Let $G$ be a non-elementary two generator subgroup of $\text{PSL}(2, \mathbb{R})$. The discreteness algorithm determines whether or not $G$ is discrete. It has both a geometric and an algebraic formulation. We re-interpret the algorithm as a type of Euclidean Algorithm using non-Euclidean distances given by translation lengths. The geometric discreteness algorithm thus becomes a non-Euclidean Euclidean algorithm. We show that this formulation of the algorithm simplifies the Gilman-Jiang proof of polynomial time complexity. (Received July 19, 2010)