G. William Chapman IV

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Summary

Researcher in neuromorphic machine learning for hardware constrained online learning. With an additional six years experience as a software developer and scientific analyst for data intensive research application. As a scientific analyst I have specialized in temporally-aware analysis, with a strong emphasis on interacting with subject-experts. As an independent researcher, I have focused on novel deep learning architectures to support time series prediction, computer vision, spatial navigation, and symbolic reasoning.

Education

- **Boston University** — Boston, MA
  Doctor of Philosophy - Computational Neuroscience — *May 2023*
- **University of Colorado** — Boulder, CO
  Master of Arts - Cognitive Neuroscience — *May 2018*
- **Boston University** — Boston, MA
  Bachelor of Science - Biomedical Engineering, Minor in Electrical Engineering — *May 2012*

Skills

- **Languages**: Python, MATLAB, Bash, SQL, R, LaTeX
- **Frameworks**: Scikit Learn, PyTorch, Pandas, Numpy, Slurm, SGE, Git
- **General**: Machine Learning, Deep Learning, Time Series Prediction, Advanced Statistical Analysis, Dynamical Systems, Biomedical Engineering, Project Management, Scientific & Data Communication

Experience

- **Sandia National Labs** — Albuquerque, NM
  Postdoctoral Appointee, Neuromorphic Computing — *2023 - Present*
- **Boston University** — Boston, MA
  Graduate Research Fellow — *2018 - 2023*
  - **Biological Predictive Coding**: Created a novel, biologically inspired, machine learning architecture and learning rule for temporal prediction. Functions above state-of-the-art for both short-term and long-term time series prediction, with applications for lifelong learning, and generalization.
  - **Egocentric-Allocentric Transformations**: Designed an explainable ML model which receives self-centered sensor and motor information, fusing sensor information through recurrent hidden layers. Hidden layers create explicit reference-frame transformations, in addition to low-dimensional latent representations.
  - **Symbolic Predictive Learning**: Created a novel architecture which utilizes predictive coding and dynamic attentional routing to solve a symbolic reasoning task.
- **eCortex & University of Colorado** — Boulder, CO
  Neural Modeler — *2016 - 2018*
  - **Symbolic Reasoning**: Extended existing computational models of working memory to create a model capable of simple symbolic processing, utilizing attentional mechanisms.
  - **Electrophysiology**: Designed and ran a corresponding EEG experiment to test model predictions. Created novel causal frequency-time analyses to determine timecourse of functional connectivity.
- **Center for Systems Neuroscience** — Boston, MA
  Research Software Engineer — *May 2012 - August 2016*
  - **Software Design**: Primary designer for centralized OOP software for standardized data storage and exploratory analyses of neural and behavioral data across multiple labs, which is now used at over half a dozen independent research locations.
  - **Data Pipelines**: Created standardized data pipelines for preprocessing various unstructured data and combining into a centralized SQL database, automated by cloud-computing frameworks.
  - **Data Analysis**: Primary statistical analysis expert for over ten peer-reviewed publications in systems and computational neuroscience, including time-series analysis, frequentist statistics, generalized linear models, and data visualization.
- **Boston Medical Center** — Boston, MA
  Neuroimaging Research Assistant — *May 2009 - May 2012*
  - **Alzheimer's Disease**: Primary individual for data pipelines and novel analysis of structural MRI and behavioral data, leading to predictive models of clinical Alzheimer's Disease progression.

Teaching Experience

- **Boston University** — Boston, MA
  Graduate Teaching Fellow — *2018 - 2020*
  - **Cognitive Neuroscience & Learning and Memory**: Led weekly discussion groups, reviewing and previewing material; created exams.
- **University of Colorado** — Boulder, CO
  Graduate Teaching Fellow — *2016 - 2018*
  - **Advanced Cognitive Neuroscience & Research Methods**: Independently designed lab section for both courses, leading students through a semester-long experiential learning in R (programming language), leading to a capstone project for each group.
- **Boston University** — Boston, MA
  Teaching Assistant — *2011-2012*
  - **Biomedical Instrumentation I & II**: Led three sections of laboratory in each semester, guiding students in experiments based on control theory and signal processing.

Professional Service

- **Invited reviewer**: Neural Networks (2018-present); Neural Information Processing Systems (NeurIPS) (2019-present); International Conference on Learning Representations (ICLR) (2020-present)
- **Academic Planning Committee**: Graduate Student representative on a small panel of faculty responsible for overseeing and approving changes in undergraduate and graduate degree program requirements. 2018 - 2019.

Peer Reviewed Publications

1. G. W. Chapman and M. E. Hasselmo, "Predictive learning by a burst-dependent learning rule," *Neurobiology of Learning and Memory*, 2023 (Accepted)
2. A. S. Alexander, J. C. Tung, G. W. Chapman, A. M. Conner, L. E. Shelley, M. E. Hasselmo, and D. A. Nitz, "Adaptive integration of self-motion and goals in posterior parietal cortex," *Cell Reports*, vol. 38, p. 110504, Mar. 2022
3. L. C. Carstensen, A. S. Alexander, G. W. Chapman, A. J. Lee, and M. E. Hasselmo, "Neural responses in retrosplenial cortex associated with environmental alterations," *iScience*, vol. 24, p. 103377, Nov. 2021
4. M. E. Hasselmo, A. S. Alexander, A. Hoyland, J. C. Robinson, M. J. Bezaire, G. W. Chapman, A. Saudargiene, L. C. Carstensen, and H. Dannenberg, "The unexplored territory of neural models: Potential guides for exploring the function of metabotropic neuromodulation," *Neuroscience*, p. S0306452220302141, Apr. 2020
5. A. S. Alexander, J. C. Robinson, H. Dannenberg, N. R. Kinsky, S. J. Levy, W. Mau, G. W. Chapman, D. W. Sullivan, and M. E. Hasselmo, "Neurophysiological coding of space and time in the hippocampus, entorhinal cortex, and retrosplenial cortex," *Brain and Neuroscience Advances*, vol. 4, p. 239821282097287, Jan. 2020
6. A. S. Alexander, L. C. Carstensen, J. R. Hinman, F. Raudies, G. W. Chapman, and M. E. Hasselmo, "Egocentric boundary vector tuning of the retrosplenial cortex," *Science Advances*, July 2019
7. J. R. Hinman, G. W. Chapman, and M. E. Hasselmo, "Neuronal representation of environmental boundaries in egocentric coordinates," *Nature Communications*, vol. 10, p. 2772, Dec. 2019
8. C. K. Monaghan, G. W. Chapman, and M. E. Hasselmo, "Systemic administration of two different anxiolytic drugs decreases local field potential theta frequency in the medial entorhinal cortex without affecting grid cell firing fields," *Neuroscience*, vol. 364, pp. 60–70, 2017
9. J. R. Hinman, M. P. Brandon, J. R. Climer, G. W. Chapman, and M. E. Hasselmo, "Multiple Running Speed Signals in Medial Entorhinal Cortex," *Neuron*, vol. 91, no. 3, pp. 666–679, 2016
10. M. Ferrante, C. F. Shay, Y. Tsuno, G. W. Chapman, and M. E. Hasselmo, "Post-Inhibitory Rebound Spikes in Rat Medial Entorhinal Layer II/III Principal Cells: In-Vivo, In-Vitro, and Computational Modeling Characterization," *Cerebral Cortex*, vol. 27, no. March, 2016
11. Y. Tsuno, G. W. Chapman, and M. E. Hasselmo, "Rebound spiking properties of mouse medial entorhinal cortex neurons in vivo.," *The European journal of neuroscience*, vol. 42, pp. 2974–2984, Jan. 2015
12. C. F. Shay, M. Ferrante, G. W. Chapman, and M. E. Hasselmo, "Rebound spiking in layer II medial entorhinal cortex stellate cells: Possible mechanism of grid cell function," *Neurobiology of Learning and Memory*, 2015
13. F. Raudies, M. P. Brandon, G. W. Chapman, and M. E. Hasselmo, "Head direction is coded more strongly than movement direction in a population of entorhinal neurons," *Brain Research*, vol. 1621, pp. 355–367, Sept. 2015

14. A. L. Jefferson, K. A. Gifford, S. Damon, G. W. Chapman, D. Liu, J. Sparling, V. Dobromyslin, and D. Salat, "Gray & white matter tissue contrast differentiates Mild Cognitive Impairment converters from non-converters," *Brain Imaging and Behavior*, vol. 9, pp. 141–148, June 2015

15. K. a Gifford, D. Liu, S. M. Damon, G. W. Chapman, R. R. Romano, L. R. Samuels, Z. Lu, and A. L. Jefferson, "Subjective Memory Complaint Only Relates to Verbal Episodic Memory Performance in Mild Cognitive Impairment," *Journal of Alzheimer's Disease*, vol. 44, pp. 309–318, Jan. 2015

Conference Talks and Posters

1. G. W. Chapman, "NeuroML for Predictive Learning," Feb. 2023
2. G. W. Chapman, "A Model of Biological Predictive Learning for Spatial Navigation," Dec. 2022
3. G. W. Chapman, "Egocentric Signals to Allocentric Maps, and Back Again," May 2022
4. G. W. Chapman and M. E. Hasselmo, "Trajectory prediction in a biologically inspired network with a strong inductive bias," Oct. 2020
5. G. W. Chapman and M. E. Hasselmo, "Trajectory prediction in a biologically inspired network," Nov. 2020
6. G. W. Chapman, "A model of relational reasoning through selective attention and working memory," Mar. 2019
7. L. C. Carstensen, A. Alexander, G. W. Chapman, and M. E. Hasselmo, "Representations of landmarks in the retrosplenial cortex," Oct. 2019
8. A. Alexander, L. C. Carstensen, G. W. Chapman, F. Raudies, J. R. Hinman, and M. E. Hasselmo, "Egocentric boundary vector tuning of the retrosplenial cortex," Oct. 2019
9. J. R. Hinman, G. W. Chapman, and M. E. Hasselmo, "Neuronal representation of egocentric boundaries in egocentric coordinates," Oct. 2018
10. J. R. Hinman, G. W. Chapman, and M. E. Hasselmo, "Egocentric representation of environmental boundaries in the striatum," June 2018
11. L. C. Carstensen, A. Alexander, J. R. Hinman, G. W. Chapman, and M. E. Hasselmo, "Spatial correlates of the retrosplenial cortex during free exploration," Oct. 2018
12. A. Alexander, L. C. Carstensen, F. Raudies, G. W. Chapman, J. R. Hinman, and M. E. Hasselmo, "Retrosplenial and entorhinal cortical representations during visually-based triangulation," Oct. 2018
13. J. R. Hinman, G. W. Chapman, and M. E. Hasselmo, "Egocentric representation of environmental boundaries in the striatum," Oct. 2017
14. J. R. Hinman, G. W. Chapman, and M. E. Hasselmo, "Representation of environmental boundaries within an egocentric reference frame," Oct. 2016
15. Y. Tsuno, G. W. Chapman, and M. E. Hasselmo, "In Vivo rebound spike characteristics of medial entorhinal cortex cells," Oct. 2015
16. C. K. Monaghan, G. W. Chapman, and M. E. Hasselmo, "Medial Septal infusion of a serotonin 1A agonist anxiolytic reduces theta frequency in the medial entorhinal cortex," Oct. 2015
17. J. R. Hinman, J. R. Climer, G. W. Chapman, and M. E. Hasselmo, "A novel slow oscillatory neuron in the lateral septum," Oct. 2015
18. C. F. Shay, M. Ferrante, G. W. Chapman, and M. E. Hasselmo, "Layer II Medial Entorhinal Cortex Stellate cells in rat display phase specific post inhibitory rebound spiking," Nov. 2014
19. M. Ferrante, C. F. Shay, Y. Tsuno, G. W. Chapman, and M. E. Hasselmo, "Modeling Intrinsic and Extrinsic mechanisms in rat entorhinal cortex and hippocampus that may influence grid and place cells," Nov. 2014
20. J. R. Climer, R. DiTullio, J. R. Hinman, G. W. Chapman, M. P. Brandon, M. E. Hasselmo, and U. T. Eden, "Addressing Theta rhythmicity in extracellularly recorded neurons in rat and bat," Oct. 2014
21. F. Raudies, M. P. Brandon, G. W. Chapman, and M. E. Hasselmo, "Movement Direction is Not Coded by the Firing of Most Entorhinal Cells, but Required by Grid Cell Models," Oct. 2013
22. J. R. Hinman, M. P. Brandon, G. W. Chapman, and M. E. Hasselmo, "Speed Modulation of Medial Entorhinal Cortical Neurons During Medial Septal Inactivation," Oct. 2013
23. K. A. Gifford, S. Damon, R. R. Romano, G. W. Chapman, and A. L. Jefferson, "Cognitive Complaints are related to memory performance in older adults with Mild Cognitive Impairment," Feb. 2013
24. M. Ferrante, C. F. Shay, G. W. Chapman, M. Migliore, N. J. Kopell, H. Eichenbaum, and M. E. Hasselmo, "Modeling Intrinsic and Extrinsic Mechanisms in Rat Entorhinal Cortex and Hippocampus that May Influence firing of grid and place cells," Oct. 2013
25. G. W. Chapman, N. W. Schultheiss, M. P. Brandon, and M. E. Hasselmo, "Theta Cycle Skipping Relationships in the Medial Entorhinal Cortex are Robust," Oct. 2013

26. A. L. Jefferson, G. W. Chapman, J. Sparling, K. A. Gifford, B. Martin, V. Dobromyslin, and D. Salat, "Semi-automated Method for Quantifying Infarcts in Older Adults with and without Dementia," Feb. 2012

27. G. W. Chapman, A. L. Jefferson, K. A. Gifford, J. Sparling, N. Cantwell, R. R. Romano, V. Dobromyslin, and D. Salat, "Grey-White Matter Contrast Ratio Relates to Progression in Mild Cognitive Impairment.," July 2012

28. G. W. Chapman, A. Gentile, N. Cantwell, V. Williams, D. Salat, and A. L. Jefferson, "White Matter Integrity in Entorhinal Cortex & Parahippocampal Region is Associated with Memory Performances in Individuals with Mild Cognitive Impairment.," Feb. 2010

29. M. Badaracco, K. A. Gifford, A. Gentile, G. W. Chapman, Y. Tripodis, and A. L. Jefferson, "The Relation of Hypertension to Cognition in Observational Studies: A Meta-Analysis," Feb. 2010