benrbray@gmail.com
JP (070) 1311-1364

Benjamin R. Bray

benrbray.com
github.com/benrbray

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

Research Engineer, National Institute of Informatics (国立情報学研究所) (Tokyo, Japan) *Feb 2023 – Now*

» ERATO Metamathematics for Systems Design Project led by Prof. Ichiro Hasuo.

Backend Engineer, Smartpay K.K. (Tokyo, Japan) *March 2022 – Feb 2023*

» Contributed to the backend API powering the mobile app & web frontend for a buy-now-pay-later service.
» Led the design, implementation, testing, and release of a new "programmatic disbursements" backend service which integrates with bank APIs to automatically issue merchant payouts and consumer refunds.
» Wrote purely functional **Scala** in tagless-final style. Used GCP, Terraform, Grafana, GraphQL, `cats-effect`.

Machine Learning & Graphics Engineer, EmbodyMe (Tokyo, Japan) *May 2020 – Feb 2022*

» Improved visual quality of our face reenactment app by training a new GAN inpainting architecture.
» 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 (理化学研究所), 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.

Software Engineering Intern, Microsoft (Seattle, WA) *Summer 2016*

» Built a multiplatform mobile app (**C#** / Xamarin) to display Windows telemetry statistics to developers.

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.

Yagi, (*incomplete*) a toy language for understanding dependent type theory, written in **Haskell** *2021*

» Parsing, type checking, and language server. Built with Haskell, `megaparsec`, `lsp`.

Borscht, (*incomplete*) 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`.

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 weekly labs attended by roughly twenty students.

Relevant Coursework (*audited)

Cs 6241, Advanced Compiler Optimizations (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

Cs 6290, Advanced Computer Architecture (GT) *S19*

» Pipelining; instruction-level parallelism; superscalar processors; VLIW; Tomasulo/ROB/RAT
» Memory hierarchies; multiprocessors; shared memory vs. message passing; cache coherency/consistency

Cse 6220, High-Performance Parallel Computing (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 (GT) *F18*

» Brownian motion; mean-square calculus; continuous-time martingales; stochastic integration

Isye 7687, Discrete Optimization for Machine Learning (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 (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 (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 (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* (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 (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