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Anthony Jarjour B.S.

Education

California State University, Fullerton — California, United States
B.S. Computer Science, Minor in Mathematics and Physics — 2021.08 - 2026.05

- Extended degree by one year to formally pursue advanced physics and mathematics coursework and research in theoretical physics.

Experience

Mathematical Circle Instructor - CSUF | Fullerton, California — 2026.01 - 2026.05

- Lead problem-solving sessions for middle- and high-school students in an open university outreach program, delivering lectures and workshop-style activities.
- Design and curate challenging problem sets and guided solutions to strengthen mathematical reasoning, proof skills, and creativity.
- Collaborate with faculty mentorship to select topics, refine lesson plans, and adapt instruction to varied student backgrounds and ability levels.

Undergraduate Tutor (Volunteer) - CSUF | Fullerton, California — 2025.08 - 2025.12

- Mentored undergraduate students through homework and exam preparation in vector and tensor analysis.
- Broke down complex derivations into approachable steps and emphasized geometric/physical interpretation alongside formalism.
- Developed targeted practice problems and review notes to address recurring conceptual gaps.

Internships

Cybersecurity Analyst - El Paso Water Utility | El Paso, Texas — 2022.06 - 2022.08

- Designed and automated reports to visualize trends across multidimensional data streams, enhancing system performance and predictive diagnostics.

Research

Undergraduate Research Assistant | Theoretical Physics – QFT — 2025.05 – Present

- Investigated thermodynamic properties of inequivalent Rindler vacua in Minkowski spacetime following Lochan et al. (2025), focusing on Bogoliubov transformations, vacuum inequivalence, and Planck-scale aspects of quantum field theory.
- Built graduate-level theoretical foundation in General Relativity and Quantum Field Theory using Schutz (1985), Wald (1994), Ashtekar (1975), and Panangaden (1979), covering algebraic QFT, Green's functions and propagators, and Kähler structures.

Presentation

Bogoliubov Transformations Between Shifted Rindler Frames | 2026.01
Joint Mathematics Meetings (JMM)

- Presented at the 2026 Joint Mathematics Meetings an expanded study of Bogoliubov transformations between shifted Rindler frames, exploring how different quantization schemes yield distinct vacuum structures and physical interpretations.

Bogoliubov Transformations Between Shifted Rindler Frames | 2025.10
Math Research Symposium

- Delivered an in-depth exposition of Lochan Padmanabhan (2025), reproducing their derivation of Bogoliubov transformations between shifted Rindler frames and analyzing the resulting inequivalent vacuum structure in detail.

Data Science in Sport Analytics | *ECS Innovation Expo* — 2025.04

- Cleaned and preprocessed soccer match data to develop machine learning models for predicting game outcomes, and presented application at an expo.

Awards & Honors

Dean's List | *California State University, Fullerton* 2021.08 - 2025.12

- Recognized for academic excellence for the Fall 2024, Spring 2025, Fall 2025 semesters

3rd Place Award | *CSUF CS Showcase* 2025.04

- Awarded 3rd place for developing a machine learning model to predict soccer match outcomes, presented at the Computer Science Showcase at California State University, Fullerton.

Projects

Large Language Model for Code Generation 2024.09 – 2024.11

- Technologies: Python, NLTK, Numpy, PyTorch, Pandas
- Notes: Evaluated model output using unit tests to validate code correctness across multiple functional tasks, with a 93% pass rate.

2-Body Problem Simulator 2024.08 – 2024.10

- Technologies: Python, Numpy, MatPlotLib
- Notes: Implemented Runge-Kutta integration to model two-body dynamics in a Newtonian gravitational system; visualized orbit evolution and field behavior.
- Simulated gravitational fields using Newtonian mechanics with relativistic corrections

Residual Neural Network Image Classifier 2024.01 – 2024.05

- Technologies: Python, PyTorch, NodeJS, Javascript, FastAPI, ScikitLearn, Pandas
- Notes: Implemented an RNN based on K. He, X. Zhang, S. Ren, and J. Sun, "Deep residual learning for image recognition," arXiv preprint arXiv:1512.03385, 2015, and achieved 95% validation accuracy with 0.25 loss, on bird species images

Skills

Programming Languages:

Python, C++, MATLAB, R

Frameworks:

Pandas, Numpy, PyTorch, Tensorflow, NTLK, Sickit-Learn

Relevant Coursework

Completed

Computer Science: Compilers and Languages; Algorithm Engineering; Theory of Computation; Artificial Intelligence; Machine Learning

Mathematics: Vector and Tensor Analysis; Mathematical Probability; Partial Differential Equations; Differential Geometry; Quantum Field Theory; Intro to General Relativity

Physics: Thermodynamics, Kinetic Theory, and Statistical Physics; Classical Dynamics

Planned

Real Analysis I–II; Linear Algebra; Complex Analysis; Topology; Electromagnetic Theory I–II; Quantum Mechanics I–II

Academic Interests

Theoretical Physics, Quantum Field Theory, General Relativity, Quantum Gravity, Computational Physics, Machine Learning for Physical Systems.

Selected References

K. Lochan and T. Padmanabhan, "A Nested Sequence of Inequivalent Rindler Vacua: Universal Relic Thermality of Planckian Origin," *Classical and Quantum Gravity*, vol. 42, no. 3, 03LT01, 2025.

B. F. Schutz, *A First Course in General Relativity*. Cambridge University Press, 1985.

R. M. Wald, *Quantum Field Theory in Curved Spacetime and Black Hole Thermodynamics*. University of Chicago Press, 1994.

A. Ashtekar and A. Magnon, "Quantum Fields in Curved Space-Times," *Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences*, vol. 346, no. 1646, pp. 375–394, 1975.

P. Panangaden, "Positive and Negative Frequency Decompositions in Curved Spacetime," *Journal of Mathematical Physics*, vol. 20, no. 12, pp. 2506–2510, 1979.