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Benjamin R. Bray

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Education

Georgia Institute of Technology, M.S. Computer Science (Atlanta, GA) *2017 – 2019*
» Focus on high performance computing and machine learning theory. Advised by Dr. Jacob Abernethy.
University of Michigan, B.S. Honors Applied Mathematics (Ann Arbor, MI) *2013 – 2017*

Work Experience

Machine Learning & Graphics Engineer, EmbodyMe (Tokyo, Japan) *May 2020–Present*
» Improved visual quality of our face reenactment app by training a new GAN inpainting architecture.
» Introduced good software engineering & documentation practices to accommodate a growing team.
» Refactored training and visualization code to improve modularity and leverage **Python**'s static typing features.
» Led a biweekly deep learning & graphics reading group to distribute knowledge and follow new developments.
Research Intern, RIKEN AIP, advised by Dr. Emtiyaz Khan (Tokyo, Japan) *Summer 2019*
» Studied training dynamics of variational autoencoders (VAEs) and the amortization gap.
Research Assistant, University of Michigan, advised by Dr. Peter McIsaac (Ann Arbor, MI) *2013 – 2015*
» Built a `flask` app for humanities researchers to visualize topic models on 19th-century German periodicals.
» Corrected noisy digital scans using a Hidden Markov Model over word fragments. Trained on a synthetic dataset of eroded digital scans with known text. Segmented words based on letter-successor-variety.
» Implemented online variational inference for LDA/HDP from scratch in Python.
» Trained a logistic regression classifier to detect toponyms using `word2vec` features on a Dutch dataset.
Software Engineering Intern, Microsoft (Seattle, WA) *Summer 2016*
» Built a multiplatform mobile app (**C#** / Xamarin) to display Windows telemetry statistics to developers.
Data Science Intern, Are You a Human (*now Distil Networks*) (Detroit, MI) *Summer 2015*
» Improved webcrawler detection accuracy with feature engineering and random forest models for device fingerprinting.

Projects & Open Source

Noteworthy, an open-source Markdown editor with bidirectional links and excellent math support *2020*
» Markdown parsing, processing, and serialization via abstract syntax tree transformations.
» My `prosemirror-math` package adds interactive WYSIWYG math editing support to ProseMirror.
» My `remark-cite` package adds `pandoc`-style citation syntax to the `remark` markdown parser.
» Built with Electron, **TypeScript**, ProseMirror, KaTeX, and SolidJS.
Open Source Contributions
» `pandoc` (Haskell) Added support for hyperlinked citation titles. Improved syntax for fenced blocks.
» `byline` (Haskell) Added support for vivid ANSI terminal colors. Resolved unlawful semigroup instance.
Incompressible Fluid Simulation *2019*
» Interactive **C++/CUDA** simulation of incompressible flow using parallel Jacobi solver with vorticity confinement.
» Compared against CPU implementation with incomplete Cholesky preconditioned conjugate gradient.
Borscht, a command line tool for music library tagging, written in **Haskell** *2021*
» Queries the Discogs API to assign metadata to local music files, storing the result in a SQLite database.
» Implemented a custom Datalog inference engine (semi-naive evaluation with stratified negation) allowing playlist creation from first-order logical formulas (parsed with monadic parser combinators).
» Built with Haskell, cabal, `req`, `aeson`, `persistent`, `mtl`, `stm`.

Technical Skills	*Advanced*	*Proficient*	*Familiar*
Languages	TypeScript, Python	Haskell, C++, C#, Java	Scala, Coq
ML	`numpy`, `gensim`	`pytorch`, `scikit-learn`	`tensorflow`
Graphics		CUDA	OpenGL, OpenCV
Tools		LaTeX, Git, LLVM, `flask`	Node, Docker

Teaching

Teaching Assistant, CSE 7640, Computational Data Analysis (GT)	*S20*
Teaching Assistant, CS 4540, Advanced Algorithms for Machine Learning (GT)	*F18, F19*
Teaching Assistant, EECS 545/445, Machine Learning (UM)	*S16, F17, S17*

» Gave lectures on numerical methods, convex geometry, linear programming, statistical inference.
» Authored lecture notes and designed projects. Taught a weekly discussion section of around twenty students.

Relevant Coursework (*audited)

Cs 6290, Advanced Computer Architecture (Prof. Tom Conte, GT) *S19*
» Pipelining; instruction-level parallelism; superscalar processors; VLIW; Tomasulo/ROB/RAT
» Memory hierarchies; multiprocessors; shared memory vs. message passing; cache coherency/consistency

Cs 6241, Advanced Compiler Optimizations (Prof. Santosh Pande, GT) *S19*
» For projects, wrote LLVM transform passes to perform optimizations discussed in class.
» Reaching definitions; available expressions; partial redundancy elimination; infeasible paths
» Data/loop/control dependencies; loop parallelism, reordering, unrolling, and vectorization

Cse 6220, High-Performance Parallel Computing (Profs. Aluru & Catalyurek, GT) *S19*
» Parallel runtime analysis; efficiency; interconnection networks & embeddings; MPI programming
» Prefix sum; bitonic sort; sample sort; Cannon's algorithm; parallel FFT

Math 7244, Stochastic Calculus (Prof. Michael Damron, GT) *F18*
» Brownian motion; mean-square calculus; continuous-time martingales; stochastic integration

Isye 7687, Discrete Optimization for Machine Learning (Prof. Sebastian Pokutta, GT) *S18*
» Boosting and online learning; bandits and reinforcement learning; away-step conditional gradient
» Completed a final report surveying algorithms for online submodular maximization.

Stats 700, Bayesian Nonparametrics Seminar (Prof. Long Nguyen, UM) *F14, S16*
» Existence and construction of Dirichlet processes; stick-breaking and Chinese restaurant processes
» Indian Buffet Processes; Hierarchical Dirichlet Processes; online variational inference and natural gradients
» Likelihood and sufficiency principles; Bayesian vs. frequentist statistics
» Exponential families and conjugacy; Gibbs sampling; variational inference

Cs 7545, Statistical Learning Theory (Prof. Jacob Abernethy, GT) *F17*
» PAC-learning and VC-dimension; margin learning and kernel methods; boosting
» Online convex optimization; convex-concave games; exponential weights; mirror descent

Cs 6550, Design & Analysis of Algorithms (Prof. Jamie Morgenstern, GT) *S18*
» Matroids and greedy algorithms; graph connectivity and shortest paths; matchings; linear programming
» Gradient and mirror descent; ellipsoid method; Johnson-Lindenstrauss and random projections
» Completed a final report on random matrix theory and algorithms for sampling random matrices.

Math 6455, Differential Geometry* (Prof. Mohammad Ghomi, GT) *S18*
» Smooth manifolds; vector fields; geodesics; Riemannian metrics; Levi-Civita connection
» Submanifolds; differential forms; Lie groups; integral curves and flows

Math 571, Numerical Linear Algebra (UM) *F15*
Math 671, Fast Numerical Methods (UM) *S17*

Cse 8803, Advanced Scientific Computing (Prof. Edmond Chow, GT) *S18*
» Stationary iterative methods; conjugate gradient and Krylov subspaces; Chebychev polynomials
» Nonuniform FFT and butterfly algorithms; Ewald summation; multigrid; fast multipole methods
» Finite element analysis; molecular simulation with hydrodynamic interactions

Math 597, Measure Theory & Real Analysis (UM) *S16*
Math 525, Probability Theory (UM) *F16*
Math 420, Advanced Linear Algebra (UM) *F15*

Other Involvement

President, Michigan Student Artificial Intelligence Lab *2015-2017*
» Organized a weekly machine learning reading group for undergraduate & graduate students