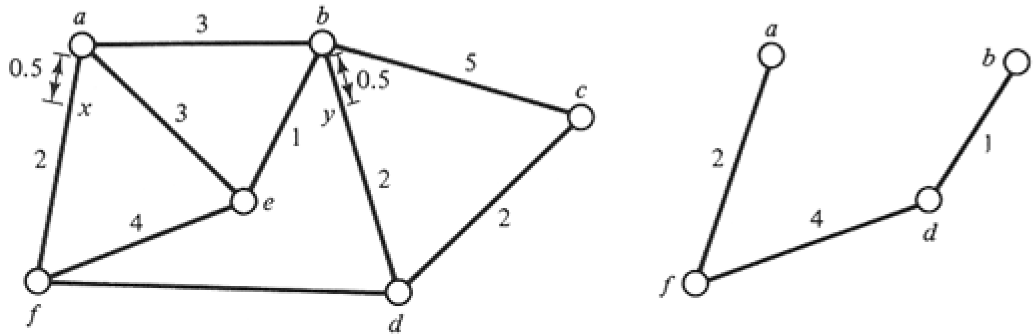
Edges 1 and 2 **are adjacent** as the **vertex a is common.**

Edges 2 and 3 **are adjacent** as the **vertex c is common.**

Edges 1 and 3 **are not adjacent** as they don't share any vertices in common.

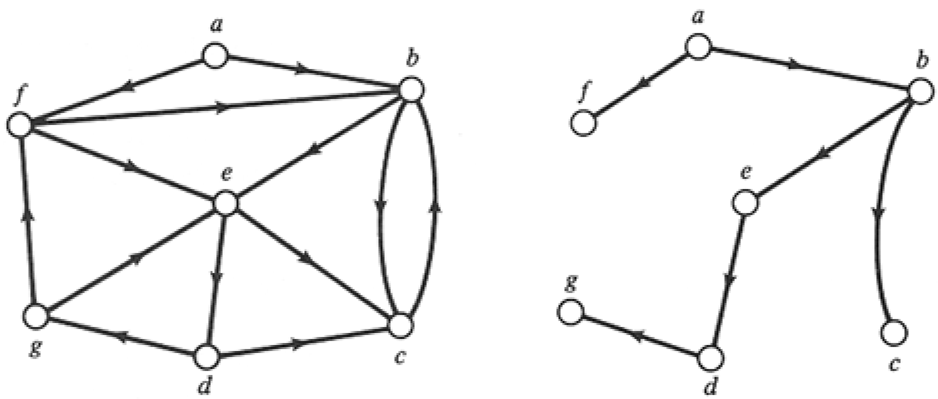
ii. Adjacent Nodes

An edge is incident on the two nodes it connects. Any two nodes connected by an edge or any two edges connected by a node are said to be adjacent. The degree of a node in an undirected graph is the number of edges incident on it; for directed graphs the indegree of a node is the number of edges leading into that node and its outdegree, the number of edges leading away from it (see also Figures 6.1 and 6.2).



(a) (b)

FIGURE 6.1 (a) An undirected graph G with six nodes and nine edges. Nodes a and b are adjacent; a and c are not. The degree of node e is 3, since edges (b, e) (a, e), and (f, e) are incident on it. A path from node a to node d is the path $\{a, e, f, d\} = \{(a, e), (e, f), (f, d)\}$; this path is both simple and elementary. The path $\{a, b, e, f, d, b, c\}$ contains a cycle. G is connected. (b) A subgraph of G which is also a tree but not a spanning tree. The numbers on the links of G (Fig. 6.1a) are the link lengths. The shortest distance between nodes a and c, $d(a, c)$ is equal to 7 units. The shortest distance between the points $x \in (a, f)$ and $y \in (b, d)$ is 4 units.



(a) (b)

FIGURE 6.2 (a) A directed graph G. The nodes f and e are adjacent; the nodes a and d are not. The path $\{a, f, e, d, g, f, b\}$ is simple; it is not elementary, since it contains a cycle. G is connected but not strongly connected since it is impossible to go, for instance, from node g to node a. (b) A subgraph of G which is also a directed tree rooted at node a. Moreover, this tree is an arborescence, since it contains all nodes of G. The indegree of node e on G (Figure 5.2a) is 3 and its outdegree is 2.

iii. Closed Graph

In mathematics, particularly in functional analysis and topology, closed graph is a property of functions

v. Cycle

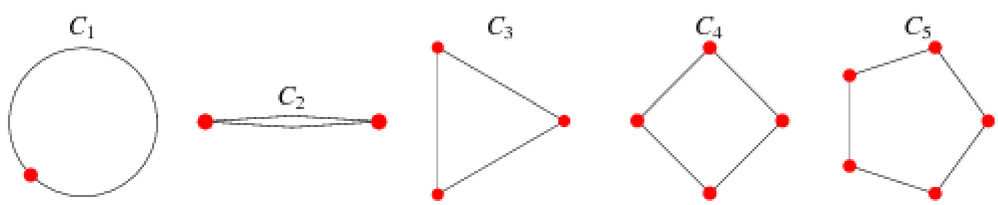
In graph theory, a cycle graph C_n, sometimes simply known as an n-cycle (Pemmaraju and Skiena 2003, p. 248), is a graph on n nodes containing a single cycle through all nodes. A different sort of cycle graph, here termed a group cycle graph, is a graph which shows cycles of a group as well as the connectivity between the group cycles.

Special cases include C_3 (the triangle graph), C_4 (the square graph, also isomorphic to the grid graph $G_{2,2}$), C_6 (isomorphic to the bipartite Kneser graph $H(3, 1)$), and C_8 (isomorphic to the 2-Hadamard graph). The $2n$-cycle graph is isomorphic to the Haar graph $H(2^{n-1}+1)$ as well as to the Knödel graph $\mathcal{W}_{2,2n}$.

Cycle graphs (as well as disjoint unions of cycle graphs) are two-regular.

The chromatic number of C_n is given by

$$\chi(C_n) = \begin{cases} 3 & \text{for } n \text{ odd} \\ 2 & \text{for } n \text{ even.} \end{cases}$$



Q3. Sort the following list using Insertion Sort. (10 Marks)

15, 4, 11, 3, 5, 1

Ans:

The following steps of insertion algorithm

- Get a list of unsorted numbers
- Set a marker for the sorted section after the first number in the list
- Repeat steps 4 through 6 until the unsorted section is empty
- Select the first unsorted number
- Swap this number to the left until it arrives at the correct sorted position
- Advance the marker to the right one position
- Stop

15	**4**	**11**	**3**	**5**	**1**
15	**4**	**11**	**3**	**5**	**1**
4	**15**	**11**	**3**	**5**	**1**
4	**11**	**15**	**3**	**5**	**1**
4	**11**	**3**	**15**	**5**	**1**
4	**3**	**11**	**15**	**5**	**1**
3	**4**	**11**	**15**	**5**	**1**
3	**4**	**11**	**5**	**15**	**1**
3	**4**	**5**	**11**	**15**	**1**
3	**4**	**5**	**11**	**1**	**15**
3	**4**	**5**	**1**	**11**	**15**
3	**4**	**1**	**5**	**11**	**15**
3	**1**	**4**	**5**	**11**	**15**
1	**3**	**4**	**5**	**11**	**15**