**COLLOQUIUM**

Department of Computer Science and Engineering

University of South Carolina

**A Proposed Numerical Data Standard Supporting Automated Network Cluster Analytics**

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# Abstract

A standard is proposed for all numeric data that tightly integrates (1) each numerical value with (2) its units, (3) accuracy (uncertainty) level, and (4) defining metadata into a new object called a MetaNumber (MN) with full mathematical processing of dimensional and error analysis along with full management of associated defining metadata tags. This lays a foundation for fully automated processing by intelligent agents. This MN standard has been designed, programed, and is now operational on a server in a Python environment as a multiuser cloud application using any internet linked device. Both transactional computations and API calls are supported. All numeric data is easily readable by both humans and computers and every data value has a unique name which can serve as its variable name in computation. Two examples are then explored of how such a data standard can support new AI directions and Big Data applications with: (1) automated cluster analysis of the associated derived networks using our theorems based upon Markov type Lie algebras and groups and (2) with additional cluster analysis, the tracking of computational processes identifying the underlying mathematical structures, core constants, component data, and user models. The MN design creates a network of all linked clusters of numerical information and computational processes providing a new vision of our “numerical universe”. The system has extensive applications to business, scientific, and industrial processing with fully automated data exchange.

**Joseph E. Johnson** is a Distinguished Professor Emeritus in the Department of Physics at University of South Carolina. Dr. Johnson's primary research interest is theoretical physics and information theory with specialization in the foundations of relativistic quantum theory utilizing Lie Algebras where his initial work developed a new formulation of relativistic position operators thus generalizing the Poincare group. Later he found a new method of decomposing the Lie group and algebra for the most general linear transformation group in n dimensions into a scaling algebra and an n(n-1)-dimensional Markov type Lie algebra. This latter algebra, when restricted using a particular Lie basis, generates all possible continuous Markov transformations. This is instrumental in the study of entropy, information theory, and diffusion. One of his most important discoveries was that the Markov algebra is exactly isomorphic to all possible networks. This now allows the power of Lie groups and algebras to link to the theory of Markov transformations, and likewise to the full theory of networks and their classifications. He has developed an expansion of an arbitrary network as a series of Renyi’ entropy metrics with decreasing term importance and full network information similar to a Fourier expansion. His USC R&D team (the Advanced Solutions Group – www.asg.sc.edu ) developed advanced software systems for which he was the sole PI for over 120 grants for $14M between 1992 to 2012 to USC. His funding by DARPA, with $2.4M in 2004-2007, funded investigations in Markov entropy metrics and clustering for analyzing networks. Currently his work concentrates on (1) the proposed numerical metadata system www.metanumber.com, (2) the QRECT classroom system that uses advanced expert algorithms for self-correcting systems to determine optimal responses, (3) the mathematical foundations of networks and cluster analysis, and (4) a proposed methodology for the integration of general relativity with quantum theory (May 5, 2016 Colloquium in Physics). He just presented a paper titled: “Clustering and Network Analysis as a Data Analytic Tool” at the American Physical Society national annual meeting in Salt Lake City Utah. He currently is the PI for three active grants: Aspire 1, Aspire II, and SC Floods.