

The Result:

First, I want to show the errors for the following $k=1,\dots,6$

For $k = 1$: the error 5.1447837631

For $k = 2$: the error 4.3301187587

For $k = 3$: the error 1.6436015877

For $k = 4$: the error 1.0289119749

For $k = 5$: the error 0.5013474154

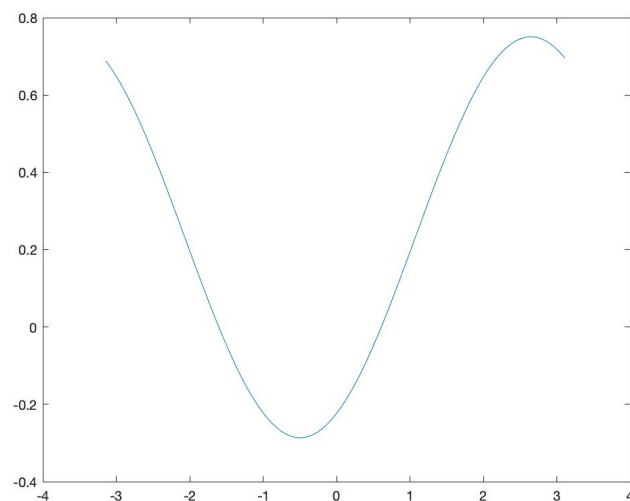
For $k = 6$: the error 0.2749858098

As you can see the error is getting smaller for higher k 's.

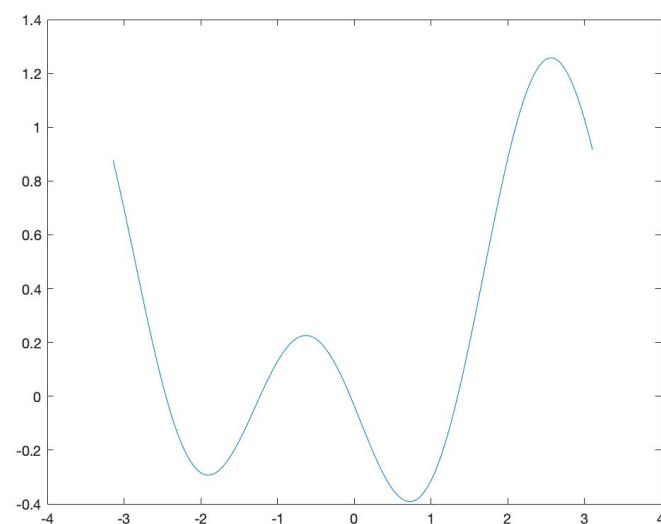
Hereby, I used the error formula: $E = \int_{-\pi}^{\pi} (f(x) - s(x))^2 dx$ with the bounds $-\pi$ and π

Now, I will continue with the three plotted graphs for $k=1,2,3$

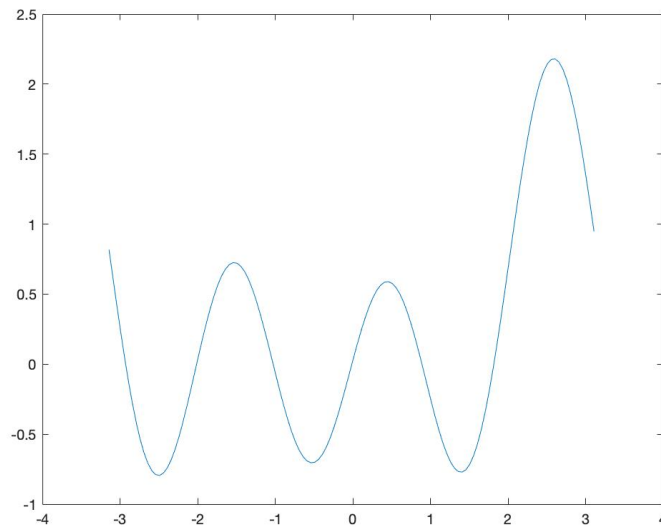
For $k = 1$



For $k = 2$:



For $k = 3$:



Although you can still see similarity between the graphs, it is obvious that the approximation with $k = 3$ is more accurate than with the smaller k 's.

Lastly, here are the resulting coefficients A and B for $k = 6$, for the smaller k 's, you just have to delete the last element.

Note however that Coefficient A has one more element, since we need an a_0 , but not an b_0 for the Fourier series.

coefficient A: 0.4643 -0.4558 0.1890 0.0598 -0.2572 0.4027 -0.2516
coefficient B: 0.2471 -0.4729 0.9228 -0.3599 0.0761 0.0935

My Approach:

First to the structure, I have one runner method and four helper method.

My first helper method, coefficientsCalc, calculates the coefficients A and B for $k=1,\dots,6$. It just takes as input the function, as well as, a certain k and it returns two arrays, which represent the coefficients. These I calculate using a for loop and the given formula:

$$A = 1/\pi * \int_{-\pi}^{\pi} (\cos(kx)f(x)) dx$$

$$B = 1/\pi * \int_{-\pi}^{\pi} (\sin(kx)f(x)) dx$$

In the second method, functionCalc, I compute the fourier series function with the help of the two computed coefficients and a for loop.

Then in the third method, plotFunction, I plot the graph.

Lastly in the fourth method, errorCalc, I calculate the error for a given k using the error formula (see above).

In my runners method, I implement a for-loop, which runs 6 times and each time I calculate the coefficients, the Fourier series and the error. The first 3 runs I also plot the graph.