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Presidency Group

OVER 40 YEARS OF ACADEMIC WISDOM

Euler Graph

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Some basic Term

- **Vertices**: sometimes called a node, is a point or circle. It is the fundamental unit from which graphs are made
- An edge is line joining a pair of nodes.
- **Degree** of a vertex is the number of edges that connect to that vertex, loop count twice.
- **Path:** is a sequence of edges that begins at a vertex, and travels from vertex to vertex along edges of the graph.
- **Traverse:** It is the process of visiting number of vertex through different path.

- **Connected Graph:** A graph where every pair of vertices has a path.
- **Circuit:** It is a path that begin and ends at the same vertex

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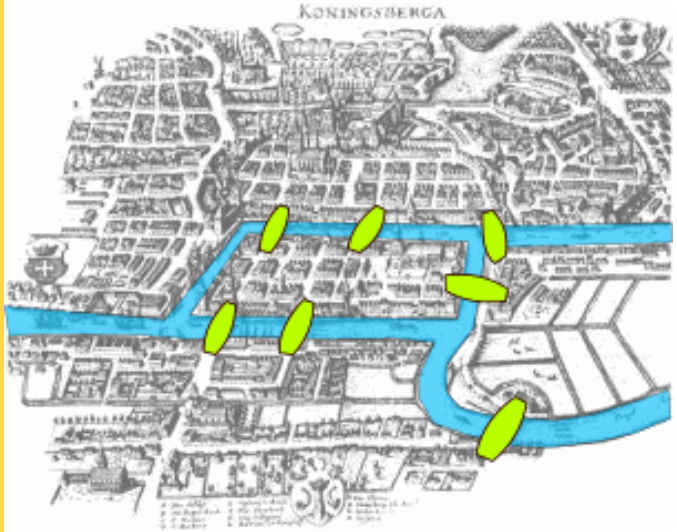
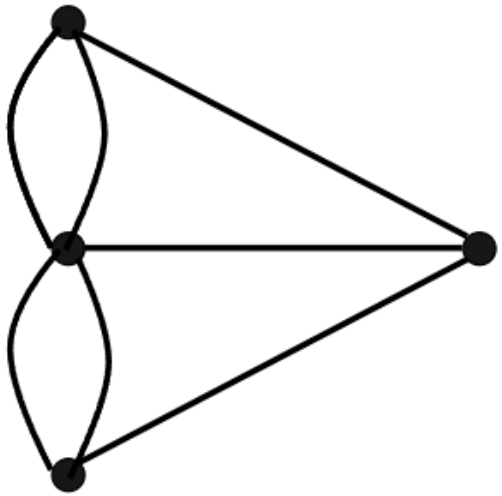
Königsberg bridge problem

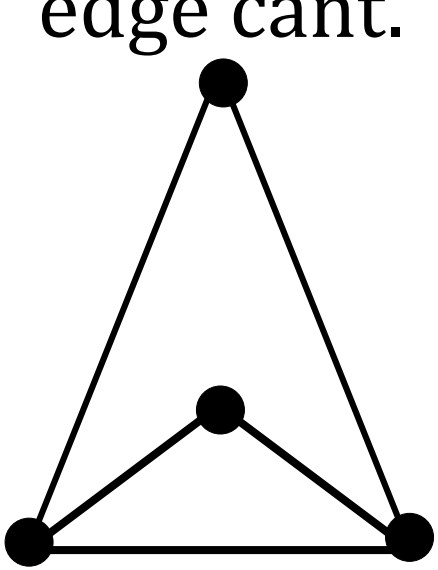
- The city of Königsberg in Prussia was set on both sides of the Pregel River, and included two large islands—Kneiphof and Lomse—which were connected to each other, or to the two mainland portions of the city, by seven bridges. The problem was to devise a walk through the city that would cross each of those bridges once and only once.
- By way of specifying the logical task unambiguously, solutions involving either
- reaching an island or mainland bank other than via one of the bridges, or
- accessing any bridge without crossing to its other end

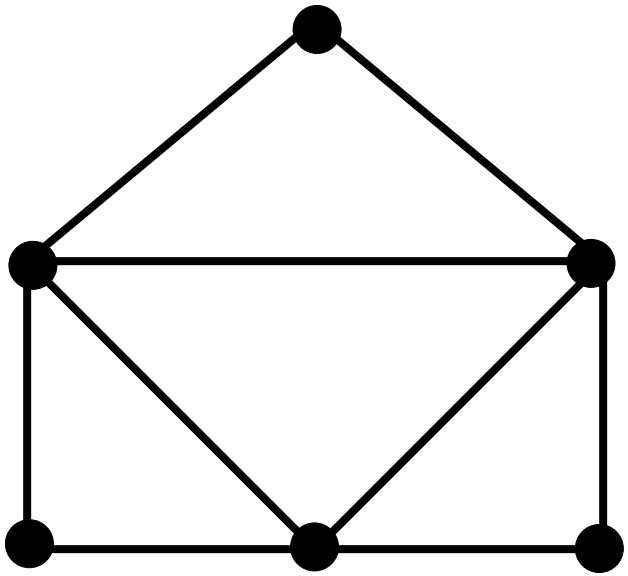




Euler Path

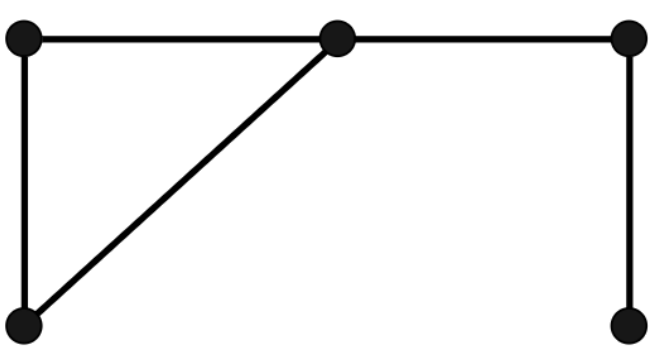
- Euler path is a path that traverses each edge of the graph exactly once and only once.
- In Euler path vertex can be repeated but edge cant.

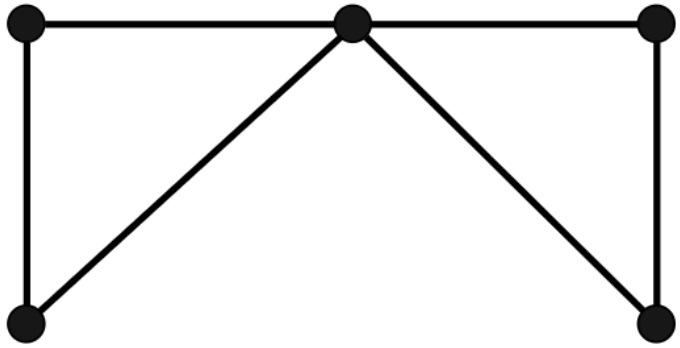


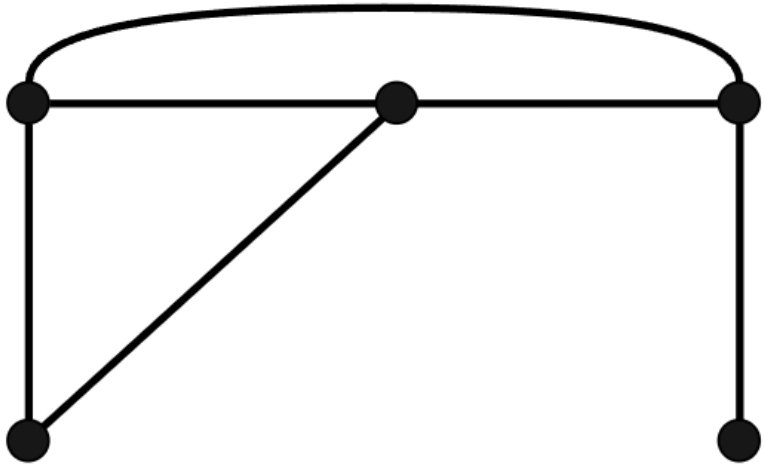


Condition for Euler Path

- A Connected graph is Euler Path if it has exactly 2 odd degree vertices.

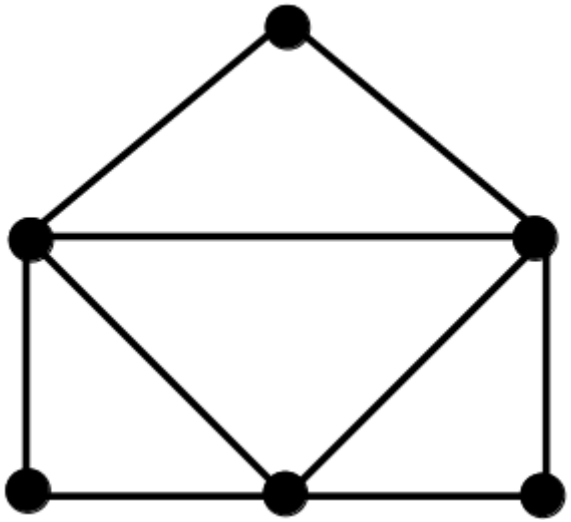






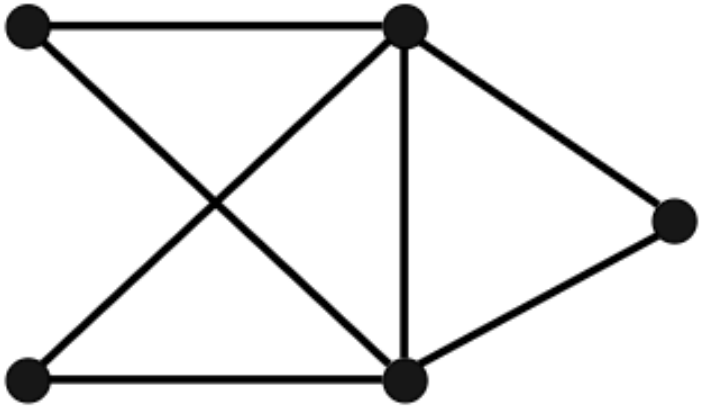
Euler Circuit

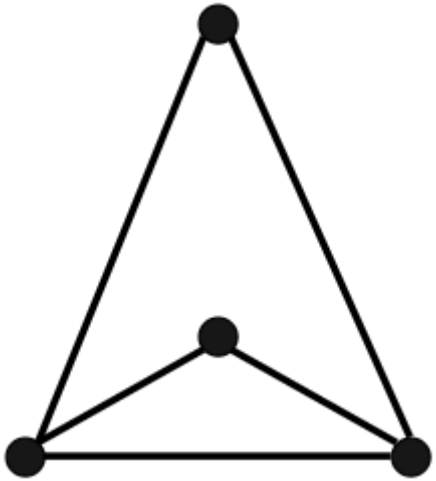
- Euler Circuit is a circuit that traverses each edge exactly once and only once



Condition for Euler Circuit

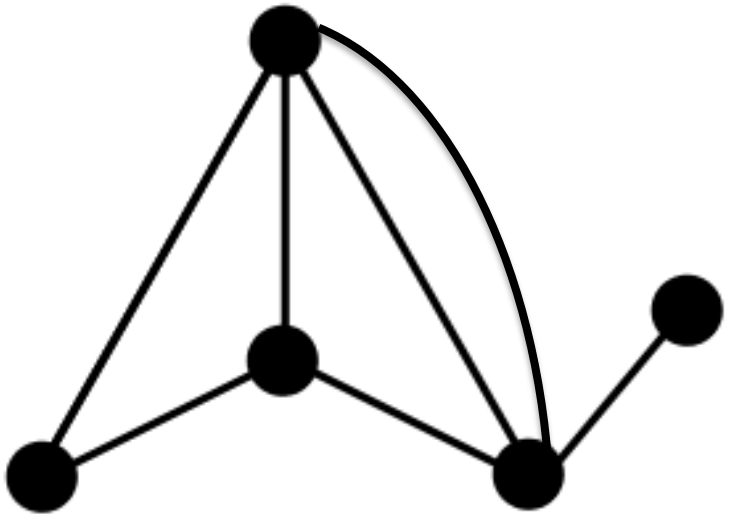
- A connected graph is Euler circuit if each vertex is of even degree.





Question

- Check for Euler Path and Euler Circuit in the following graph



Fleury algorithm

- This algorithm is used to find Euler Circuit or Euler Path in a the given graph
- Make sure the graph has either 0 or 2 odd vertices.
- If there are 0 odd vertices, start anywhere. If there are 2 odd vertices, start at one of them.
- Follow edges one at a time. If you have a choice between a bridge and a non-bridge, always choose the non-bridge.
- Stop when you run out of edges.
- “don’t burn bridges“ so that we can come back to a vertex and traverse remaining edges.

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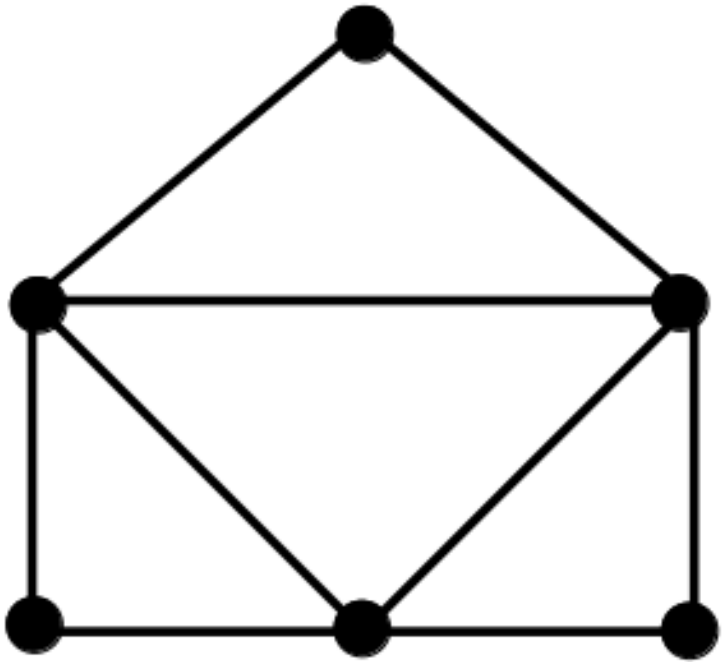
Example on Fleury Algorithm



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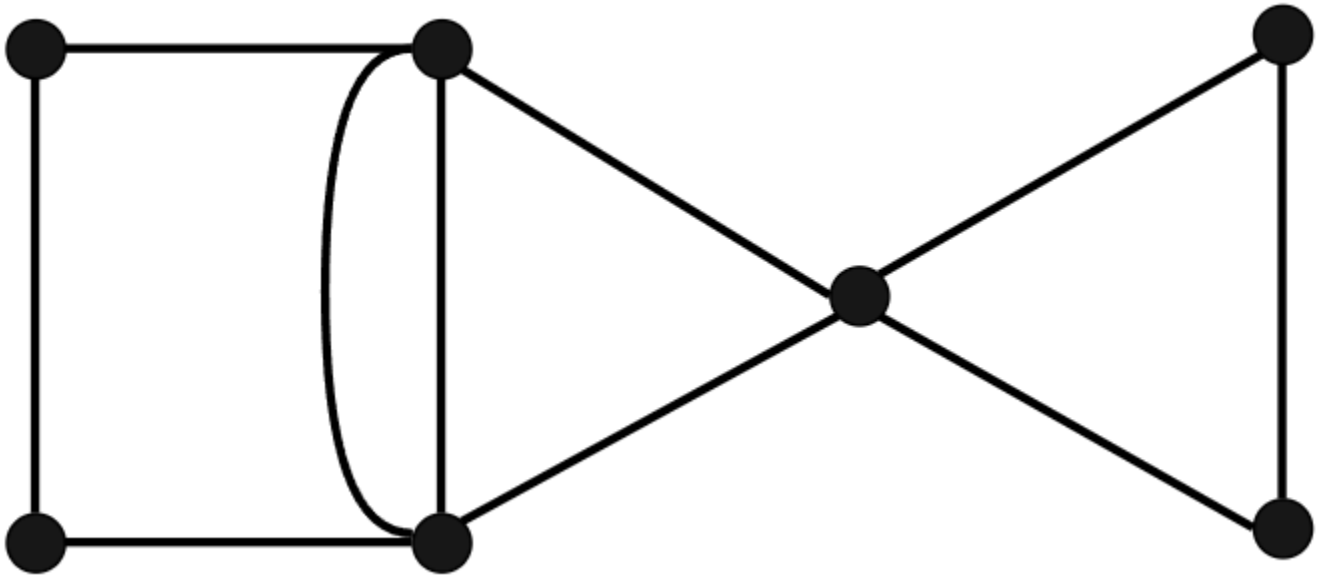

Eulerization

- **Eulerization** : Eulerization is the process of adding edges to a graph to create an Euler circuit on a graph. To eulerize a graph, edges are duplicated to connect pairs of vertices with odd degree. Connecting two odd degree vertices increases the degree of each, giving them both even degree. When two odd degree vertices are not directly connected, we can duplicate all edges in a path connecting the two.

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Example on Eulerization