Josh Marks, Ph.D.

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Self driven Research Engineer looking to make computational systems work. Looking to make an impact and work hard with a team of enthusiastic and driven engineers. To employ creative thinking to ensure design specifications are met. To be a passionate leader and player in a team environment to ensure timely product delivery, and team success.

Areas of Expertise

- Research and development of solutions to computer software and hardware problems.
- Architecture design of complex systems, integration, and system testing.
- Working closely with leadership, engineers, and business partners to identify opportunities for the application of science and engineering. Communicating appropriately for different audiences through spoken and written mediums.
- Converting high level requirements into actionable design, test goals, and project schedules.
- Writing scalable production level code and architectures.
- Training different types of ML models.
- Low level knowledge of compute systems and writing code to maximize computational efficiency. Low level code has included: OpenCL, embedded C, and C++.
- Novel and traditional applications of machine learning architectures to solve hard problems.
- Designing experiments, performance metrics, test plan development, hands-on troubleshooting, and system analysis both in a development environment and in production. Anomalous behavior determination, and improving system performance through the application of scientific experiments and measurement method design. Data Analysis (Python) for analyzing test results and generating plots to communicate why problems are occurring.
- Engineering management: Sprint planning, Leading multi-disciplinary teams, managing budgets and timelines, managing the testing and build process to achieve product integration success.

Technical Skills

Software: Python, SQL, C/C++, Golang, Terraform, Javascript / Typescript, and Linux.

Experienced With: Scipy, Numpy, PyTorch, Docker, Git, API design, Front-end development, Back-end development

ML Architectures: Transformers and attention networks, Convolutional Neural Networks, Recurrent Neural Networks, LSTMs, Regression techniques.

Istari Digital

Principal AI Engineer *2023 – Present*

- Performed fundamental research and experimentation on 3D object classification.
- Filed 2 Machine Learning related patents.
- Performed Kubernetes Infrastructure development for platform and data pipeline.
- Wrote and Deployed production APIs to access internal services.
- Designed and architected data-centric tools targeting aspects of the Istari system.
- Designed, implemented, trained and tested machine learning models and algorithms.

Tesla

Staff Electrical Engineer

- Wrote system requirements for software, hardware, and security on the drive unit components. *2022–2023*
- System level troubleshooting of integration problems.
- Software development on internal web application tools (Python, SQL, Javascript)
- Worked on electronics and firmware development for the Cybertruck differential.

Chief Digital AI Office at the Pentagon

Digital Service Expert

2022–Present

- Advises the Department of Defense on an array of technical aspects of Machine Learning and Artificial Intelligence Applications and how these technologies can be adapted to the warfighter and the department as a whole.

Defense Digital Service in the Office of the Secretary of Defense

Digital Services Expert

Defense Digital Service *2019–2022*

- Designed a novel solution for non-invasively classifying internet routers using IP header options as the feature vector and neural networks to analyze egress packet jitter. Individual neural networks were used as a feedback mechanism for a blind de-convolution algorithm to separate timing distributions of routers in a chain.
- Worked with senior Defense Department Officials to solve for emerging strategic problem sets.
- Took ownership of large scale systems integration, and testing for important Defense systems.
- Worked on a Command and Control network in Golang and sensor analysis component for an RF sensor fleet. Designed detection / alerting metrics for operators using the Dashboard view of the sensor outputs. Frontend written in typescript. Worked on TLS implementation, and gRPC messaging API.
- **Impact:** Learned to apply research and test methodologies at an Enterprise scale. Understand high level open ended requirements from non-technical sources and create solutions.

Detailed Responsibilities of Chip Design Systems

Chip Design Systems	*2011–2019*
Tiled Infrared LED micro display	*Principal Engineer*
Non-uniformity Correction Test	*Senior Test Engineer*
ASIC Test	*Senior Test Engineer*
Micro display analog electronics	*Senior Electrical Engineer*
Micro display system hardware	*Senior Electrical Engineer*
Read-In-Integrated Circuit ASIC	*Senior Electrical Engineer*
Micro display hardware	*Design Engineer*

- Worked with large, multi-dimensional data sets to characterize, optimize and debug an Infrared LED micro-display. Data sets included: Luminosity vs Drive voltage curves for the 4 Million pixels in the display and the 20 drive levels, Thermal data relating to the LED brightness, and signal integrity of the drive voltages.
- Worked on and tested Python / GPU code for Non-Uniformity Correction algorithms that ran on each one of the 4 Million pixels at a 1KHz frame rate. Work included spline fitting to enable function inversion, OpenCL kernel development, and system optimization such as efficient memory pinning.
- Designed testing metrics for measuring ASIC yield, quality, and operability using automated test equipment.
- Designed and wrote a pixel operability data pipeline using numpy for determining the quality of pixels on a CMOS die. "Good" pixels were classified based on a statistical model created from a smaller run of transistors. Data labels were sanitized using Regex queries to look for abnormalities. Output of the data pipeline was used to make a $250,000 decision that determined the success of the business.

- Improved the pixel operability data pipeline by building a physics based model, and adding a Support Vector machine to analyze the plots generated by the previous steps in order to further reduce the need for human supervision.
- Led an effort to determine anomalous system behavior. Used the scientific method to devise appropriate measurement strategies. Analyzed large test data sets with image processing and statistical methods. This resulted in anomalous system behavior being understood, and the updating of non-uniformity correction algorithms, and process design.
- Designed instrumentation for measuring settling time of analog electronic signals. The system self optimized high speed analog nodes through a feedback routine that used a combination of C code on a micro-controller and an ODE solver in Python to minimize error in the output of the system.
- Led a large multi-disciplinary team (internal team members and external corporate partners) to design and manufacture the largest at time, 1024x2048 infrared LED micro-display hybrids (CMOS and GaSb). Manufacturing required development of new methods for die singulation, abutment, thermal management, and attachment. Managed the associated budget ($1 Million), timeline, and project risk.
- Led various teams of 3+ team members to accomplish firmware development; cabling; board spins; system performance testing; characterization measurements; interfaced with firmware engineers, ASIC engineers, device physicists, optical engineers, processing and fabrication engineers, and mechanical engineers.
- Wrote monthly progress reports to program sponsors and customers. Presented Program updates at meetings and working groups. Actions communicated program progress accurately and managed expectations. Authored system specifications and documentation.
- Took ownership of an internal project that had slipped by 1 year and successfully delivered a product.
- **Impact:** Grew from a new design engineer into an engineer with a larger picture view of the system and the current challenges and limitations we were facing. Learned how to mentor new engineers to quickly make them productive contributing design members.

Education

University of Delaware
Bachelors of Electrical Engineering B.E.E. *2007–2011*

University of Delaware
Ph.D. Electrical and Computer Engineering, 3.72 *2011–2019*
Ph.D. Dissertation: *Abutted IRLED Infrared Scene Projector Design and Characterization*, Focus Area: Electro-optics and Embedded Systems.

Selected Research Projects

Seabed Erosion Metrology: Worked on a novel sensor for studying beach erosion. The sensor used 4-point current sensing to detect salt concentration levels and measure the height of the sea bed. Efforts allowed the measurement of sand water interface for the first time.

Accessibility Research: Designed a low cost head tracking system using two Wiimotes to increase availability of usability technology. Designed a user experience test with a 3D game engine. Attained Institutional Review Board approval for human subject testing. Used the results of the testing to influence a product redesign.

Community Outreach and Open Source Projects

RF Fingerprinting: Working on identification of Radio transmitters using spectral characteristics caused by differences in the I and Q transmitters as well as parasitics caused by the underlying hardware design of the transmitter. Use case is drone detection in a battle field where current radar techniques are limited by the size and material choice of low cost drones.

Founding Member DEFCON Beijing Hardware Hacking Village: First time conference was held in China. Planned logistics, setup workshop, taught conference attendees about hardware hacking, and setup group communication to grow a community for the following years. Learning how to communicate across the language and cultural barrier.

BotBadge: Worked in a team that designed and released BotBadge as an open hardware project focused on helping beginners learn about electronics via an interactive Jurassic Park themed game. Manufactured medium volume of boards and distributed them to DEFCON attendees. Board included: RF communication component, antenna, microcontroller, LCD, input device design, and user experience design.

Staticbs: Researched methods for performing numerical analysis, simulation, and modeling of static electro-magnetic fields. Designed and wrote a 3D electro-magnetostatic simulator in python called Static-bs. Static-bs takes arbitrarily sized current elements and solves the biot-savart equation for each element then uses the law of superposition to add the individual responses together to calculate the total response of all current elements. (https://github.com/grungy/staticbs)

Fellowships and Awards

NAROM Summer Fellow: This Fellowship offered the opportunity to study in Andenes, Norway about the methods used to improve landscape surveying. The program focused on using spectroscopic data collected at a local level and extrapolating it to data collected by drone imagery. Methods used included: machine learning, feature extraction, statistical modeling, clustering methods, and different spectroscopic measurement methods.

NSF-EAPSI Fellow: The EAPSI Fellowship was designed to increase collaboration between American Graduate Students and Graduate Students in South East Asia. American Graduate Students travel to one of seven countries and work closely in a research laboratory with their counterparts.

Outstanding TA Award: Awarded to a Teaching Assistant for excellence in teaching and mentoring undergraduate students.

Hobbies

Rock climbing, running, ballroom dancing, foreign languages, mountaineering, home improvement projects (plumbing, electrical, etc.).