

B.Tech Project

Final Presentation

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Results on number of Word Representable
Graphs



Introduction

The problem of determining whether a graph is word representable is NP-complete. However, we wanted to develop a tool that can do so for smaller graphs.

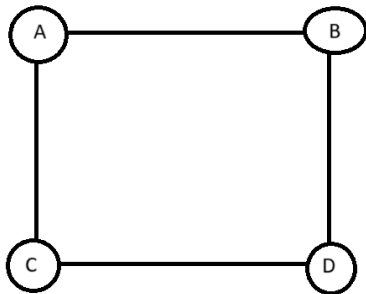


Word Representable Graphs

Word-representable graphs can be represented by a word (or sequence) whose entries alternate in a prescribed way. In essence, each pair of vertices connected by an edge in the graph corresponds to an alternating pair of letters in the word.



Word Representable Graphs



- $W = abcadcbd$
- $W_{ab} = abab$
- $W_{ad} = aadd$



Word Representable Graphs

Importance of WRG

Contains these important classes of graph

- circle graphs
- 3-colorable graphs
- comparability graph

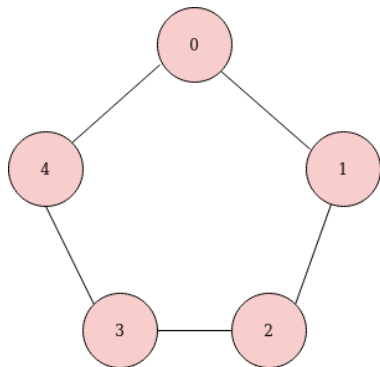


Graph Isomorphism

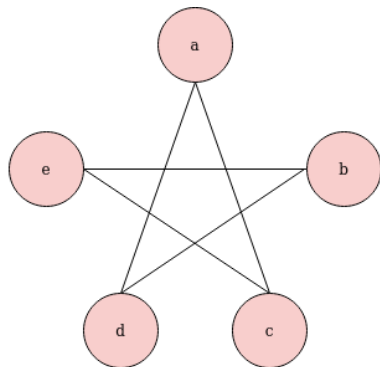
The Graph isomorphism problem refers to determining whether two graphs are structurally identical. Two isomorphic graphs have a bijection between vertices which preserves the edges.



Graph Isomorphism



G1



G2



Problem Statement

Designing an algorithm to determine whether a given **graph is word-representable or not**.

For this, we use a property of directed graphs called **semi-transitive orientation**.



Semi Transitive Orientation

Semi-transitive orientation refers to a directed arrangement of edges in a graph that meets certain conditions.

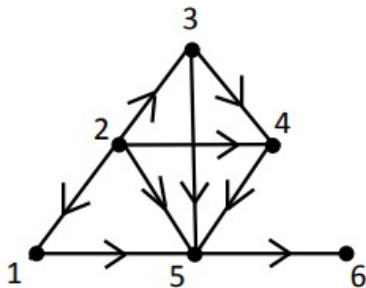
For any directed path from vertex A to vertex B:

Either there is no direct edge from A to B, or

If there is a direct edge from A to B, all vertices on the directed path should exhibit transitive property.

LOGO HERE

Semi Transitive Orientation



- Example of semi-transitive orientation



The Algorithm

After surveying the existing literature on word-representable graphs, we found that graphs that exhibit semi-transitive orientation are word-representable and vice-versa.

So now, the algorithm needs to check for the existence of such an orientation.



The Algorithm

Input: Adjacency matrix of the graph

Working: Checks for all the graph orientations and looks for a semi-transitive one.

Output: Returns YES if it finds one and NO if it does not.



Results

Time Complexity - $O(2^{n^2})$

Number of non-isomorphic non-word representable graphs

- 6 - 1 out of 112 (W_5) Time taken 1 s
- 7 - 25 out of 853 Time taken 10 s
- 8 - 929 out of 11117 Time taken 1000 s



Conclusion

Now that we have a tool to check the word-representability of graphs with 8 or fewer vertices, we can use this to get quick results and find patterns in word-representable graphs.



THANK YOU!
Any Questions?

