Baran Bodur

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Particle physicist and engineer eager to apply quantitative reasoning, data analysis, programming, and teamwork skills to tackle challenging problems. 10 years of experience in working within large collaborations, building quantitative simulation and analysis programs, learning new tools quickly, and presenting findings to the team.

Skills Summary

Languages	C++, MATLAB, Python, Perl, Fortran, Verilog, LabVIEW, SQL, HTML.
Libraries	NumPy, SciPy, Pandas, Shiny, scikit-learn, PyTorch, ROOT, TMVA
Development Tools	Git, Docker, AWS, Linux shell
Simulation Tools	LTspice, KeyCreator, QUARTUS-2, FLUKA
Other	Data Analysis, Data Visualization, Machine Learning, Monte Carlo, Presentation

Professional Experience

2024 **Quality Analyst in Outlier AI (Freelance)**

- Preparing complex, multi-modal prompts for large language models (LLM).
- Assessing the response quality and constructing ideal responses to train the LLMs.
- Inspecting the work of other contributors and providing constructive feedback.

2017 – 2023 **PhD. Research Assistant at Duke University**

- Worked as a member of the 150-people Super-Kamiokande Collaboration. Regularly presented and collaborated in international meetings.
- Developed calibration and real-time monitoring tools for high-quality data-taking.
- Utilized machine learning tools to classify particle interactions in the detector.
- Modeled multi-dimensional probability distributions and their response to over 100 parameters via MC simulations and kernel density estimation.
- Using these models, TBs of particle physics data, and a custom unbinned maximum likelihood fitter; performed the first measurement of electron-neutrino oxygen cross section. The detected signal was 3.6 standard deviations away from the null hypothesis.
- Co-authored 40 papers published in top-rated physics journals.
- Designed and taught college physics classes, both as an instructor and teaching assistant.

2013 – 2017 **Student Researcher at Middle East Technical University**

- Developed original simulation and reconstruction algorithms with MATLAB for using particle detectors under extremely high detection rates.
- Performed Monte Carlo simulations to determine radiation doses around a beamline.

2015 **Intern at CERN**

- Collected muon radiation data near an accelerator and analyzed the time dependence of the data (MATLAB) to estimate the background for other experiments in the location.

Selected Projects

2024 **Turkey Local Election Prediction Competition** | *Python, Shiny, SQL, HTML, Docker*

- Interactive website where users could predict the winners of 2024 Turkish local elections by clicking on the district map. The predictions can be compared with other users and shared on specially generated maps.
- Both the back end and front end are built with Python-Shiny. An AWS EC2 instance was used as a server. The application was stored as a Docker image, and a new container started to serve every connected user.
- Candidate information, geographical information, and user predictions were stored in a PostgreSQL server in AWS communicating with the server.
- The application was active the week before the elections reaching about 120 users. Currently, a demo version is active here without the database connection.

2022 **TANGRAM, KDE Based Unbinned Fitter** | *C++, ROOT*

- A multi-dimensional, unbinned maximum likelihood fitter using ROOT libraries in C++.
- Probability distributions are automatically produced from input Monte Carlo samples by weighted kernel density estimation (KDE). Nuisance parameters are incorporated by re-weighting and shifting the events and re-calculating the KDEs.
- Allows Toy Monte Carlo studies to determine sensitivities or expected errors of measurements.

2019 **NEWTON, Monte Carlo Event Generator** | *C++, ROOT, Fortran*

- C++-based software to simulate low-energy neutrino interactions in water and produce outgoing particle vectors.
- Implements directional cross-sections from the relevant literature. Uses Fortran to interact with TALYS libraries to determine nuclear decay products for neutrino-oxygen interactions.
- Different detector geometries, fluxes, operation settings, and interaction rates can be provided via card files without recompiling.

Education

2017 – 2023 **Ph.D. in Physics, Duke University**
Thesis title: *Measurement of Atmospheric Flux-Weighted Charged-Current* ν_e*-* ^{16}*O Cross Section with the Super-Kamiokande Experiment* - CGPA: 3.93

2013 – 2017 **B.Sc. in Physics, Middle East Technical University**
Specialized in Particle, Nuclear and Atomic Physics - CGPA: 3.89

2012 – 2016 **B.Sc. in Electrical-Electronics Engineering, Middle East Technical University**
Specialized in Telecommunications - CGPA: 3.83