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proof that a path connected space is connected

Canonical name	ProofThatAPathConnectedSpaceIsConnected
Date of creation	2013-03-22 12:46:30
Last modified on	2013-03-22 12:46:30
Owner	n3o (216)
Last modified by	n3o (216)
Numerical id	6
Author	n3o (216)
Entry type	Proof
Classification	msc 54D05

Let X be a path connected topological space. Suppose that $X = A \cup B$, where A and B are non empty, disjoint, open sets. Let $a \in A$, $b \in B$, and let $\gamma : I \rightarrow X$ denote a path from a to b .

We have $I = \gamma^{-1}(A) \cup \gamma^{-1}(B)$, where $\gamma^{-1}(A), \gamma^{-1}(B)$ are non empty, open and disjoint. Since I is connected, this is a contradiction, which concludes the proof.