Jordan J. **Bannister**

BASc. Engineering Physics PhD. Biomedical Engineering

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About

Machine learning scientist, software developer, and project manager. Interested in solving real world problems with cutting-edge technology. Experienced in developing ML solutions for research and industry. Expert in 3D machine learning, imaging, rendering, and generative modelling. Proficient with popular ML frameworks (Jax, PyTorch, Tensorflow), programming languages (Python, C++), and cloud computing services (AWS). Passionate about excellent team organization, and communication practices. Adept at high level problem decomposition and creative problem solving.

Skills

- **Management**: Project Planning, Team Organization, Agile/Scrum, Stakeholder Management
- **Technical Communication:** Academic Publishing, Teaching and Course Development, Public Speaking, Data Visualization.
- **Software Development:** Python, C++, AWS, Git, Docker, Continuous Integration/Deployment, Infrastructure as Code
- **Machine Learning:** Jax, PyTorch, Tensorflow, Taichi, Numpy, Pandas, Deep Learning, Generative Models (Diffusion, VAE, Normalizing Flows), Differentiable Physical Simulations
- **Mathematics and Physics:** Linear Algebra, Vector Calculus, Probability and Information Theory, Digital Signal Processing, Optics, Medical Imaging, 3D Rendering (Rasterization, Ray Tracing)

Education

University of Calgary
Calgary, AB

PhD. in Biomedical Engineering, Medical Imaging Specialization
2017 - 2023

- Developed ML models and algorithms to automatically diagnose genetic syndromes using 3D facial surface scans.
- Published five academic papers as first author and co-authored several other papers and conference proceedings.
- Co-founded Deep Surface AI and served as senior AI scientist at the company, whose software product was substantially based on my research.
- Participated in an academic research exchange with the IBM Thomas J. Watson research center in New York.
- Served as VP academic of the Biomedical Engineering Graduate Student Association for one year.
- Co-organized and lectured in two graduate student lead courses on statistics and machine learning.
- Provided mentorship to undergraduate and newer graduate students within the lab.

University of British Colombia
Vancouver, BC

BASc. in Engineering Physics, Electrical Specialization
2011 - 2017

- Awarded the Roy Nodwell memorial prize for the senior design project ”A Hardware Platform to Consolidate Real-Time Data Streams From 3D Sensors for an Autonomous Wheelchair Navigation System”.
- Designed, fabricated, and programmed an autonomous target shooting robot called ”Squeaky” that placed first in the annual Engineering Physics robot competition.

Experience

Mila - Quebec AI Institute
Montreal, QC

3D Machine Learning Scientist
2023 - Present

- Collaborated with the McGill Graphics Lab to develop open-source software, research, and educational content in the domain of differentiable rendering.
- Developed TinyDiffRast, an open course and code-base. The project explores, explains, and implements state-of-the-art algorithms for differentiable triangle rasterization.
- Developed a state-of-the-art differentiable fractal flame rendering algorithm. The approach is the first of it’s kind to be capable of generating colorful, non-linear fractal flame artwork based on reference images.
- Developed a ray-tracing renderer code-base and assignment set for a McGill course on advanced image synthesis.

Deep Surface AI
Calgary, AB
Co-Founder & Senior AI Scientist
2020 - 2023

- Served as a development lead for a greenfield 3D facial surgery simulator web application.
- Created and administered a multi-account AWS organization to manage company data and computing resources following AWS architecture best practices.
- Created an infrastructure as code project and CI/CD pipeline for the application using the AWS cloud development kit. This enabled reliable and repeatable application deployments and separated production, staging, and testing environments required for product certification. On-boarded a development team to the codebase.
- Developed core machine learning models and internal libraries to process 3D facial scans, analyze 3D facial morphology, and create surgical simulations.
- Collaborated closely with the chief medical officer to maximize the value that the 3D facial morphing application provided to surgeon and patient users.
- Mentored junior developers and scientists, helping them to learn the company tech stack and become effective contributors to the development team.

University of Calgary
Calgary, AB
Teaching Assistant
2020 - 2022

- Served as the teaching assistant for three offerings of a graduate course on medical image analysis.
- Created and delivered lectures on Bayesian inference.
- Developed and administered statistics assignments.

Live Cell Imaging Facility
Calgary, AB
Research Co-op Student
2014 - 2015

- Developed a GUI application to consolidate open source super-resolution microscopy image reconstruction algorithms.
- Served as a teaching assistant for courses on optics, microscopy and image processing.
- Set up and administered a 3D printing station for the facility. Designed and printed replacement microscope parts.
- Created an endoscope-style video game controller to help clinicians learn and practice endoscope controls.

Crescent Point Energy
Calgary, AB
Engineering Co-op Student
2012

- Analyzed well production metrics and produced data visualization dashboards.

Projects and Publications

TinyDiffRast
Open Source Software
Primary Author
2024

- An open course and code-base that covers a class inverse rendering approaches for learning 3D scene parameters from 2D image supervision.
- Includes several state-of-the-art differentiable triangle rasterization algorithms implemented in the GPU accelerated Taichi programming framework.

Learnable fractal flames
Under Review
Primary Author
2024

- A novel differentiable rendering approach that allows latent fractal flame parameters to be learned from image supervision.
- Extends the state-of-the-art in differentiable iterated function system fractal rendering through support for color images, non-linear generator functions, and multi-fractal compositions.

Comparing 2D and 3D representations for face-based genetic syndrome diagnosis
European Journal of Human Genetics
Primary Author
2023

- A subject-matched comparison of 2D and 3D facial representations for computer-assisted genetic syndrome diagnosis.
- Demonstrated the advantage of 3D facial imaging systems for computer-assisted genetic syndrome diagnosis.

A deep invertible 3D facial shape model for interpretable computer-assisted genetic syndrome diagnosis
IEEE Journal of Biomedical and Health Informatics
Primary Author
2022

- Developed a novel, multi-functional 3D face-based diagnostic model for genetic syndromes using a generative, conditional normalizing flow architecture.

Detecting 3D syndromic faces as outliers using unsupervised normalizing flow models *Artificial Intelligence in Medicine*

Primary Author *2022*

- Developed 3D face-based diagnostic models for genetic syndromes using unsupervised density- and manifold-estimating normalizing flow models.

Sex differences in adult facial three-dimensional morphology *Journal of Facial Plastic Surgery and Aesthetic Medicine*

Primary Author *2022*

- Analyzed 3D surface scan data and developed visualizations to help facial surgeons better understand masculine and feminine facial characteristics.

Fully automatic landmarking of syndromic 3D facial surface scans using 2D images *Sensors*

Primary Author *2020*

- Developed an automated pipeline to process and landmark 3D facial surface scans using image-based ML models.

An interactive atlas of three-dimensional syndromic facial morphology *American Journal of Human Genetics*

Co-Author *2024*

Invertible modeling of bidirectional relationships in neuroimaging with normalizing flows: Application to brain aging *IEEE Transactions on Medical Imaging*

Co-Author *2022*

An exploratory causal analysis of the relationships between the brain age gap and cardiovascular risk factors *Frontiers in Aging Neuroscience*

Co-Author *2022*

Automated syndrome diagnosis by three-dimensional facial imaging *Genetics in Medicine*

Co-Author *2020*

Supervised machine learning tools: a tutorial for clinicians *Journal of Neural Engineering*

Co-Author *2020*

Rapid automated landmarking for morphometric analysis of three dimensional facial scans *Journal of Anatomy*

Co-Author *2017*

References available upon request.