Ques!. What is Travelling Salesman problem. Explain with suitable example.

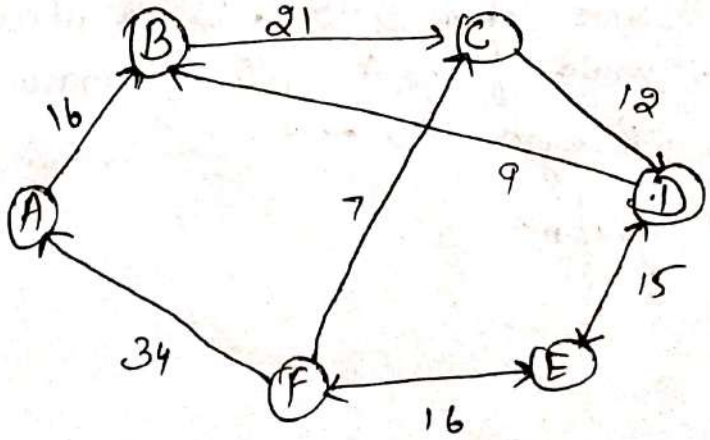
The travelling salesman problem is a classic optimization problem in the field of operations research and computer science. It involves finding the shortest possible route that visits a set of given cities (or locations) exactly once and returns to the starting city.

In other words, it seeks to determine the most efficient way for a salesperson to visit a list of cities and return to the original city, minimizing the total distance traveled.

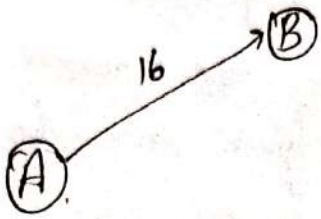
There are various approaches to find the solution to the travelling salesman problem: native approach, greedy approach, dynamic programming approach, etc.

Example :-

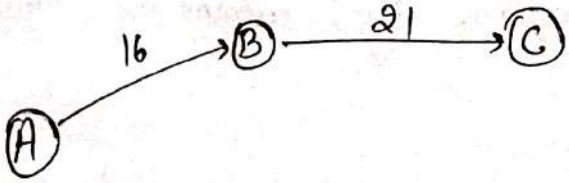
Consider the following graph with six cities and the distances b/no them.



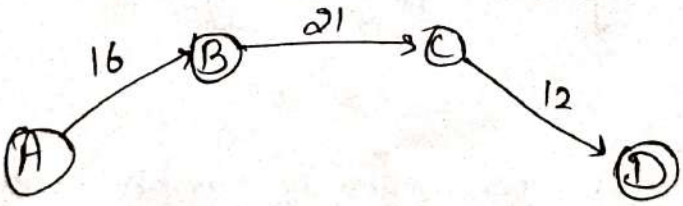
From the given graph, since the origin is already mentioned the solution must always start from that node. Among the edges leading from A, A → B has the shortest distance.



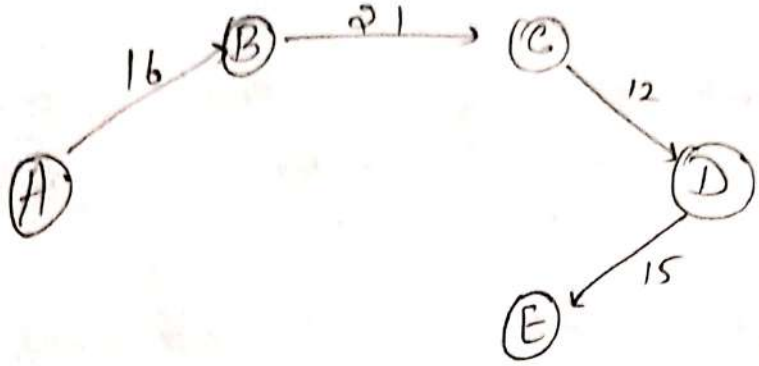
Then, B → C has the shortest and only edge b/w, therefore it is included in the output graph.



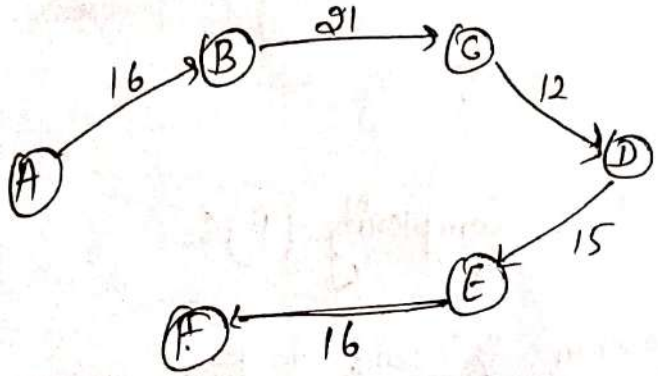
There's only one edge b/w C → D, therefore it is added to the output graph.



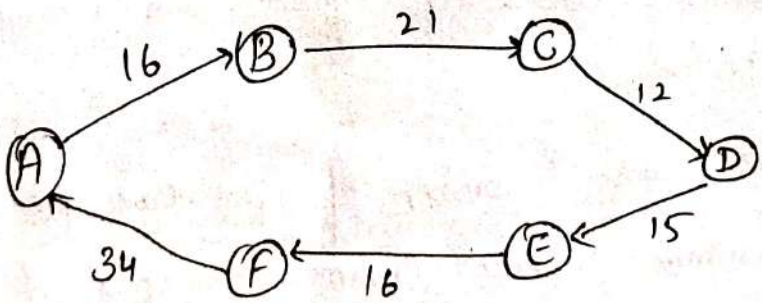
There's two outward edges from D. Even though, D → B has lower distance than D → E, B is already visited once and it would form a cycle if added to the output graph, Therefore, D → E is added into the output graph.



There's only one edge from E, that is E→F. Therefore, it is added into the output graph.



Again, even though F→C has lower distance than F→A, F→A is added into the output graph in order to avoid the cycle that would form and C is already ~~visit~~ visited once



The shortest path that originates and ends at A is

A → B → C → D → E → F → A.

The cost of the path is 16 + 21 + 12 + 15 + 16 + 34 = 114

Ques. What is Polynomial time vs non-Polynomial time complexity. Explain in details.

Polynomial Time and Non-Polynomial Time complexity are terms used in the context of computational complexity theory to classify algorithms based on their efficiency in solving problems. Let's dive into the details of each.

- Polynomial Time Complexity (P):

  → An algorithm is said to have polynomial time complexity if its running time is bounded by a polynomial function of the input size.

  → A problem that can be solved in polynomial time is considered efficient from a computational perspective.

  → The class P consists of problems for which efficient algorithms exist. Common examples of problems in P include addition, sorting, searching in a sorted list, and matrix multiplication.

  → Polynomial time complexity is denoted as $O(n^k)$, where 'n' is the input size and 'k' is a positive integer.

for example, $O(n^2)$ represents a quadratic time complexity

- Non-Polynomial Time Complexity (NP):

→ Non-Polynomial Time Complexity refers to problems for which no known polynomial-time algorithm exists, but a potential solution can be verified in polynomial time.

→ In NP, it's relatively easy to check if a given solution is correct, but finding the solution efficiently is a challenging task.

→ The most famous problem in NP is the Travelling Salesman Problem (TSP), which is known to be NP-hard, meaning that if you could find a polynomial-time algorithm for TSP, you could also solve all problems in NP efficiently.

→ The class NP includes problems for which a proposed solution can be quickly verified. It doesnot imply that finding a solution is equally fast.

- P vs NP:

→ One of the most significant open questions in computer science is whether P equals NP. This is known as the P vs NP problem.

→ If P = NP were proven true, it could mean that problems in NP could be solved in polynomial time, making many computational problems tractable.

→ However, if P ≠ NP, it would imply that there are problems in NP that are inherently hard to solve efficiently, even though verifying solutions is easy.

Ques 3- What is sorting Networks, Crypto graphic, and computations.

Sorting Networks, Cryptographic Networks, and Computational Networks are different concepts in computer science and information theory. Let me explain each of them.

1. Sorting Networks :-

A sorting network is a specific type of network used for sorting a list of elements. It is a parallel sorting algorithm that works by comparing and swapping pairs of elements to arrange them in the desired order.

→ Sorting networks are designed as a sequence of interconnected comparators, where each comparator compares two elements and swaps them if they are out of order. The structure of the network ensures that, after a sequence of comparisons, all elements end up in sorted order.

→ Sorting networks have a fixed structure, and their sorting time is not influenced by the input data. They are typically used for sorting a small number of elements because their size and complexity grow rapidly as the number of elements increase.

2. Cryptographic Networks :-

Cryptographic networks are not a common term in cryptography. Cryptography involves the study of secure communication techniques, including encryption, decryption, and secure protocols.

→ Cryptographic algorithms and protocols are designed to protect the confidentiality, integrity, and authenticity of data in various communication and computation scenarios. Cryptographic networks can refer to networks or systems where cryptographic techniques are used to secure data and communications.

3. Computational Networks :-

→ Computational Networks are not a standard term, but they could refer to networks of interconnected computational devices or systems.

→ Computations refers to the process of performing calculations or executing algorithms using a computer or other computational device.

→ Computational methods are fundamental to various fields, including computer science, mathematics, science, engineering, and more.

Ques4. Explain BIN Packing and cook's theorem.

□ Bin Packing :-

→ Bin Packing is a classic combinatorial optimization problem in which a set of items with varying sizes must be packed into a minimum number of bins, each with a fixed capacity.

→ Bin Packing is like a puzzle where you have different-sized items to put into boxes (bins).

→ The goal is to fit these items into the bins in the most efficient way, using the least number of bins.

→ Each bin has a fixed size, and you need to make sure the items fit within the bin's size limit.
→ It's used in real-life situations like packing cargo into trucks or optimizing computer memory usage.
→ Bin Packing is a challenging problem in computer science and optimization.

Cook's Theorem:-

→ Cook's Theorem is about understanding how hard some problems are to solve using computers.
→ It showed that a problem called Boolean satisfiability problem (SAT) is very hard to solve.
→ This led to the concept of NP-completeness, meaning that if you can solve one hard problem (SAT), you can solve many other hard problems efficiently.
→ Cook's Theorem is a crucial part of computer science theory and helped us understand the limits of what computers can do.
→ It has practical applications in designing efficient algorithms and solving complex problems.

Ques What is Multicast Routing?

The Multicast routing protocols are able to route packets from one source to multiple destination or a group of destinations. The destination address in this type of routing are group addresses. Whenever a router receives a multicast packet, it routes it from a number of ports. If the router is not in a multicast path, it simply discards the packets on receiving.

1. Internet Group management Protocol :-

The Internet group management protocol (IGMP) is a group management protocol that mainly manages the group memberships in a multicast networks. In a multicast network, multicast routers are used to route packets to all the computer that are having membership of a particular group. The multicast router use the information from IGMP to determine which hosts are having membership of which group.

IGMP is not a routing protocol, it is a group management protocol.

Working of IGMP

The multicast router of the network has a list of multicast addresses for which the network is having any members.

A host or a multicast router can be a member of the group. When a host is having membership, it means that any process running on that host is a member of the group and when a router is having membership of group, it mean one of the networks connected to the router is having membership of the group.

Joing a Group: Both the host or a router can join a group. When a process on the host wants to join a group, it sends the request to the host. The host adds the name of the process and group name to its list. If this is the first entry for that particular group. the host sends "membership report". message to the multicast router of that group.

Leaving a Group: Whenever a host sees no process interested in a group, it sends a "leave report" message and if a multicast router sees no network interested in a group, it sends a "leave report" message to the router of the group. The membership is not purged by the multicast router of the group, rather it immediately transmits query packets repeatedly to see if anyone still interested.