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It is well known that any polycyclic group, and hence any finitely generated nilpotent group, can be embedded in $GL_n(\mathbb{Z})$ for some $n \in \mathbb{N}$; that is, each element in the group has a unique matrix representation. In this talk, we will describe an algorithm (due to W. Nickel) that determines this embedding. We determine the complexity of the crux of the algorithm and the dimension of the matrices produced. (Received February 10, 2013)