Andrew L. Beers

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https://github.com/AndrewBeers
https://github.com/QTIM-Lab
short resume: http://anderff.com/resources/ABeers_Resume_Short.pdf

Education

Brown University, 3.76 GPA, Magna Cum Laude

- Concentration: Environmental Studies
- *Best Research Project 2015*, Institute at Brown for Environment and Society.
- *Library Innovation Prize 2015*, Brown University (sole recipient).
- *Explore Grant 2013*, Social Innovation Initiative (SII) at Brown University.

Research

Quantitative Tumor Imaging Lab, Center for Machine Learning @ the MGH/HST Martinos Center for Biomedical Imaging - Boston, MA, Research Assistant (2016-2017), Programmer (2017)

- Design deep learning models for 3D image segmentation, synthesis, classification, regression, denoising, sequence generation, and superresolution of medical imaging data using Tensorflow and Keras.
- Develop open-source software packages (3D Slicer, Glue, DeepNeuro) for both clinical and academic users.
- Create in-house machine learning pipelines for diagnosis, prognosis, and treatment planning for brain tumors. Facilitate the usage of this pipeline by clinicians testing new treatments in ongoing clinical trials.
- Design curricula and give lectures for machine learning classes at MIT and the Martinos Center.

Cedar Creek Ecosystem Science Reserve, NSF Long-Term Ecological Research Site - East Bethel, MN, Research Intern (2015)

- Formalized and enacted a protocol for surveying diseased trees in Cedar Creek's forests, in support of a larger project on oak wilt epidemiology.

Brown University Center for Environmental Studies
Providence, RI, Research Assistant (2014-15)

- Made a website to visualize 134 years of iceberg data using Javascript, and d3.js. Modeled iceberg observer behavior to determine unrecorded changes in observers in the historical record.

American Civil Liberties Union
Boston, MA, Researcher (2014)

- Contributed to a rebuttal for an expert witness in an upcoming state-level reproductive justice case, and critiqued statistical methods in the opposition's supporting epidemiological literature.

Employment

American Civil Liberties Union
New York, NY, Online Production Assistant (2015-16)

- Ran statistical analysis on the ACLU's email fundraising campaign, and coded responsive donation pages.

Ceres
Boston, MA, Insurance Intern (2014)

- Created a tool with VBA and Bloomberg to track eco-friendly "green bonds" in the global market.

Planned Parenthood Federation of America
Washington, DC, Digital Fundraising Intern (2013)

- Created a tool in R to evaluate and rank the effectiveness of PPFA's national fundraising campaigns.

TIC
Washington, DC, Programming Counselor (Summers 2011/2012)

- Created and taught a programming curriculum using LOGO for game creation aimed at children aged 6-14.

Talks / Conferences

IEEE International Symposium on Biomedical Imaging 2018 – Session Chair, "Lung Nodule Malignancy Prediction Based on Sequential CT Scans". Gave two talks, one explicating our previous work on multi-interval lung nodule segmentation, and one reviewing the results of a competition on lung nodule segmentation.

BrainHack Boston 2018 – Talk, "Deep Learning @ BrainHack". Reviewed advances in deep learning in neuroscience.

Teaching

Introduction to Deep Learning and Medical Imaging – Two series of classes teaching deep learning with Python as applied to medical imaging. The first iteration was aimed towards .NET programmers with an MGH industry partners, and the second towards more experienced Python programmers among the clinicians, professors, and researchers of MGH and Harvard Medical School. Some class lectures found at https://bit.ly/2xTXDXd.

Guest Lecture, MIT Winter Session – Gave a pair of classes on feature extraction and computer vision in a MIT winter class.

Journal Publications

Automated Diagnosis of Plus Disease in Retinopathy of Prematurity Using Deep Convolutional Neural Networks. James M. Brown; J. Peter Campbell; Andrew Beers; Ken Chang; Susan Ostmo; R. V. Paul Chan; Jennifer Dy; Deniz Erdogmus; Stratis Ioannidis; Jayashree Kalpathy-Cramer; Michael F. Chiang. JAMA Ophthalmology (2018). https://goo.gl/9pyj9U

- We develop a method to automatically grade retinopathy of prematurity, which can result in blindness in prematurely-born babies if not effectively treated. We use convolutional neural networks to achieve performance equal to a composite ranking of experts, and show that our ranks can track disease progression and treatment response. I performed the project's initial analyses, and provided software support for deep learning throughout the project's development.

Semi-Automated Pulmonary Nodule Interval Segmentation using the NLST data. Yoganand Balagurunathan, Andrew Beers, Jayashree Kalpathy-Cramer, Michael McNitt-Gray, Lubomir Hadjiiski, Bensheng Zhao, Jiangguo Zhu, Hao Yang, Stephen S.F. Yip, Hugo J.W.L. Aerts, Sandy Napel, Dimitry Cherenov, Kenny Cha, Heang-Ping Chan, Carlos Flores, Alberto Garcia, Robert Gillies, Dimitry Goldgof. Medical Physics (2018). https://goo.gl/Ujq43n

- We compare state of the art lung CT nodule segmentation methods from several institutions, evaluate their effectiveness at estimating nodule growth between two time points, and grade their ability to separate malignant tumors from benign nodules using nodule growth statistics. I contribute all statistical analysis, a visualization platform for the data (https://goo.gl/YC6deC), and figures.

Distributed deep learning networks among institutions for medical imaging. Chang, Ken, Niranjan Balachandar, Carson K. Lam, Darvin Yi, James M. Brown, Andrew Beers, Bruce R. Rosen, Daniel L. Rubin, and Jayashree Kalpathy-Cramer. Journal of the American Medical Informatics Association (2018). https://goo.gl/ewMKn7

- Researchers at medical institutions want to use deep learning algorithms on their imaging data, but patient privacy concerns and prohibitions on data-sharing mean that no one institution has enough data to train an effective model. We compare the effectiveness of different methods by which institutions can share model weights, but not their underlying training data, in order to circumvent this need for large, shared datasets. I contribute software support for machine learning aspects, data analysis, and writing.

ISLES 2016 and 2017-Benchmarking Ischemic Stroke Lesion Outcome Prediction Based on Multispectral MRI. Winzeck, Stefan, Arsany Hakim, Richard McKinley, José A. A. D. S. R. Pinto, Victor Alves, [25 authors], Andrew L. Beers, Pablo Arbelaezs, Oskar Maier, Ken Chang, James M. Brown, Jayashree Kalpathy-Cramer, Greg Zaharchuk, Roland Wiest and Mauricio Reyes. Frontier in Neurology (2018). https://goo.gl/Cuf7Ee

- I participated in a competition for segmenting stroke lesions based on a noisy dataset anatomical and diffusion tensor imaging (DTI) MR sequences. The implementation for this competition was an early version of

DeepNeuro, and implemented what has a now become a standard 3D U-Net with data augmentation. As to our ranking in the competition, well, you can't win em' all.

Residual Convolutional Neural Network for Determination of IDH Status in Low- and High-grade Gliomas from MR Imaging. Chang Ken, Harrison X Bai, Hao Zhou, Chang Su, Wenya Linda Bi , Ena Agbodza, Vasileios K. Kavouridis, Joeky T. Senders, Alessandro Boaro, Andrew L. Beers, [...], Elizabeth Gerstner, Paul J. Zhang, Bruce Rosen, Li Yang, Raymond Y Huang. Clinical Cancer Research (2017). https://goo.gl/yLu4dX

- Gliomas with the IDH genotype present different visual phenotypes on MR imaging scans. The presence of IDH in glioblastoma is one of the best predictive biomarkers available to the clinician for patient survival, so there is much interest in developing a fast and reliable classifier for IDH prediction in MR images. We present such a method using "2.5D" convolutional neural networks, and show physician-level performance on both high- and low grade tumors derived from clinical scans. Contributed software support for deep learning, writing.

A Multi-Institutional Comparison of Dynamic Contrast-Enhanced Magnetic Resonance Imaging Parameter Calculations. Ger, Rachel B., Abdallah SR Mohamed, Musaddiq J. Awan, Yao Ding, Kimberly Li, Xenia J. Fave, Andrew L. Beers, [...], John D. Hazle, Laurence E. Court, Jayashree Kalpathy-Cramer & Clifton D. Fuller. Nature Scientific Reports (2017). https://goo.gl/1my75U

- DCE-MRI is a 4D imaging modality -- 3D images + time -- wherein a high intensity contrast agent is injected into a patient's bloodstream, and the time-course of that contrast agent is monitored via MRI imaging. Vascular permeability is a biomarker useful for benchmarking brain tumor development, and it can be extracted from DCE-MRI by fitting its time-curves to a standard model. I developed a fitting algorithm for determining BBB permeability that outperformed all other submissions in a multi-institution study on such algorithms.

Conference Papers, Abstracts, arXiv, Datasets

DeepNeuro: an open-source deep learning toolbox for neuroimaging. Andrew Beers, James Brown, Ken Chang, Katharina Hoebel, Elizabeth Gerstner, Bruce Rosen, Jayashree Kalpathy-Cramer. arxiv (2018). https://arxiv.org/pdf/1808.04589.pdf

- I created a deep learning package for medical imaging and neuroimaging. It provides functions data preprocessing specific to the fields of neuroimaging and deep learning, and templates for common neural network architectures for image segmentation, classification, and synthesis in 2D and 3D. Its primary use is for creating end-to-end pipelines for deep learning, which can then be packaged with helper scripts into Docker containers and command-line interfaces for wider distribution. It is currently in use in clinical trials at MGH, and is being tested for wider clinical use.

High-resolution medical image synthesis using progressively grown generative adversarial networks. Andrew Beers, James Brown, Ken Chang, J. Peter Campbell, Susan Ostmo, Michael F. Chiang, and Jayashree Kalpathy-Cramer. arxiv (2018). https://arxiv.org/pdf/1805.03144.pdf

- An adaptation of T. Karras' progressively-growing generative adversarial networks (PG-GANs) to the use case of medical images. In practice, GANs are neural networks that aim to generate "synthetic" images that are indistinguishable from a trainings set of images according to a given criteria. We show that PGGANs can be profitably implemented with 2D retinal and MR data, and describe the benefits of synthesizing tissue-of-interest segmentation maps along with image data for creating more realistic images.

Sequential neural networks for biologically-informed glioma segmentation. Beers, Andrew, Ken Chang, James Brown, Emmett Sartor, C. P. Mammen, Elizabeth Gerstner, Bruce Rosen, and Jayashree Kalpathy-Cramer. SPIE 2018. https://arxiv.org/abs/1709.02967.

- When treating glioblastoma, a particularly-malignant form of brain cancer, clinicians spend an inefficient amount of time manually demarcating different tissues of interest on MRI scans. To relieve clinicians of this time burden, many have attempted to create fully-automatic 3D tumor segmentation algorithms. I contribute to the field with a deep learning software package that takes into account prior knowledge about the spatial distribution of different tissues of interest. Derivatives of this algorithm are currently in use in clinical trials in my lab. Submitted to the MICCAI BraTS tumor segmentation competition, rankings not yet released.

Anatomical DCE-MRI phantoms generated from glioma patient data. Beers, Andrew, Ken Chang, James Brown, Xia Zhu, Dipanjan Sengupta, Theodore Willke, Elizabeth Gerstner, Bruce Rosen, and Jayashree Kalpathy-Cramer. SPIE 2018. https://goo.gl/NCM8mj

- DCE-MRI is a 4D imaging modality -- 3D images + time -- that radio-oncologists use to extract information about tumor blood-flow and vessel functioning. DCE-MRI data is extremely noisy, and many have developed denoising

algorithms that extract blood-flow signal from the noise to create predictive and reproducible cancer biomarkers. In support of our own efforts to de-noise DCE-MRI using deep learning, I create a public dataset of patient-derived noiseless "phantom" data for the purpose of evaluating denoising algorithms. No such phantom exists derived from in-vivo patient data, particularly for the case vessel structure of brain tumors.

Fully automated disease severity assessment and treatment monitoring in retinopathy of prematurity using deep learning. Brown, James M., J. Peter Campbell, Andrew Beers, Ken Chang, Kyra Donohue, Susan Ostmo, R.V. Paul Chan, Jennifer Dy, Deniz Erdogmus, Stratis Ioannidis, Michael F. Chiang, Jayashree Kalpathy-Cramer. Oral presentation, SPIE 2018. https://goo.gl/qUK35R

- Retinopathy of prematurity is a disease that causes blindness is premature babies. We use a U-Net architecture paired with GoogleNet to assess the severity of this disease based on retinal imaging scans. Retinal scans are first segmented into vessels using the UNet, and then vessel maps are used as supplements to GoogleNet-based classifications. I contribute software support, particularly for the U-Net portion of the code, and data collation and organization.

Repeatability of ktrans derived from DCE-MRI in newly diagnosed glioblastoma across multiple baseline images and processing methods. Andrew Beers, Yi-Fen Yen, Kyrre Eeg Emblem, Elizabeth R Gerstner, Bruce Rosen, and Jayashree Kalpathy-Cramer. ISMRM 2017. https://goo.gl/9C1gzP

- *Ktrans*, commonly interpreted as blood brain barrier permeability, is a valuable imaging biomarker when treating glioblastoma. I show with with multiple no-treatment baseline scans that its statistical repeatability is lower than previously thought, and very much subject to the particular method by which *ktrans* is calculated.

Multimodal Imaging of Vascularity and Drug Delivery in GBM Patients Treated with Anti-angiogenesis Inhibitor. Yi-Fen Yen, Jayashree Kalpathy-Cramer, Ciprian Catana, Xiao Da, Yangming Ou, Andrew L. Beers, Jacob Hooker, Bruce Rosen, Tracy Batchelor, and Elizabeth R. Gerstner. ISMRM 2017. https://goo.gl/hv5g3h

- In this abstract, members of our lab attempt to find proxies in MR imaging for chemotherapy drug delivery, in order to assess treatment and guide further research. I contribute data collation and image pre-processing software.

Making sense of large data sets without annotations: analyzing age-related correlations from lung CT scans. Yashin Dicente Cid; Artem Mamonov; Andrew Beers; Armin Thomas; Vassili Kovalev; Jayashree Kalpathy-Cramer; Henning Müller. SPIE 2017. https://goo.gl/B7WC7t

- 12,000+ lung CT scans from 9,000+ patients in Belarus' national lung screening program are available, but are bereft of almost any clinically-useful information. We show that one can use random forests to predict patient age from imaging features extracted from automatically-segmented lungs in these scans. I contribute code for machine learning and statistical analysis. Won Best Student Paper award on Medical Informatics track at SPIE.

The Grand Banks Iceberg Mapper. Andrew Beers. Brown Digital Repository. (2015). doi:10.7301/Z0HT2M7B

- Iceberg sightings off the coast of Newfoundland are both valuable and problematic indicators of climate change in the North Atlantic Ocean. I merged iceberg sightings from shipside, aerial, radar, and satellite sighting databases into a single, unprecedented dataset spanning from 1880 to the present day. The Iceberg Mapper uses d3.js to create a interactive web platform for users to investigate these sightings, and better understand the difficulty of reconciling differences in sighting methods between different eras.

Open-Source Software

DeepNeuro - https://github.com/QTIM-Lab/DeepNeuro

- Open-source deep learning Python package for medical imaging. DeepNeuro is an open-source, extensible framework for all of our labs deep learning projects that includes qtim_gbmSegmenter. qtim_gbmSegmenter is a one-off application of a deep learning segmentation model for glioblastoma currently in use in our lab's clinical trials. Sole creator.

Segmentation Wizard (3D Slicer) - https://github.com/QTIM-Lab/SlicerSegmentationWizard

- I contribute a module to 3D-Slicer, an open-source platform for medical imaging software. Includes tools for drawing tumor annotations via intensity thresholding via differences between treatment time points. Used for clinical studies at MGH before being supplanted by DeepNeuro. Sole creator.

glue-viz :: medical - https://github.com/glue-viz/glue-medical

- Glue is a visualization Python package for astronomical data, but nothing in principle prevents it from being a medical imaging visualization tool too. I am working with the creator of Glue to extend glue to medical image data formats -- beta releases available.

qtim_preprocessor - https://github.com/QTIM-Lab/qtim_PreProcessor

- A dockerized a Python-runnable version of our labs internal preprocessing pipeline for brain MRIs. Has been used by our collaborators in Tata Memorial Hospital. Now included in DeepNeuro. Sole creator.

Press

"AI better than most human experts at detecting cause of preemie blindness"

- https://eurekalert.org/pub_releases/2018-05/ohs-abt050218.php

"AI Beats Experts At Diagnosing Childhood Disease"

- https://www.opb.org/news/article/artificial-intelligence-ai-childhood-eye-disease/

"A story in time: Icebergs & Climate Change": Rhode Island NSF Epscor

- http://web.uri.edu/rinsfepscor/2015/06/15/a-story-in-time-icebergs-climate-change/.

"At Loyola HS: 'Empathy boxes' to raise awareness of autism": Angelus News

- https://angelusnews.com/content/at-loyola-hs-empathy-boxes-to-raise-awareness-of-autism

Technical Skills

Programming: Experienced with Python (Tensorflow / Keras / Packaging), R (Shiny), Matlab, Javascript (d3.js, tensorflow.js), C++. Comfortable with CUDA, Linux, Docker, GPU Programming, ArcGIS, LaTeX, SPSS, Adobe Suite, and VBA. Extensive knowledge of softwares and data formats used in medical image analysis.

Advocacy

Lucy Parsons Center – Organizing Collective Member (2016-2018)

- Promoted events and organized finances for a radical community center and bookstore in Jamaica Plain.

Bluestockings Magazine – Art Director (2014-15), Designer (2013-14)

- Designed three 100-page print issues, illustrated 1-3 articles per week, and managed a staff of 10 illustrators for the feminist magazine's website, which reached 10,000+ hits on featured pieces.

Brown/RISD Design for America Chapter – Project Lead (2013-14), Project Member (2012-13)

- Developed the Empathy Box Project, which sought to spread the stories of those with autism via stories shared on social media. Applied for and won grant funding ($1400+).

Brown University Social Action Housing Group – President (2013-14), Head of Publicity (2012-13)

- Organized events and interviewed prospective members in a 45-person residential housing group for those doing social justice work.

The Brown Conversation - Facilitator (2011-2015)

- Facilitated public discussions about the meaning of an undergraduate education, alternate models for Brown's curriculum, equality in education, and ways to guide one's own educational experience.