A Minimal Counterexample Proof is one where you show that some result must be true because if there were a minimal counterexample that would be contradictory. While not every proof by contradiction is a minimal counterexample proof, many are. The first proof in DAM of the Euler Cycle Theorem is such a proof. Here is another; compare with the direct induction proof of the same result in DAM (p145).

**Theorem.** In every round-robin tournament, the teams may be ordered so that each team beat the next one in the ordering.

**Proof.** Suppose not. Let $n$ be the minimum number of teams for which there is a round-robin tournament $T$ in which no such ordering exists. Then $n \geq 2$ since such an ordering exists (vacuously) for $n = 1$.

Temporarily ignore one team $t$. Then by minimality, the subtournament on the remaining teams has such an ordering. Now recall $t$. It can’t be that $t$ beat the first team in the ordering, for then putting $t$ ahead of it creates the nonexistent ordering in $T$. For the same reason, it can’t be that there are two teams $t_k$ and $t_{k+1}$ in the ordering such that $t_k$ beat $t$ and $t$ beat $t_{k+1}$. But this means that all the other teams in $T$ beat $t$. That can’t be either, for then putting $t$ last creates the nonexistent ordering in $T$. Therefore it is impossible for $T$ to exist, i.e., the existence of a minimal counterexample is a contradiction. ■