DOE Office of Advanced Scientific Computing Research (ASCR) Applied Mathematics Research Program – Steven Lee & Bill Spotz

DOE Office of Science ($7B): Delivers scientific discoveries & tools to transform our understanding of nature & advance energy, economic & national security of the US

- Provides ~half of US Federal support for basic research in the physical sciences
- Supports 23,000+ researchers & staff at 300+ institutions and 10 DOE Labs
- World's largest collection of science user facilities operated by one organization

ASCR	Basic Energy Sciences	Biological & Environmental Research	Fusion Energy Sciences	High Energy Physics	Nuclear Physics

ASCR Applied Math lays the algorithm, modeling & simulations groundwork for

- transforming DOE's scientific computing capabilities,
- accelerating the process of scientific discovery, and
- creating AI ecosystems for science at scale

Portfolio of Major Programs (Applied Math Budget: $40M)

- Base Math projects: Linear Algebra, Optimization, PDEs, UQ, Core areas
- Math Postdoc Fellowships for DOE Lab workforce development
- Early Career Research Program for 5-year projects (universities, Labs)
- Multifaceted Mathematics for large collaborative projects & grand challenges
- Scientific Machine Learning and Artificial Intelligence: New awards (FY19, FY20)
- **Algorithms for AI & Data Science at Scale:** New workshop!

Workshop on Randomized Scientific Computing: Algorithms for AI and Data Science at Scale

Purpose: Explore the **use of randomness** as a foundation & key strategy for high-performance scientific computing

Randomized algorithms are transforming scientific computing in

- **AI & Deep Learning**: Stochastic Gradient Descent
- **Data reduction**: Compressive Sensing, Randomized Projections
- **Massive & streaming data analysis**: Randomized Numerical Linear Algebra

Virtual meetings: Winter 2020

Fundamental properties of randomness can be harnessed for other massive data & post-Moore **computational grand challenges**

- High computational complexity and the development of efficient algorithms
- High data dimensionality and finding sparse representations for **data from user facilities**
- Better algorithm scalability for low-power, high-performance **edge computing**
- Reduced ill-conditioning and sensitivity for inverse problems
- Improved algorithm reliability and robustness to noise

Foundational long-term research & plans are needed for **hybrid algorithms** that anticipate massive data & post-Moore computing challenges over the next decade

Chair: Tammy Kolda (Sandia)
Co-Chairs: Aydin Buluc (LBNL), Stefan Wild (ANL)