Ben duPont

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RESEARCH INTERESTS

- Machine learning algorithms, specifically emergent intelligence via local rules to cheapen inference and training.
- Generative peptide modeling and de novo design at an all-atom level; collective protein behavior, particularly phase behavior, via both experiment & theory.

EDUCATION

- **University of Cambridge** *Oct 2024 - Present*
  MPhil Candidate in Chemistry Cambridge, UK
  ◦ Advisor: Prof. Tuomas Knowles.
  ◦ Thesis Topic: Boltzmann-generator-based model for designing cyclic peptides via diverse chemistries.

- **Harvard College** *May 2024*
  A.B. in Physics Cambridge, MA
  ◦ GPA: 3.925/4.0, *Cum Laude*, Departmental High Honors.
  ◦ Relevant Coursework: Electronics for Physicists, Advanced Laboratory, Statistical Inference, Information Theory, Learning & Statistical Mechanics, Solid State Physics, Fluid Mechanics.

PUBLICATIONS C=CONFERENCE, J=JOURNAL, R=IN REVIEW

[J, R]   A. Basu, T. Krug, **B. du Pont**, Q. Huang, S. Sun, S. Adam, R. Goldman, D. Weitz. (2024). **Phase separated liquid vimentin droplets stabilize actin fibers through wetting**. Accepted to *PNAS*, doi: 10.1101/2024.06.15.597620

MISC. WORK

B. du Pont, H. Ye, J. Brenner, C. Li (2024). **Prediction and noise networks capture Brownian and Lévy foraging movements without training**. Extended abstract. doi: 10.5281/zenodo.14253587

RESEARCH EXPERIENCE

- **Sandbox AQ** *Oct 2024 - Present*
  Simulation & Optimization Resident (Intern) Cambridge, UK
  ◦ Part time (10 hrs/week) virtual internship pursued concurrently with MPhil.
  ◦ Solving interesting materials science problems with ML; unable to provide more details due to legally-binding NDA, but very distinct from MPhil research.

- **W∼Agi, ML startup based on work done in Gabriel Kreiman's lab** *June 2024 – Oct 2024*
  Research Assistant Cambridge, MA
  ◦ Modified existing machine learning methods to solve challenging reinforcement learning problems, such as 2D trail-tracking and autonomous casting behavior.
  ◦ Analytically derived approximate step size distributions for simplified ML agents using stochastic calculus and attractor dynamics.
  ◦ Gave weekly technical presentations on methodology and intermediate results to the startup team.

- **Weitz Lab** *May 2023 – June 2024*
  Undergraduate Research Assistant Cambridge, MA
  ◦ Developed an algorithm to detect and quantify the number and length statistics of actin filaments in widefield microscopy images of cells with Python and OpenCV; this showed actin filaments wet by mutant vimentin droplets are, on average, approx. 2.7 times longer than their wild-type counterparts after exposure to Cytochalasin B, results that are statistically significant.
  ◦ Above work featured in the biorxiv preprint "Phase separated liquid vimentin droplets stabilize actin fibers through wetting."
  ◦ Cultured immortalized mouse cells.
  ◦ Developed an algorithm in MATLAB to filter droplet tracks produced by TrackMate in FIJI by their colocalization with actin in their first frame.

- **High Energy X-Ray Imaging Lab, Prof. Jonathan Grindlay** *May 2022 – Sept 2022; Jan 2023 – May 2023*
  Undergraduate Research Assistant Cambridge, MA
  ◦ Developed a 1500+ line Python package for Prof. Jonathan Grindlay's small satellite telescope program for full-sky coverage and prompt imaging.
  ◦ Calculated all points potentially visible to an array of satellites within a given orbit with NumPy and HealPy, accounting for regions blocked by the Moon, Sun and Earth.
  ◦ Built functionality to transform points and fields of view to any arbitrary frame of reference by specifying orbital pole; in cases of known reference frames (ie: equatorial, galactic, ecliptic), predetermined formulae were used.

HONORS

- **Detur Book Prize** *Nov 2022*
  Harvard College
  ◦ Recognizes Sophomores who have attained very high academic standing in their first three semesters of study (before declaring a concentration), honoring them with a book of their choice.

- **John Harvard Scholar** *Sept 2020 - May 2021*
  Harvard College
  ◦ Awarded to students who achieved superior academic standing in the specified year, encompassing the top 5% to 10% of their class at that time.

GRANTS & FUNDING

- **Harvard College Research Program** *May 2023 - Aug 2023*
  Harvard College
  ◦ Awarded $3500 to cover housing and cost of living for research in Weitz lab over the summer of 2023.

TECHNICAL SKILLS

- **Programming Languages, Packages & Frameworks:** Python, Jax, Pytorch, Keras, OpenCV2, MatLab, ImageJ (FIJI), Mathematica, Dart, Flutter
- **HPC Technologies:** Slurm
- **Computer Assisted Design Software:** SolidWorks, Avogadro (Chemistry)

MISCELLANEOUS PROJECTS

- **Heraldry Auto-Blazoner** *June 2023 - Aug 2023*
  HCS AI x HUMIC Vision Fellowship
  ◦ Used Beautiful Soup to web scrape and assemble a database of roughly 9,000 coats of arms and their blazons (a technical description of the arms); wrote and implemented Python script to enable manual data cleaning.
  ◦ Finetuned Generative Image to Text (GIT) transformer on test-set of arms via HuggingFace datasets and transformers packages in pursuit of building a model that could infer a heraldic blazon given an input set of arms.

- **Postur App Development** *July 2023 - Aug 2023*
  Programmer & Graphic Designer
  ◦ Co-built a prototype app as part of a hobby project which could ameliorate event organization, invitation management, and event promotion; refactored application's existing front-end code, providing a faster and easier development experience.
  ◦ Integrated Flutter application with Firebase backend, enabling email-based user authentication.
  ◦ Designed application's User Interface in Figma.

EXTRACURRICULARS & HOBBIES

Cryptography: I enjoy making human readable ciphers that are difficult to computationally crack.
Heraldry: I enjoy the study of coats of arms and various medieval insignia.
Music Production: I like to produce and compose music; a recent choral peice of mine was performed in Sander's Theater by Ensemble Veritas as part of the Harvard College New Music Initiative