README

What is this?

This repository serves as but a home for one of what I assume is many explorations of the `phyphox` experiments. In particular, the focus centers around `GPS` data, something gripping every facet of the modern world. But don't be confused; in describing it that way, I make it out to sound more grandiose than it actually is. The reality is that my set of experiments revolve around interpreting snippets of data I produced, walking around my living space.

In first transforming coordinate data and then examining it, I'm able to fit the data by deriving the associated physics such that I have a vague idea of the motion. No, this is not groundbreaking physics, but it is a testament to the skills that I gathered and reinforced during this course, the contents of which can be found in this repository.

What can I find here?

There are a few major destinations of this repository. First, the `GPS.ipynb` file - this is where all of the experiments are executed. I utilize Jupyter Notebook as a shell to do basic computations (pushing the more intensive ones to their own `.py` files) and display the associated results. You should be able to run this notebook with a simple installation of Python; in some cases, `pandas` may need to be installed, but it depends on how the Anaconda Distribution was installed. A detailed breakdown of that can be found here.

Although no docker is included with this assignment, it is because most of the associated libraries are included with Anaconda Navigator by default and, if an experienced data science, they might already be installed.

Besides that, there are a few subfolders. Namely, `data`, `figures`, and `utility`:

- The `data` folder houses all of raw data from `phyphox`, including the `.zip` files in case data is somehow corrupted. These are titled `sample_1.csv`, `sample_2.csv`, etc such that they can be easily iterated over, at the cost of uniqueness. What I mean is that if a particular dataset interests you, you'll find it difficult to recover that data unless you record the exact file name. I do not create new data as much of that can be handled by ease by the functions in `utility`.
- In the `figures` folder, all of the resulting graphs are saved as a `.pdf`. Foremost, this allows for the user to look at the results without having to actually run the notebooks. Further, the `.pdf` is vectorized such that the user can zoom in to a reasonable extent without image loss.
- Lastly, `utility`: this folder holds all of the `.py` files used for background computation. Without expanding on every single one (see `code` in the repository for this; code in the notebook is explained there), most of them are named according to the `Theory` section in the wiki. They also have mild documentation if long-form reading isn't your taste. In this folder is another subfolder `tests`, which stores the unit testing for all of these `.py` files. These are a good read in order to get an idea of how these functions should behave. By putting these functions in the background, `GPS.ipynb` has less clutter and is thus more readable.

However, this repository also has the wiki, in both `.md` and `.pdf` (just like this file). Effectively, this tells you much of the same information here, but with far more elegance and deeply elaborate. Basically, regardless of your understanding of the material, reading the wiki is important because it defines everything from essentially the ground up. Ideally, it should answer all of your simple questions. This `readme` is like a movie to the book that is the wiki.

What else can be done?

Since this project is effectively open source in that all of the data can be generated by the user, free of charge, there are a few areas where this repository could be expanded. More so, since this is a physics project and there's always physical systems to explore. A few of these expansions that immediately come to mind or are a consequence of the current work:

- applying a dynamic algorithm like `BFGS` such that the error is minimized and the fit becomes the most accurate that it could.
- looking at velocity trajectories for an accelerated system with different force equations
- adjusting the coordinate system to more closely agree with `WGS84`
- using this data in other physical equations such as energy and momentum
- cleansing the data of noise caused by fluctuations in the `GPS` measurements

Of course, this is anything but a complete list - physics is a seemingly endless field. However, these are good starting points to expand into other fields, from data science to planetary motion.

Notes

This is a final project for PHY 410, at SUNY Buffalo. As such, the scope of the project is not as grand as it could be. Rather, it is designed more as an exercise of the semester's material. None of this is meant as a formal declaration of physics, but rather understanding what went right and what went wrong, while simultaneously displaying our knowledge.

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