Daniel Martí (PhD)

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Profile

I am a machine learning generalist and a data scientist with a strong foundation in mathematical modeling. I use analytical, statistical, and computational tools to gain insight into data.

Skills: Dynamical Systems, Neural Networks, Statistical Mechanics, Stochastic Processes, Random Matrix Theory, Numerical Methods, Machine Learning (supervised learning, non-parametric Bayesian methods), C, C++, python (numpy/scipy/scikit-learn/pandas), spark, functional programming, R, unix, git, gdb, shell scripting.

Education

PhD. in Computational Neuroscience, *Sep 2003 – Sep 2008*
Universitat Pompeu Fabra, Barcelona. *Summa Cum Laude.*

- Investigated the neural substrate of decisions from a computational perspective, using neural networks.
- Simulated a neural network model (custom code in C++) and investigated the possible regimes of network activity using analytical tools (Mean-field, Stochastic Differential Equations, Dynamical Systems).
- Graduate courses on Artificial Intelligence, Data Structures, Image Processing.

M. Sc. degree in Theoretical Physics, *Sep 1999 – Sep 2002*
Universitat Autònoma de Barcelona. *Summa Cum Laude*

- Studied extensions of the Standard Model of elementary particles based on supersymmetry and extra dimensions, and derived the spectrum of masses of predicted by the model.
- Graduate courses in Particle Physics, Gravitation, and Differential Geometry.

B. Sc. degree in Physics *Sep 1999*
Universitat Autònoma de Barcelona. *GPA: 93.5%*

Experience

Blackpills, Paris, *Jul 2016–current*
Data Scientist & Machine Learning Engineer

- Design of A/B testing protocols using both frequentist & Bayesian approaches.
- Implementation of on-line ranking systems based on implicit feedback from users.

École Normale Supérieure, Paris, *2013–Jun 2016*
Postdoctoral Researcher in Theoretical Neuroscience

- Investigated the dynamics of large ($\sim 10^4$) neural networks with random, partially symmetric couplings.
- Analyzed the system with tools from statistical mechanics of disordered systems (Martin-Siggia-Rose formalism, Random Matrix Theory) to characterize the autocorrelation function of neural activities.
- Developed C code to simulate the dynamics of the neural network and to compute different statistical measures characterizing network activity (average autocorrelation of spike-trains, population firing rates).
- Coded python modules and scripts to organize, analyze, and visualize simulated data.
- Administered the Linux cluster of the research group.
- Organized external seminars with invited international speakers.

Columbia University, New York *Jan 2012–Dec 2012*
Postdoctoral Researcher in Theoretical Neuroscience

- Investigated the scalability of multimodular neural networks, both theoretically and numerically.
- Implemented a neural classifier in a multi-core, neuromorphic TrueNorth IBM chip.
- Compared classification accuracies with standard sparse support vector classifiers.

New York University, New York, *Nov 2008–Dec 2011*
Postdoctoral Researcher in Computational Neuroscience

- Investigated with network models how feature categorization could be implemented in cortical circuits as a dynamical phenomenon (bifurcation theory, weakly nonlinear analysis)
- Studied several potential circuit architectures that could underlie the correlations in the reaction times observed during eye-hand coordination tasks.
- Analyzed a network of spatially distributed neurons driven by spatiotemporal patterns of stimuli
- Coded a framework to optimize with a simplex algorithm the goodness of fit of different dynamical models to behavioral data.

Teaching

Mentor at New York University and École Normale Supérieure, *2010, 2015*

- Supervised students working on their master project in Applied Mathematics (Courant Institute), Statistical Physics (École Normale Supérieure)
- Teaching at the Research Master in Cognitive Science (Perceptrons, Hopfield Networks, Neural Decoding)

Teaching assistant at Universitat Pompeu Fabra *2003-2008*

- Tutored undergraduate students in Computer Science on *Introduction to Neural Networks & Machine Learning*, *Nonlinear Time Series Analysis*, *Introduction to Independent Component Analysis*, and *Physics for Computer Science*.

Teaching assistant at Universitat Autònoma de Barcelona *1999-2003*

- Tutored undergraduate students in Physics on *Quantum Physics*, *Theoretical Mechanics*, *Physics for Life Sciences*, *Differential Equations*, and *Experimental Physics* (laboratory sessions).

Peer-reviewed publications

- Martí D, Brunel N, Ostojic S, Correlations between synapses in pairs of neurons slow down dynamics in randomly connected neural networks, (submitted).
- Martí D, Rigotti M, Seok M, Fusi S, Energy-Efficient Neuromorphic Classifiers *Neural Computation* 2016, **28**(10):2011–2044.
- Martí D, Rinzel J, Dynamics of Perceptual Categorization, *Neural Computation* **25**(1)1–45.
- Dean H*, Martí D*, Tsui E, Rinzel J, Pesaran B, Reaction Time Correlations during Eye-Hand Coordination: Behavior and Modeling, *The Journal of Neuroscience* **31**(7):2399 –2412, February 2011. *Equal contribution.
- Deco G, Martí D, Ledberg A, Reig R, Sanchez Vives MV, Effective Reduced Diffusion-Models: A Data-Driven Approach to the Analysis of Neuronal Dynamics, *PLoS Computational Biology* **5**(12): e1000587, December 2009.
- Martí D, Deco G, Mattia M, Gigante G, Del Giudice P, A Fluctuation-Driven Mechanism for Slow Decision Processes in Reverberant Networks, *PLoS One* **3**(7): e2534, June 2008.
- Deco G, Martí D, Extended method of moments for deterministic analysis of stochastic multistable neurodynamical systems,*Physical Review E*, **75**:031913, March 2007.
- Deco G, Martí D, Deterministic analysis of stochastic bifurcations in multi-stable neurodynamical systems, *Biological Cybernetics*, **96**(5), May 2007.
- Martí D, Deco G, Del Giudice P, Mattia M, Reward-biased probabilistic decision making: mean field predictions and spiking simulations, *Neurocomputing* **69** 10-12, June 2006.
- Martí D, Pomarol A, 5D Fayet-Iliopoulos terms and its phenomenological implications, *Physical Review D*, **66**: 125005, May 2002. `hep-ph/0205034`.
- Martí D, Pomarol A, Supersymmetric theories with compact extra dimensions in $N = 1$ superfields, *Physical Review D*, **64**: 105025, June 2001. `hep-th/010625`, **topcite 200+**.

Lecture notes, technical reports

- Del Ferraro G, Wang C, Martí D, Mézard M, Cavity Method: Message Passing from a Physics Perspective Lectures by Marc Mézard at the *Autumn school Statistical Physics, Optimization, Inference, and Message-Passing Algorithms*, Les Houches (France) from September 30th to October 11th 2013.
- Short tutorial on path integral formalism for stochastic differential equations, given at the Workshop in Theoretical Neuroscience in November 2014.