John Mahoney

DATA SCIENTIST, APPLIED MATHEMATICIAN

Contact

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Education

Ph.D. in Physics
University of California, Davis

"Extensions of the Theory of Computational Mechanics", advisor James P. Crutchfield.

B.S., Physics & Math
CSU, Chico

Interests And Skills

Software Development

- 10 years experience in scientific computing
- Expert in Python
- Experienced in MATLAB
- Familiarity with JavaScript/HTML, C++, SQL, Excel

Research Interests

- machine learning techniques
- time-series, hidden Markov models
- dynamical systems and chaos
- reacting fluid flows
- information theory

Communication

- Skill in communicating technical ideas to expert and non-expert audiences
- Extensive conference presentation and teaching experience
- Authored many peer-reviewed publications.

Projects

Music Theory & Multidimensional Scaling

- Use MDS, PCA, and L_1 metric on musical modes to rediscover the famous circle of fifths.

Kirkwood Gaps

- Discover connection between asteroid-belt gaps and orbital resonance. Explicit construction of integrators.

Simpson's Paradox Interactive Lesson

- Interactive lesson (JavaScript) teaches how data aggregation can lead to trend reversal.

Magnacules

- Engineering design of table-top "magnetic-molecules" through magnetic field simulation.

Burning Invariant Manifolds (closed)

- Compute invariant manifolds that govern evolution of reactions in active fluids.

Computational Mechanics in Python (closed)

- Compute information theoretic and topological measures of stochastic processes.

Experience

Data Science Consultant

Client - Columbia Univ., Dept. of Biomed Informatics, (2017-2018)

- Developed a personalized medicine, machine-learning approach to management of type II diabetes.
- Analyzed irregularly sampled time-series data using time-lagged correlation.
- Developed synthetic data generators to test sensitivity of machine learning methods.

Project Scientist

UC Davis, Department of Physics, (2015-2017)

- Developed Python code for analyzing quantum representations of stochastic processes.
- Demonstrated resource advantages in simulating 1D spin systems and rare-event sampling.
- Lead a group of PhD students.
- co-PI: John Templeton Foundation ($440k); co-PI: FQXi ($73k).

Postdoctoral Scholar

UC Merced, School of Natural Sciences, (2010-2015)

- Built a theory of *active fluids* based on theoretical tools for passive fluid flow: invariant manifolds, lobe dynamics, and finite-time Lyapunov exponents.
- Created MATLAB package for analysis and visualization of active fluids.
- Results impact: combustion system design, mitigation of oceanic algae blooms, path planning in underwater vehicles.
- Grant contributor: NSF ($350k)

Math and Physics educator

UC Davis, CSU Maritime, and Napa Valley CC, (2017-present)

- Created and lead Jupyter-based boot camp on Python and scientific computing for REU Program.
- Inspired students in calculus, statistics, and physics.

Graduate Student Researcher

UC Davis, Department of Physics, (2006-2010)

- Analyzed causal representations of classical stochastic processes using information theory, topology, and automata theory.
- Contributed to in-house Python package: HMMs, causal structures, information measures.
- Implemented efficient algorithm for predictive power of causal structures.
- Investigated time-asymmetry and its relation to causal structure.

UC Davis, Department of Geology, (2007-2010)

- Wrote an interactive Python application with C++ extension to study pattern formation in cyanobacteria.