Mathematics Colloquium

University of Texas at Arlington - Department of Mathematics
Proudly Presents:

Dr. Edray Herber Goins

Pomona College

March 27th, 2026
2 pm – 3 pm
Pickard Hall 309

"What are Adinkras? A Mathematician's Tour of a Physicist's ``Theory of Everything''"

Abstract:

It is widely believed that there are four Fundamental Forces in nature: gravity, electromagnetism, the strong nuclear force, and the weak nuclear force. Today, many physicists are searching for a ``Theory of Everything'', namely, a Grand Unified Theory (GUT) which explains all of these forces at once.

The Standard Model asserts that these forces can be described by the exchange of certain elementary particles. Indeed, matter consists of ``fermions'' (e.g., the electron), while force is carried by ``bosons'' (e.g., electricity is just the exchange of photons). One way to think of these forces is by their related symmetries on the bosons: General Relativity asserts that gravity corresponds to the Lorentz group $O(3,1)$; Quantum Electrodynamics (QED) asserts that electromagnetism to the unitary group $U(1)$; Quantum Chromodynamics (QCD) asserts that the strong nuclear force to $SU(3)$; and Electroweak Theory asserts that the weak nuclear force to $SU(2) \times U(1)$. One candidate for GUT corresponds to irreducible representations of the Lie group $SO(10)$.

String Theory is another possible candidate. It relies on the principle of Supersymmetry (SUSY), namely that there exists a symmetry between bosons and fermions. Simply put, the equations for force and the equations for matter should be identical. To create a theory of SUSY, one is forced to move from representations of Lie algebras to introducing Lie superalgebras. In 2004, physicists Michael Faux and Jim Gates invented Adinkras as a way to better understand representations of such superalgebras. These are bipartite graphs whose vertices represent bosons and fermions and whose edges represent operators which relate the particles.

In this talk, we give a friendly tour of the mathematics employed for a ``Theory of Everything''. In the first part, we review some Representation Theory, explaining how irreducible representations of some Lie groups explain the existence of some interesting particles. In the second part, we review form Graph Theory, explaining how Adinkras limit the possible representations of certain Lie superalgebras. We do not assume any prior knowledge of physics, representation theory, or graph theory.

Refreshments before the talk and socializing following the talk
http://www.uta.edu/math/seminars