Solution for Weekly Proof 3

We supposedly "proved" that if we can show the conclusion holds for $n = k$, then it must hold for $n = k + 1$. The flaw is that this statement is not true when $k = 1$. Let's investigate that.

In the above proof I have written: "since we know that $k - 1$ of these people have blond hair, it follows that everybody in this group must have blond hair." We use the fact that there are $k - 1$ people common to the two groups we considered: the one where Patrick is excluded, and the one where Patricia is excluded. So these $k - 1$ people who belong to both groups must have the same colour hair as Patrick, *and* the same colour hair as Patricia. The overlap between these two "sets" of people enables us to justify why Patrick and Patricia have the same hair colour as everyone else. However, if $k = 1$, there is no overlap between these two groups, so we cannot use this argument. To illustrate, if Patrick has blond hair and Patricia has green hair, then there is no way we can correctly argue that these two people have the same hair colour, because they do not! Note: the induction hypothesis for $k = 1$ is a useless statement (obviously in a group of one, every person in that group has the same hair colour as everybody else), so that does not tell us anything.