Let C be a nonempty closed bounded subset of the real line and $f : C \to C$ be a nondecreasing continuous function. Show that there exists a point $p \in C$ such that $f(p) = p$.
(A set is closed if its complement is a union of open intervals. A function g is nondecreasing if $g(x) \leq g(y)$ for all $x \leq y$.)