54+54+5 = 113

113/117

Phys 304: Assignment 2

Mary Smith*
Haverford College Department of Physics
(Dated: February 15, 2024)

✓ .5

[Survey question: The homework took me about 5 hours to complete. I learned about how to plot imported data and non-Cartesian functions. The Curve plotting problem was the most interesting, because I didn't know that matplotlib could plot those types of functions. The problem set length was just right.]

1. PROBLEM 1: PLOTTING SUNSPOTS

The Sun, like most stars, has a very strong magnetic field. In some areas across the Sun's surface, the magnetic field concentrates. This acts to dampen the the convection of heat from the Sun's surface. To observers on Earth, this appears as dark spots in the sun, called sunspots. The change in magnetic field is periodic, so sunspots change their location and number with time and can be plotted.

Great Explanation!

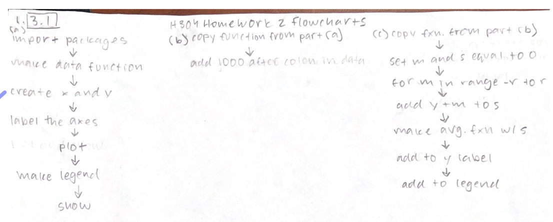


FIG. 1: [Pseudocode of the following plots in this problem can be seen here.]

1.1. Part (a): A graph of sunspots as a function of time

The observed number of sunspots on the Sun for each month since January 1749 is plotted.

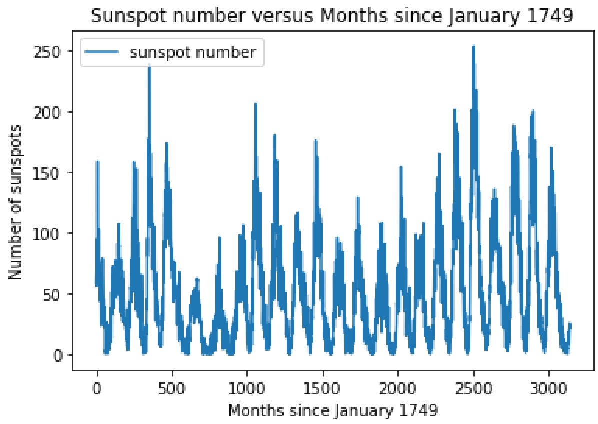


FIG. 2: [A graph of sunspots since January 1749. The periodic nature of sunspots can be clearly observed.]

1.2. Part (b): Limiting the data

The plot was then limited to the first 1000 data points.

1.3. Part (c): The running average

The running average of the data is defined by the following:

$$\Upsilon_k = \frac{1}{2r+1} \sum_{m=-r}^{r} y_{k+m}, \tag{1}$$

where y_k are the sunspot numbers, and r=5 in this case. The running average, given by Eq. 1, is then graphed with the original data.

*Electronic address: masmith@haverford.edu

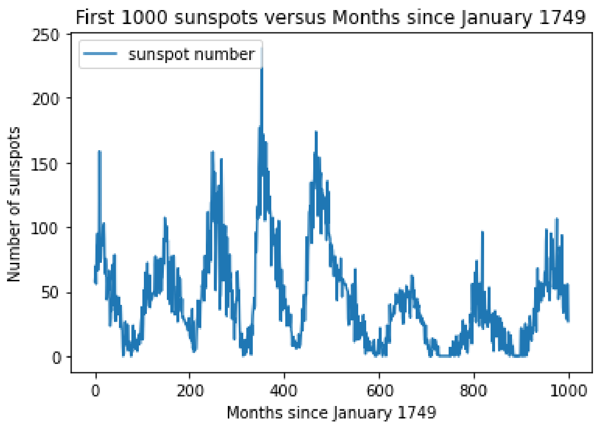
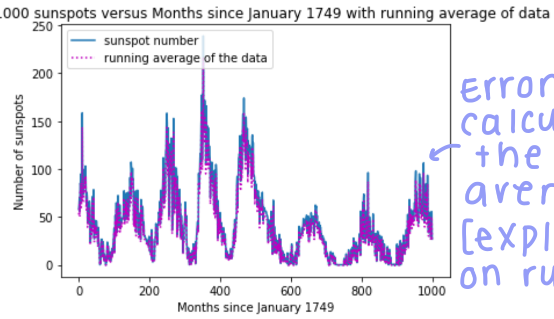


FIG. 3: [A graph of sunspots since January 1749. The graph is limited to the first 1000 data points.]



error calculating the running average [explained on rubric]

FIG. 4: [A graph of sunspots since January 1749, limited to the first 1000 data points. The running average of the data is plotted with the data itself.]

2. PROBLEM 2: CURVE PLOTTING

The plot function is adapted for use of parametric functions. The pseudocode in Fig. 5 is used to create the following plots.

2.1. Part (a): The deltoid curve

The deltoid curve is given by the following parametric equations:

$$x = 2cos\theta + cos2\theta$$
$$y = 2sin\theta - sin2\theta, \tag{2}$$

where θ is $0 \leq \theta < 2\pi$. This is then plotted in Fig. 8.

2.2. Part (b): The Galilean spiral

Polar plots are created by taking $r = f(\theta)$ for some function f over a range of θ, and then converted into

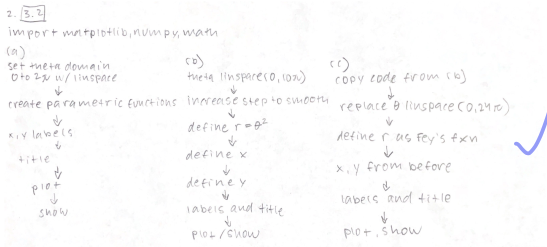


FIG. 5: [The pseudocode for problem 2.]

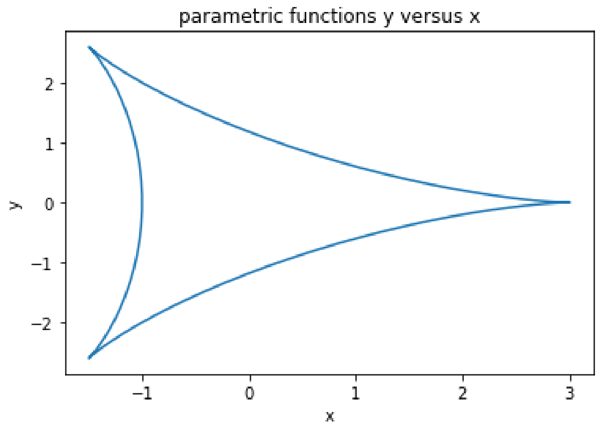


FIG. 6: [From Eq. 2, y is plotted as a function of x to obtain the deltoid curve.]

Cartesian coordinates in the code. The Galilean spiral is for $r = \theta^2$ over a range of $0 \leq \theta \leq 10\pi$.

2.3. Part (c): Fey's function

Fey's function is given by:

$$r = e^{\cos\theta} - 2\cos 4\theta + \sin^5 \frac{\theta}{12}, \tag{3}$$

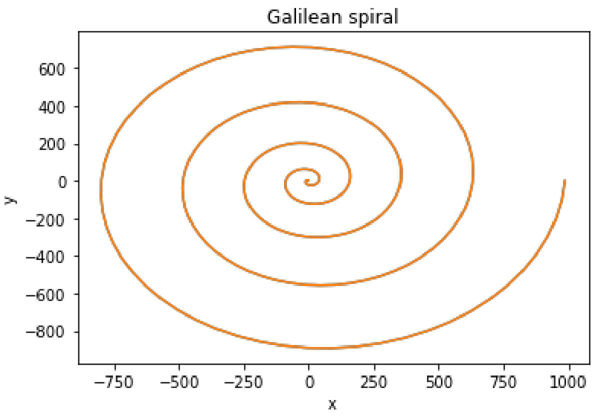


FIG. 7: [The Galilean spiral is plotted over $0 \leq \theta \leq 10\pi$.]

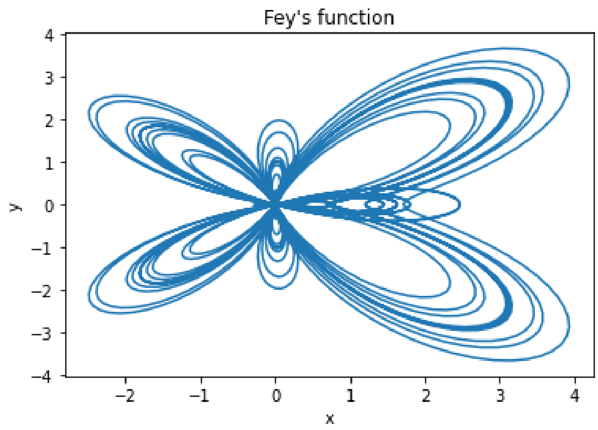


FIG. 8: [Fey's function is plotted over $0/leq\theta/leq24\pi$.]

taken over the range of $0/leq\theta/leq24\pi$.

\leq

Ex. 3.1 54/56

Computational Physics/Astrophysics, Winter 2024:

Grading Rubrics [1]

Haverford College, Prof. Daniel Grin

For coding assignments, roughly 56 points will be available per problem. Partial credit available on all non-1 items.

4 1. Does the program complete without crashing in a reasonable time frame? (+4 points)

2 2. Does the program use the exact program files given (if given), and produce an answer in the specified format? (+2 points)

3 3. Does the code follow the problem specifications (i.e numerical method; output requested etc.) (+3 points)

5 4. Is the algorithm appropriate for the problem? If a specific algorithm was requested in the prompt, was it used? (+5 points)

4 5. If relevant, were proper parameters/choices made for a numerically converged answer? (+4 points)

3 6. Is the output answer correct? (+4 points). Error calculating the running average, the final term in the equation is y_{k+m} with m in the index, your code solved $y_k + m - 1$

3 7. Is the code readable? (+3 points)

. 5.1. Are variables named reasonably?

. 5.2. Are the user-functions and imports used?

[1] Inspired by rubric of D. Narayanan, U. Florida, and C. Cooksey, U. Hawaii

. 5.3. Are units explained (if necessary)?

. 5.4. Are algorithms found on the internet/book/etc. properly attributed?

2 8. Is the code well documented? (+3 points)

. 6.1. Is the code author named? Please comment your name at the top of your code -1

. 6.2. Are the functions described and ambiguous variables defined?

. 6.3. Is the code functionality (i.e. can I run it easily enough?) documented?

9. Write-up (up to 28 points) Great write-up!

5 . Is the problem-solving approach clearly indicated through a flow-chart, pseudo-code, or other appropriate schematic? (+5 points)

✓ . Is a clear, legible LaTeX type-set write up handed in?

3 . Are key figures and numbers from the problem given? (+ 3 points)

4 . Do figures and or tables have captions/legends/units clearly indicated. (+ 4 points)

3 . Do figures have a sufficient number of points to infer the claimed/desired trends? (+ 3 points)

2 . Is a brief explanation of physical context given? (+2 points)

1 . If relevant, are helpful analytic scalings or known solutions given? (+1 point)

3 . Is the algorithm used explicitly stated and justified? (+3 points)

2 . When relevant, are numerical errors/convergence justified/shown/explained? (+2 points)

2 . Are 3-4 key equations listed (preferably the ones solved in the programming assignment) and algorithms named? (+2 points)

1 . Are collaborators clearly acknowledged? (+1 point)

2 . Are any outside references appropriately cited? (+2 point)

Ex. 3.2 54/56

Computational Physics/Astrophysics, Winter 2024:

Grading Rubrics [1]

Haverford College, Prof. Daniel Grin

For coding assignments, roughly 56 points will be available per problem. Partial credit available on all non-1 items.

4 1. Does the program complete without crashing in a reasonable time frame? (+4 points)

2 2. Does the program use the exact program files given (if given), and produce an answer in the specified format? (+2 points)

3 3. Does the code follow the problem specifications (i.e numerical method; output requested etc.) (+3 points)

5 4. Is the algorithm appropriate for the problem? If a specific algorithm was requested in the prompt, was it used? (+5 points)

4 5. If relevant, were proper parameters/choices made for a numerically converged answer? (+4 points)

4 6. Is the output answer correct? (+4 points).

3 7. Is the code readable? (+3 points)

. 5.1. Are variables named reasonably?

. 5.2. Are the user-functions and imports used?

---

[1] Inspired by rubric of D. Narayanan, U. Florida, and C. Cooksey, U. Hawaii

. 5.3. Are units explained (if necessary)?

. 5.4. Are algorithms found on the internet/book/etc. properly attributed?

2 8. Is the code well documented? (+3 points)

. 6.1. Is the code author named? Please comment your name at the top of your code −1

. 6.2. Are the functions described and ambiguous variables defined?

. 6.3. Is the code functionality (i.e. can I run it easily enough?) documented?

9. Write-up (up to 28 points) Great write-up!

5 . Is the problem-solving approach clearly indicated through a flow-chart, pseudo-code, or other appropriate schematic? (+5 points)

✓ . Is a clear, legible LaTeX type-set write up handed in?

3 . Are key figures and numbers from the problem given? (+ 3 points)

3 . Do figures and or tables have captions/legends/units clearly indicated. (+ 4 points) Figures need legends −1

3 . Do figures have a sufficient number of points to infer the claimed/desired trends? (+ 3 points)

2 . Is a brief explanation of physical context given? (+2 points)

1 . If relevant, are helpful analytic scalings or known solutions given? (+1 point)

3 . Is the algorithm used explicitly stated and justified? (+3 points)

2 . When relevant, are numerical errors/convergence justified/shown/explained? (+2 points)

2 . Are 3-4 key equations listed (preferably the ones solved in the programming assignment) and algorithms named? (+2 points)

1 . Are collaborators clearly acknowledged? (+1 point)

2 . Are any outside references appropriately cited? (+2 point)