Joel T. Kaardal

Education

2017 **Ph. D. Physics**, *University of California*, San Diego.
2013 **M. S. Physics**, *University of California*, San Diego.
2010 **B. S. Physics & B. S. Chemistry**, *University of Minnesota*, Minneapolis.

Experience

2019– **Machine learning research engineer**, *Doc.ai -Acquired-by-> Sharecare*, Palo Alto, CA.

- Designed a probabilistic model to deliver online traffic to relevant health surveys and client ad campaigns to maximize revenue. Achieved a consumer/campaign matching in under 150 ms.
- Designed an artificial memory system[1] to extract relationship data from natural language and store the data in a graph database for recall in a cognitive behavioral therapy chatbot session.
- Led a project to build emotion and sentiment anaylsis models that exceeded the performance of available APIs in the mental health domain. Productionized these models into an internal API.
- Built a content-based recommendation system based on BERT using data annotations gathered through Mechanical Turk.
- Prototyped a computer vision/NLP application[2] to extract metadata from prescription bottles via mobile phone cameras. The model is currently deployed on the Sharecare mobile platform.
- Other general responsibilities include (mostly backend) software engineering to build out new platforms from scratch and leading data science efforts. Technologies used include Clojure, Python, Nodejs, Dgraph, Postgresql, and Google cloud platform.

2018–2019 **Data scientist/software engineer**, *The Markov Corporation (DBA Level)*, Palo Alto, CA.

- Designed the LEVEL oven's image classification system[3] that infers the suggested identity of over 100 different foods with >95% precision in about 30 ms and leverages customer feedback to continuously improve.
- Conceptualized and implemented an experimental apparatus to generate pixel-precision ground truth depth data to train a deep stereo vision model in TensorFlow. A robot was designed to generate high-precision data while minimizing sample collection time.
- Wrote software to optimize and evaluate food detection and generative semantic segmentation models that locate food to pixel precision within the oven. Managed crowdsourced annotation of detection and segmentation data reducing the costs of building a quality dataset.
- Developed the first production version of the of the LEVEL oven's backend software in Python.
- Performed research related to predictive modeling of heating patterns in the oven. Modeling included applications of Markov processes and constrained optimization to predicting future heating and sensor calibration.

2011–2018 **Post-doctoral/graduate student researcher**, *Salk Institute for Biological Studies*, La Jolla, CA.

- Designed a dimensionality reduction technique to analyze the receptive fields of neurons that make up deep biological neural networks.
  - Technique was published in a journal article[4] and was presented at the 2016 Computational and Systems Neuroscience conference (COSYNE).
  - Led to novel insights into how neurons deep in the auditory system make decisions based on multiple inputs. The method predicted responses of neurons to new stimuli better than prior dimensionality reduction methods for nearly all 50 neurons in the data set.
- Developed a model and algorithm for decoding the computations underlying the responses of sensory neurons.
  - Method was published in a computational neuroscience journal[5] and presented in a talk at the 2012 Society for Neuroscience meeting and the 2013 COSYNE conference.
  - Independently reproduced the expected biological inputs of retinal neurons and newly discovered that these neurons compute a particular type of logical operation.

Other activities.

○ Authored nonlinear constrained optimization algorithms including a GPU capable interior-point method in Python and augmented Lagrangian in MATLAB both of which are top search results on Google.

○ Created the website https://buythenhold.com to calculate ideal contributions and withdrawals to/from a portfolio as well as portfolio rebalancing. Frontend is React/Redux while the backend uses Flask.

Publications/Patents

[1] E. W. Dolan, J. T. Kaardal, J. F. Hartman, S. S. Bhat, S. A. Sharma, and W. A. De Brouwer, "Artificial memory for use in cognitive behavioral therapy chatbot." U.S. Patent 20220068462A1, Published March 2022.

[2] K. Thakore, S. A. Sharma, S. M. Kirk, J. T. Kaardal, A. Sly, and W. A. De Brouwer, "Artificial intelligence-based drug adherence management and pharmacovigilance." U.S. Patent 20210249139A1, Published August 2021.

[3] L. R. Speiser and J. T. Kaardal, "Computer vision classifier using item micromodels." U.S. Patent 11126898B2, Issued September 2021.

[4] J. T. Kaardal, F. E. Theunissen, and T. O. Sharpee, "A low-rank method for characterizing high-level neural computations," *Frontiers in Computational Neuroscience*, vol. 11, p. 68, 2017.

[5] J. Kaardal, J. D. Fitzgerald, M. J. Berry, and T. O. Sharpee, "Identifying functional bases for multidimensional neural computations," *Neural computation*, vol. 25, no. 7, pp. 1870–1890, 2013.

[6] J. T. Kaardal, *Decoding the computations of sensory neurons*. PhD thesis, UC San Diego, 2017.

[7] E. W. Dolan, J. T. Kaardal, J. F. Hartman, S. S. Bhat, S. A. Sharma, and W. A. De Brouwer, "Systems and methods for tangential conversations in a cognitive behavioral therapy chatbot." U.S. Patent 20220068463A1, Published March 2022.

[8] J. D. Knighton Jr., P. J. Dow, M. Titova, S. S. Sharma, W. A. De Brouwer, J. T. Kaardal, G. G. Zaccak, and S. A. R. Steyaert, "System and method with federated learning model for medical research applications." U.S. Patent 20210225463A1, Published July 2021.

[9] J. D. Knighton Jr., P. J. Dow, M. Titova, S. A. Sharma, W. A. De Brouwer, J. T. Kaardal, G. G. Zaccak, S. Vivona, and D. D. Reich, "Systems and methods of training processing engines." U.S. Patent 20210166111A1, Published June 2021.