Gerard J. Rinkus 736 Mt Auburn St, Watertown, MA 02472 (c) 617-997-6272
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Education

2004-2006	Postdoc, Computational neuroscience, with John Lisman. Brandeis University. Jointly supported by NIH and The Redwood Neuroscience Institute.
1996	Ph.D., Cognitive & Neural Systems. Boston University, Boston, Mass. Advisor: Daniel H. Bullock, Associate Professor, Cognitive & Neural Systems Thesis: A Combinatorial Neural Network Exhibiting Episodic and Semantic Memory Properties for Spatio-Temporal Patterns.
1989-1990	Ph.D. Student (Teaching Asst.), Exper. Psych. Dept., NYU, New York, N.Y.
1986	M.A., Computer Science. Hofstra University, Hempstead, N.Y.
1983	B.A., Cognitive Science. University of Rochester, Rochester, N.Y.

Programming Experience

Current: Java, ImageJ, Git, HTML, CSS, Dreamweaver

Past: C++, multithreading, Web apps (applet, servlet, JSP, MySQL, JDBC, Javascript), Java3D, Perl, Tcl, Tk, LabView, Excel Macros, OPS5, Pascal, Assembler, Lisp

Employment History

Nov 2020 – Present President & Chief Scientist, Neurithmic Systems, Newton, MA

R&D on biologically-inspired, probabilistic, hierarchical associative memory for unsupervised learning, recognition, recall of spatiotemporal patterns, e.g., video, speech, biosequences.

May 2019 –Nov 2020 Lead Research Scholar, Center for Brain-Inspired Computing (C-BRIC), Purdue University, College of Engineering, West Lafayette, IN

Developing brain-inspired machine intelligence algorithms enabling ultra-low power learning and inference, scalable to massive, streaming, spatiotemporal data, and co-developing these algorithms with new hardware technologies/substrates. Mentoring students.

Jan 2010 – May 2019 President & Chief Scientist, Neurithmic Systems, Newton, MA

R&D on biologically-inspired, probabilistic, hierarchical associative memory for unsupervised learning, recognition, recall of spatiotemporal patterns, e.g., video, speech, biosequences.

Funded by research contracts: DARPA MTO UPSIDE Seedling (FA8650-13-C-7432); Northrop Grumman (Sub on Cortical Processing Seedling); ONR 341 (Tom McKenna) (N00014-12-C-0539); DARPA Deep Learning: Sub#337178J on N00173-09-C-2038.

Jan 2007 - Jul 2009 Senior Research Engineer, Scientific Systems Co Inc., Woburn, MA

Conceptual design for heterogeneous database alignment including geospatial reasoning. Proposal writing, Presentation preparation (Powerpoint, animation).

Sep 2004 - Dec 2006 Computational Neuroscience Postdoc / Visiting Scientist, Brandeis University, Mentor: John Lisman, Waltham, MA

Developed neuromorphic, hierarchical models of sequence learning and recognition (Java). Developed cell-assembly-based, canonical cortical microcircuit model.

Developed GUI/visualization software in Swing/Java3D-based.

Jun 1999 - Oct 2003 Research Programmer, Enkidu Research. Lockport, NY

Developed apps for R&D and commercial augmentative communication devices including

- Web-based (Applet, Servlet, JSP, Javascript, JDBC, Tomcat, MySql) teaching application concerning the design/use of augmentative communications devices.
- Multithreaded webcrawler (C/MFC) that scraped web page text to generate language statistics.
- Windows/MFC-based application for statistical analysis of log files.

Jun 1996 - Jun 1999 Senior Scientist, Charles River Analytics. Cambridge, MA

Managed/executed DoD/Nasa Phase I/II SBIRs developing Bayes nets, case-based reasoning, and other AI technologies for situation/threat assessment, cognitive state estimation, battlefield course-of-action estimation and planning.

Oct 1995 - Mar 1996 Programmer, Mercury Computer Systems, Inc. Chelmsford, MA

Developed and ran QA test suite of input/output and interprocess communication APIs for Mercury's multi-computer operating system, using Perl and Perl/Tcl/Tk.

Sep 1992 - Sep 1995 Research Programmer Army Research Lab, Watertown, MA

Developed data acquisition modules (GPIB/LabView), neural-net-based process control and analysis of tank shock absorber data.

Sep 1990 - Aug 1991 Asst. System Admin. Cognitive & Neural Systems, Boston University

Performed Sysadmin duties for CNS Dept, while enrolled as full-time PhD student.

Sep 1989 - Aug 1990 Graduate Teaching Asst., Experimental Psychology, NYU, NY

Organized and ran recitation sections, assisted with grading for Fundamentals in Neuroanatomy.

Sep 1986 - Aug 1988 Instructor, Math & Comp. Sci., Adelphi University, Garden City, NY

Full responsibility for developing all curricula/materials, teaching, grading, and advising undergraduates for three classes, Introduction to Computer Science, Data Structures, and Computer Architecture and Assembly Language, each taught multiple times.

Jul 1984 - Apr 1986 Software Engineer, Hazeltine Inc. Greenlawn, NY

Developed Expert System (in OPS5) for controlling the manufacture of printed circuit boards.

Patents

1. Overcoding-and-Paring: A bufferless chunking process and uses thereof US Pat. 8,983,884

Journal Papers

Rinkus, G. (2024) A Radically New Theory of how the Brain Represents and Computes with Probabilities. In Machine Learning, Optimization, and Data Science. 9th Int'l Conf, LOD 2023, Grasmere, UK. Revised Selected Papers, Part II. Springer Nature Switzerland.

Rinkus, G. (2014) Sparsey: Event recognition via deep hierarchical sparse distributed codes. Frontiers in Neuroanatomy. doi: 10.3389/fncom.2014.00160

Rinkus, G. (2012) Quantum Computation via Sparse Distributed Representation. NeuroQuantology **10**(2) 311-315.

Rinkus, G. (2010) A cortical sparse distributed coding model linking mini- and macrocolumn-scale functionality. Frontiers in Neuroanatomy 4:17. doi:10.3389/fnana.2010.00017

Sincebaugh, P., Green, W. & Rinkus, G. (1996) A Neural Network Based Diagnostic Test System for Armored Vehicle Shock Absorbers. *Expert Systems with Applications*, **11**(2) 237-244.

Talks

06/14/23: Semantic memory as a computationally free side-effect of sparse distributed generative episodic memory. Generative Episodic Memory (GEM) 2023 (Link)

05/27/21: Hierarchical Sparse Distributed Binary Representations for Spatiotemporal Pattern Learning, Recall and Recognition. The Aerospace Corp. Host: Jacob Everist. (Link)

02/24/20: Representing Probabilities as Sets instead of Numbers Allows Classical Realization of Quantum Computing: Purdue Quantum Science and Engineering Institute Quantum Afternoon Seminar (Abstract)

11/01/19: A Sparse Combinatorial Neural Code and Corresponding Atemporal Population Spike Code. Invited video talk to: Micron Research Lab, Host: Sean Eilert

08/16/19: Overview of Hyperdimensional Computing: Tutorial to C-BRIC Purdue Research Groups. Host: Kaushik Roy.

04/08/19: A highly efficient similarity-preserving learning algorithm for a sparse distributed associative memory, Ila Fiete Lab Seminar, Brain & Cognitive Sciences Dept., MIT.

01/15/19: The Coming KB Paradigm Shift: Representing Knowledge with Sparse Embeddings. Presented at "Intelligent Systems with Real-Time Learning, Knowledge Bases and Information Retrieval" Army Science Planning and Strategy Meeting (ASPSM). UT Austin.

07/23/18: Sparse distributed representation, hierarchy, critical periods, metaplasticity: the keys to lifelong fixed-time learning and best-match retrieval. (abstract) Biological Distributed Algorithms 2018 (London)

12/18/17: A Radically Novel Theory of Probabilistic Computing in the Brain. To Xaq Pitkow Lab

04/21/17: Sparse Distributed Coding Enables Super-Efficient Probabilistic Modeling. Intel Microarchitecture Technology Lab. Hillsboro, OR Host: Narayan Srinavasa

04/20/17: Sparse Distributed Coding Enables Super-Efficient Probabilistic Modeling. IBM Almaden Machine Intelligence Lab, San Jose, CA. Host: Winfried Wilcke

09/02/16: Sparsey®: Scalable Machine Intelligence via Hierarchical Sparse Distributed Representations. GE Global Research, Niskayuna, NY. Host: Joe Salvo

03/07/16: Sparse Distributed Representation Trumps Machine Parallelism for Improving Computational Efficiency. Neuro-Inspired Computational Elements (NICE 2016), Berkeley, CA

03/11/14: Sparse Distributed Coding & Hierarchy: The Keys to Scalable Machine Intelligence. DARPA UPSIDE Year 1 Review Presentation.

06/26/13: A Cortical Macrocolumn Model based on Sparse Distributed Representation. Large-Scale Applications Using Cortical Processing Models Wkshp, DARPA, Arlington, VA.

02/25/13: Constant-Time Probabilistic Learning & Inference via Hierarchical Sparse Distributed Representations. Neuro-Inspired Computational Elements (NICE) Workshop, Sandia Labs, Albuquerque. Feb 25-27. Host: Murat Okandan.

12/14/12: Probabilistic Computing via Sparse Distributed Representations. Lyric Semiconductor Theory Seminar. Host: Ben Vigoda.

08/31/09: Overcoding-and-Pruning: A Novel Neural Model of Temporal Chunking and Short-term Memory. Kreiman Lab, Dept. of Ophthalmology and Neuroscience, Children's Hospital, Boston. Host: Gabriel Kreiman.

10/07: A Functional Role for the Minicolumn in Cortical Population Coding. Cortical Modularity and Autism Symposium. The U. of Louisville, Health Sciences Center. Host: Manuel Casanova.

02/06: Hierarchical Sparse Distributed Representations of Sequence Recall and Recognition. The Redwood Center for Theoretical Neuroscience. (UC Berkeley). Host: Bruno Olshausen.

06/04: A Sparse Distributed Model of Episodic and Semantic Spatiotemporal Memory. Redwood Neuroscience Institute, Menlo Park, CA. Host: Fritz Sommer.

Selected Conference Papers, Posters, arXiv

Rinkus, G. GEM 2023 (accepted as talk): Semantic memory as a computationally free side-effect of sparse distributed generative episodic memory.

Rinkus, G. ACAIN 2023 (paper): A Radically New Theory of how the Brain Represents and Computes with Probabilities. See Rinkus (2024) journal paper above.

Rinkus, G. CCN 2023 (rejected abstract): The Classical Tuning Function is an Artifact of a Neuron's Participations in Multiple Cell Assemblies.

Rinkus, G. NNPC 2023 (accepted as poster, abstract): World Model Formation as a Side-effect of Non-optimization-based Unsupervised Episodic Memory.

Rinkus, G. NNPC 2023 (accepted as poster, abstract): A cell assembly simultaneously transmits the full likelihood distribution via an atemporal combinatorial spike code.

Rinkus, G. COSYNE 2023 (rejected abstract): A cell assembly transmits the full likelihood distribution via an atemporal combinatorial spike code.

Rinkus, G. (rejected abstract): COSYNE 2021. Efficient Similarity-Preserving Unsupervised Learning using Modular Sparse Distributed Codes and Novelty-Contingent Noise.

Rinkus, G. (accepted abstract): NAIsys (From Neuroscience to Artificially Intelligent Systems) 2020. A combinatorial population code can simultaneously transmit the full similarity (likelihood) distribution via an atemporal first-spike code. CSHRL Nov 9-12, 2020.

Rinkus, G. (accepted abstract): NIPS Continual Learning Wkshp 2018. Sparsey, a memory-centric model of on-line, fixed-time, unsupervised continual learning. Montreal 2018

Rinkus, G. (2018, accepted abstract), withdrawn because cannot attend): First Spike Combinatorial Coding: The Key to Brain's Computational Efficiency. Cognitive Computing 2018.

Rinkus, G. & Leveille, J. (2017, arXiv) Superposed Episodic and Semantic Memory via Sparse Distributed Representations.

Rinkus, G. (2017, arXiv) A Radically New Theory of how the Brain Represents and Computes with Probabilities.

Rinkus (2017) A Radically New Theory of How the Brain Represents and Computes with Probabilities. (Poster) Neuro-Inspired Comp. Elements (NICE 2017), IBM Almaden, San Jose

Rinkus, G. (2014) Cortex-inspired technology yields scalable probabilistic inference over events. (Poster) IARPA Machine Intelligence from Cortical Networks (MICrONS) Wkshp: 2/11/14

Rinkus, G. (2013) A cortical theory of super-efficient probabilistic inference based on sparse distributed representations. 22nd Annual CNS Meeting, Paris, July 13-18. *BMC Neuroscience* 2013, **14**(Suppl 1): P324

Rinkus, G. (2009) Overcoding-and-pruning: a bufferless neural chunking model. Frontiers in Computational Neuroscience. COSYNE '09 Abstract: doi: 10.3389/conf.neuro.10.2009.03.292

Rinkus, G. (2008) Population Coding Using Familiarity-Contingent Noise. *AREADNE 2008: Research in Encoding and Decoding of Neural Ensembles*, Santorini, Greece, June 26-29

Rinkus, G. & Lisman, J. (2005) Time-Invariant Recognition of Spatiotemporal Patterns in a Hierarchical Cortical Model with a Caudal-Rostral Persistence Gradient. *Society for Neuroscience Annual Meeting, 2005*. Washington, DC. Nov 12-16

Rinkus, G. (2005) A Neural Network Model of Time-Invariant Spatiotemporal Pattern Recognition *First Annual Computational Cognitive Neuroscience Conference*, Washington, DC, Nov. 10-11

Rinkus, G. (2004) A Neural Model of Episodic and Semantic Spatiotemporal Memory. *Proc. of the 26th Annual Conference of the Cognitive Science Society*. Kenneth Forbus, Dedre Gentner & Terry Regier, Eds. LEA, NJ. 1155-1160. Chicago, Ill.

Lesher, G.W., Moulton, B.J., Rinkus, G. & Higginbotham, D.J. (2003) Software tools for emulation and analysis of augmented communication. *CSUN 2003*, California State University, Northridge.

Lesher, G.W. & Rinkus, G. (2002) Leveraging word prediction to improve character prediction in a scanning configuration. *Proc. of the RESNA 2002 Annual Conference*, Reno.

Lesher, G.W. & Rinkus, G. (2001) Domain-specific word prediction for augmentative communications. *Proc. of the RESNA 2002 Annual Conference*, Reno.

Lesher, G.W. & Rinkus, G. (2001) Domain-specific word prediction for augmentative communications. *Proc. of the RESNA 2002 Annual Conference*, Reno.

Lesher, G.W., Rinkus, G., Moulton, B.J., & Higginbotham, D.J. (2000) Logging and analysis of augmentative communication. *Proc. of the RESNA 2000 Annual Conference*, Reno. 82-85.

Gonsalves, P.G. & Rinkus, G. (1998) Intelligent fusion and asset manager processor (IFAMP). *Proc. of the IEEE Information Technology Conference* (Syracuse, NY) 15-18.

Rinkus, G. (1997) A Monolithic Distributed Representation Supporting Multi-Scale Spatio-Temporal Pattern Recognition. *International Conference on Vision, Recognition, and Action: Neural Models of Mind and Machine*, Boston University, Boston, Mass. May 29-31.

Rinkus, G. (1995) TEMECOR: An Associative, Spatio-Temporal Pattern Memory for Complex State Sequences. *Proc. of 1995 World Congress on Neural Networks*, v. I, 442-448, Wash., DC

Rinkus, G. (1993) Context-sensitive Spatio-temporal Pattern Memory. (1993) *Proc. of the 1993 World Congress on Neural Networks*, v. II, 344-347, Portland, OR.

Rinkus, G. (1992) A Neural Model for Spatio-temporal Pattern Memory. *Proc. Wang Conference: Neural Networks for Learning, Recognition, and Control*, Boston University, Boston, Mass

Rinkus, G. (1988) Learning as Natural Selection in a Sensori-Motor Being. *Proc. 1st Annual Conference of the Neural Network Society*, Boston, Mass.

Mulgund, S., Rinkus, G., Illgen, C. & Zacharias, G. (1997) Situation Awareness Modeling and Pilot State Estimation for Tactical Cockpit Interfaces. *HCI International*, San Francisco, CA, August.

Mulgund, S.S., Illgen, C., Rinkus, G., Zacharias, G.L. & Friske. J. (1997) OLIPSA: On-Line Intelligent Processor for Situation Assessment. *Proc. of 2nd Ann. Symp. on Situational Awareness in the Tactical Air Environment*. NAWCAD, Patuxent River, Md. June 3-4.

Blogs

04/16/20: The Classical Realization of Quantum Parallelism.
01/27/19: Learned Multidimensional Indexes.
09/10/15: Sparse distributed representations compute similarity relations exponentially more efficiently than localist representations.
10/30/18: A Hebbian cell assembly is formed at full strength on a single trial.
02/26/19: Intelligence is not primarily about optimization or spikes, but about how information is represented.

Book Chapters

Mulgund, S.S., Zacharias, G.L. & Rinkus, G. (2003) Adaptive Pilot-Vehicle Interfaces for the Tactical Air Environment. in *Psychological Issues in the Design and Use of Virtual Adaptive Environments*. Hettinger, L.J. & Haas, M. (Eds.) LEA, NJ 483-524.

Theses

Rinkus, G. (1996) A Combinatorial Neural Network Exhibiting Episodic and Semantic Memory Properties for Spatio-Temporal Patterns. Ph.D. Thesis. Boston University, Boston, Mass.

Rinkus, G. (1986) Learning as Natural Selection in a Sensori-Motor Being. Master's Thesis. Hofstra University, Hempstead, N.Y.

Professional Activities

Guest Associate Editor of Special Topic: Human and Artificial Models of Memory (Frontiers in Cognitive Science) (2019-current).

Program Committee: 1st International Workshop on Computational Models of the Visual Cortex, Dec 2-5, 2015 NYC.

Program Committee: Workshop on Unsupervised & Transfer Learning: ICML 2011, Bellevue, WA

Organization for Computational Neurosciences, Faculty Member, 2012-2014.

Presenter & Panel Discussant. IARPA Automatic Machine Learning Workshop (4/16-17, 2012), NSF, Arlington, VA.

Funding

- Northrop Grumman: Awarded in response to NG RFQ 6000675674 (follow-on to Cortical Processing Algorithm) 7/15-1/16
- Northrop Grumman: Con# 8200176119 IRAD Cortical Processing Algorithm 1/21/14-4/21/14
- DARPA MTO (UPSIDE Program): FA8650-13-C-7432: Sparse Distributed Representation and Hierarchy: The Keys to Scalable Machine Intelligence: 4/29/13-12/30/15
- ONR 341: N00014-12-C-0539: Scalable Machine Vision via Hierarchical Sparse Distributed Representations: 8/15/2012-2/15/2014
- DARPA Deep Learning Program: Sub#337178J on Con#N00173-09-C-2038: 03/2010–05/2011
- NIH Postdoc Training Grant 5 T32 NS07292 (Brandeis) 9/2004-4/2006