UNCLASSIFIED

Information Science and Technology Seminar Speaker Series and Data Science at Scale Summer School Speaker Series

John L. Gustafson
Ceranovo, Inc.

The End of Numerical Error

Wednesday, October 8, 2014

3:00 - 4:00 PM

TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: It is time to overthrow a century of methods based on floating point arithmetic. Current technical computing is based on the acceptance of rounding error using numerical representations that were invented in 1914, and acceptance of sampling error using algorithms designed for a time when transistors were very expensive. By sticking to an antiquated storage format (now codified as an IEEE standard) well into the exascale area, we are wasting power, energy, storage, bandwidth, and programmer effort. The pursuit of exascale floating point is ridiculous, since we do not need to be making 10^18 sloppy rounding errors per second; we need instead to get provable, valid results for the first time, by turning the speed of parallel computers into higher quality answers instead of more junk per second.

We introduce the ‘unum’ (universal number), a superset of IEEE Floating Point, that contains extra metadata fields that actually save storage, yet give more accurate answers that do not round, overflow, or underflow. The potential they offer for improved programmer productivity is enormous. They also provide, for the first time, the hope of a numerical standard that guarantees bitwise identical results across different computer architectures. Unum format is the basis for the ‘ubox' method, which redefines what is meant by “high performance” by measuring performance in terms of the information obtained about the answer and not the operations performed per second. Examples for practical application include structural analysis, radiation transfer, the n-body problem, and both linear and nonlinear systems of equations. This is a fresh approach to scientific computing that allows proper, rigorous representation of real number sets for the first time.

Biography: Dr. John Gustafson is an applied physicist and mathematician best known as a disruptive thought leader in High Performance Computing. He introduced cluster computing in 1985 and first demonstrated scalable massively parallel performance on real applications in 1988, for which he won the inaugural Gordon Bell Award. 'Gustafson’s Law’ is taught in computer science courses everywhere. He was Director of the Extreme Research Lab at Intel, where he led their exascale computing program and other energy-efficient computing research. At Sun Microsystems, he led a $50 million supercomputer project centered on breaking the "memory wall". He is the recipient of the IEEE Computer Society’s Golden Core Award. An honors graduate of Caltech and Iowa State University, he has held a number of CTO and CEO positions at publicly held and startup companies, and most recently was Chief Product Architect at AMD, before accepting the CTO role at Ceranovo Inc. in November 2013.

For more information contact the technical host Curt Canada, cvc@lanl.gov, 665-7453.

Hosted by the Information Science and Technology Institute (ISTI)

Los Alamos NATIONAL LABORATORY EST. 1943

Los Alamos Data Science at Scale Summer School

ISTI INFORMATION SCIENCE & TECHNOLOGY INSTITUTE