Lab Assignment 4

Task 1

Give your implementation of the `plot_approx` function from Lab 4.

Use it to produce a plot of a Fourier series approximation of the function defined by

$$f(x) = \begin{cases} -\frac{1}{2}x & -2 \leq x < 0 \\ 2x - \frac{1}{2}x^2 & 0 \leq x < 2 \end{cases} \qquad f(x+4) = f(x),$$

using the first 10 terms of the Fourier series.

Task 2

Solve Exercise 3.1 from Lab 4, but with the initial condition

$$u(x,0) = f(x) = \begin{cases} 1 & L/2 - 1 < x < L/2 + 1 \\ 0 & \text{otherwise.} \end{cases}$$

Note that to ensure the code runs in reasonable time, you should use $L = 10$ and run the animation for $0 \leq t \leq 20$, with only 2 frames per second. You should use at least 200 terms of the series solution in order to obtain a good approximation.

Describe the behaviour of the solution.

Note

Your submission should be a self-contained piece of exposition, i.e. you should give a concise description of what you are doing, as well as doing it. It should not be necessary to consult this description of the tasks to understand what you are doing.

Submission instructions

After producing the animation (as in the lab), you should also use the following line of code to produce an mp4 file of your animation. The file should then appear alongside the .ipynb file in your Jupyter file list.

```
In [ ]: ani.save('hdeq_la4_task2.mp4', writer='ffmpeg', fps=20)
```

Please **follow these instructions carefully** to ensure that your submission can be seen by the markers:

1. In Jupyter Notebook, click the menu item: "Kernel > Restart & Run All". This will check that your code runs properly from scratch, and does not rely on intermediate calculations that you've since deleted. If the output is not what you expected, then you've got a chance to fix it before submitting!
2. Click "File > Download as > Notebook (.ipynb)" and save the file in your documents folder.
3. Produce a PDF of the notebook and save that file in your documents folder too (see instructions on Learn - in the Skills Labs section, "Producing a PDF from Noteable.pdf").
4. Go to your list of files in Jupyter, and download the hdeq_la4_task2.mp4 file.
5. On the "Lab Assignment 4" submission page on Learn, upload **three files**: the .pdf, the .ipynb, and the .mp4.