

# MICHAEL J. PRERAU

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## EDUCATION

**BOSTON UNIVERSITY**, Program in Neuroscience, Boston MA:

Ph.D. Candidate in Neuroscience, September 2004-Present, Expected Graduation: May 2008.

**COLUMBIA UNIVERSITY**, School of Engineering and Applied Science, New York, NY:

M.S. in Biomedical Engineering (Computational Neuroscience specialization), May 2003.

**COLUMBIA UNIVERSITY**, School of Engineering and Applied Science, New York, NY:

B.S. in Computer Science (Intelligent Systems track), May 2002.

**BROOKLINE HIGH SCHOOL**, Brookline, MA, May 1998 (Graduated with Honors).

## AWARDS

**2007 CAS DEAN'S AWARD**: Best graduate research project of Boston University College of Arts and Science, Science and Engineering Research Symposium, 2007.

## RESEARCH

**Laboratory of Cognitive Neurobiology**, BOSTON UNIVERSITY, 2004-PRESENT

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### NEUROSCIENCE

- Research under Dr. Howard Eichenbaum, Dr. Michael Hasselmo, Dr. John White, and Dr. Uri Eden.
- Development of novel statistical methods for the analysis of neural spiking data from the rat hippocampus.
- Prediction of rat turn direction on a T-maze from neural firing patterns, and the analysis of neural encoding paradigms for learning and memory.
- Development of an extensive software package and GUI, using MATLAB and MEX, to implement these new statistical algorithms.

### NANOTECHNOLOGY

- Collaboration with Dr. Zhifeng Ren at Boston College to develop nanoscale (<200nm) electrodes for use in intracellular recordings.

**Laboratory for Neuroscience Statistics**, MASSACHUSETTS GENERAL HOSPITAL, 2003-PRESENT

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### STATISTICS OF LEARNING AND BEHAVIOR

- Statistical Neuroscience research under Dr. Emery Brown for the analysis of learning experiments.
- Development of a dynamic state-space estimation algorithm combining information for simultaneously recorded continuous-valued and point process measurements.
- Application of algorithm to animal behavioral data from the laboratories of Dr. Ann Graybiel at MIT and Dr. Daniel Salzman at Columbia University

## **Laboratory for Intelligent Imaging and Neural Computing, COLUMBIA UNIVERSITY, 2002-2003**

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### **BRAIN-COMPUTER INTERFACES/NEURAL PROSTHETICS**

- Design and execution of experiments related to EEG studies, under Dr. Paul Sajda.
- Brain-Computer Interface research on the detection of target recognition from a rapid serial visual presentation (RSVP) system using EEG data.

### **NEUROSCIENCE OF MUSIC**

- Design and execution of psychophysical experiments on the neuroscience of music and the perception of rhythm.
- Research into psychophysical perceptual differences between rhythms perceived visually vs. rhythms perceived aurally.

## **Columbia Intrusion Detection Group, COLUMBIA UNIVERSITY, 2001-2002**

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### **ARTIFICIAL INTELLIGENCE/NETWORK SECURITY**

- Development of machine learning techniques to detect attacks on computer networks.
- Execution of unsupervised anomaly detection using clustering and k-nearest neighbor algorithms.

## **Columbia Computer Music Center, COLUMBIA UNIVERSITY, 1998-2002**

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### **COMPUTER MUSIC**

- Development of a process that enables a computer to compose a piece of music based on the analysis of other user-selected musical works.
- Use of genetic algorithms to combine extracted motifs for automated composition.

## **Additional Research**

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### **COMPUTER VISION**

- Developed the “Intellisignal”—an intelligent traffic light that detects the presence of vehicles with a 360 degree camera and changes the light for the most efficient traffic flow.

### **NATURAL LANGUAGE PROCESSING**

- Developed “Blank Verse”—a program that automatically generates bank verse style poetry.
- Used syntactic graph traversal algorithm.

## **INVITED TALKS**

### **NEUROSCIENCE SEMINAR, APRIL 23, 2006, BOSTON UNIVERSITY, BOSTON, MA:**

“Bayesian framework using empirical distributions for the analysis of differential firing in hippocampal place cells. Or: How to tell which way a rat will turn on a T-maze, while making few assumptions”

### **BRAIN AND MUSIC COLLOQUIUM, MAY 6, 2003, JULLIARD, NEW YORK, NY:**

Lecture to faculty and graduate students from the Juilliard School of Music on the neuroscience behind music and on my research in the field.

## PATENTS

“Methods of unsupervised anomaly detection using a geometric framework.” – Co-Inventor. Provisional patent later incorporated into: “System and methods for adaptive model generation for detecting intrusions in computer systems.” U.S. patent no. 7,225,343, issued May 29, 2007.

## SELECTED PUBLICATIONS

M.J. Prerau, A.C. Smith, Y. Kubota, M. Yanike, W. Suzuki, A.M. Graybiel, E.N. Brown, Characterizing learning using continuous and discrete measures of performance, *Journal of Neurophysiology*, 2007, Submitted.

M.J. Prerau, A.C. Smith, M. Yanike, W.A. Suzuki, E.N. Brown, A mixed filter algorithm for cognitive state estimation from simultaneously recorded continuous-valued and binary measures of performance, *Biological Cybernetics*, 2007, Submitted.

M.J. Prerau, U.T. Eden, Beyond the Gaussian: A Bayesian framework using empirical distributions for the analysis of differential firing in hippocampal place cells. *Society for Neuroscience abstract*, 2006.

M.J. Prerau, Y. Kubota, A.M. Graybiel, A.C. Smith, E.N. Brown, Estimating learning from simultaneously recorded continuous and discrete measures, *Society for Neuroscience Abstract*, 2004.

C.D. Salzman, M.J. Prerau, M.A. Belova, J.J. Paton, A.C. Smith, E.N. Brown, Bias estimation using dynamic estimation on binary measures of performance, *Society for Neuroscience Abstract*, 2004.

M.J. Prerau, Who could ask for anything more? Mixed modality rhythmic discrimination aptitude in human subjects, *Proceedings of the International Conference on Music Perception and Cognition*, April 2004.

E. Eskin, A. Arnold, M. Prerau, L. Portnoy, S. Stolfo, 2002. A geometric framework for unsupervised anomaly detection: detecting intrusions in unlabeled data. In: D. Barbara, S. Jajodia, (Eds.), *Applications of Data Mining in Computer Security*, Kluwer, Dordrecht, ISBN 1-4020-7054-3 (Chapter 4).

M.J. Prerau, On the possibilities of an analytic synthesis system, *Proceedings of the European Conference on Artificial Life 2001 Workshop: Artificial Life Models for Musical Applications*. Prague, Czech Republic, September 2001.

## TEACHING EXPERIENCE

**Boston University, FALL 2007. COMPUTATIONAL INSTRUCTOR/TEACHING FELLOW**

- Graduate level statistics course: The Statistical Analysis of Point Process Data.
- Focus on the analysis of neural spiking data using state-of-the-art statistical methods.

## INDUSTRY EXPERIENCE

### **Caminus Corporation**, SUMMER 2001. **SOFTWARE ENGINEER**

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- Architected and developed NT scripts for the integration SQL procedures into a versatile program designed for rapid deployment of the Caminus suite of products at client sites.
- Created and administered Oracle databases for script testing purposes.
- Languages/Paradigms utilized: Java, SQL, NT Scripting, Unix Scripting, Oracle 8.1.6.

### **Concrete Incorporated**, SUMMER 2000. **SOFTWARE ENGINEER**

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- Developed back-end software for commercial e-businesses.
- Created login and registration systems as well as central permissions servlet.
- Languages/Paradigms utilized: Java, JSP, Servlets, WebLogic Server, JDBC, HTML.

### **Microsoft WebTV**, FALL 1999. **SOFTWARE ENGINEER**

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- Developed software using Java Servlets to introduce WebTV users to eBay.
- Languages/Paradigms utilized: Java, HTML, UML, MBASE.

### **CenterLine Systems, Inc.**, SUMMER 1999. **SOFTWARE ENGINEER**

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- Designed and created several major portions of a commercial software product.
- Created company website including the graphic design.
- Languages utilized: Visual Basic, C++, JavaScript, HTML.

### **Cambridge Digital Media**, SUMMER 1998. **WEB DEVELOPER**

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- Created dynamic web pages using SQL, which generated scripts and layers from database queries.
- Languages utilized: JavaScript, HTML, SQL.

### **Soundimage**, SUMMER 1997. **GRAPHICS DESIGNER AND ASSISTANT PRODUCER**

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- Created commercial Web pages and CD-ROMs.
- Software utilized: Adobe Premier, MacroMedia Director, Adobe Illustrator, Adobe Photoshop.

## INTERESTS AND SKILLS

### **COMPUTERS/COMPUTER GRAPHICS**

- Computational modeling of neural systems, Artificial Intelligence, Machine Learning, Computer Vision, Artificial Life, Computer Music, Robotics.
- MATLAB expert.
- Languages: MEX, Java, C, C++, Visual Basic, JSP, SQL, Servlets, JavaScript, MacroMedia Flash, LISP, ML, HTML, PASCAL, BASIC.
- Systems: Mac, Windows, DOS, UNIX, Linux.

**COMPANIES/ORGANIZATIONS FOUNDED:**

- The Food Monkey ([www.thefoodmonkey.com](http://www.thefoodmonkey.com)).
  - One of Boston's most popular food websites.
  - Freelance food writing and restaurant reviews, BostonNOW daily newspaper.
- Sphereworks Associates – Founder and General Partner.
  - Provided domain names and services for the digital music community.

**PROFESSIONAL AFFILIATIONS/CAMPUS ASSOCIATIONS**

- Society for Neuroscience: 2004-present.
- American Association for Artificial Intelligence (AAAI): 1999-present.
- Institute of Electrical and Electronics Engineers (IEEE): 2001-present.
- Columbia Outdoor Orientation Program: 1999-2002, President of Alumni Club, former Trail Leader and Head of Orientation Committee—leader of 4-day hiking treks.
- Brazilian Jiu Jitsu Club.

**PERFORMANCE****INTERACTIVE PERFORMANCE ART**

- Pas de Dieu—The creation of an Intelligent Dance Agent that can react in real-time to a human dancer in the performance of a dance duet.
- Dischord—A dynamic installation for three dancers, with computer music and video controlled by motion-sensors.

**ACTING (RECENT ROLES)**

- “The Pillow Man”, Emerson College.
- “Wired Awake”, Independent Film. Something Unseen productions.
- “The Importance of Being Ernest”, Columbia University.
- Comedy Improv Troupe.

**LANGUAGES**

- Spoken/Written: French.
- Writing systems: Japanese (Hiragana, Katakana), Cyrillic, Greek, Hebrew, some Chinese/Kanji.

**OTHER INTERESTS**

- Music: Guitar, Piano, Clarinet, Banjo, Composition.
- Sports: Hiking, Running, Tennis, Rugby, Canoeing, Football, Squash.
- Traveled to over 40 countries.