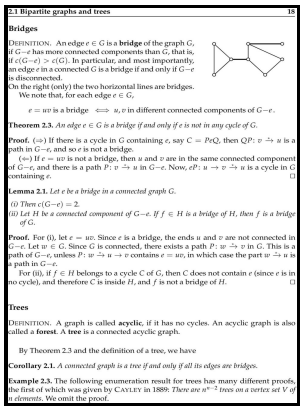
Cycles and bridges in graphs

Kluwer Academic Publishers - Undirected Graphs


2.1 Bipartite graphs and trees 15

Bridges

DEFINITION. An edge $e \in G$ is a **bridge** of the graph G, if $G-e$ has more connected components than G, that is, if $c(G-e) > c(G)$. In particular, and most importantly, an edge e in a connected G is a bridge if and only if $G-e$ is disconnected.
On the right (only) the two horizontal lines are bridges.
We note that, for each edge $e \in G$,

$e = uv$ is a bridge $\iff$ u, v in different connected components of $G-e$.

Theorem 2.3. *An edge $e \in G$ is a bridge if and only if e is not in any cycle of G.*

Proof. ($\Rightarrow$) If there is a cycle in G containing e, say $C = PeQ$, then QP: $v \overset{*}{\to} u$ is a path in $G-e$, and so e is not a bridge.
($\Leftarrow$) If $e = uv$ is not a bridge, then u and v are in the same connected component of $G-e$, and there is a path P: $v \overset{*}{\to} u$ in $G-e$. Now, eP: $u \to v \overset{*}{\to} u$ is a cycle in G containing e. □

Lemma 2.1. *Let e be a bridge in a connected graph G.*

(i) Then $c(G-e) = 2$.
(ii) Let H be a connected component of $G-e$. If $f \in H$ is a bridge of H, then f is a bridge of G.

Proof. For (i), let $e = uv$. Since e is a bridge, the ends u and v are not connected in $G-e$. Let $w \in G$. Since G is connected, there exists a path P: $w \overset{*}{\to} v$ in G. This is a path of $G-e$, unless P: $w \overset{*}{\to} u \to v$ contains $e = uv$, in which case the part $w \overset{*}{\to} u$ is a path in $G-e$.
For (ii), if $f \in H$ belongs to a cycle C of G, then C does not contain e (since e is in no cycle), and therefore C is inside H, and f is not a bridge of H. □

Trees

DEFINITION. A graph is called **acyclic**, if it has no cycles. An acyclic graph is also called a **forest**. A **tree** is a connected acyclic graph.

By Theorem 2.3 and the definition of a tree, we have

Corollary 2.1. *A connected graph is a tree if and only if all its edges are bridges.*

Example 2.3. The following enumeration result for trees has many different proofs, the first of which was given by CAYLEY in 1889: *There are n^{n-2} trees on a vertex set V of n elements.* We omit the proof.

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Mathematics and its applications (East European series) ;Cycles and bridges in graphs
Notes: Includes bibliographical references (p. 245-262) and indexes.
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5.3: Hamilton Cycles and Paths

The problem concerns planar maps—that is, subdivisions of the plane into nonoverlapping regions bounded by simple closed curves. To implement this strategy, we maintain a queue of all vertices that have been marked but whose adjacency lists have not been checked.

algorithm

Notice that perfection and this theorem require in the premise that you can partition the vertices of any induced subgraph of G into a number of cliques given by the independence number of that subgraph. Vertices How many with even degree How many with odd degree 9 10 11 12 13 14 Footnotes Leonhard Euler 1707 - 1783 , a Swiss mathematician, was one of the greatest and most prolific mathematicians of all time.

Bridge (graph theory)

Bridges and articulations points are important because they represent a single point of failure in a network. Thus a bipartite or two colorable graph is one whose vertex set V can be split into two parts, and all edges contain one vertex from each part. Woodall, Circuits containing specified edges, J.

Königsberg bridge problem

Hint 1 using DFS : run DFS from some vertex s and consider the first vertex in DFS that finishes. Design an algorithm to find all of the bridges and bridge components using E + V time plus E + V union-find operations. There is a stronger statement that has been a conjecture for about 40 years but has just recently been proven.

Königsberg bridge problem

Here are some definitions that we use.

Cycles and Bridges in Graphs

Before discussing and proving it we make some remarks, which we will prove 1. On the other hand, if S is a set of k vertices, these conclusions do not necessarily hold, and we characterize the exceptional cases. By removing the edge c, e from the graph, it becomes a disconnected graph.

5.3: Hamilton Cycles and Paths

When you get back to where you start, v would have to have the opposite color than it had at first when the cycle has odd length, and this is a contradiction.

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