Alexander G. Gray

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Objective

■ Establish a multi-disciplinary research group at the intersection of advanced statistical learning methods and advanced computational methods, driven directly by outstanding problems in computational science and engineering.

Research Interests

■ Statistical computation and computational statistics, which encompasses:

Statistical learning and data mining. Machine learning, statistics, pattern recognition, large-scale data analysis, AI architectures, syntactic and symbolic methods.

Computational mathematics. Numerical methods, Monte Carlo, computational geometry, optimization, computational logic, search, simulation.

Challenge applications. Examples have included cosmology, drug discovery, genomics, planetary exploration.

In progress: alternatives to maximum likelihood, control and tracking, rendering.

Selected Results

■ **New methods.** Derived the fastest practical algorithms to date for these problems:

- General n-point correlation functions (spatial statistics) [1,7,11, 16,17]
- Multivariate kernel density estimation (nonparametric statistics) [11,12,13, 14,17]
- Exact bichromatic all-k-nearest-neighbors (computational geometry) [4,11, 17]
- Exact nonparametric Bayes classification (pattern recognition) [2]
- Exact k-nearest-neighbor classification (pattern recognition) [5,10] and approximate k-nearest-neighbor (computational geometry) [6] (work led by PhD student Ting Liu)

■ **Applications enabled.** Results enabled by application of my algorithms:

- Largest quasar catalog to date, constituting the deepest/widest mass map of the universe (astronomy) [34,35]
- Significant large-scale evidence explaining elliptical galaxies (astrophysics) [38]
- Most comprehensive third-order statistical comparison of the Standard Model versus observation to date (cosmology) [33]
- Physical evidence of dark energy (cosmology) [Scranton *et al.* 2003]; *Science* Magazine #1 Breakthrough of 2003

Honors

■ **Research awards.**

- SIAM International Conference on Data Mining Best Algorithm Paper Prize, winner 2003 (1 selected from 106 submissions)
- ASA Computational Statistics Student Paper Prize, co-winner 2003
- JPL NOVA Team Award for Multi-Rover Integrated Science Understanding System, co-winner 1999
- JPL NOVA Individual Award for Excellence in Research & Development, winner 1997
- NASA Group Achievement Award for Multimission VICAR Planner, co-winner 1995

■ **Academic awards.** NASA Graduate Research Fellowship. L. Wrasse Scholarship. Fankhauser Scholarship. J. Grossmith Scholarship. Levi Strauss Scholarship. Bank of America Mathematics Scholarship. President's Undergraduate Fellowship. University Scholar. Regents'/Chancellor's Scholarship (full scholarship to UC Berkeley).

EDUCATION

■ **Carnegie Mellon University.** .... Summer 2003-present
Postdoctoral Fellow, *Robotics Institute*, Pittsburgh, PA.
Prof. *Andrew Moore*, supervisor.

Responsibilities: fundamental research in methods for large-scale computational science, (co-)advising of Computer Science students. Significant collaborations and projects:

Pfizer Global Research and Development. Ann Arbor, MI. Computational chemistry and protein modeling for drug design.

- High-throughput screening (metric learning, classification, molecular representations)
- Automatic molecule synthesis (active learning, experiment design)

Pittsburgh Computational Astrostatistics Group. CMU, U. Pittsburgh, U. Portsmouth, Princeton, NCSA. Computational statistics for cosmology, using SDSS.

- Quasar discovery (nonparametric classification)
- Cosmological and astronomical statistics (density estimation, spatial correlations)

Auton Laboratory. CMU.

- Alternatives to MCMC (high-dimensional integration)
- Conception and completion of the Proximity Project, an empirical comparison of the best existing proximity data structures, supervising undergraduates Dongryeol Lee and Christopher Rotella
- Advising of Computer Science undergraduate senior honors thesis of Dongryeol Lee, on N-body algorithms for statistics and computer graphics
- Co-advising of Computer Science PhD student Ting Liu, on algorithms for high-dimensional nearest-neighbor searching and support vector machine prediction

■ **Carnegie Mellon University.** .... Fall 1999-Spring 2003
PhD *Computer Science*, 4/29/03. Pittsburgh, PA.
Committee: *Andrew Moore* (chair), Sebastian Thrun, Larry Wasserman (Statistics), Robert Nichol (Physics), Dennis Decoste (NASA/JPL).

PhD thesis. *Bringing Tractability to Generalized N-body Problems in Statistical and Scientific Computations.* I unified a large class of problems which I call *generalized N-body problems.* These problems have the essential structure of the Coulombic N-body problem of computational physics, consisting of decomposable operators (like summation or maximization) on evaluations of certain kernel or potential functions on n-tuples of points in a D-dimensional metric space. I devised a unified solution approach for this class based on the introduced principle of *higher-order divide-and-conquer*, or divide-and-conquer over multiple sets – in this case over multiple space-partitioning data structures from computational geometry. I used this general strategy to develop new algorithms, which I call *multi-tree methods*, for four problems: all-k-nearest-neighbors, kernel density estimation, n-point correlation functions, and smoothed particle hydrodynamics, demonstrating one to seven orders-of-magnitude speedups over existing methods. I listed over 30 well-known problems to which the methodology is directly applicable.

PhD was completed in 3 years and 8 months. Work was presented in NIPS*2000 plenary-selected talk. Thesis has been invited for possible publication as a book by a major publisher.

■ **University of California, Berkeley.** .... Fall 1988-1993
AB *Applied Mathematics*, AB *Computer Science*, 1993. Berkeley, CA.

Concentration in *Computational Statistics.* Undergraduate research. Graduate coursework in AI and machine learning (at Berkeley and later, at Caltech and USC).

EXPERIENCE

- **NASA Jet Propulsion Laboratory, Caltech.** .... Fall 1993-1999
  Member of Technical Staff, Machine Learning Systems Group. Pasadena, CA.
  Dr. *Usama Fayyad*, supervisor, 1993-1995. Dr. *Paul Stolorz*, supervisor, 1996-1999.

  Responsibilities: machine learning algorithm design and software engineering, solving real scientific data mining problems with working systems, working closely with scientists and other domain experts. Significant collaborations and projects:

  Caltech Astronomy Dept., Djorgovsky Group. Pasadena, CA.
  - POSS-II star/galaxy classification (decision trees) (SKICAT)
  - POSS-II galactic morphology clustering and exploratory data analysis (mixture models, online clustering, dendrograms, parallel EM) (SKICLUST)

  Caltech Biology Dept., Wold Group. Pasadena, CA.
  - Microarray clustering and gene regulation network induction (multi-parent clustering, statistical physics methods)

  Abbott Laboratories. Pasadena, CA.
  - Blood-glucose prediction (neural networks) (BGM)

  Advanced Rovers Group, JPL/NASA.
  - Multi-rover autonomous team exploration for Mars geology (integrating learning and planning, distributed mixture models) (MISUS)

  Computer Vision Group, JPL/NASA.
  - Computer vision for autonomous vehicles (parallel stereo)

  Artificial Intelligence Group, JPL/NASA.
  - Task sequencing for image processing (partial-order planning) (MVP)

  General Motors R & D Center. Warren, MI.
  - Automotive fault diagnosis (rule induction) (MLTT)

  Quantum Computing Group, JPL/NASA.
  - Automated quantum circuit design (genetic programming operators)

  Ultracomputing Group, JPL/NASA.
  - El Niño climate prediction (neural networks, autoregressive models, dynamical systems methods)

  Machine Learning Systems Group, JPL/NASA.
  - Anomaly detection for spacecraft monitoring (hidden Markov models, hierarchical mixture of experts) (ELMER)
  - Exploratory data analysis of asteroid belts (kernel density estimation)
  - Fault detection in antenna systems (hidden Markov models)
  - Volcano recognition in Venus geology images (principal components analysis) (JARtool)
  - Data analysis software infrastructure (compiler generation) (Pleodata)

- **Simulation Laboratories.** .... Summer 1992
  Mr. James Kalin, supervisor. Epidemiological simulations. Berkeley, CA.

- **Los Alamos National Laboratory & Santa Fe Institute.** .... Summer 1991
  Dr. Alan Lapedes, supervisor. Protein structure prediction. Los Alamos, NM.

- **Software and Hardware Reliability, Inc.** .... Summer 1990
  Dr. Myron Hecht, supervisor. Powerplant fault tolerance. Beverly Hills, CA.

CONSULTING

- 10 years experience in applied statistical learning for first-of-a-kind science and engineering applications, in over 20 major projects.

  Over 20 years programming. Highly skilled in C, Matlab. Experience with Mathematica, Prolog, lex/yacc, Unix tools. Exposure to at least 30 other languages and numerous platforms from CP/M to Cray. Facility with MEX, PVM and MPI, Numerical Recipes, proprietary DA, and Auton libraries.

- **NASA Ames Research Center, QSS.** 2002
  Research Consultant, Automated Software Engineering Group. Moffett Field, CA.
  Dr. *Bernd Fischer*, supervisor.

  Responsibilities: machine learning algorithm design and software engineering on the ambitious AutoBayes Project begun by Dr. Wray Buntine in 1995.

- **Utopia Compression Corporation.** .... Fall 2003
  Dr. Jacob Yadegar, supervisor. Prediction in image compression. Los Angeles, CA.

- **Clairvoyance Corporation.** .... Winter 2002
  Dr. David Evans, supervisor. Prediction in natural language processing. Pittsburgh, PA.

PROFESSIONAL SERVICE

- **Teaching.** Course TA, graduate Machine Learning, CMU CS Dept., Fall 2001. Course TA, undergraduate Database Applications, CMU CS Dept., Fall 2001.

- **Academic community.** Co-organizer of CMU Machine Learning Lunch seminar, 2002-present. Organizer of CMU Robot Learning talks, 2000-2001. Member of CMU CS Dept. Doctoral Review Committee, 1999-2003. Member of UC Berkeley CS Dept. Curriculum Committee, 1993. Co-editor of *Cal Sciences*, the Berkeley Undergraduate Science Journal, 1992.

- **Research community.** Conference Webmaster for NIPS*2002, NIPS*2001, NIPS*2000, KDD-98, and KDD-97. Reviewer for AAAI-05, JMLR (Journal of Machine Learning Research), JAIR (Journal of Artificial Intelligence Research), DMKD (Data Mining and Knowledge Discovery) Journal, PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence). Current or former member of SIAM (Society of Industrial and Applied Mathematics), ACM (Association of Computing Machinery), ASA (American Statistical Association), Interface Society (statistics and computing), IASC (International Association for Statistical Computing), ENAR (International Biometric Society), ISCB (International Society for Computational Biology). Elected to Sigma Xi Scientific Research Society.

RESEARCH PAPERS

- **Computational and statistical methods**

  COMPUTATIONAL METHODS

  [1] **Computing n-Point Correlation Functions on Large Datasets**. Gray, A. G., Moore, A. W., Nichol, R., Connolly, A., Genovese, C., Grone, L., Kanidoris II, N., Kulkaurni, G., Miller, C., Schneider, J., Szalay, A., Szapudi, I., Wake, D., and Wasserman, L., to be submitted to *Science*, 2005.

  [2] **Massive-Scale Nonparametric Bayes Classification for Quasar Discovery**. Gray, A. G., Richards, G., Nichol, R., Brunner, R., and Moore, A. W., to be submitted to *International Conference on Knowledge Discovery and Data Mining*, 2005. See [34].

  [3] **FIRE: Function Integration by Reconstruction**. Gray, A. G., to be submitted to *International Conference on Machine Learning*, 2005.

[4] **Nearest Neighbor Searching in Practice: A Selective Survey/Comparison, Code, Insights, and Fast New Methods**. Gray, A. G., Lee, D., Rotella, C., and Moore, A. W. Carnegie Mellon University Auton Laboratory internal report, 2004, to be submitted to *SIAM Review*, 2005.

[5] **New Algorithms for Efficient High-Dimensional Nonparametric Classification**. Liu, T., Moore, A. W., and Gray, A. G. *Journal of Machine Learning Research*, accepted 2004 (to appear 2005). Journal version of [10].

[6] **An Investigation of Practical Approximate Nearest Neighbor Algorithms**. Liu, T., Moore, A. W., Gray, A. G., and Yang, K., in *Advances in Neural Information Processing Systems 17*, 2004 (proceedings will appear in 2005). Selected for brief plenary oral presentation.

[7] **Fast Computation of the Pair Correlation and n-Point Correlation Functions**. Gray, A. G. and Moore, A. W. In *Conference on Computational Physics*, 2004. Selected for plenary oral presentation.

[8] **Fast Kernel Matrix-Vector Multiplication with Application to Gaussian Process Regression**. Gray, A. G., Carnegie Mellon University Computer Science Department Technical Report TR CMU-CS-04-110, 2004. [unrefereed]

[9] **Data-dependent Algorithmic Analysis for Proximity Searching in Arbitrary Dimension**. Gray, A. and Moore, A. W. Carnegie Mellon University Computer Science Department Technical Report TR CMU-CS-04-108, 2004. [unrefereed]

[10] **New Algorithms for Efficient High-Dimensional Nonparametric Classification**. Liu, T., Moore, A. W., and Gray, A. G. In *Advances in Neural Information Processing Systems 16*, 2003 (proceedings appeared 2004).

[11] **Bringing Tractability to Generalized N-body Problems in Statistical and Scientific Computations.** Gray, A. G., PhD thesis, Carnegie Mellon University Computer Science Department, 2003. [unrefereed]

[12] **Very Fast Multivariate Kernel Density Estimation via Computational Geometry**. Gray, A. G. and Moore, A. W. In *Proceedings of the ASA Joint Statistical Meeting*, 2003. Co-winner of ASA Computational Statistics Paper Prize.

[13] **Rapid Evaluation of Multiple Density Models**. Gray, A. G. and Moore, A. W. In *Artificial Intelligence and Statistics*, 2003. Selected for plenary oral presentation.

[14] **Nonparametric Density Estimation: Toward Computational Tractability**. Gray, A. G. and Moore, A. W. In *SIAM International Conference on Data Mining*, 2003. Winner of Best Algorithm Paper Prize.

[15] **Automatic Derivation of Statistical Algorithms: The EM Family and Beyond**. Gray, A. G., Fischer, B., Schumann, J., and Buntine, W. In *Advances in Neural Information Processing Systems*, 2002 (proceedings appeared 2003).

[16] **Fast Algorithms and Efficient Statistics: n-Point Correlation Functions**. Moore, A. W., Connolly, A., Genovese, C., Gray, A., Grone, L., Kanidoris II, N., Nichol, R., Schneider, J., Szalay, A., Szapudi, I., and Wasserman, L. In *Proceedings of MPA/MPE/ESO Conference on Mining the Sky*, 2000.

[17] **'N-Body' Problems in Statistical Learning**. Gray, A. G. and Moore, A. W. In *Advances in Neural Information Processing Systems 13*, 2000 (proceedings appeared 2001). Selected for plenary oral presentation.

[18] **Derivation of the EM Algorithm for Mixture Models for Parallel Computers**. Gray, A. G. Jet Propulsion Laboratory Machine Learning Systems Group internal report, 1998. [unrefereed]

Statistical methods

[19] **Probabilistic Classification in High Dimensions, With Application to Drug Discovery**. Gray, A. G., Komarek, P., Liu, T., and Moore, A. W. *International Symposium on Computational Statistics*, 2004. Selected for plenary oral presentation.

[20] **Multi-Parent Clustering Algorithms for Large-Scale Gene Expression Analysis**. Mjolsness, E., Castaño, R., Gray, A. G. Jet Propulsion Laboratory Technical Report JPL-ICTR-99-5, 1999. [unrefereed]

[21] **Blind Rule Induction: A Simple Idea for Exploratory Data Analysis.** Gray, A. G. and Smyth, P. Jet Propulsion Laboratory Machine Learning Systems Group internal report, 1998. [unrefereed]

[22] **Retrofitting Decision Tree Classifiers Using Kernel Density Estimation**. Smyth, P., Gray, A. G., and Fayyad, U. In *Proceedings of the Twelfth International Conference on Machine Learning*, 1995.

■ Next-generation engineering systems

Autonomous systems for science

[23] **An Integrated System for Multi-Rover Scientific Exploration**. Estlin, T., Gray, A. G., Mann, T., Rabideau, G., Castaño, R., Mjolsness, E., and Chien, S., in *Proceedings of the Seventeenth National Conference on Artificial Intelligence (AAAI)*, 1999.

[24] **An Integrated Architecture for Cooperating Rovers**. Estlin, T., Hayati, S., Jain, A., Yen, J., Rabideau, G., Castano, R., Petras, R., Peters, S., Decoste, D., Tunstel, E., Chien, S., Mjolsness, E., Steele, R., Mutz, D., Gray, A. G., Mann, T., in *International Symposium on Artificial Intelligence Robotics and Automation in Space (ISAIRAS)*, 1999.

Advanced computer systems

[25] **Profetching: Profile-based Prefetching for Pointer-Based Data Accesses**. Gray, A. G. and Jensen, R. Carnegie Mellon University Computer Science Department 15-745 graduate course report, 2001. [unrefereed]

[26] **StatMax: A Novel Scheme for Dynamic Routing with Automatic Load Balancing**. Agrawal, M., Gray, A. G., Konemann, J., and Schroeder, B. Carnegie Mellon University Computer Science Department 15-744 graduate course report, 2001. [unrefereed]

[27] **Automated Design of Quantum Circuits**. Williams, C. P., and Gray, A. G. In Williams, C. W., Zak, M., Gulati, S., editors, *Lecture Notes in Computer Science*, Special Issue on Quantum Computing and Quantum Communications. Springer-Verlag, 1998.

■ Computational science by data mining

Computational biology, biochemistry, medicine

[28] **Drug Screening by Nonparametric Posterior Estimation**. Gray, A. G., Komarek, P., Liu, T., and Moore, A. W. *International Biometric Society ENAR Spring Meeting* 2004, and Carnegie Mellon University Computer Science Department Technical Report TR CMU-CS-04-109. [unrefereed]

[29] **Clustering Methods for the Analysis of *C. elegans* Gene Expression Array Data**. Mjolsness, E., Castaño, R., Mann, T., Roden, J., Gray, A. G., and Wold, B. In *Proceedings of Pacific Symposium on Biology*, 1999.

[30] **Noninvasive Monitoring of Blood-Glucose Levels with Conjugate Gradient-Based Neural Networks**. Gray, A. G. and Roden, J. Jet Propulsion Laboratory Machine Learning Systems Group internal report, 1996. [unrefereed]

Computational climatology, planetary geology

[31] **Hypothesis-driven Active Data Analysis of Geological Phenomena Using Semi-Autonomous Rovers: Exploring Simulations of Martian Hydrothermal Deposits**. Davies, A. G., Mjolsness, E., Gray, A. G., Mann, T., Castaño, R., Estlin, T., and Saunders, S. In *American Geophysical Union Spring Meeting*, 1999.

[32] **Prediction of El Niño Events based on Sea Surface Temperature Dynamics**. Gray, A. G. and Zak, M. Jet Propulsion Laboratory Machine Learning Systems Group internal report, 1998. [unrefereed]

Computational cosmology, astronomy, astrophysics

[33] **The Three-Point Correlation Function of the Sloan Digital Sky Survey Galaxy Sample**, Nichol, R., Blanton, M., Connolly, A., Gardner, J., Gray, A. G., Jain, B., Kayo, I., Kulkarni, G., Moore, A., Pope, A., Schneider, J., Sheth, R., Suto, Y., Szalay, A., Szapudi, I., Zehavi, I., submitted to *Astrophysical Journal Letters*, 2004.

[34] **Efficient Photometric Selection of Quasars from the Sloan Digital Sky Survey: 100,000 $z < 3$ Quasars from Data Release One**. Richards, G., Nichol, R., Gray, A. G., Brunner, R., Lupton, R., Vanden Berk, D., Chong, S., Weinstein, M., Schneider, P., Anderson, S., Munn, J., Harris, H., Strauss, M., Fan, X., Gunn, J., Ivezic, Z., York, D., Brinkmann, J., *Astrophysical Journal Supplement*, 155:257-269, 2004. Journal version of [35].

[35] **Efficient Color Selection of Faint Quasars from SDSS Imaging: Toward 1,000,000 SDSS Quasars**. Richards, G., Nichol, R., Gray, A. G., Brunner, R., Lupton, R., Vanden Berk, D. In *The 194th Meeting of the American Astronomical Society*, Bulletin of the American Astronomical Society Series, 2004.

[36] **The Clustering of Active Galactic Nuclei in the Sloan Digital Sky Survey**, Wake, D., Miller, C., Di Matteo, T., Nichol, R., Pope, A., Szalay, A., Gray, A., Schneider, D., York, D., *Astrophysics Journal Letters*, 610:L85-L88, 2004.

[37] **Multi-Tree Methods for Statistics on Very Large Datasets in Astronomy**. Gray, A., Moore, A. W., Nichol, R., Connolly, A., Genovese, C., and Wasserman, L. In *Astronomical Data Analysis Software and Systems XIII ASP Conference Series*, 2003 (proceedings appeared 2004). Selected for plenary oral presentation..

[38] **Galaxy Ecology: Groups and Low-Density Environments in the SDSS and 2dFGRS**, Balogh, M., Eke, V., Miller, C., Lewis, I., Bower, R., Couch, W., Nichol, R., Bland-Hawthorn, J., Baldry, I.K., Baugh, C., Bridges, T., Cannon, R., Cole, S., Colless, M., Collins, C., Cross, N., Dalton, G., De Propris, R., Driver, S. P., Efstathiou, G., Ellis, R.S., Frenk, C.S., Glazebrook, K., Gomez, P., Lahav, O., Lumsden, S., Maddox, S., Madgwick, D., Norberg, P., Gray, A. G., Hawkins, E., Jackson, C., Peacock, J.A., Percival, W., Peterson, B.A., Sutherland, W., and Taylor, K., *Monthly Notices of the Royal Astronomical Society*, Vol. 348, p. 1355, 2004.

[39] **Mining for Galaxy Anomalies in Color-Color Spaces**. Gray, A. G., Fasnacht, M., and Shern, R., Carnegie Mellon University Computer Science Department 16-732 graduate course report, 1999. [unrefereed]

[40] **Data-Mining a Large Digital Sky Survey: From the Challenges to the Scientific Results**. Djorgovski, S.G., de Carvalho, R.R., Odewahn, S.C., Gal, R.R., Roden, J., Stolorz, P., and Gray, A. G., In *Applications of Digital Image Processing XX*, Proceedings of SPIE 3164, 1997.

[41] **Towards an Objectively Defined Catalog of Galaxy Clusters from the Digitized POSS-II**. de Carvalho, R.R., Djorgovski, S.G., Pahre, M., Gal, R.R., Gray, A. G., and Roden, J. In *Proceedings of the 2nd Conference on Wide-Field Spectroscopy*, Astrophysics and Space Science Library, 1997.

[42] **Analysis of Digital POSS-II Catalogs Using Hierarchical Unsupervised Learning Algorithms**. Yoo, J.P., Gray, A.G., Roden, J., and Fayyad, U.M. In *Astronomical Data Analysis Software and Systems V ASP Conference Series*, Vol. 101, 1996.

[43] **Clustering Analysis Algorithms and Their Applications to Digital POSS-II Catalogs**. de Carvalho, R.R., Djorgovski, S.G., Weir, N., Fayyad, U., Cherkauer, K., Roden, J., and Gray, A. G. In *The 185th Meeting of the American Astronomical Society*, Bulletin of the American Astronomical Society Series, 1995.

Selected Talks

- **Invited talks.**
  - **Neural Information Processing Systems 04**, Workshop on Fast N-body Learning, Vancouver, Canada, Dec. 2004 (2 talks).
  - **UCLA Institute for Pure and Applied Mathematics**, Workshop on Multiscale Geometric Methods in Astronomical Data Analysis, Nov. 2004.
  - **Sloan Digital Sky Survey Fall Meeting**, Pittsburgh, PA, Oct. 2004.
  - **UCLA Institute for Pure and Applied Mathematics**, Workshop on Multiscale Structures in the Analysis in High Dimensional Data, Oct. 2004.
  - **Stanford University Statistics Department**, Department Seminar, Mar. 2004.
  - **Univ. Maryland Center for Scientific Computation and Mathematical Modeling**, Workshop on Fast Multipole Methods, Tree-Codes, and Related Approximate Algorithms, Apr. 2004.

- **Tutorial for the field.**
  - **International Conference on Machine Learning 04**, "Data Structures for Fast Statistics", with A. W. Moore, Jul. 2004.

- **Plenary-selected talks.**
  - **Astronomical Data Analysis Software and Systems 04**, Pasadena, CA, Oct. 2004.
  - **Conference on Computational Physics 04**, Genoa, Italy, Sep. 2004.
  - **International Biometric Society ENAR 04**, Pittsburgh, PA, Mar. 2003.
  - **Astronomical Data Analysis Software and Systems 03**, Strasbourg, France, Oct. 2003.
  - **SIAM International Conference on Data Mining 03**, San Francisco, CA, May 2003.
  - **Neural Information Processing Systems 00**, Denver, CO, Dec. 2000.
  - **Astronomical Data Analysis Software and Systems 95**, Tucson, AZ, Oct. 1995.

References

- More detailed contact information available upon request.

Andrew Moore, Carnegie Mellon University, Computer Science Department and Robotics Institute, awm@cs.cmu.edu.

Larry Wasserman, Carnegie Mellon University, Statistics Department, larry@stat.cmu.edu.

Robert Nichol, University of Portsmouth, Institute of Cosmology and Gravitation, bob.nichol@port.ac.uk.

Padhraic Smyth, University of California Irvine, Information and Computer Science Department, smyth@ics.uci.edu.

Zoubin Ghahramani, University College London, Gatsby Computational Neuroscience Unit, zoubin@gatsby.ucl.ac.uk.

David Donoho, Stanford University, Statistics Department, donoho@stat.stanford.edu.

Personal

- **Background.** Citizen of USA and Canada.

Interests. Art and design (former freelance illustrator), martial arts (black belt, former US National taekwondo bantamweight medalist), equity options trading (former accredited investor).