VIOLET I JOHNSON, PHD

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Recent computer science doctoral graduate with 10+ years scientific research-focused software engineering experience, including practical paid work with delivered products, & 4 years related teaching experience. Primary skillsets: Game Programming, Machine Learning, & DSP. Currently seeking full-time roles.

EDUCATION

University of North Texas, *Doctor of Philosophy (PhD) in Computer Science* — TX, USA — Jul 2024
University of North Texas, *Master of Science (MS) in Computer Science* — TX, USA — 3.8 — May 2017
University of North Texas, *Bachelor of Science (BS) in Computer Science, Minor in Math* — TX, USA — 3.2 — May 2013

Finalist: Aspirations in Computing Award 2024, NCWIT

DISSERTATION

Convolutional Neural Networks in the Domain of Non-Lexical Audio Signals — Published Jul 2024

This research explored the intersection of convolutional neural networks and raw non-lexical audio signals by designing, training, & testing models for mutation detection, upscaling, classification, & generation. Studied at a granular level all aspects of the application of CNNs to discrete temporal signals with dense periodic features, with a focus on music and audio components for composition and video game production. All projects demonstrated quantifiably successful approaches to their respective problems, & in the case of generation, provided an extensive ground-up analysis of the impact of 150+ architecture variations on early training inference quality. This included 2 novel architecture categories (PrismGAN & SBIGAN) proposed and demonstrated to solve an artifacting phenomenon observed to be uniquely problematic for strided deconvolutional models operating on digital signals.

PUBLICATIONS

Articles/Papers

- **V. Johnson, I. Parberry** (2020). Music Upscaling Using Convolutional Neural Networks. *2020 3rd International Conference on Sensors, Signal and Image Processing (SSIP 2020)*, 58-62
- **R. West, V. Johnson, I.C. Yeh, Z. Thomas, E. Mendelowitz, L. Berg** (2018). Instrument | one antarctic night. *ACM SIGGRAPH 2018 Art Gallery (SIGGRAPH '18)*, 439-440
- **R. West, V. Johnson, I.C. Yeh, Z. Thomas, M. Tarlton, E. Mendelowitz** (2018). Experiencing a slice of the sky: Immersive rendering and sonification of Antarctic astronomy data. *Electronic Imaging: The Engineering Reality of Virtual Reality 2018*
- **J.P. Lewis, I.C. Yeh, A. Migalska, V. Johnson, R. West** (2017). Exploring the definition of art through deep net visualization. *31st Conference on Neural Information Processing Systems*
- **M. Parola, V. Johnson, R. West** (2016). Turning presence inside-out: MetaNarratives. *Electronic Imaging 4*: 1-9

Posters

- **V. Johnson, R. Renka** (2016). Triangle mesh generation combining edge splitting and angle-based smoothing. *Posters, 25th International Meshing Roundtable, Sandia National Laboratories*

Presentations

- **R. West, V. Johnson, I.C. Yeh, T. Margolis, J. Gossmann, A.S. Horn, J.P. Lewis, R. Singh, J. Schulze, I. Mostafavi, B. Hackbarth, W. Li, T. Henthorn, J.I. Girardo, A. Prudhomme** (2017). ATLAS in silico. *MOFO Festival at the Museum of Old and New Art in Hobart, Tasmania*
- **R. West, T. Margolis, J. Gossmann, A.S. Horn, J.P. Lewis, R. Singh, J. Schulze, V. Johnson, I.C. Yeh, I. Mostafavi, B. Hackbarth, W. Li, T. Henthorn, J.I. Girardo, A. Prudhomme** (2016). ATLAS in silico. *The National Academies Keck Futures Initiative Conference*

EXPERIENCE

xRez Lab *Lead Research Engineer* | TX, USA — Aug 2014 - Jul 2018

- Leveraged game programming experience to design, implement top-to-bottom, & exhibit multiple NEA/NSF-funded hybrid art-science interactive installations, with a focus on 3D data-driven multiplayer VR experiences.
- Contributed to many varied projects as the lab's primary software engineer. Lead projects involving transforming large-scale scientific datasets into collaborative immersive analytics tools which simultaneously serve as artworks, games, and functional data exploration systems.
- Developed novel procgen & graphics optimization systems, allowing seamless stereoscopic rendering of millions of data-accurate interactable procedural polyhedrons in 90 FPS with no dropped frames on consumer hardware.
- Primarily used, not limited to: Unity, C#, C++, Python, MySQL, PD, Max/MSP, CUDA, HLSL, & OpenCV.

University of North Texas, Dept of Comp Sci & Eng, *Teaching Faculty/Instructor & Graduate Teaching Assistant* | TX, USA — Aug 2020 - Jun 2024

- Curriculum design & deployment, tutoring, development of teaching tools, lecturing, grading, & directing labs.
- Game Programming I & II (TF/Instructor) - Game programming techniques for implementation of functional projects from scratch in a combination of Unreal & a pure C++/DirectX engine.
- Game Math & Physics (TA) - OOP linear algebra physics system programming for games.
- Computer Science I & II (TA) - Software design, structured programming, OOP, C/C++.
- Database Admin I & II (TA) - Postgresql management. (More courses unlisted)

University of North Texas, College of Engineering, *Web Developer* | TX, USA Aug 2012 - Jul 2014

- Maintained the college's primary website, full stack.

SKILLS

Languages	Python, C/C++, C#, DirectX, HLSL, Java, CUDA, Matlab, Git, Bash, LaTeX, PHP, Postgres/MySQL
Software	Linux, Tensorflow, Theano, Keras, Unity, OpenCV, Unreal, PD, Max/MSP, Most DAWs
Roles	Research Scientist, Software Engineer, Machine Learning Engineer, Game Programmer, Audio Programmer
Certifications	Game Programming Certification, Laboratory for Recreational Computing, UNT CSE

PROJECTS

ML Projects – *Doctoral research* – Mostly Tensorflow, Theano, Python Jan 2018 - Jan 2024

- **Generative raw audio adversarial networks** - Implemented over 150 GAN architectures for instrument & sound effect sample generation, for exhaustive granular controlled experimental comparison, representing the largest multivariate analysis of structural model variations in this domain to date. This included the structurally novel PrismGAN & SBIGAN models, which both quantifiably succeed at eliminating spectral artifacts in inference. Analysis was performed along 79 metrics, including several novel spectral comparison methods for audio inference evaluation.
- **Music upscaling** - Dilated CNN for raw audio music super-resolution. Consistently outperforms baseline in average 2x case according to log-spectral distance metric, with increased advantage with repeated upscaling.
- **Instrument sample classification** - Compact CNN for supervised raw audio sample classification by instrument type. Achieves over 95% accuracy on any class combination.
- **Data mutation detection** - Dilated CNN for detecting the presence of sparse hidden messages injected into online game network traffic by a system resistant to statistical analysis methods. Requires no prior knowledge of network protocol and needs only a partial play session (less than an hour) for reasonable confidence.

ML Projects – *Graduate* – Mostly Tensorflow, Theano, Python Jan 2016 - Jan 2018

- **Transform-robust art classification and activation visualization** - Deep CNN for binary classification of images as human-made art, trained on large dataset of human-made artworks along with semi-curated scraped non-art images. The trained network was used to iteratively optimize an image toward maximizing activations, with the idea of visualizing the network's concept of what makes an image qualify as art. Proposed and implemented intermediate random transform layers during training and image synthesis, which vastly increased the network's perceptual range (over 50% improvement in large test set classification accuracy) without needing any additional data.

Research Projects – *Graduate* – Unity/C# with many other platforms & languages Jan 2014 - Jan 2020

- **Instrument: One Antarctic Night** *(Featured in SIGGRAPH 2018)* - Multiplayer VR art-science data exploration system, exhibited at several museums & conferences. Utilizing night sky observation data collected from the AST3 telescope, combined with web-scraped metadata extensions from multiple sources, this system provides a VR interface where users are placed inside the cloud of astronomical bodies and can explore millions of data points through manual manipulation of any individual point. Doing so allows users to drill down to all available metadata about each point, while procedurally generating a unique audio-visual component which can be activated as part of a collaborative composition with other players.
- **Binaural Positional Audio Simulation** - Utilizing sine-sweep inverse convolution of recordings placed around a binaural microphone array, provides a system for artificially positioning audio in a perceptual 3D space as a real-time software effect (similar to HRTFs).
- **ATLAS In Silico** - Projected full-body interactive data exploration tool with autostereographic virtual environment rendering the Global Ocean Survey (GOS) dataset. Restored and updated the project after a large portion of the code was lost by a previous team. Built a new control scheme from scratch using a custom IR camera OpenCV multi-user body tracking interface. Oversaw the exhibition of the reworked project as an installation at several museums and conferences.
- **RePhoto** - Mobile iOS app designed primarily for use in urban tree survey research, and adapted for a number of other applications. The application provides and records a collaborative database of photo records taken by users, with a system designed to align photos from previous shots to allow for a clear history of the object to form from the aggregate observations.

Game Projects – *Undergrad/Graduate* – All pure C++, DirectX, xAudio (no GUI engine) Jan 2010 - Jan 2017

- **Audio-only experimental game** - Utilizing xAudio and positional audio tools, a 3D world simulation with no graphical interface at all meant to be explored purely through sound with interactable goals throughout. Developed as part of a study designed to test if humans are capable of navigating game worlds through audio.
- **Soundflight** - A 3D rhythm game wherein a music track is split into stems which can be activated by a player one by one, with the goal of keeping the full composition going. The stems are on individual lanes the player can move between, and activated by moving a flying ship along notes procedurally placed on these lanes using a peak detection algorithm.
- **Stick Fighter** - A 2D fighting game with stick figure characters. The system uses 2D animated sprites for the characters rendered against a 3D background. The game features standard fighting systems like special moves and combos, with features such as a gravity and scaling based juggle system.
- **Bot** - A simple 3D platformer designed around technical movement, with features such as wall-runs and wall-jumps.
- **AudioSnipe** - Tool developed for a research study in HCI and translational perception mapping. Audio-only UI formed by a collection of tracer tones with effects modulated by position, with the goal of centering a reticle. Study tested whether a human can orient in a game world with only translational audio feedback.