# Bridges and Articulation points

Bridges in graphs are the edges which it’s deletion cause in disconnecting the graph into two new graphs.

Articulation point in graphs are nodes (vertexes) which it’s deletion cause in disconnecting the graph into two or more new graphs

### **Problem 1:**

Given connected undirected graph G of size n and m edges, find the number of bridges in this graph.

Solution 1 : For each edge try to remove it and check if the graph becomes disconnected

Brute force all edges. Time complexity O(E \* (V + E)) = O(E^2)

Solution 2 :

We will start by Numbering the graph while traversing in the DFS and keep the lowest (according to id) node that the current node can reach. and check if an edge’s two end points are connected only by this edge, if that’s true then this edge is a bridge.

Back edge : is the edge that goes from node v to node u with idx[v] > idx[u] (And u isn’t the parent of v)

Back edge (in code) : is an edge that connected a node to another discovered node in the graph which is not the parent

### **Problem 2:**

Given connected undirected graph G of size n and m edges, find the number of new graph after removing each node

Solution 1 : Try to remove each point and start a DFS from each none visited child

## Problems :

<https://www.spoj.com/problems/EC_P/> //Bridges Implementation

<https://codeforces.com/contest/118/problem/E> // Make edges directed

<https://codeforces.com/problemset/problem/193/A> //Art-points in grid

<https://www.spoj.com/problems/SUBMERGE/> //Art points

<https://www.spoj.com/problems/GRAFFDEF/>  //Probability

<https://codeforces.com/problemset/problem/555/E>

<https://codeforces.com/contest/700/problem/C>

<https://codeforces.com/contest/732/problem/F>

[https://www.spoj.com/problems/ONBRIDGE](https://www.spoj.com/problems/ONBRIDGE/) //Online Bridges

<https://www.hackerearth.com/practice/algorithms/graphs/articulation-points-and-bridges/practice-problems/> //Problem list

<https://codeforces.com/contest/1000/problem/E> //Not straight forward

## Resources :

<https://www.hackerearth.com/practice/algorithms/graphs/articulation-points-and-bridges/tutorial/>

<https://en.wikipedia.org/wiki/Bridge_(graph_theory)>