Timothy James Baker

856-628-7242 | bakertim@umich.edu | LinkedIn | GitHub | Gitlab | Google Scholar

Summary

Computer scientist with 7 years of interdisciplinary research experience developing data-driven solutions to challenges in computer architecture and healthcare. Past projects include noise modeling for stochastic circuits and segmentation of 3D medical images using neural networks. Has expertise in Python, high performance computing, and machine learning.

Education

University of Michigan — **Ann Arbor, MI**
Ph.D. Computer Science and Engineering — *Sept 2017 - May 2023*

Rowan University — **Glassboro, NJ**
B.Sc. Physics — *Sept 2013 - May 2017*
B.Sc. Computer Science — *Sept 2013 - May 2017*

Skills

- **Programming Languages:** Python, Verilog, SQL, MATLAB, C++
- **Python Deep Learning:** Pytorch, Pytorch-Lightning, MONAI, Weights and Biases
- **Python Data Analysis and Visualization:** Numpy, Pandas, Scipy, Seaborn, Matplotlib
- **Image Processing:** 3D Segmentation (U-Net), 3D Registration (Elastix), Statistical shape modeling (SSM)
- **Other:** Probabilistic modeling, Monte Carlo simulation, Linux, Git, High performance computing (HPC) clusters

Professional Experience

Michigan Medicine — **Ann Arbor, MI**
Research Fellow — *2023 - Present*

- Developed machine learning models that aid in the treatment of aortic aneurysm by analyzing 3D medical images.
- Automated routine clinical research tasks by developing new software tools and ETL pipelines that allow for rapid creation of large curated clinical datasets for statistical analysis and discovery.
- Validated automated solutions, implemented algorithmic safeguards, and worked closely with clinicians to ensure that software met clinical safety standards and adequately addressed clinical challenges.

Computer Engineering Lab, University of Michigan — **Ann Arbor, MI**
Graduate Student Research Assistant — *2017 - 2023*

- Designed energy-efficient neural networks for devices with limited size and battery like medical devices.
- Developed and maintained simulation codebase in Python and utilized the software to assess performance of application specific integrated circuits (ASICs) for machine learning and for digital signal processing.
- Formulated probabilistic models to provide causal explanations for simulation data. Analysis validated empirical results and produced new insights that led to circuit designs with 12 times higher accuracy and 30% smaller size.

Selected Projects

Segmenting the Aorta in Diverse 3D Medical Images — *2023 - Present*

- Created robust data extraction, transform, load (ETL) pipelines to prepare 900+ 3D medical images for training deep neural networks (U-Nets) to segment the aorta and localize key anatomical landmarks in 3D images.
- Developed high-throughput U-Net training pipeline using distributed parallel GPU training on high performance SLURM computing cluster. Reduced training time and dollar cost by 100x using caching and other optimizations.
- Validated the U-Net performance with 10-fold cross validation and implemented post-processing techniques to improve reliability; U-Net is about 10+ minutes quicker per scan than manual segmentation by an expert.

Noise Modeling and Reduction in Stochastic Circuits — *2017 - 2023*

- Developed an error analysis framework using Bayesian estimation theory to account for both systematic and random error sources in stochastic computing circuits. Methodology accurately reproduces Monte Carlo simulation results.
- Formulated probabilistic models that quantify stochastic circuit accuracy using tools like Markov chains. Analysis provided insights into new design methods that led to circuits with 12 times higher accuracy and 30% smaller size.
- Applied new smaller and more accurate designs to application circuits for neural networks (image classification) and for finite impulse response (FIR) filtering of ECG signals and audio signals.