**Abstract:** Arithmetic homogeneous spaces and their quotients are ubiquitous in number theory. All-important examples are the modular curve, more general Shimura varieties, and the space of lattices in the Euclidean space of a fixed dimension. In this talk we will discuss questions about equidistribution of arithmetic objects on homogeneous spaces. These objects often arise as periodic orbits of actions by an algebraic group. Some of the most interesting actions on homogeneous spaces, from an arithmetic point of view, are those of diagonalizable groups, viz. algebraic tori. They are related, inter alia, to Galois orbits of special points on Shimura varieties, such as the Heegner points on the modular curve. These actions also generalize the geodesic flow on a hyperbolic manifold.

The orbits of diagonalizable group actions on homogeneous spaces remain mysterious. I will review several outstanding questions about equidistribution of periodic orbits for higher rank diagonalizable groups and some major challenges they pose. I will then discuss recent progress based on a fusion of ideas from homogeneous dynamics, arithmetic and automorphic forms.