Graph Theory and its implementation in board games

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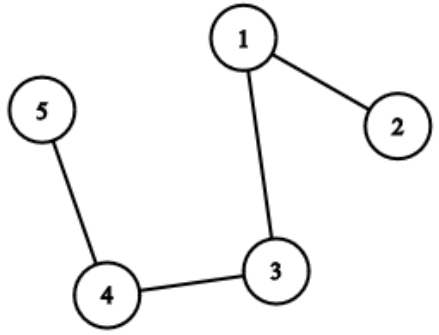
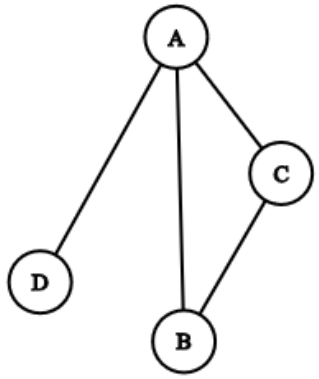
GRAPH : a list of pairs of “things” called vertex/vertices, and lines between those points, called edges

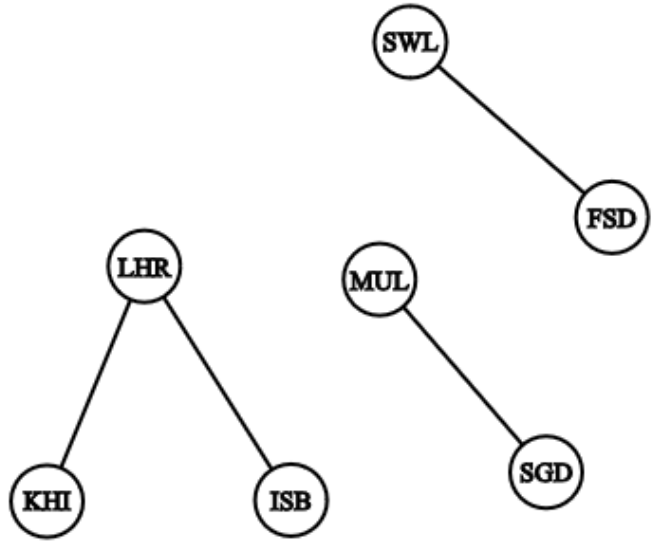
A = {(1, 2), (1, 3), (3, 4), (4, 5)}

B = {(A, B), (B, C), (A, C), (A, D)}

C = {(LHR,KRA), (LHR,ISB), (FSD,SWL), (STD,MUL)}







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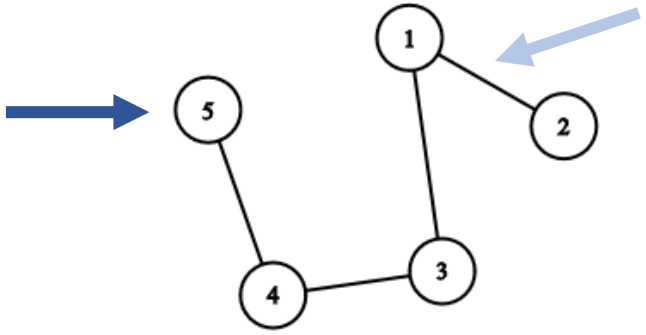

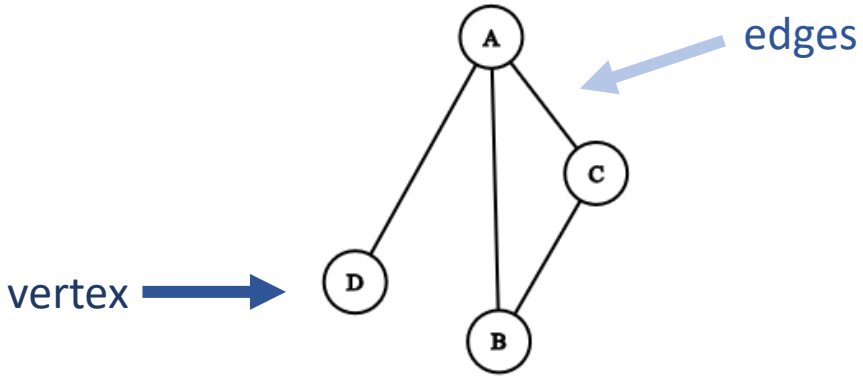

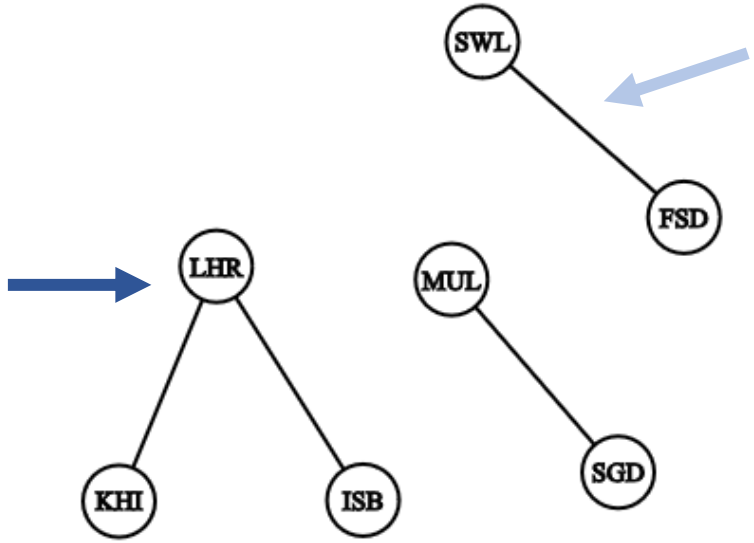

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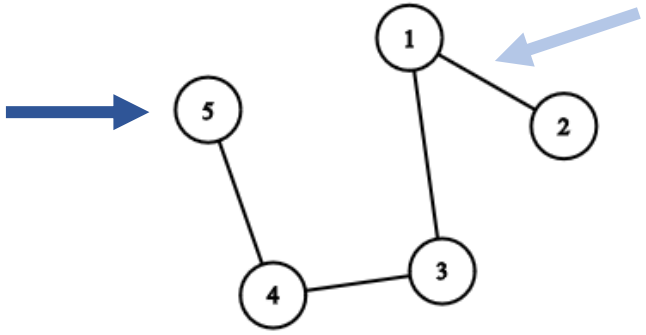
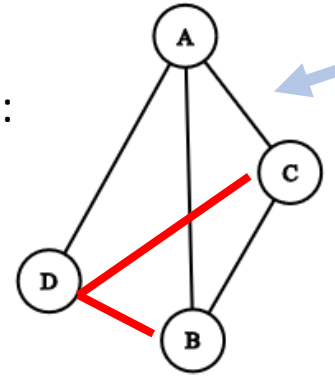
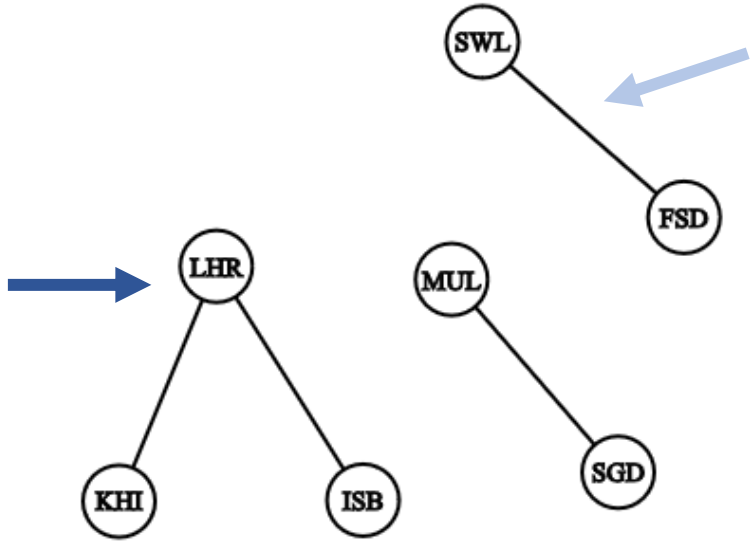


Total edges:
(n(n-1))/2

vertex

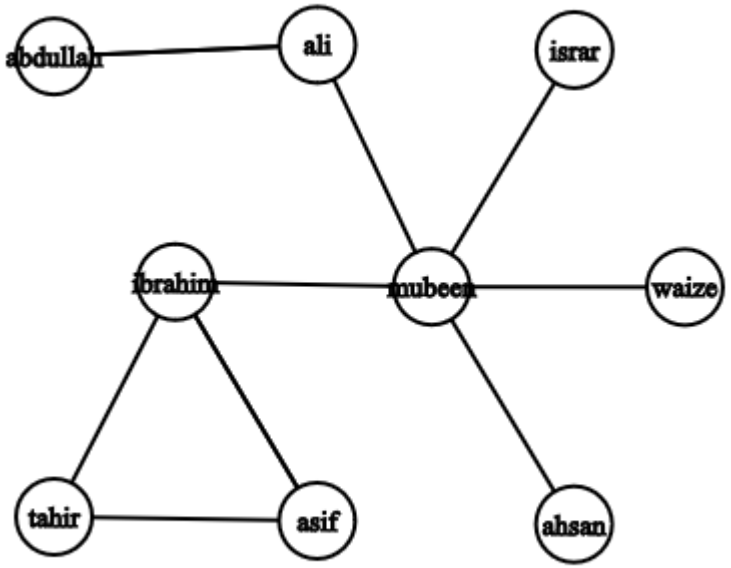


edges

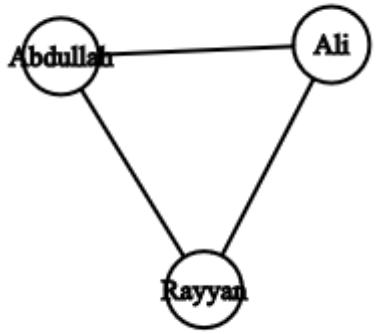


Difference between Directed and undirected graphs?

Instagram followers



Siblings Relation



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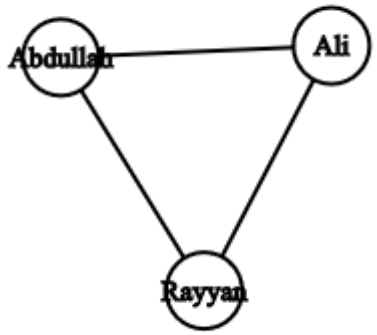

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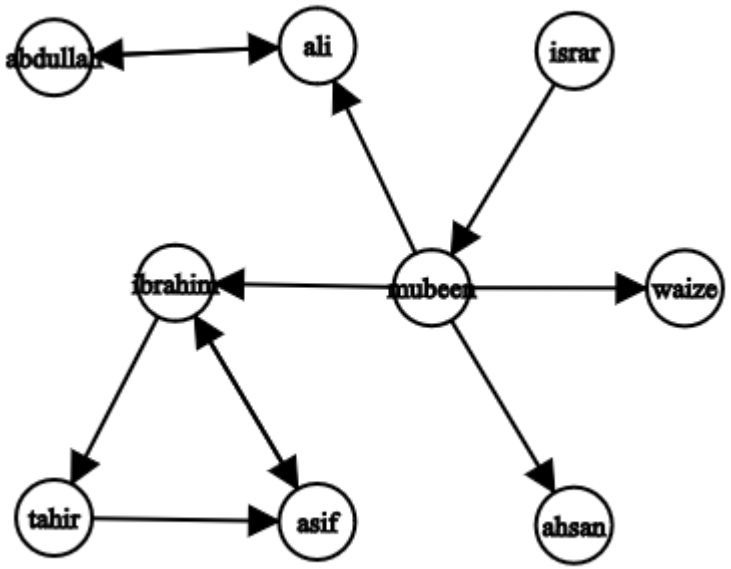
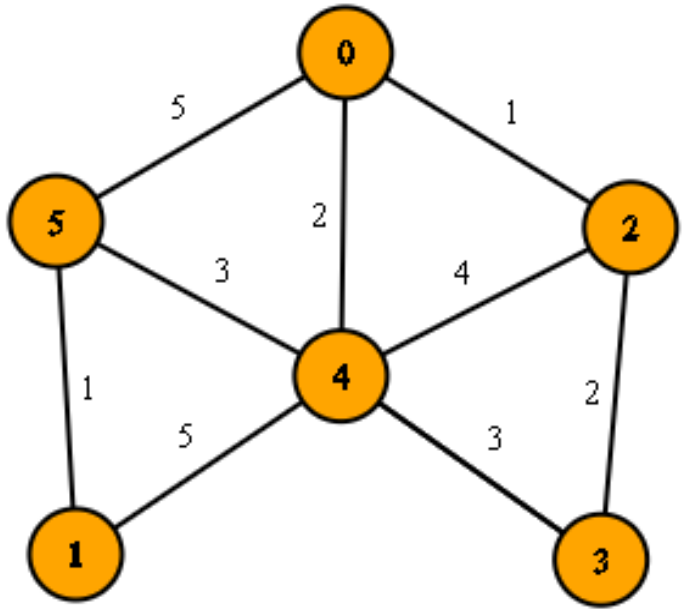


Weighted Graphs

Many graphs can have edges that contain a certain weight to represent an arbitrary value such as cost, distance, quantity, etc.
This suggests that all edges cannot be treated equally in certain cases.

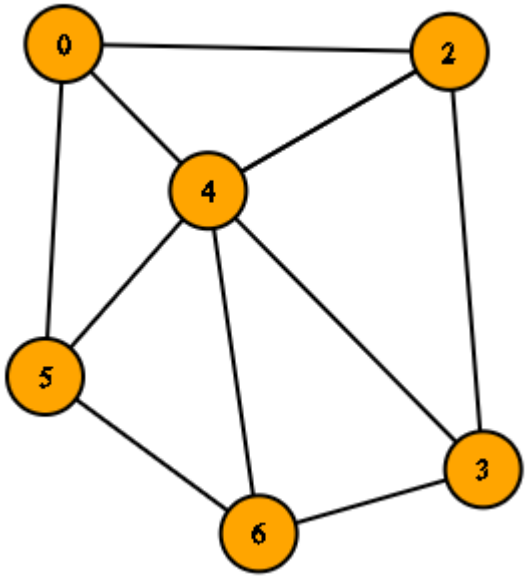


USE IN GAME:

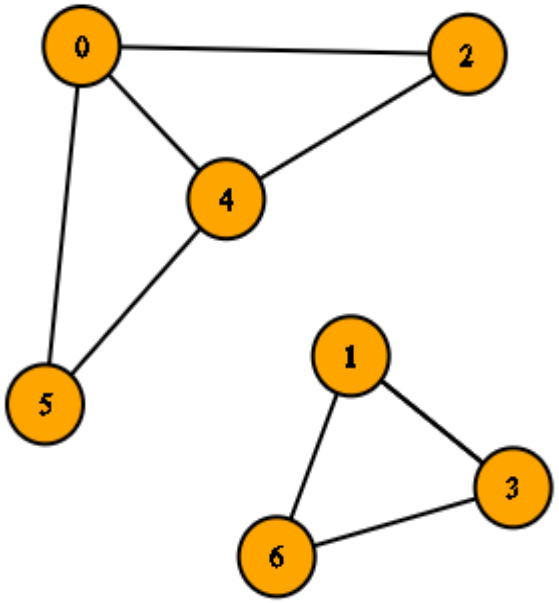
- to represent the potential impact or strategic value of certain moves.
- Weights could represent how close a sequence is to completion
- In more advanced AI implementations, weighted graphs can help find paths that maximize player's advantage while minimizing the opponent’s.

Connected vs Disconnected Graphs

A graph is called connected when a path exist between all of its vertices.



A graph is called connected when a path doesn’t exist between all of its vertices.



GRAPH REPRESENTATION

1. Edge List
    1. Individual track of all edges
    2. Need to check all edges

2. Adjacency List
    1. Track of all adjacent to a particular edge
    2. Need to check relevant list of adjacent

3. Adjacency Matrix
    1. Table in form of rows and columns that keep track of all possible edges in terms of YES/NO
    2. Only need to check one cell.

Things we need for our area of research:

1. How to traverse a graph
2. Count neighbors of a vertex
3. Count degree of a vertex(number of edges meeting at that vertex)
4. Deleting and inserting edges
5. Path and cycle of vertices

Graph in Board Games

Most board games are played two-dimensional grid.

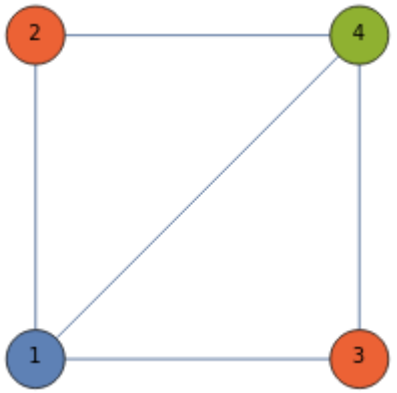
- Nodes represent the cells where game pieces are placed.
- Winning conditions involve finding paths (edges) with consecutive stones.

Implementation

Topics like graph theory, and recursion play crucial roles in modeling and solving the game.

Graph Coloring in Board Games

- involves assigning different colors to the vertices of a graph such that no two adjacent vertices share the same color.
- Simplifies game design by managing player interactions and organizing regions.



1. Territory Colouring: Assigning different colours to neighbouring territories.
2. Player moves: Useful in multiplayer games to minimize conflicts.
3. Puzzle Solving: No two adjacent players have the same colours.

TREES AND SPANNING TREES

Tree is a simple, connected ,undirected ,acyclic(having a unique path between any two vertices) graph.

A **spanning tree** of a graph is a subgraph that includes all vertices of the graph and is a tree.
- Spanning trees connect all vertices with the minimum possible edges.

In games, spanning trees can help create unique paths with no loops.