

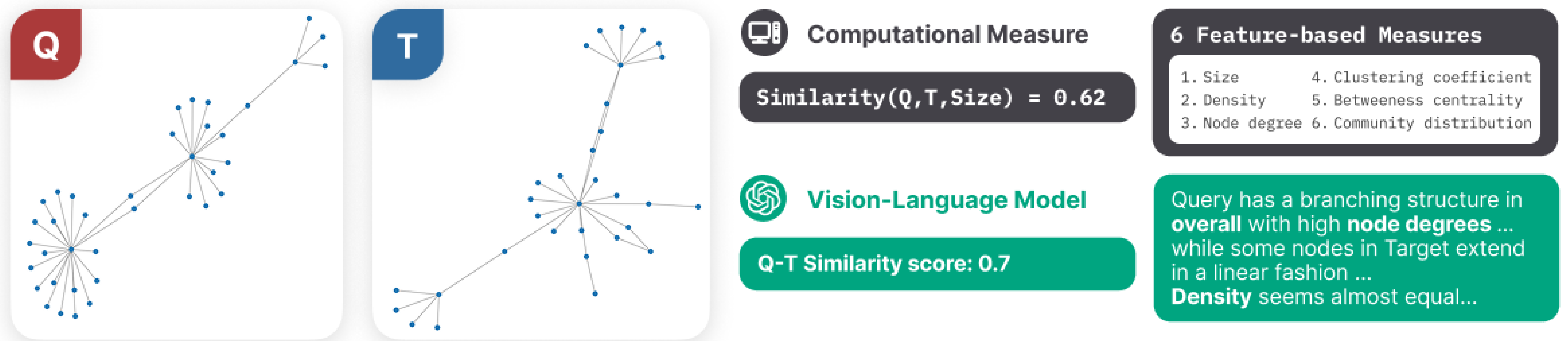
# Can VLMs Assess Similarity Between Graph Visualizations?

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**Research Goal:** Explore the potential of Vision Language Models (VLMs) to assess the graph similarity.



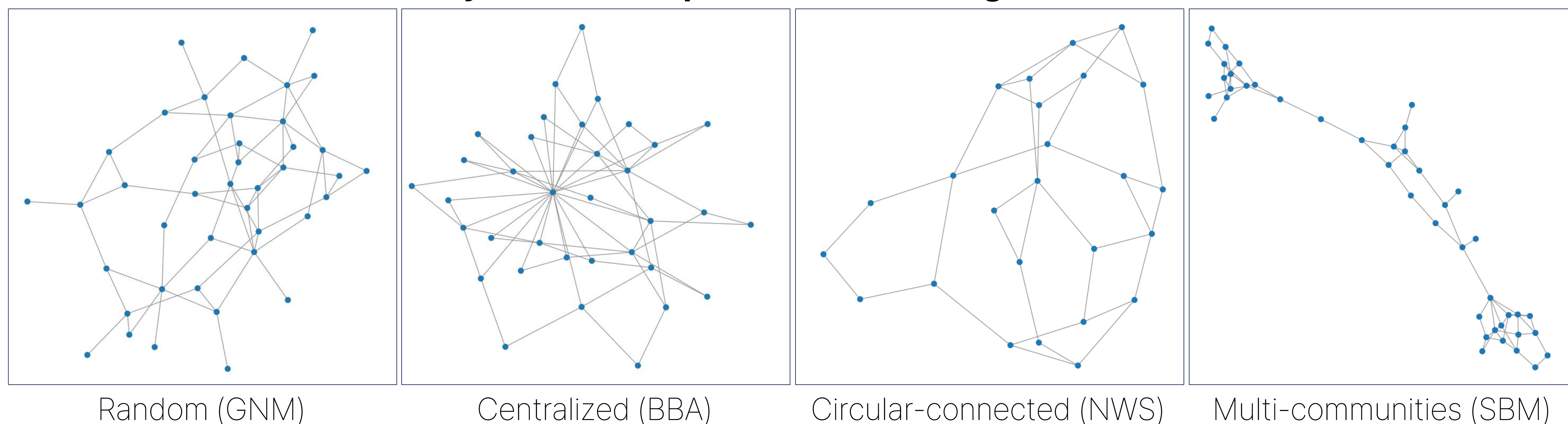
Compute the similarity between node-link diagrams of two graphs, **query Q** and **target T**.

## Graph Data Generation & Visualization

### Size & Density

Var.	Size (S)
Form.	$ V $
Val.	- Small: [10, 20] - Medium: [21, 50] - Large: [51, 200] - Very large: [201, 400]
Var.	Density (D)
Form.	$ V / E $
Val.	- Sparse: [1, 2] - Dense: [2, 3] - Very dense: [3, 10]

### Synthetic Graph Generation Algorithms



## VLM (GPT-4o) Prompt

### Instruction :

I will provide two images of node-link diagrams (graphs). The first is a query graph (**Graph Q**), and the other is a target graph (**Graph T**). Look at the **Q** and compare it visually to the **T**.

### Similarity Assessment (Q vs. T):

For a comparison, assign a similarity score on a scale of [0-1], where 0 indicates no similarity and 1 indicates complete visual identity.

-Similarity Score (Q vs. T): [0, 1]

### Reasoning (Q vs. T):

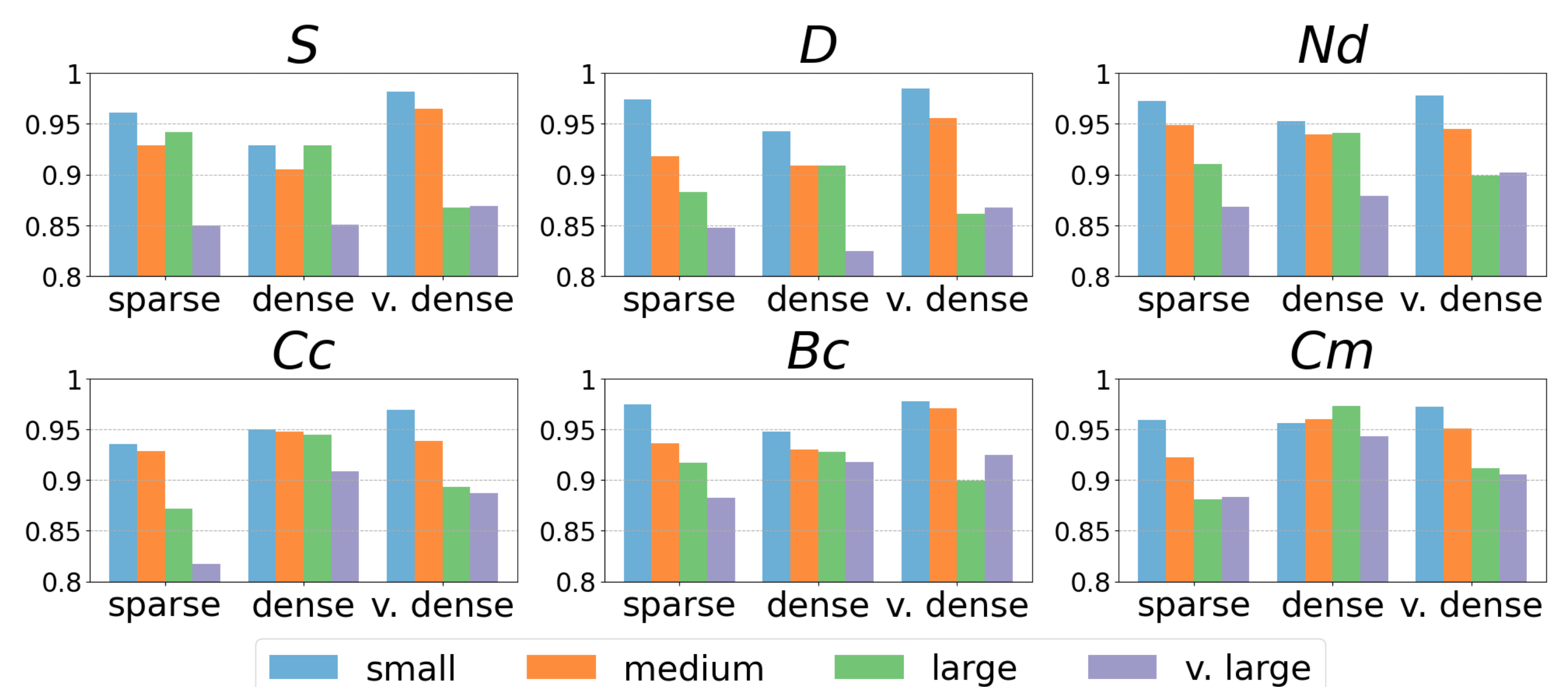
When you provide your answer, tie your explanations directly to the visual evidence in each image. Your explanation should be grounded in the visual features shared between **Q** and **T**, such as:

- Overall shape (e.g., ring shapes, star shapes, clusters)
  - Local shapes or repeating patterns (e.g., triangles, cliques)
  - Node degrees (which nodes appear to have high or low degrees)
  - Edge density (which part of the graph has high or low density)
  - Number of communities (how many discrete communities exist)
- You can suggest other visual features that provide noticeable differences.

## Feature-based Graph Similarity Measures

Measure	Abb	Formula
Size	$S$	$1 - \frac{  V_1  -  V_2  }{\max( V_1 ,  V_2 )}$
Density (Linear)	$D$	$1 - \frac{  E_1 / V_1  -  E_2 / V_2  }{\max( E_1 / V_1 ,  E_2 / V_2 )}$
Node degree	$Nd$	$1 - JSD(Nd(G1), Nd(G2))$
Clustering coefficient	$Cc$	$1 - JSD(Cc(G1), Cc(G2))$
Betweenness centrality	$Bc$	$1 - JSD(Bc(G1), Bc(G2))$
Community distribution	$Cm$	$1 - JSD(Lv(G1), Lv(G2))$

## Correlations Between Measures and GPT-4o



**Result:** Our findings indicate VLMs can assess graph similarity in a manner similar to feature-based measures, even though differences among the measures exist.

**Future Works:** We plan to extend our research by conducting experiments on human visual graph perception.

