Dennis Nathan Bromley, Ph.D.

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RESEARCH & ENGINEERING INTERESTS

I am a Principal Research Scientist at Tableau Research where I invent new technologies that enable people to make the most of their data. My current areas of focus are interactive visual analytics, natural language and large language model applications to data analysis, and software architectures that speed up the feature development process. Before moving to Tableau Research, I was a Principal Software Engineer developing the Tableau Desktop and Server product. In that role, I invented multiple technologies that were executive and customer favorites (Set and Parameter Actions, Patchbay), led architecture and design efforts, was a senior engineering leader and mentor across multiple scrum teams, delivered executive presentations, and gave technical courses and keynote speeches at Tableau Conference.

Before Tableau, I earned my Ph.D. with Dr. Valerie Daggett at the University of Washington Medical School where I invented new *in silico* analysis and prediction techniques for cancer drug development. I used molecular dynamics simulations of the p53 tumor suppressor protein to predictively identify small molecule drug candidates to rescue wild-type tumor suppressive functionality. My *in silico* rescue predictions for the p53 Y220C tumorigenic mutant were wetlab verified by Professor Sir Alan Fersht at Cambridge University (publication below) and demonstrate the opportunity to boost R&D efficacy by integrating computer simulations into biomedical research.

Earlier in my career, I invented new cryptographic protocols and anti-hacker techniques for Microsoft's digital rights management (DRM) platform as a senior and lead engineer. And prior to that, I began my career at multiple MIT Media Labs startup companies doing everything from AI to MIDI to DSP. These experiences strengthened my conviction in the value of intellectual diversity and multidisciplinary experience, skills, and approaches, particularly those that orbit around the central discipline of computer science.

The consistent threads through my career are invention, innovation, and an ability to both go deep in a known field and to quickly learn and become productive in a new field. I am happiest and most productive in a collaborative, team-oriented, and entrepreneurial environment. I am a proven technical and personal leader in both blue chip companies and startups, with experience balancing business demands, innovation, people, and technical practicalities and logistics.

SUMMARY
- A.B. Computer Science, Harvard College
- Ph.D. Bioinformatics (structural biology and drug design), University of Washington Medical School
- Principal Research Scientist, Tableau Research
- Principal Member of Technical Staff (Principal Software Engineer), Tableau/Salesforce
- Peer reviewed papers in human-computer interaction, visual and data analytics, software architecture, and structural and molecular biology
- Patents in cryptography, software architecture, artificial intelligence, human-computer interaction, and visual and data analytics
- Breadth of Experience
    - Fortune 500 companies (Microsoft, Salesforce)
    - Startups (JuniorNet, Harmonix, Nearlife, Ingeeni)
    - Research (University of Washington, Microsoft, MERL, Ingeeni, Tableau/Salesforce)
    - Visual and Data Analytics (Tableau/Salesforce, University of Washington, MERL)
    - Biotech (University of Washington Medical School)
    - Video Games, Audio, DSP, and Interactive Media (Harmonix, Nearlife, Ingeeni, JuniorNet)

- ○ Cryptography and Security (Microsoft)
- ○ Music Composition and Sound Design (Juniornet, Nearlife, Ingeeni, contractor)
- Accomplishments
  - ○ Led multiple org-wide software architecture design efforts
  - ○ Hacked/invented multiple Tableau features (Set Actions, Parameter Actions, and Patchbay)
  - ○ Winner and multi-finalist, Tableau Hackathon, CEO & CTO selection
  - ○ Shipped multiple versions of Microsoft Windows, Microsoft Media Center, Microsoft Media DRM, Tableau Desktop, and Tableau Server
  - ○ Developed novel algorithms for improved protein drug targeting, mutant rescue, and lead generation
  - ○ Developed Harmonix Sony Playstation music authoring system and real time DSP engine
  - ○ Authored multiple peer-reviewed papers and patents
  - ○ Sole music composer for $100M media startup serving top tier clients such as Jim Henson and Sports Illustrated
- Skills
  - ○ Research, Software architecture, Paper and Patent authoring, Technical management and mentoring
  - ○ Executive communication and technical business decision making
  - ○ C/C++, C#, Javascript, Typescript, React, Python, SQL
  - ○ Structural & molecular biology, Molecular dynamics, Drug design
  - ○ Computational music and audio (DSP, VST, MIDI)

EDUCATION

Ph.D., Biomedical Informatics and Medical Education, University of Washington Medical School, 2014
A.B., Computer Science, Harvard College 1996

HONORS

National Library of Medicine Research Fellowship 2008-2011

PUBLICATIONS

Bromley, D. and Setlur, V., 2024. DASH: A Bimodal Data Exploration Tool for Interactive Text and Visualizations. *IEEE Transactions on Visualization and Computer Graphics, VIS 2024 (to appear), arXiv preprint arXiv:2408.01011.*

Sultanum, N., **Bromley, D.** and Correll, M., 2024. Data Guards: Challenges and Solutions for Fostering Trust in Data. *IEEE Transactions on Visualization and Computer Graphics, VIS 2024 (to appear), arXiv preprint arXiv:2407.14042.*

Bendeck, A., **Bromley, D.** and Setlur, V., 2024, March. SlopeSeeker: A Search Tool for Exploring a Dataset of Quantifiable Trends. In *Proceedings of the 29th International Conference on Intelligent User Interfaces* (pp. 817-836).

Bromley, D. and Setlur, V., 2023, October. What Is the Difference Between a Mountain and a Molehill? Quantifying Semantic Labeling of Visual Features in Line Charts. In *2023 IEEE Visualization and Visual Analytics (VIS)* (pp. 161-165). IEEE.

Bromley, D. and Daggett, V., 2020. Tumorigenic p53 mutants undergo common structural disruptions including conversion to α-sheet structure. *Protein Science*, *29*(9), pp.1983-1999.

Bromley, D., Bauer, M.R., Fersht, A.R. and Daggett, V., 2016. An *in silico* algorithm for identifying stabilizing pockets in proteins: test case, the Y220C mutant of the p53 tumor suppressor protein. *Protein Engineering, Design and Selection*, *29*(9), pp.377-390.

Bromley, D.N., 2014. *Visual Analytics Methods for Analyzing Molecular Dynamics Simulations of Mutant Proteins* (Doctoral dissertation).

Rysavy, S.J., **Bromley, D.** and Daggett, V., 2014. DIVE: A graph-based visual-analytics framework for big data. *IEEE computer graphics and applications*, *34*(2), pp.26-37.

Bromley, D., Rysavy, S.J., Su, R., Toofanny, R.D., Schmidlin, T. and Daggett, V., 2014. DIVE: a data intensive visualization engine. *Bioinformatics*, *30*(4), pp.593-595.

Bromley, D., Anderson, P.C. and Daggett, V., 2013. Structural consequences of mutations to the α-tocopherol transfer protein associated with the neurodegenerative disease ataxia with vitamin E deficiency. *Biochemistry*, *52*(24), pp.4264-4273.

Bromley, D. and Daggett, V., 2013. Analyzing disease-associated protein structures with visual analytics. *AMIA Summits on Translational Science Proceedings*, *2013*, p.33.

van der Kamp, M.W., Schaeffer, R.D., Jonsson, A.L., Scouras, A.D., Simms, A.M., Toofanny, R.D., Benson, N.C., Anderson, P.C., Merkley, E.D., Rysavy, S., **Bromley, D.**, and Daggett, V., 2010. Dynameomics: a comprehensive database of protein dynamics. *Structure*, *18*(4), pp.423-435.

Gonzalez-Heydrich, J., **Bromley, D.**, Strohecker, C., Marks, J., DeMaso, D.R., Ackermann, E., Gibson, S., Shen, C. and Umasehi, M., 1998. Experience journals: using computers to share personal stories about illness and medical intervention. In *MEDINFO'98* (pp. 1325-1329). IOS Press.

Bers, M.U., Ackermann, E., Cassell, J., Donegan, B., Gonzalez-Heydrich, J., DeMaso, D.R., Strohecker, C., Lualdi, S., **Bromley, D.** and Karlin, J., 1998, January. Interactive storytelling environments: coping with cardiac illness at Boston's Children's Hospital. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 603-610).

ISSUED PATENTS *(multiple other patent applications [filed](#) and pending)*
Dynamic visualization and data analytics based on parameter actions, US11605189B2, Granted 2023-03-14
Anonymous verifiable public key certificates, US9621341B2, Granted 2017-04-11
Protocol for Protecting Third Party Cryptographic Keys, US9003192B2, Granted 2015-04-07
Separating keys and policy for consuming content, US8353049B2, Granted 2013-01-08
Method and system for displaying icons representing information items stored in a database, US6211876B1, Granted 2001-04-03

PROFESSIONAL AFFILIATIONS
American Medical Informatics Association (AMIA)
The Institute of Electrical and Electronics Engineers (IEEE)

SKILLS
Languages/APIs: C/C++, C#, Java, SQL, .NET, Javascript, Typescript, Python, Django
Coursework: Biological, clinical, and public health informatics coursework

WORK HISTORY
Principal Research Scientist, Tableau Research
Seattle, WA 2022-
Investigate new interactive analytics methodologies to bring powerful data analysis capabilities to non-expert data consumers. Recent work includes research into quantitative semantics, natural language interfaces and large language model interaction, text/visualization bimodal interfaces, and extensible software architectures (see publications). Multiple patents pending. Responsible for executive reviews, patent and paper authoring, presenting research at conferences and meetings, mentoring, and developing and pursuing a research agenda relevant to Tableau's mission.

Principal Member of Technical Staff (Software Developer), Tableau/Salesforce
Seattle, WA 2014-2022

Invented, pitched, developed, shipped, and patented several executive and customer favorite Tableau Desktop features including Parameter Actions, Set Actions, and Patchbay (video interview). Led architecture and software design efforts throughout the interactive analytics organization. Mentored interns, new hires, and existing engineers. Developed new functionality in both the user-facing interfaces and the core data analytics engine. Won the CEO and CTO selections for multiple company-wide hackathons. Led executive technical reviews and ROI discussions. Gave technical lectures and a Devs On Stage keynote speech at Tableau Conference.

Ph.D. Candidate, Division of Biomedical and Health Informatics, University of Washington Medical School
Seattle, WA 2008-2014
Dr. Valerie Daggett, Advisor
Ph.D. research involved developing *in silico* techniques for improved drug discovery. Designed and implemented a flexible and object-oriented visual analytics engine capable of interactively analyzing terascale data sets. This engine was used to discover small drug-like molecules that could interact with target protein structures while not interfering with non-target protein function. Specific data analysis approaches and technologies used involve molecular dynamics simulations, data warehousing, clustering, descriptive statistics, logical inference, dynamic code handling, computational resource management, multi-platform client/server/plugin software architecture, and high-performance graphics and visualization. See publications for specific discoveries and findings.

Senior Developer / Developer Lead, Microsoft Corporation
Seattle, WA 2005-2009
Established anti-hacker and reverse-engineering research group to protect Microsoft Media DRM software clients including Zune, Windows Mobile OS, Windows Media Center, Napster, Amazon UnBox, Verizon V CAST, Nokia, Netflix, CinemaNow, Blockbuster, and others. Responsible for developing novel anti-hacker technologies and analyzing and responding to security breaches.   Planned features and lead strategic development. Collected five *Ship It* awards and filed four security and cryptographic patents.

Biological Simulations Developer, Independent Work
Boston, MA 2004
Developed *SimCycle*, a two-part parameterized software system for modeling and analyzing embryonic cell division cycles by simulating tritiated thymidine uptake during DNA replication. The first application of SimCycle performed a first-principles virtual experiment in which cell uptake of tritiated thymidine is monitored throughout a developing embryo and then presented for analysis. The analysis of this idealized experimental output from SimCycle not only confirmed controversial findings but was also used to help interpret the underlying mechanisms of tissue formation and was a cornerstone of a subsequent Harvard Medical School PhD thesis.

The second application of SimCycle performed data-fitting of laboratory data. An analytic model of the idealized cell growth curve was developed and then fit to the laboratory data. The parameters extracted from the best-fit curve provided insight into the cell-growth mechanism.

Lead Software Engineer / Music Director, Ingeeni Studios Inc
Cambridge, MA 2003 –2005
Designed and implemented the underlying technology foundation for the Ingeeni interactive artificial intelligence engine. Co-designed and implemented the primary C++ interactive character engine. Designed the platform independent scripting and database language, debugging tools, and visualization and design tools for Ingeeni's interactive character technologies. Multiple patents filed.

Audio Software Engineer (Sony PS2 / Windows), Harmonix Music Systems
Cambridge, MA 2001 – 2003
Shipped *Guitar Hero* precursor games *Frequency* and *Amplitude*. Designed and implemented from scratch the low-level synth and DSP engines for *Amplitude*. Synth engine features included full MIDI compatibility, real-time DSP such as filters, flange, delay, and distortion, audio-feedback effects, runtime bank

configuration, and audio streaming from disk. Matlab, Scilab, and custom DSP tools built in C++ were used for modeling, analyzing, and tuning the DSP effects. Built a custom back end control that allowed PS2 sound banks to be edited, built, and compiled in Microsoft Excel. Several verification and conversion tools were also built using the same shared codebase. Built a custom VSTi plugin that allowed composers to run the actual game synth and game audio banks on the PS2 directly from Cubase, Sonar, and Logic on the PC.

Software Engineer / Audio Engineer & Designer / Composer, Nearlife Inc.
Cambridge, MA 2000 - 2001
Designed and implemented virtual experiences, large-scale installations, and interactive museum exhibits. Designed sound and composed original music for Nearlife clients including *Discovery Kids' Real Toons* for the Discovery Channel and NBC, and the Chicago Museum of Science and Industry's permanent exhibit *Networld.*

Composer and Digital Audio Software Engineer, JuniorNet Corporation
Boston, MA 1998 – 2000
Developed interactive audio software for the JuniorNet online service. Member of the Microsoft DirectMusic and DirectX Audio Advisory Board. Composed original music for the JuniorNet online service and content partners including *Jim Henson's Bear in the Big Blue House, Highlights for Children*, *Ranger Rick*, *Weekly Reader, Zillions*, *Sports Illustrated for Kids*, and *Reading Rainbow*.

Programmer, Mitsubishi Electric Research Labs (MERL)
Cambridge, MA 1996-1998
Primary research involved the development of psychological and social therapy tools for children in conjunction with Boston's Childrens' Hospital. These tools included work in automated information retrieval, multi-dimensional data representation, and user interfaces appropriate for young children and were granted both European and American patents.

Head Teaching Assistant, Harvard University Extension School
Cambridge, MA 1997 - 2000
Head TA for a course in introductory computer science. Responsible for teaching advanced computer science concepts such as animation, computer graphics, artificial intelligence, signal processing, and networking to introductory students through laboratory demonstrations, teaching sessions, and individual appointments. Ranked by students as one of the best courses ever taught at the extension school.

Research Programmer, Harvard University Robotics Laboratory
Cambridge, MA 1995-1996
Primary research involved the development of a photo-tactile robotic arm and membrane-deformation based sensing system.