**Name: Sundas Shoukat**

**Roll no.057**

**Section: BSDS-3A**

**What is A\* Algorithm**

The **A\*** (A-Star) algorithm is a **pathfinding algorithm** used to find the **shortest path** between two points (nodes).  
It combines the ideas of **Dijkstra’s algorithm** (which uses actual distance) and **Greedy Best-First Search** (which uses estimated distance).

It uses the formula:

f(n)=g(n)+h(n)f(n) = g(n) + h(n)f(n)=g(n)+h(n)

* **g(n)** → the actual cost from the start node to the current node
* **h(n)** → the estimated cost (heuristic) from the current node to the goal
* **f(n)** → total estimated cost

The node with the **lowest f(n)** value is always selected next.

**Why We Use the A\* Algorithm**

* It finds the **shortest and most efficient path**.
* It is **faster and smarter** than Dijkstra’s algorithm.
* It is widely used in **maps, navigation systems, games, and robotics** for route planning.

**How It Works**

1. The algorithm starts with the **start node** and adds it to the **open list**.
2. In each step, it selects the node with the **lowest (g + h)** value.
3. It checks all the **neighboring nodes** of that current node.
4. It calculates the cost to reach each neighbor and updates it if a shorter path is found.
5. This process continues until the **goal node** is reached or there are no nodes left to explore.
6. Once the goal is reached, the algorithm **reconstructs the shortest path** by tracing back through the parent nodes.

**Important Terms**

* **Open List:** contains the nodes that need to be explored next.
* **Closed List:** contains the nodes that have already been visited.
* **Heuristic Function (h):** an estimate of the distance or cost from a node to the goal.

**Output Example**

