ABDULLAH BURKAN BEREKETOĞLU

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https://github.com/Bradshard ⋄ bradshard.github.io

EDUCATION

Middle East Technical University   *September 2018 - (Expected) Februrary 2024*
Bachelor of Science in Physics   cGPA: 3.00 (3.0 is 2:1 equivalent)
Rank: Top 13% (29th out of 213)

Particle, Nuclear and Atomic Physics Major(Concentration) GPA = 3.7
Statistics Minor GPA = 3.58
Concentrations in Computational Physics, Nuclear & Particle Physics, Data Science, Machine Learning
Completed eight Graduate (Msc, PhD) level courses on STEM
Minor in Computational Science and Engineering, Statistics

Middle East Technical University   *September 2018 - (Expected) July 2025*
Bachelor of Science in Chemical Engineering (Double Major/Dual Degree)
Planning on converting to minor as Chemical Reaction Engineering

Anadolu University (Open Education Faculty)   *September 2021 - (Expected) July 2025*
Bachelor of Arts in Economics (Open Education)

Gundogdu Science High School   *September 2014 - June 2018*
                    cGPA: 96.03/100 - A (or 4.00)

PROMINENT COURSES

MMI541 - Physics for Computer Games (Graduate level course on Physics Engine Design)

CENG501 - Deep Learning (Graduate level course - Representation Learning, CNN, RNN, AutoEncoders, Introduction to Machine Learning; Deep hierarchies and learning mechanisms in humans; Artificial neural networks; Deep vs. shallow architectures; Representation in terms of basis functions; Representation learning; Independent component analysis; Sparse representations; Convolutional neural networks; Restricted Boltzmann Machines; Deep Belief networks; Applications to pattern recognition, speech recognition and natural language processing.)

CENG574 - Statistical Data Analysis (Graduate level course - Unsupervised Learning, statistical learning, tSNE, Gauss Kernel, UMAP, DBSCAN, K-means/medoid, cluster validation, PCA, MDS and so. R and Python used, paper presentation made.)

STAT291 - Statistical Computing I (Basic statistical analysis methods such as Linear Regression with R)

STAT203 - Probability I (Sample space, events, basic combinatorial probability, conditional probability, Bayes theorem, independence, random variables, distributions, expectation.)

STAT204 - Probability II (Transformations of random variables, generating functions, conditional expectation, limit theorems, central limet theorem, limiting distributions.)

STAT303 - Mathematical Statistics I (Common theoretical distributions. Sampling distributions. Principles of point estimation. Techniques of estimation. Properties of point estimators. Optimality criteria in estimation. Selected topics from robust inference. Bayesian inference.)

STAT363 - Linear Models I (Simple and Multiple Linear Regression Models. Estimation, interval estimation and test of hypothesis on the parameters of the models. Model Adequecy Checking. Multicollinearity. Transformation.)

PHYS353 - Physics of Energy (Introduction to basic energy principles and thermodynamics, descriptions of various forms of energy, energy resources and fundamental physical principles of various energy processes, physics in energy technologies, energy production, storage and transmission)

PHYS403 - Nuclear Physics II Nuclear reactions; nuclear fission; nuclear fusion; fundamental interactions in nuclei: nucleon structure, the strong interaction, the electroweak interaction; nuclear astrophysics.)

PHYS407 - Particle Physics I Introduction to particles; discoveries of particles; classification of particles and their interactions; relativistic kinematics; measurement techniques, accelerators, detectors; introduction to Feynman calculus.)

PHYS408 - Particle Physics II (Quantum electrodynamics; the Feynman rules for QED; Parton model; Bjorken scaling; quantum chromodynamics and color forces; weak interactions of leptons and quarks; electroweak unification; introduction to gauge theories.)

CEIT310 - VISUAL C PROGRAMMING FOR EDUCATORS (This course is designed to teach the fundamentals of C. A particular focus will be on creating Windows desktop applications using C. While this course will mostly cover the fundamental programming concepts, such as variables, string operations, conditions, etc., in the C context, some advance topics such as databases, LINQ will also be introduced.)

IAM567 - Mathematical Modelling (Graduate level course - • Dimensional Analysis: Dimensional Analysis and Buckingham -Theorem, Scaling • Modeling with ODEs:Stability, Regular and Singular Perturbation Methods, Chemical Reactions, Population Dynamics • Modeling with PDEs: Classification of PDEs and Model Problems, Balance and Conservation Laws, Calculus of Variations • Case Studies - Mathematical Biology - Presented on Endemic Disease Models)

STAT499 - Undergraduate Research (Senior Project in Statistics - Took it with consent of statistics department- Project on COVID and PISA Test scores analysis.)

MATH496 - Supervised Independent Study & Research (Senior Project in Mathematics - Took it with consent of mathematics department- Project on mathematical aspects of probabilistic machine learning: a review, with measure theoretical approach.)

PHYS400 - Special Problems in Physics (Senior Project in Physics - GEANT4 based muon tomography imaging simulation and theory.)

STAT457 - Statistical Design of Experiments (Strategies for Experimentation, Randomized Complete and Balanced Incomplete Block Designs, Latin Squares. General, Two-Level and Fractional Factorials. Blocking and Confounding in Two-Level Factorials. Introduction to Response Surface Methodology. Second-Order Experimental Designs. Non-normal Responses. Unbalanced Data in Factorials. Split-Plot Designs, Nested Designs, Random Effect Models. Repeated Measures)

STAT493 - New Horizons in Statistics (Big data, Machine Learning, Bioinformatics, and Neuroscience concepts are studied with Data Science Methods and paper reading, analysis.)

PHYS443 - Computational Physics I (Statistical Computational Physics - Regression, Monte Carlo, TMVA, MLM, ROOT, Machine Learning methods)

PHYS444 - Computational Physics II (On Numeric Methods and their usage in Physics Monte Carlo Method)

PHYS328 - Nuclear Physics and Particles (Intro to Intermediate Nuclear and Particle Physics course)

EE381 - Systems and Control (Feedback Systems, Control Theory, Transform functions...)

CENG798 - Quantum Computing (Graduate level course - Properties of quantum computational systems and their mathematical representations. Basic quantum theory. Quantum mechanical principles, superposition, entanglement, interference. Quantum algorithms. Quantum teleportation. Superdense coding. Quantum computational complexity classes. Quantum error correction. Quantum finite automata. Quantum programming languages.)

ASN501 - Asia in World Affairs (Graduate level course - Contemporary Asia and Historical Asian Relations, History, International Relations Ontology and Epistemiological ways are discussed.)

MATH373 - Geometry I (Foundations: The parallel axiom, models, Hilbert's theorem. Triangles: Theorems of Menelaus and Ceva, classical remarkable points. Circles: Power of a point with respect to a circle, coaxal systems of circles, inversive geometry. Conic sections: Focus and directrix, reflection property, theorems of Poncelet)

PHYS417 - Principles of Measurement & Instrumentation I (Control, Electronics, Device Design...)

CENG310 - Data Structures and Algorithms with Python (Introduction to Algorithms, Space and Time Considerations, Python built-in types, Linked lists, Stacks, Queues, Recursion. Trees, Sorting, Searching, Implementations in Python, Introduction to graphs.)

CENG562 - Machine Learning (Graduate Level course - machine learning, decision trees, bayesian decision theory, kNN, early pattern recognition, perceptrons, multilayer perceptrons, support vector machines, Kernel Machines, Reinforcement Learning, Bayesian Estimation, Hidden Markov Models, Combining Multiple Learners, Local Models, Supervised, Unsupervised learning, paper project presented. ...)

COGS516 - Introduction to Probabilistic Programming (Graduate Level Course - Probabilistic Programming, Bayesian Data Analysis, Python and PyMC3, Single Parameter Models in Probabilistic Programs, Regression, DAGs, Confounding and Colliders, Validation of Bayesian Probabilistic Programs and Overfitting, Inference, MCMC, Assessing Convergence, Generalized Linear Models, Hamiltonian Monte Carlo, Sensitivity Measures, Categorical Outcomes, Multi-level Models, Measurement Error missing data, Advanced PPL, Paper project presented...)

STAT554 - Computational Statistics (Graduate Level Course - Introduction to Computational Statistics, Generating Random Variables, Exploratory multi-dimensional data analysis, Monte Carlo Integration and variance reduction, MC methods for inferential statistics, Resampling, bootstrapping, jackknifing, nonparametric density estimation)

EE553 - Optimization (Graduate Level Course - Mathematical preliminaries on functions of several variables. Convexity and convex functions. Unconstrained minimization problems. Computational algorithms such as steepest descent, Newton, and quasi-Newton methods. Constrained minimization problems and Kuhn-Tucker theory. Fundamental theorems of linear optimization and the simplex algorithm)

EE583 - Pattern Recognition (Graduate Level Course - Introduction to machine perception, Bayes decision theory. Parameter estimation and supervised learning; nonparametric techniques. Linear discriminant functions, unsupervised learning, and clustering. Scene analysis, applications of pattern recognition)

EXPERIENCE

Research Scientist - Physicist and Data Scientist, TARLA - Turkish Accelerator and Radiation Laboratory   *September 2023 -*
Data Cleaning, EDA, Superconductor-RF, Accelerator Physics, Simulations in Beam Diagnostics, Particle Physics, Lecturing in Machine Learning and Data Analytics, Design and simulation of FEL structure with Ocelot-multiphysics, Under supervision Dr. Haris Dapo & Dr. Veliko Atanasov Dimov The Physics of Particle Accelerators: An Introduction used to learn the basics.

Undergraduate Research Fellow, Harvard Medical School - Athinoula Center for Biomedical Imaging   *January 2023 - April 2023*
Computer vision, Medical Imaging, Deep Learning and Representation Learning with Signal Processing

Simulation, Modelling and Instrumentation Engineer/Engineer Intern (R&D Packaging Design and Project Planning division with Technology), Eti Gida Sanayi ve Ticaret A.S *July 2022- April 2023*
ETI D.E(developer edition) Internship Program Mathematical Modelling & Simulation System Design Data acquisition system design (sensor selection, TCP-IP comm), Real-Life Test System Design Data Analysis, Mathematical & Physical & Chemical System Design, Transport test device design, and finding the correct teammates to hire to run the procedure.

Teacher(Tutor), University of Oxford - Prof. Alexander Lvovsky Quantum Club   *September 2022- May 2023*
Tutoring on Quantum Physics, Linear Algebra and mathematics of Quantum Mechanics

Summer Research Internship, University of Liverpool - CERN   *July 2021- September 2021*
Jet Tagger Improvement with Machine Learning Techniques. Details can be discussed.

Winter Business Finance Industry Traineeship, Brainnest - GERMANY *February 2022- March 2022*
One month intensive business finance project-based traineeship. Lectures are given then real life accounting data, and balance sheets are given and expected to deliver reports as business finance trainees.

Tutor, Gostudent - Austria   *October 2021 -*
Teaching Mathematics, Physics, Chemistry, Biology, Programming, Microsoft Office to undergraduate students, high school students and middle school students.

Research Internship, TugrulLab   *July 2020- October 2020*
Biophysical modelling with machine learning applications.

Fellow Data Scientist, Data Science Lab - METU   *February 2020 - June 2021*
One of the twelve accepted members of the Data Science Community. One semester Big data, Data visualization, Prediction lectures.One semester, Data Science project with a chosen mentor(Academician). Fellowship is permanent.

PROJECTS

Quantum 2.5D Puzzle Game - RoboPuzzle, MMI-547 Physics for Computer Games *March 2023 - May 2023*

Investigation of Effects of Radionuclides in Radiotherapy   *March 2023 - May 2023*
GEANT4 based brachytherapy simulation and DNA-GEANT4-based dosimetry, and DNA damage simulations are made. Results are shown in ROOT with histogram and bars

Investigation of Atmospheric Neutrino for future non-invasive medical imaging techniques
March 2023 - May 2023
A GEANT4 based ν_e simulations on ORNL-MIRD human female phantom made with different GeV and TeV scales. General atmospheric neutrino is 1-GeV up to 10-TeV given in Walter Winter's paper on imaging with neutrino. Literature review for where to use the neutrino for imaging and why it is not feasible to not use neutrino in medical imaging.

Self-Supervised Feature Learning on Magnetic Resonance Imaging, HMS-Athinoula Martinos Center for Biomedical Imaging   *January 2023 - April 2023*
Custom loss, Simple CNN, Keras, Tensorflow, AutoEncoder, U-Net architecture, Image generation, Signal Proccessing, MRI processing (Will continue with another project - Professor decided impossible to solve with current linear activation functions. Unsupervised systems can be used, however; not enough computation power.)

Real-Time Transport Testing System Modelling and Simulation, METU- ETI Cooperation
July 2022 - April 2023
Industrial RD project with ETI GIDA Sanayi ve Ticaret A.S, modeling and simulation system with a special design of data acquisition system. We built a system that has 6000mAh and can run for 168 hours without charging and get data from the route for the statistical pattern recognition system, later to get the eigenvalues from the eigenfunctions determined(parameters), parameter coefficients optimized and new design parameters used for minimal cost and optimum quality packaging.

Unsupervised Learning Pattern Analysis on Crime in Berlin Data set, Statistical Data Analysis (Statistical Learning)   *October 2021 - February 2022*
CENG574 - Statistical Data Analysis (Statistical Learning) Term Project to finish the graduate-level course. We prepared a paper in ACM format and presentation on the patterns of crime and clusters of total crime reported by Berlin Police in 2012-2017, error and reliability tests are done.

Mean lifetime measurement of Muon by Monte Carlo sampling and statistical approaches, Nuclear Physics and Particles   *February 2021 - June 2021*
PHYS328 - Nuclear Physics and Particles, Term Project. From the collected data, resampled and increased the pool with a random probability biased system to converge the mean to a point at less decimal level. Noise - Filtering techniques used, less than 0.05 error achieved.

Positron Emission Tomography, Health Physics   *October 2021 - February 2022*
A term paper presented for Health Physics senior grade class on Positron Emission Tomography with data acquisition techniques, physics background, conclusion - discussion, how does a PET works, what is the image formed represent, how to detect a bad tissue, with CT how reliable is PET. Summary, PET physics, image formation, data acquisition, medical priors, advantages presented in the paper.

Tagging Jets at LHCb using Machine Learning, University of Liverpool - CERN   *July 2021 -*

September 2021

Current b-jet taggers at LHCb proceed first by requiring a reconstructed secondary vertex (or SV) in the event, and the classifiers are trained on the properties of this SV and the jet as a whole. However, the SV reconstruction only has a reconstruction efficiency of approximately 65-70 percent. For low statistics studies, the loss of efficiency at this stage reduces the statistical power of the measurement. Additionally, the use of both jet and SV information in the tagger biases some measurements studying jet hadronisation. The project aims to produce three different taggers to suit different tasks. First aim is to reproduce the current LHCb jet performance using the standard technique, then develop a classifier that bypasses the secondary vertex requirement, and finally train a tagger that only uses the secondary vertex information. Later on compare and contrast the performance of the three for the final results.

Important gains - learn more UNIX, Machine learning and how to think. Also learn how to work in a tough place (mentally not environmentally). I learned to push my boundaries and after the project, with one month later gained confidence to do things that I think I could not do.

Mammal Sleep Behavior Analysis, Statistical Computing I   *December 2021 - February 2022*

A term paper is prepared with five people on Mammal Sleep Behavior patterns, basic statistical approaches and further discussions are made. ANOVA, Q-Q linearity test, Visual Variance Analysis, Linear Regression models, Mean and outlier analysis, Pearson moment correlation, welch t-test is used on various mammal features (-vore type, conservation(wildlife types or domesticated), brain weight, brain size ...), Metadata is analyzed, reviewed and discussed in the paper.

Forecast for Sunspot Cycle 25, Special Problems in Physics   *October 2021 - February 2022*

A poster and term paper is made for Arslan Volkan Aktas (Co-owner of the project). For Arslan Volkan Aktas, I built a forecasting model using ARIMA and Hodrick Prescott filter, other than that linear predictors, simplex algorithm are also used but at the end due to Autoregressive hyperparameter tuning flexibility of ARIMA, and its Moving Average (MA) part made the prediction from a smaller data set rather than using the whole cutthroated the error levels represented as remnants (MMSE, SSE and so.). HPfilter is great compared to linear filters ekfilter, and helped to have a good time series trend and cyclic separated outputs, which gave the hurst exponent and helped to make the prediction. At the end paper finished with the conclusion from the graphs achieved from the program and a poster presentation and term paper presentation made.

Chinese Diaspora: Effects on the Rise of China, Asia in World Affairs   *February 2021 - June 2021*

As the term paper of the interdisciplinary Asian studies graduate level course, I presented a paper on Chinese Diaspora and effects of the diaspora on the rise of current that contemporary china, in three ways cultural appreciation, economical and politically. Paper is a literature review paper, which is mostly citing many of the articles and books read when a literature review made on a specific research topic.

Binary Constraint Satisfaction by using Quantum Computing Techniques, Special Topics in Computer Engineering: Quantum Computing   *February 2021 - June 2021*

As the term project of the Quantum Computing graduate level course, we with my partner Utku Birkan, whom made the most of the programming with pennylane and qiskit libraries. I explained the part of what is Binary Constraints, talked about eight queen problem, and other constraint problems, and how to approach them with quantum computing, their complexities, what quantum computing adds to the case of Binary Constraint Satisfaction problem.

Water Pipeline Design, Fluid Mechanics   *December 2021 - January 2022*

Term Project for Intensive Fluid Mechanics course which covers both Fluid Mechanics I and II. In this project it is expected from a group of four people (Abdullah Burkan Bereketoğlu, Furkan Musa

Çetinkaya, Betül Özler, Yaren Satar) designed a water pipeline that is built between a lake close to the plant and the main water by selecting optimum pipe size, determining where to put open globe valve, 45 and 90 degree elbows, water pump, which pipe material should be picked are determined to find an optimal cost. Electricity and plant cost is also determined from current day kWh prices and area prices from local news. This project helped me to pass the course in the online semester. Excel and fluid mechanics formulas are used, such as finding turbulent or laminar flow by epsilon/d, Reynolds number and so...

Stress & Strain Measurement Systems, Principles of Measurement and Instrumentation I *October 2021 - January 2022*
In this term project, I presented a paper on the types of Stress & Strain Measurement Systems, on how to acquire data on mechanical strain gauges, piezoelectric, semiconductor ones are also discussed. In which devices it can be applied, physics background these systems, such as bridges, their calibration requirements are also discussed. Later on, I needed to prepare a strain gauge money counting precision scale, such as one in vending machines. One device built by HX711, but some calibration on prior trial & error is made. Great experience on making Arduino Nano based LC interface, and an interface on the PC to control the options of the precision scale, such as counting Turkish Lira coins, and kitchen precision scale in 0.001 and 0.01 scale of error. Precision calibration trial & error had issues in the latter option due to using only such small sample size.

Gaussian Process Applications in Physics, Data Science Community(LAB) - METU   *January 2021 - June 2022*
Second term project of Data Science Community.
Research paper presented at the end of the year at Data Science Community(LAB) conducted under mentorship of Osman Barış Malcıoğlu
A paper is planned to be published in a local/global journal as a result of the project.

ACTIVITIES

Former Member, METU Computer Club   *November 2018 - December 2019*
In the organization group of the METU CClub, we organize competitions and seminars and arrange small speeches given by successful computer business people or scientist

Active Member, METU Youth Tema   *October 2019 - September 2022*
We inform people about environmental issues and how to solve them and how not to solve them, and also inform people about the misuse of environmental data.

Active Member, METU OSA - SPIE Student Chapter   *February 2020 - January 2022*
Optics and Photonics society that is located in METU Physics department. Member of OSA and SPIE. To be able to become active member one must be member of these societies and prove affiliation with the student chapter.

SKILLS

Programming Languages and Frameworks
Python, Java, C++, C#, R & R Studio, JavaScript, HTML, CSS, Matlab, SQL, Django, Node.js, Mathematica

Computer Tools
Microsoft Office tools(Powerpoint, Excel, Word), Google tools, Pycharm, Pytorch, Keras, Spyder, LibreOffice, Anaconda 3, Git, Visual Studio, GEANT4, FeynCalc/FeynArts, Root, Qt, Unity, Bluej

Languages
Turkish - Native
English - Fluent/Bilingual
German - Intermediate B1
Spanish - Beginner A2
Chinese - Beginner
Japanese - Intermediate N2
French - Beginner A1

CERTIFICATES AND EXAMS

EXAMS
SAT - 1420 (Evidence-Based Reading & Writing - 630, Mathematics - 790) - 3/13/2018
GRE - 320 (Verbal Score - 155, Quantitative Reasoning - 165) - 9/1/2023
TOEFL IBT - 104 (Reading-29, Listening-29, Speaking-23, Writing-23) - 7/8/2023
Turkish University Entrance Exam - 23923rd out of ~ 2400000 in 0.01 or 99% - 31/06/2018

CERTIFICATES
Introduction to Quantum Computing (Bronze Certificate) via QWorld - QTurkey
Introduction to Physical Chemistry from University of Manchester via Coursera
Python Data Structures from University Michigan via Coursera
Python Basics from University of Michigan via Coursera
Programming for Everybody (Getting Started with Python) from University of Michigan via Coursera
Understanding and Visualizing Data with Python from University of Michigan via Coursera
R Programming from Johns Hopkins University via Coursera
The R Programming Environment from Johns Hopkins University via Coursera
The Data Scientist's Toolbox from Johns Hopkins University via Coursera
Introduction to Psychology from Yale University via Coursera
Financial Markets with Honors from Yale University via Coursera
Statistical Molecular Thermodynamics from University of Minnesota via Coursera
HTML, CSS, and Javascript for Web Developers from Johns Hopkins University via Coursera
Semiconductor Physics from University of Colorado at Boulder via Coursera
Mathematics for Machine Learning: Multivariate Calculus from Imperial College London via Coursera
Chinese for Beginners from Peking University via Coursera
Introduction into General Theory of Relativity from National Research University - Higher School of Economics (HSE) via Coursera
Spanish Vocabulary: Meeting People from University of California at Davis via Coursera
Mandarin Chinese 1: Chinese for Beginners from Shanghai Jiao Tong University via Coursera
First Step Korean from Yonsei University via Coursera
Advanced Programming in C++ via EdX NYUx
Introduction to Programming in C++ via EdX NYUx

AWARDS AND SCHOLARSHIPS

2205 Full Undergraduate Scholarship Programme TÜBİTAK *October 2018*
It's a scholarship for students who achieved high rankings in higher education examinations and continue their successes.

2248 Mentorship Programme , TUBİTAK *September 2019*
It's a program for successful and aspiring natural sciences students to help them on their academic journey through mentorship and research opportunities.

2017 Benjamin Franklin Transatlantic Fellowship Runner-up ECA *May 2017*
Program of the U.S. Department of State's Bureau of Educational and Cultural Affairs

National Science Olympiad, TUBITAK *December 2016*
4th in the Biology Olympiad section in Turkey, but exam cancelled due to a national cheating scandal.

Fellow Data Scientist, Data Science Lab - METU *February 2020*
A selective Data Science Community for undergraduate students who want to pursue a career containing data science.

PUBLICATIONS AND CONFERENCES

Publications - Preprints
Health Insurances: Gender Rating and Region Effect on Insurance Prices -
https://europepmc.org/article/ppr/ppr530353

Vision Transformer is All You Need: Class Level Augmented Multiclass Breast Cancer Detection in High Imbalance, Low Source Domain - https://doi.org/10.48550/arXiv.2310.09981

Conferences - Invited Talk
Presented - International Conference on Social and Healthcare Studies - 15th - 16th of November, 2022, Kolegji Universum - Pristhine - KOSOVO

REFERENCES (WITH CONTACT MAIL)

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Asst. Prof. Berkin Bilgic (NeuroImaging, Image Processing, Machine Learning)
bbilgic@mgh.harvard.edu
More if requested.