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## EDUCATION:

**University of Michigan, Ann Arbor MI:** Ph.D. Physics 2021; M.Sc. Physics, 2017. GPA: 3.744

**The Ohio State University, Columbus, OH:** B.S. Physics, Mathematics with Honors Research Distinction, 2016. GPA: 3.811

## NOTABLE RESEARCH EXPERIENCE:

### Intelinair, Inc.

#### Machine Learning Scientist: November 2021- February 2023

- Design, build and deploy a ResNet50 classifier with temporal Viterbi-decoder postprocessor for modeling the growth state of corn and soybean fields with 1m Airbus satellite imagery. Train on synthetic data, generated using transfer functions applied to 10cm fixed-wing RGBN imagery.
- Lead development on a Hierarchical Pretrained Vision Transformer model based on state-of-the-art work from histopathology, hierarchically pretrained on unlabeled data using DINO and fine-tuned on annotated field state data.
- CVPR 2022 Agriculture-Vision Workshop: Discussion panel host, paper reviewer

### ATLAS High Energy Experimental Physics Group at University of Michigan

#### PhD Candidate; Advisor Dr. Thomas Schwarz

#### Measurements of Higgs Boson Properties in the Diphoton Decay Channel at $\sqrt{s} = 13$ TeV with the ATLAS Detector: May 2018-April 2021

- First-ever observation of rare top-associated Higgs production process (ttH)
  - (Press Release: <https://atlas.cern/updates/briefing/observation-tth-production>)
- Generate template signatures for key observable in background classes, perform signal shape parameterization, measure major systematic uncertainties related to signal mismodelling
  - Process real and synthetic data samples on the Worldwide LHC Computing Grid using HTCondor and CERN Grid cloud-computing architectures
- Develop, implement and test a novel Bayesian Gaussian Process Regression (GPR) tool to model shape of underlying continuum background process
  - Validate GPR efficacy using statistical tests across multiple regimes
- As analysis group data manager, produce and validate DAOD data/ Monte Carlo samples
  - Respond promptly to ATLASSIAN JIRA tickets
  - Maintain data sample production codebase

#### CP Properties of Higgs Boson Interactions with Top Quarks in the ttH and tH Processes Using $H \rightarrow \gamma\gamma$ with the ATLAS Detector: October 2018-March 2020

- Implement and compare novel “semantically high-level” physics object detection methods using “semantically low-level” features extracted from images of proton-proton collisions taken using CERN’s ATLAS Detector. Methods explored include a Gradient Boosted Decision Tree (BDT) in XGBoost and a Maximum Likelihood Estimation based method
- Use synthetic data to train two complementary BDT classifiers to sort observed collision events into null-hypothesis signal, alternative-hypothesis signal, and background categories using a mixture of high-level and low-level engineered features.

- Parameterize expected statistical distributions of major observables for null-signal, alternate-signal, and background events in many regions of differing classifier confidence; perform simultaneous Maximum Likelihood Estimation across these regions in order to measure total contribution of signal process to observed event counts and whether it does or does not conform to null hypothesis
- Supervise undergraduate students in introductory data analysis tasks
- Lead paper editor responsible for writing and maintaining internal analysis documentation
- Present analysis summary at 2019 USATLAS Collaboration Meeting in Amherst, Massachusetts

**CMS/CDF Computational Physics Lab at The Ohio State University**  
**Undergraduate Researcher; Advisor Dr. Richard Hughes**

**Using Convolutional Neural Networks to Identify ttH Events at the LHC: August 2014-June 2016**

- Build a simple VGG/AlexNet style Deep Convolutional Neural Network model in Lua/Torch7 to distinguish between signal process (*ttH*) and background (*tt+jets*) using raw physics detector signals rather than high-level engineered features
- Compare CNN against traditional MLP-based methods for classification of synthetic event images generated from a simulated high-energy physics detector using the Monte Carlo method
- Explore regularization techniques such as Dropout and L1/L2 regularization to improve performance

**ADDITIONAL MACHINE LEARNING EXPERIENCE:**

**TOOLS AND PACKAGES:**

**Proficiency with:** C++, UNIX/Linux, git, bash/csh, TensorFlow/Keras, Pytorch/Pytorch-Lightning, Python (scikit-learn, pandas, numpy/scipy, matplotlib/seaborn, rasterio, PIL, beautifulsoup, networkX, nltk, etc.), postgresSQL, AWS, Docker, various ML lifecycle tools such as ClearML and Tensorboard, various agile workflow tools such as JIRA/Confluence, ROOT, pyROOT

**Familiarity With:** MatLab, Lua, Torch7

- EECS 545: Machine Learning at University of Michigan
  - Covered topics such as Linear/Logistic Regression, Kernels, K-Nearest Neighbors, Support Vector Machines, Decision Trees, Neural Networks
  - Final project: predict political party affiliation from text of political speeches
  - Class projects and assignments on my github page!
- PHYS 510: Statistical Mechanics at University of Michigan
  - Final Project- Second-Order Phase Transitions in Hopfield Neural Networks
- Additional portfolio projects on my github:
  - A Deep Graph Autoencoder-Based Recommender System for Roller Derby Team Lineups
  - Predicting Tweet Sentiment with DistilBERT
  - Semantic Segmentation of Self-Driving Car Images with U-Net
  - Identifying Butterflies with ResNet
  - Using Boosted Decision Trees to Identify Mushroom Edibility
- Attended 2017 Yandex Machine Learning in High Energy Physics summer school in Reading, UK
  - Weeklong course consisting of lectures, hands-on coding sessions, and a Kaggle challenge. Covered topics such as Convolutional/Recurrent Neural Networks, Gaussian Process Regression, GANs, etc.

**NOTABLE SCHOLARSHIPS AND LEADERSHIP ROLES:**

2018 National Science Foundation Graduate Research Fellowship

2018 UM Science Communication Fellowship Program  
2017 Norman Barnett Award  
2016 Denman Research Forum, First Prize  
2016 National Science Foundation Graduate Research Fellowship, Honorable Mention  
2015 Staninovski Mathematics Scholarship  
2013 Hellen Cowan Book Award  
2012 Valentino Physics Scholarship  
2012 Honors Medalist Scholarship  
Society of Physics Students, OSU Chapter: *Vice President* 2013-2015

## **TEACHING AND SCIENCE COMMUNICATION:**

### **ComSciCon 2019**

- Attend seminars on science journalism, data visualization, podcast development
- Produce and workshop a piece of science communication writing

### **UMATLAS Virtual and Augmented Reality Outreach Program: June 2016-April 2021**

- Present ATLASRift virtual reality software (showcasing the ATLAS detector in virtual reality using HTC Vive and Oculus Rift software) to the general public at museums and showcases
- Develop novel pedagogical experiences integrating virtual and augmented reality demonstrations into introductory physics laboratory classes (ongoing effort through UMich Center for Academic Innovation XR Grant)

### **University of Michigan Dept. of Physics. Graduate Student Instructor: September 2016-December 2017**

- Instructor for a total of seven sections of introductory physics lab work
- Design and administer weekly quizzes and facilitate the completion of weekly lab reports
  - Participate in general physics tutoring through the Physics Help Room