Brian Matejek

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EDUCATION

Harvard University, Cambridge, Massachusetts, USA

Ph.D. Candidate in Computer Science — Aug 2016 – Present
Advisor: Professor Hanspeter Pfister
Focus: computer vision, neuroscience
GPA: 4.00 / 4.00

Princeton University, Princeton, New Jersey, USA

M.S.E. in Computer Science — Sep 2014 – Jun 2016
Thesis: Learning Global Features for Neuron Reconstruction in EM Images
Advisor: Professor Thomas Funkhouser
GPA: 3.85 / 4.00

B.S.E. in Computer Science — Sep 2010 – Jun 2014
Independent Research: Detecting Objects Using Google Street View Data
Independent Research: A Computational Analysis of Arbitrage Opportunities in Sports Gambling
GPA: 3.79 / 4.00, High Honors

RESEARCH EXPERIENCE

Harvard University

Compresso: Efficient Compression of Segmentation Data for Connectomics

Published September 2017 in *Medical Image Computation and Computer Assisted Intervention*.

- Co-designed a novel scheme to compress large label volumes that exploits structural redundancies inherent to the data.
- Created an open-source implementation in Python, C++, and JavaScript, with speeds reasonable for terabyte datasets.
- Compressed an 18.2 terabyte label volume of segmented brain tissue to 26.2 gigabytes, a reduction of $682\times$.

Biological-Constrained Region Merging for Connectome Reconstruction

In preparation for *Computer Vision and Pattern Recognition*.

- Developed a novel pipeline to quickly correct segmentation errors in giga- to terabyte label volumes.
- Wrote $\sim$ 8900 lines of c++ code and $\sim$ 4800 lines of python code to process, transform, and visualize gigabyte image datasets.
- Designed novel convolutional neural network architectures using Keras to predict errors in input segmentations.

Princeton University

Learning Global Features for Neuron Reconstruction in EM Images

Master's Thesis, Spring 2016 • Supervisors: Professors Thomas Funkhouser and Sebastian H. Seung

- Implemented both local greedy and global approximation algorithms to assign neuron labels to electron microscopy (EM) images.
- Trained an affinity function between neighboring supervoxels using the Shark Machine Learning Library (random forest classifier).
- Reformulated the neuron segmentation problem as a conditional random field to leverage overall global structure.
- Wrote $\sim 20,000$ lines of C++ code to read and manipulate 5–10 GB raw image datasets.

Detecting Objects Using Google Street View Data

Independent Work, Fall 2013 • Supervisor: Professor Thomas Funkhouser

- Improved on current object detection algorithms for city intersection objects by analyzing multiple Google Street View (GSV) images in 3-D space.
- Used Hough voting to estimate the real world 3-D locations of objects using 2-D image predictions
- Created several thousand variable system of linear equations to map pixels to grid voxels in order to better detect objects in 2-D and 3-D.
- Wrote $\sim$7000 lines of C++ code to handle and manipulate $\sim$150,000 images in the data set ($\sim$100GB), and create probability estimates for locations of various objects of interest.

A Computational Analysis of Arbitrage Opportunities in Sports Gambling

Independent Work, Spring 2013 • Supervisor: Dr. Christopher Moretti

- Analyzed sports gambling odds offered by 16 different bookkeepers in 90 different sports leagues in 13 different sports, scraping over $\sim$107,000 webpages to collect data for $\sim$105,000 games.
- Theorized the optimal ways to bet on an individual game by hedging bets among various bookkeepers who disagree on team win probability.
- Hypothesized and analyzed long term optimal management of gambling funds by considering redistributing bookkeeper accounts (at a cost) to keep account amounts roughly equal.
- Wrote a $\sim$3000 line Java simulation of a gambling environment using real world data.

PUBLICATIONS

[9] Lin, Z., Wei, D., Jang, W.D., Zhou, S., Chen, X., Wang, X., Schalek, R., Berger, D., Suissa-Peleg, A., **Matejek, B.**, Kamentsky, L., Parag, T., Jones, T., Haehn, D., Lichtman, J., and Pfister, H. Multimodal Active Clustering for Efficient Object Annotation in Connectomics. *Under review*.

[8] **Matejek, B.**, Wei, D., Wang, X., Zhao, J., Palagyi, K., and Pfister, H. Synapse-Aware Skeleton Generation for Neural Circuits. In *International Conference on Medical Image Computing and Computer-Assisted Intervention*. Springer, Cham.

[7] **Matejek, B.**, Haehn, D., Zhu, H., Wei, D., Parag, T., and Pfister, H. Biologically-Constrained Graphs for Global Connectomics Reconstruction. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2019*.

[6] Dmitriev, K., Parag, T., **Matejek, B.**, Kaufman, A., and Pfister, H., 2018, September. Efficient Correction for EM Connectomics with Skeletal Representation. In *British Machine Vision Conference*.

[5] Behrisch, M., Streeb, D., Stoffel, F., Seebacher, D., **Matejek, B.**, Hagen Weber, S., Mittelstädt, S., Pfister, H., Keim, D. Commercial Visual Analytics Systems - Advances in the Big Data Analytics Field. IEEE TVCG 2018.

[4] Haehn, D., Hoffer, J., **Matejek, B.**, Suissa-Peleg, A., Al-Awami, A.K., Kamentsky, L., Gonda, F., Meng, E., Zhang, W., Schalek, R., Wilson, A. et al., 2017, August. Scalable Interactive Visualization for Connectomics. In *Informatics* (Vol. 4, No. 3, p. 29). Multidisciplinary Digital Publishing Institute.

[3] Parag, T., Tschopp, F., Grisaitis, W., Turaga, S.C., Zhang, X., **Matejek, B.**, Kamentsky, L., Lichtman, J.W. and Pfister, H., 2017. Anisotropic EM Segmentation by 3D Affinity Learning and Agglomeration. *arXiv preprint arXiv:1707.08935*.

[2] **Matejek, B.**, Haehn, D., Lekschas, F., Mitzenmacher, M. and Pfister, H., 2017, September. Compresso: Efficient Compression of Segmentation Data For Connectomics. In *International Conference on Medical Image Computing and Computer-Assisted Intervention* (pp. 781-788). Springer, Cham.

[1] Dohan, D., **Matejek, B.** and Funkhouser, T., 2015, October. Learning hierarchical semantic segmentations of lidar data. In *3D Vision (3DV), 2015 International Conference on* (pp. 273-281). IEEE.

INVITED TALKS

Efficient Error Correction for Connectomics, Bioimage Computing	Jun 2019

AWARDS & SCHOLARSHIPS

Smith Family Fellowship	Jul 2017 – Jun 2018
Tess Denny Chen Graduate Student Research Fellowship	Aug 2016 – Jun 2017
Member of Sigma Xi, Scientific Research Society	Admitted Jun 2014
Member of Tau Beta Pi, Engineering Honor Society	Admitted Nov 2012

TEACHING EXPERIENCE

Harvard University

Computer Science 109A: Introduction to Data Science	Fall 2018

Princeton University

Computer Science 423: Theory of Algorithms	Spring 2016
Computer Science 402: Artificial Intelligence	Fall 2015
Computer Science 340: Reasoning About Computation	Spring 2015
Computer Science 429: Computer Vision	Fall 2014

SKILLS

Languages: Python, C++, MATLAB, Java, JavaScript, Julia, HTML, C
Other Tools: Cython, Keras, LaTex, CSS, Django