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ASTR 401
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Proposed Topics

Introduction to General Relativity concepts and exterior calculus and how to use it to derive equations of motion from actions.

Background knowledge:
My research involves using the torsion theory of gravity to calculate the equations of motion of objects around Schwarzschild black holes. I have already worked with actions written in the exterior calculus formulation and calculated variations to obtain EoMs.

About the idea:
I could write a paper simply explaining the fundamentals of general relativity and exterior calculus so the reader is able to understand how equations of motion can be calculated from an action in GR.

Why I want to do it:
When I was attempting to learn exterior calculus and first-order formalism for my literature review last semester, I was not able to find any resources that explained how to vary actions in an accessible way. I believe I can write a basic and accessible explanation for students just getting into GR.

A survey of quantitative analysis techniques used throughout astrophysics.

Background knowledge:
In the summer, I completed a project in which I used decades of historical stock data and a 2-state gaussian hidden markov model to identify volatility regimes and backtest investment strategies (you can read the report here: https://agastiyo.github.io/hmm_regime_detection/, it's rough around the edges, but I'm quite proud of it, and it may also provide you with an idea of the level of writing I am starting with in this class), and I am taking ASTR 496 FDS (Data science in astronomy).

About the idea:
This paper could include a list of quantitative analysis techniques, explain what types of problems/data they are best suited for, pros and cons, as well as popular examples of them being used in astrophysics.

Why I want to do it:
This project aligns with my future career goals, as I hope to end up working in finance or tech doing quant/data analysis. I can talk about this paper in my interviews to explain how my astrophysics background can connect to finance/tech.

Data Analysis using the NASA Exoplanet Archives

Background knowledge:
Same background knowledge as proposed topic 2.

About the idea:
Use the NASA Exoplanet Archives to find if the method with which the exoplanets were discovered impacted the planet's chance to be potentially habitable. Maybe certain detection methods favor exoplanets in positions that make them more or less habitable, and this can inform which method has the most promising to find more habitable planets in the future.

Why I want to do it:
This project aligns with my future career goals as well, and can be another project I add to my resume.