

NATIONAL UNIVERSITY OF SINGAPORE

School of Computing

C S S E M I N A R

Title: **Maximizing Information per Bit: A New Approach to the Design of Numerical Computing Systems**

Speaker: Dr. John L. Gustafson
 Visiting Professor in School of Computing

Date/Time: 6 May 2016, Friday, 10:00 AM to 12:00 PM

Venue: SR@LT19 (COM2, Level 1)
 http://www.comp.nus.edu.sg/images/resources/content/mapsvenues/COM2_Level1.jpg

Chaired by: Dr Gustafson, John L., Visiting Professor, School of Computing
 (john@comp.nus.edu.sg)

Abstract:

Claude Shannon laid down principles for maximizing the information per bit in communication protocols. A different set of rules can help us design numerical representations that have at least twice as much information per bit as conventional IEEE floating-point numbers.

A radical new approach, "unums 2.0," breaks IEEE compatibility but yields high energy efficiency and information-per-bit, with no penalty for decimal operations instead of binary, rigorous bounds on answers without the overly pessimistic bounds produced by interval methods, and unprecedented high speed up to some precision. Unlike the original unum definition with variable-sized operands, this approach is very hardware-friendly and potentially 10 to 100 times as fast as float arithmetic. As an example of the power of this format, a difficult 12-dimensional nonlinear robotic kinematics problem that has defied solvers to date is quickly solvable with absolute bounds. The approach shows the possibility of creating software-defined numeric systems that can be tailored by a compiler for particular applications, further maximizing information per bit.

Biodata:

Dr. John L. Gustafson is a Visiting Professor in SoC at NUS. He is a former Director at Intel Labs and former Chief Product Architect at AMD. A pioneer in high-performance computing, he introduced cluster computing in 1985 and first demonstrated scalable

massively-parallel performance on real applications in 1986, for which he won the inaugural ACM Gordon Bell Prize. "Gustafson's law" is named for a principle he created for that achievement, He is an honors graduate of Caltech and recipient of the IEEE Computer Society's Golden Core Award.