Jordan Bannister

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SUMMARY: Machine learning scientist, software developer, and project manager. Passionate about computer vision, imaging/rendering, and 3D machine learning. Interested in solving real world problems with cutting-edge technology.

EXPERIENCE

3D Machine Learning Scientist — *Mila, Quebec AI Institute*   July 2023 - Present

- Lead and advised R&D projects in the domain of differentiable rendering and 3D machine learning.
- Developed software using **Python, PyTorch, Jax** and **Taichi**.
- Designed a state-of-the-art algorithm for generating fractal artwork based on a user-provided reference image [1].
- Developed an open course and codebase that explains and implements algorithms for differentiable rasterization [2].

Co-Founder & Senior AI Scientist — *Deep Surface AI*   Jan 2020 - June 2023

- Served as a development lead for a 3D facial surgery simulator web application substantially based on my PhD. research.
- Developed software using **Python, AWS, Tensorflow, OpenCV** and **VTK**.
- Developed a pipeline to automatically process facial image sets, construct 3D facial models, analyze facial morphology, and create 3D surgical simulations. The pipeline could ingest images and return interactive 3D simulation results to the user in under 5 minutes.
- Created and administered a multi-account AWS organization that managed company data and computing resources.
- Created an infrastructure-as-code project and CI/CD pipeline using AWS CDK and on-boarded a development team to the project. Followed AWS best practices, enabling the product to achieve HIPAA compliance.
- Mentored developers, helping them to develop programming, 3D data processing, machine learning, and cloud computing skills.

Teaching Assistant — *University of Calgary*   Jan 2020 - June 2022

- Served as the teaching assistant for three offerings of a graduate course on medical image analysis.
- Developed and administered statistics assignments using **Python, Pandas, Seaborn** and **Scikit-Learn**.
- Created and delivered lectures on Bayesian inference.

Visiting Researcher — *IBM*   Sept 2018 - Jan 2019

- Collaborated with the Biometrics research group at the Thomas J. Watson research center.
- Applied image-based ML models for facial recognition to the task of computer-assisted genetic syndrome diagnosis [3].

Engineering Co-op Student — *University of Calgary, Live Cell Imaging Facility*   June 2014 - Dec 2014

- Developed an 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.

Engineering Co-op Student — *Crescent Point Energy*   June 2012 - Sept 2012

- Developed data visualization dashboards for well production monitoring.

EDUCATION

PhD. — *University of Calgary, Calgary, AB, Canada*   Sep 2017 - May 2023
Biomedical Engineering, Medical Imaging Specialization

- Developed normalizing flow models for interpretable, automatic, 3D face-based, genetic syndrome diagnosis [4], [5].
- Analyzed 2D and 3D representations to show the advantage of 3D facial imaging systems for genetic syndrome diagnosis [3].
- Developed a fully automated pipeline to process and landmark 3D facial surface scans using image-based ML models [6].
- Analyzed 3D surface scan data to help facial surgeons better understand masculine and feminine facial characteristics [7].
- Collaborated with researchers on various projects applying ML to medical imaging [8]–[12].
- 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.
- Mentored undergraduate students and new graduate students.

BASc. — *University of British Colombia, Vancouver, BC, Canada*   Sept 2011 - May 2017
Engineering Physics, Electrical Specialization

- Received 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.
- Programmed an autonomous, image-based, track-and-follow drone for a junior design project.

Skills

- 🖥 Software Development: Python, C++, Bash, AWS.
- 📈 Machine Learning: Tensorflow, PyTorch, Jax, Taichi.
- Ψ Math: Linear Algebra, Vector Calculus, Probability and Information Theory, Optics, Medical Imaging.
- ✏ Communication: Academic Publishing, Teaching and Lecturing, Data Visualization.
- 📉 Management: Project Planning, Agile/Scrum, Team Organization, Mentorship.

Selected Publications

[1] J. J. Bannister and D. Nowrouzezahrai, *Learnable fractal flames*, 2024. arXiv: 2406.09328 [cs.GR].

[2] J. J. Bannister, *Tinydiffrast*, https://jjbannister.github.io/tinydiffrast/.

[3] J. J. Bannister, M. Wilms, J. D. Aponte, D. C. Katz, *et al.*, "Comparing 2d and 3d representations for face-based genetic syndrome diagnosis," *European Journal of Human Genetics*, vol. 31, pp. 1010–1016, 2023. DOI: https://doi.org/10.1038/s41431-023-01308-w.

[4] J. J. Bannister, M. Wilms, J. D. Aponte, D. C. Katz, *et al.*, "A deep invertible 3-d facial shape model for interpretable genetic syndrome diagnosis," *IEEE Journal of Biomedical and Health Informatics*, vol. 26, no. 7, pp. 3229–3239, 2022. DOI: 10.1109/JBHI.2022.3164848.

[5] J. J. Bannister, M. Wilms, J. D. Aponte, D. C. Katz, *et al.*, "Detecting 3d syndromic faces as outliers using unsupervised normalizing flow models," *Artificial Intelligence in Medicine*, vol. 134, p. 102 425, 2022, ISSN: 0933-3657. DOI: https://doi.org/10.1016/j.artmed.2022.102425.

[6] J. J. Bannister, S. R. Crites, J. D. Aponte, D. C. Katz, *et al.*, "Fully automatic landmarking of syndromic 3d facial surface scans using 2d images," *Sensors*, vol. 20, no. 11, 2020, ISSN: 1424-8220. DOI: 10.3390/s20113171.

[7] J. J. Bannister, H. Juszczak, J. D. Aponte, D. C. Katz, *et al.*, "Sex differences in adult facial three-dimensional morphology: Application to gender-affirming facial surgery," *Facial Plastic Surgery & Aesthetic Medicine*, vol. 24, no. S2, S-24-S–30, 2022. DOI: 10.1089/fpsam.2021.0301.

[8] J. D. Aponte, J. J. Bannister, H. Hoskens, H. Matthews, *et al.*, "An interactive atlas of three-dimensional syndromic facial morphology," *The American Journal of Human Genetics*, vol. 111, no. 1, pp. 39–47, 2024, ISSN: 0002-9297. DOI: https://doi.org/10.1016/j.ajhg.2023.11.011.

[9] M. Wilms, J. J. Bannister, P. Mouches, M. E. MacDonald, *et al.*, "Invertible modeling of bidirectional relationships in neuroimaging with normalizing flows: Application to brain aging," *IEEE Transactions on Medical Imaging*, vol. 41, no. 9, pp. 2331–2347, 2022. DOI: 10.1109/TMI.2022.3161947.

[10] B. Hallgrímsson, J. D. Aponte, D. C. Katz, J. J. Bannister, *et al.*, "Automated syndrome diagnosis by three-dimensional facial imaging," *Genetics in Medicine*, vol. 22, pp. 1682–1693, 2020. DOI: https://doi.org/10.1038/s41436-020-0845-y.

[11] P. Mouches, M. Wilms, J. J. Bannister, A. Aulakh, *et al.*, "An exploratory causal analysis of the relationships between the brain age gap and cardiovascular risk factors," *Frontiers in Aging Neuroscience*, vol. 14, 2022, ISSN: 1663-4365. DOI: 10.3389/fnagi.2022.941864.

[12] L. L. Vercio, K. Amador, J. J. Bannister, S. Crites, *et al.*, "Supervised machine learning tools: A tutorial for clinicians," *Journal of Neural Engineering*, vol. 17, no. 6, p. 062 001, Nov. 2020. DOI: 10.1088/1741-2552/abbff2.

References available upon request.