Fourier Transforms with Wave Equations: Final Proposal

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We will find momentum-space wave functions of the following position-space functions by hand and with the DFT function of Numpy:

1. The 1st, 2nd, and 3rd stationary states of the infinite square well.

2. The 1st, 2nd, and 3rd stationary states of the simple harmonic oscillator.

3. The stationary state of the dirac delta potential.

4. A free particle with initial wave function $\Psi(x,0) = \frac{A}{x^2+a^2}$

Then, we will design and test a basic DFT algorithm of our own to find the Fourier transforms of the same position-space functions. We will test the efficiency of our function by increasing or decreasing the step size used in calculating the position-space wave function values until the time of calculation for our own DFT function roughly matches that of the Numpy DFT function, and then compare the results graphically and, if possible, analytically in some way.

This concludes the basic set of goals for our project. If time permits, we will attempt to go further and design a FFT function to increase efficiency, or numerically solve the anharmonic oscillator potential ($V = \frac{1}{2}\omega^2 x^2 + \alpha x^4$) and find its transform through all three methods. No promises.