Timothy James Baker

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Summary

Computer scientist with 7 years of research experience developing machine learning solutions to challenges in computer architecture and healthcare. Past projects include designing energy-efficient neural networks for on-device machine learning and training high-throughput neural networks for 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
- **Computer Vision:** 3D Segmentation (U-Net), 3D Registration (Elastix), Statistical shape modeling (SSM)
- **Python Deep Learning:** Pytorch, Pytorch-Lightning, MONAI, Weights and Biases
- **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-academic collaboration.
- Scaled neural network models for 3D medical image analysis by implementing parallel GPU training and data caching; training epoch speed increased by 100x and inference speed by 15x resulting in cost and time savings.
- Built high throughput neural network data pipeline for 700 GB image dataset by creating data labeling tools, implementing automated label validation, and creating robust MONAI data preprocessing and augmentation steps.
- Wrote and trained physicians to use Bash / Python scripts that automate laborious routine clinical statistical analysis.
- 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.
- 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.

Selected Projects

Segmenting the Aorta in Diverse 3D Medical Images — *2023 - 2024*

- 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 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*

- Designed low precision neural network for use in resource-constrained devices like cameras and heart monitors.
- Improved network classification accuracy by 30% by implementing an iterative training procedure that allows the network to adapt to noise generated in the specialized stochastic hardware (neuromorphic computing).
- Implemented new PyTorch convolutional layer that has 40% smaller hardware footprint than similar designs.