

Nolan Welch

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Summary: Full-Stack Software Engineer with a background in computer science, linguistics, and large-scale data. Experienced in building containerized pipelines (13TB+ EEG), quality control systems, and distributed HPC workflows. Skilled in machine learning, NLP, and cloud-native tools (AWS, Docker, Cloudflare Workers). Led projects from real-time music sync to hybrid fact-checking systems. Focused on reproducible research, explainable AI, and scalable research infrastructure.

Technical Skills

- **Machine Learning & Data Science:** Supervised and unsupervised learning, deep learning, time series modeling, regression and classification, clustering, anomaly detection, feature engineering, model evaluation and interpretability, hyperparameter tuning, deployment of scalable ML pipelines.
- **Neural Signal Processing:** EEG/fMRI analysis, time-frequency analysis, artifact rejection, statistical inference on neural data, connectivity measures, neural decoding, and experience with domain-specific toolkits such as EEGLAB, MNE-Python, FieldTrip.
- **Programming Languages & Frameworks:** Python (NumPy, SciPy, pandas, matplotlib, seaborn, Pydantic, pytest), PyTorch, TensorFlow, scikit-learn, SQL, Java, TypeScript, JavaScript (React, Next.js), FastAPI, Node.js, Bash, R, MATLAB, C/C++ , Rust (beginner).
- **Data Infrastructure & Cloud Platforms:** Docker, Singularity, Kubernetes (k8s), Slurm HPC, AWS (EC2, Lambda, S3, CloudFormation), GCP (Compute Engine, BigQuery), Redis, Kafka, Cloudflare Workers, WebSockets, RESTful APIs, GraphQL, serverless architectures.
- **Data Engineering & DevOps:** CI/CD pipelines (GitHub Actions, Jenkins, GitLab CI), containerized deployment, reproducible research pipelines, data ingestion and ETL, data validation and monitoring, logging and observability, security best practices.
- **Software Engineering Practices:** Test-driven development (TDD), modular code design, design patterns, documentation best practices, performance profiling and optimization, collaborative development with Git, code reviews.
- **Data Analysis & Visualization:** Exploratory data analysis (EDA), statistical testing, data cleaning and transformation, dimensionality reduction (PCA, t-SNE, UMAP), interactive dashboards (Streamlit, Dash, Tableau), reporting automation.
- **Other Tools & Skills:** Agile/Scrum methodologies, Jira, Confluence, MLOps, API design and management, cloud cost optimization, user authentication and authorization, familiarity with model explainability tools (SHAP, LIME), technical writing, mentoring and code reviews.

Education

UNC-Chapel Hill — B.S. Computer Science, B.A. Hispanic Linguistics

Highest Honors, Distinction | GPA: 3.63/4.0

May 2025

Chapel Hill, NC

- **Study Abroad:** Universidad Carlos III de Madrid (Spring 2024) – all coursework in Spanish; C1 proficiency
- **Research Assistant:** NLP Lab at UNC – Developed BERT-based narrative transformation models for multilingual data, contributing to publications on cross-linguistic transfer and code-switching.
- **Selected Coursework:** Software Engineering, Machine Learning, Advanced NLP, Data Structures and Algorithms, Deep Learning, High-Performance Computing, Human-Centered Computing, Semantics, LLM Alignment Seminar, Spanish Syntax, Sociolinguistics, Translation and Interpreting
- **Awards:** Sterling A. Stoudemire Prize for Excellence in Spanish; Larry King Award for Study of Minority Languages in the Iberian Peninsula; Alexandre Honors Carolina Fund Research Grant (\$500); Dean's List (5 semesters), Honors Carolina Scholar
- **Languages:** English (native), Spanish (C1 DELE), basic Portuguese.

Professional Experience

Neural Dynamics of Control Lab, Florida International University

Research Software Engineer

July 2024 – Present

Miami, FL (Remote)

- Architected and deployed modular, containerized Python pipelines to validate and preprocess 13TB+ of EEG data for a \$2.5M NIMH-funded longitudinal study (224 participants), ensuring platform-independent reproducibility and seamless integration with HPC environments.
- Designed and implemented automated quality control systems for neural signal data, incorporating automated builds and tests to boost pipeline scalability, reproducibility, and researcher confidence.
- Serve as lead administrator for lab HPC infrastructure: manage distributed file systems, automate backups, configure secure user access, and optimize cluster utilization across multiple studies.
- Improved Slurm job scheduling efficiency, raising CPU utilization from 65% to 92% and significantly accelerating EEG analysis workflows, reducing turnaround time for iterative research.
- Documented workflows and trained new staff on pipeline usage, fostering knowledge transfer and improving lab onboarding processes.
- **Technologies:** Python (pandas, NumPy, SciPy), Linux, Singularity, Slurm, Bash, Git.

Chapel Thrill Escapes (Student-run Startup)

Executive Officer (Operations, Marketing)

January – December 2023

Chapel Hill, NC

- Directed commercial expansion to a high-traffic university corridor, managing \$10K+ in renovation funds and delivering the project on time and under budget.
- Led internal process improvement initiatives using SWOT analyses and customer journey mapping to streamline workflows, enhance customer experience, and boost operational efficiency.
- Developed and operationalized the organization's core values, anchoring hiring, onboarding, and team culture for a first-of-its-kind student-run escape room.
- Negotiated and launched a campus-wide promotional event reaching 560+ students in partnership with Carolina Housing, including the development of a custom booking validation bot to automate participant management.
- Managed daily operations, overseeing staff scheduling, marketing initiatives, and vendor relationships.

Carolina Engagement Center (Donation Call Center)

Supervisor

January – September 2022

Chapel Hill, NC

- Engineered a backend tool in Python to parse PDFs into structured formats, reducing data entry time by 90% and improving record accuracy.
- Iteratively improved caller scripting and workflow design, enhancing call efficiency, donor engagement, and overall satisfaction.
- Trained and mentored 20+ new student employees, fostering a collaborative and supportive team environment.

Freelance Spanish Translator & Interpreter

2022 – 2023

- **AntFarm Youth Services** – Translated internal and external documents and webpages into Spanish, ensuring professional-grade accuracy and cultural sensitivity. Curated and composed a bilingual English-Spanish digital newsletter distributed to 300+ Latinx individuals in Clackamas County, Oregon; grew mailing list from 120 to over 300. Promoted targeted resources, events, and opportunities by interfacing with the local Latinx community, advancing cultural and linguistic equity.
- **Student Health Action Coalition (SHAC)** – Accompanied healthcare providers during clinical interviews, providing consecutive Spanish-English interpretation for Spanish-speaking patients from the Carrboro community. Enhanced healthcare access and patient experience through clear, culturally sensitive interpretation services, supporting an underserved population.
- **OneDigital** – Interpreted and translated medical insurance documents, ensuring clarity and accuracy for Spanish-speaking clients.
- **Skills:** Consecutive interpretation, document translation, medical terminology, cultural competence, community outreach.

Projects

hallMonitor 2.0 – Distributed EEG Data Validation Utility

- Re-architected legacy Bash workflows into a modular, containerized Python utility for validating 13TB+ of EEG data across 224 subjects in longitudinal cognitive neuroscience studies.
- Engineered a schema-aware pipeline framework with 180+ automated tests, supporting reproducible analyses, version-controlled validation rules, and audit-ready logs across HPC deployments.
- **Stack:** Python, Docker, HPC (Slurm), pytest

Honors Thesis – *Exploring Sentiment Analysis for Spanglish: Why Sociolinguistic Context Still Matters for NLP*

- Defended with Highest Honors; selected to present findings at two international NLP conferences.
- Analyzed 10k+ annotated code-switching events using statistical modeling and time-series features to uncover emotion-linked switching behavior.
- Built multilingual sentiment classification pipelines achieving 0.89 F1, integrating syntactic parsing, language tagging, and transformer-based embedding models.
- **Stack:** Python, PyTorch (Transformers), spaCy, scikit-learn, Jupyter

TruthSynth – Hybrid Fact-Checking with Semantic Triples (*UNC NLP Course*)

- Designed a neural-symbolic fact-checking pipeline that extracted semantic triples via few-shot chain-of-thought prompting and verified claims against a structured knowledge base (17k+ triples), achieving 0.86 F1 on BoolQ.
- Integrated ChromaDB for vector-based entity/relation grounding, enabling rapid knowledge graph expansion and interpretable verdict chains.
- Authored final course paper: *Automated Fact-Checking using Semantic Triple Extraction and Knowledge Graphs*, proposing a scalable hybrid architecture for explainable AI.
- **Stack:** Python, LangChain, ChromaDB, PyTorch, HuggingFace Transformers

Bug Golf – Distributed Bug-Fixing Game

- Designed a developer-focused debugging platform that evaluates user-submitted fixes in real time, gamifying code quality and problem-solving.
- Orchestrated 100+ globally distributed edge workers to execute and score submissions with <300ms p95 latency, ensuring low-lag interactivity.
- Built secure sandboxed runtimes and live feedback systems using event-driven queue workers and WebSockets at 100+ concurrency.
- **Stack:** TypeScript, Cloudflare Workers, Hono, Supabase (Postgres), WebSockets

Carolina Radio – Low-Latency Sync Service (*MongoDB Atlas "Best Use" Winner*)

- Developed real-time radio-style music sync service with <200ms latency across 50+ concurrent listeners using custom WebSocket batching.
- Integrated OAuth2 with Spotify's API, designing an adaptive back-off and token refresh system for seamless user experience.
- Awarded "Best Use of MongoDB Atlas" for efficient document model design, autoscaling logic, and cloud-native performance.
- **Stack:** FastAPI (Python), React, MongoDB Atlas, Docker Compose

Custom Shell – Systems-Level Engineering

- Built a POSIX-compliant shell from scratch with support for job control, IPC pipelines, and a Hoard-inspired custom memory allocator.
- Diagnosed concurrency bugs via mixed user/kernel-space debugging, leveraging GDB, Valgrind, and strace for precise fault isolation.
- **Stack:** C11, Linux syscalls, pthreads, POSIX IPC