**1. Create a Data Structure for the Graph**

The graph can be represented using an adjacency list or an adjacency matrix. Here, I'll use an adjacency list for simplicity.

**2. Determine Properties of the Graph**

**a) Acyclic or Not**

A graph is acyclic if it does not contain any cycles.

**b) Directed or Undirected**

A graph is directed if all its edges have a direction.

**c) Connected or Not**

A graph is connected if there is a path between any two vertices.

**d) Simple or Not**

A graph is simple if it does not contain multiple edges between the same pair of vertices or loops (edges that connect a vertex to itself).

**Graph Representation Using Adjacency List**

Given the graph in the second picture:

* **Vertices**: V = {1, 2, 3, 4, 5, 6, 7, 8}
* **Edges**: E = {(1, 2), (2, 3), (2, 4), (3, 5), (3, 6), (4, 5), (4, 7), (5, 8)}

**Adjacency List**

1: [2]

2: [3, 4]

3: [5, 6]

4: [5, 7]

5: [8]

6: []

7: []

8: []

**Analysis of the Graph**

**Acyclic or Not**

To determine if the graph is acyclic, we can perform a Depth-First Search (DFS) or Breadth-First Search (BFS) to check for cycles. Given the graph structure and visual inspection, it does not contain any cycles, so it is **acyclic**(Cormen et al., 2009).

**Directed or Undirected**

The given graph edges have no specified direction, so we can assume it is **undirected**(Epp, 2011).

**Connected or Not**

To determine if the graph is connected, we can check if there is a path between every pair of vertices. In this case, the graph is **connected** since there is a path between every pair of vertices(West, 2001).

**Simple or Not**

The graph does not contain any multiple edges between the same pair of vertices or loops. Therefore, it is **simple**(Diestel, 2017).

**Explanation of Terms**

* **Acyclic**: A graph is acyclic if it does not contain any cycles. A cycle is a path that starts and ends at the same vertex with all edges being distinct(Cormen et al., 2009).
* **Directed**: A graph is directed if all its edges have a direction, meaning they go from one vertex to another specific vertex(Epp, 2011).
* **Connected**: A graph is connected if there is a path between any two vertices.
* **Simple**: A graph is simple if it does not contain multiple edges between the same pair of vertices or loops(Diestel, 2017).

**References**

Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). *Introduction to Algorithms* (3rd ed.). MIT Press.

Diestel, R. (2017). *Graph Theory* (5th ed.). Springer.

Epp, S. S. (2011). *Discrete Mathematics with Applications* (4th ed.). Cengage Learning.

West, D. B. (2001). *Introduction to Graph Theory* (2nd ed.). Prentice Hall.