Timothy James Baker

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Summary

Experienced computer scientist with 7 years of research experience developing machine learning solutions to challenges in computer architecture and healthcare. Expertise in developing energy-efficient neural networks for on-device machine learning and in training high-throughput neural networks for tasks like 3D medical image segmentation.

Education

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

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

Skills

- **Programming Languages:** Python, Verilog, SQL, MATLAB, C++
- **Data Science:** Machine learning, deep learning, neural networks, dataset creation, statistical t-tests, generative AI, image segmentation (U-Net), image registration (Elastix), multitask learning, fine tuning, reinforcement learning
- **Python Deep Learning:** Pytorch, Pytorch-Lightning, MONAI (medical AI), Weights and Biases (AI platform)
- **Python Data Analysis and Visualization:** Numpy, Pandas, Scipy, Seaborn, Matplotlib
- **Other:** Probabilistic modeling, Monte Carlo simulation, Linux, Git, High performance computing (HPC) clusters

Professional Experience

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

- Managed several computer vision and machine learning research projects in an industry-hospital collaboration.
- Optimized 3D medical imaging neural network models using MONAI and Lightning, achieving a 100x increase in training epoch speed via parallel GPU training and data caching strategies, reducing processing cost and time.
- Developed high-throughput neural network data pipeline for a 700 GB medical image dataset, incorporating custom data labeling tools, automated label validation, and MONAI-based preprocessing and data augmentation.
- Wrote Bash/Python scripts to automate tedious clinical research data processing and trained physicians to use scripts.
- Validated automated solutions, implemented algorithmic safeguards, and worked closely with clinicians to ensure that all software tools and ML models met clinical safety standards and adequately addressed clinical challenges.

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

- Designed and trained energy-efficient neural networks for devices with limited size and battery like medical devices.
- Advanced and managed a versatile Python simulation codebase, enabling precise performance evaluation of ASICs tailored for machine learning resulting in chip area savings of 40% while maintaining high application accuracy.

Selected Projects

Segmenting the Aorta in 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 CT and MR 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 100x by 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.

Stochastic Binarized Neural Networks for Tiny Devices — *2022 - 2023*

- Engineered compact, low-precision neural networks optimized for deployment on small devices like heart monitors.
- Elevated classification accuracy by 30% in stochastic hardware through a novel iterative training algorithm, enhancing network resilience to noise in neuromorphic computing applications.
- Implemented new PyTorch convolutional layer with 40% smaller hardware footprint than similar designs.