Today I wrote a code that calculates the Fourier Coefficients.

In case you don't know what a Fourier Series is, then, basically it is a way of approximating or representing a periodic function by a series of *simple harmonic(sine and cosine)* functions.

You can check out the wikipedia for more information on it: https://en.wikipedia.org/wiki/Fourier_series

For a waveform
f(x) with period 2L=2π/k, we have that k=2π/2L=π/L and nkx =nπx/L , Then we have

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} \left[a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right]$$

The corresponding Fourier coefficients are

STEP ONE $$a_0 = \frac{1}{L} \int_{2L} f(x)\, dx$$

STEP TWO $$a_n = \frac{1}{L} \int_{2L} f(x) \cos \frac{n\pi x}{L}\, dx$$

STEP THREE $$b_n = \frac{1}{L} \int_{2L} f(x) \sin \frac{n\pi x}{L}\, dx$$

and integrations are over a single interval in x of $2L$

So, here's how my code works:
I created a function
[A0,A,B]=fourier(l,n,f)
Arguments:
l :half of the period, (periodicity of the function f which is to be approximated by Fourier Series)

n: no. of Fourier Coefficients you want to calculate

f: function which is to be approximated by Fourier Series
A0: The first fourier coefficient.

A: An array/matrix whose nth element is the nth coefficient An.

B: An array/matrix whose nth element is the nth coefficient Bn.

The code is:

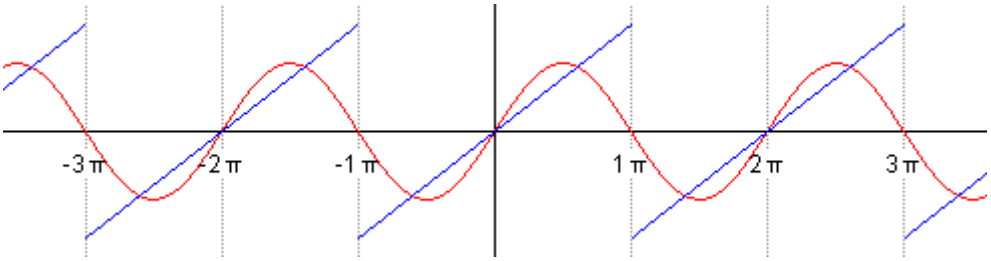
```
//Fourier Series Coefficients
//The following function returns the fourier coefficients,'a0', 'An' & 'Bn'
//
//User needs to provide the following arguments:
//
//l=periodicity of the function f which is to be approximated by Fourier Series
//n=no. of Fourier Coefficients you want to calculate
//f=function which is to be approximated by Fourier Series
//
//*Some necessary guidelines for defining f:
//*The program integrates the function f from -l to l so make sure you define the
function f correctly in the interval -l to l.
//
//for more information on Fourier Series visit:
https://en.wikipedia.org/wiki/Fourier_series
//
//Written by: Manas Sharma(manassharma07@live.com)
//For more useful toolboxes and tutorials on Scilab visit:
http://www.bragitoff.com/category/compu-geek/scilab/
funcprot(0);
function [a0, A, B]=fourier(l, n, f)
    a0=1/l*intg(-l,l,f,1e-2);
    for i=1:n
        function b=f1(x, f)
            b=f(x)*cos(i*%pi*x/l);
        endfunction
        function c=f2(x, f)
            c=f(x)*sin(i*%pi*x/l);
        endfunction
        A(i)=1/l*intg(-l,l,f1,1e-2);
        B(i)=1/l*intg(-l,l,f2,1e-2);
    end
endfunction
```

Output:


```
-->deff('a=f(x)','a=x')

-->[a0,a,b]=fourier(5,5,f)
 b  =

    3.1830989
  - 1.5915494
    1.061033
  - 0.7957747
    0.6366198
 a  =

    0.
    0.
    0.
    0.
    0.
 a0  =

    0.
```

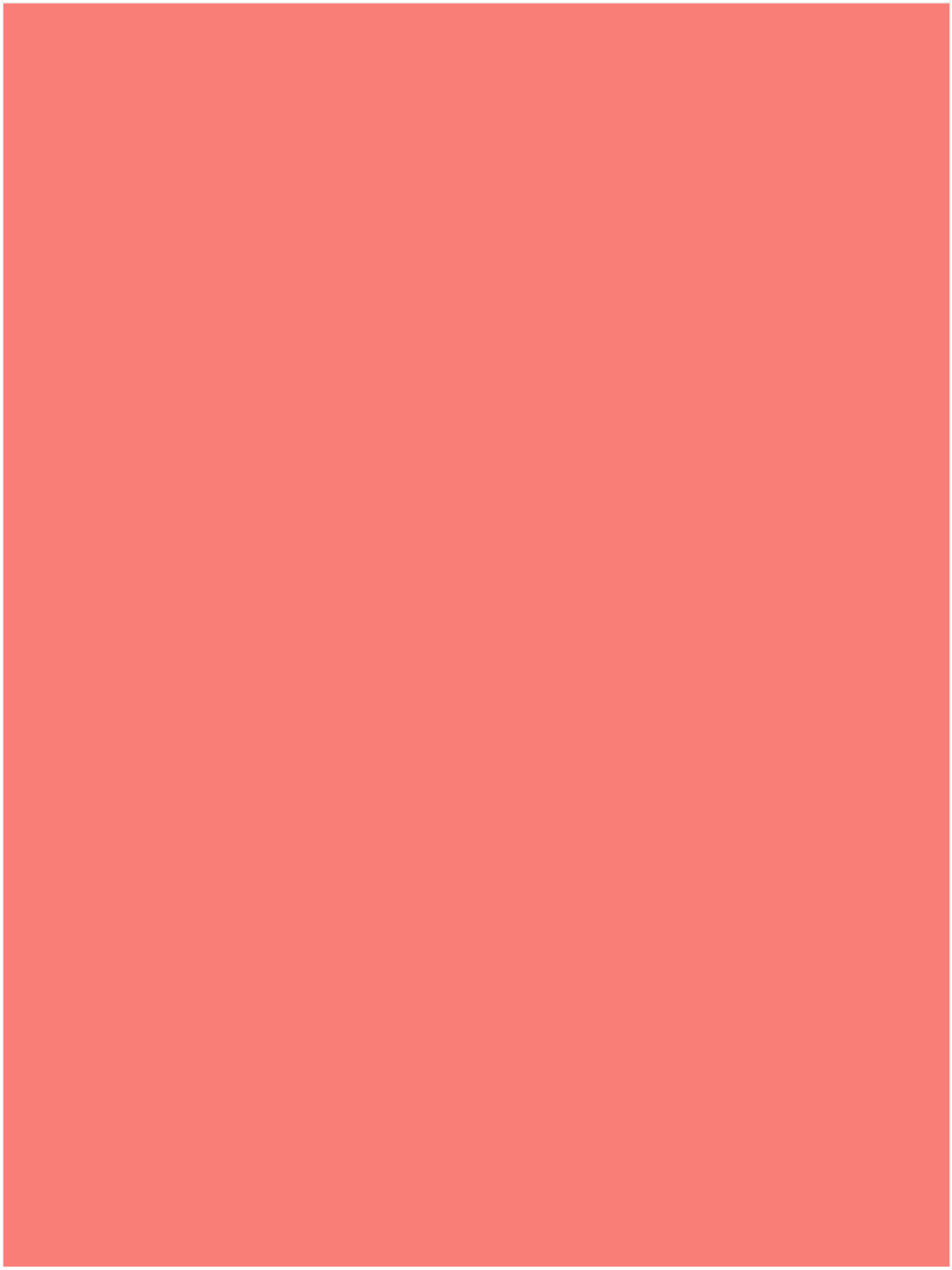
Tutorial:

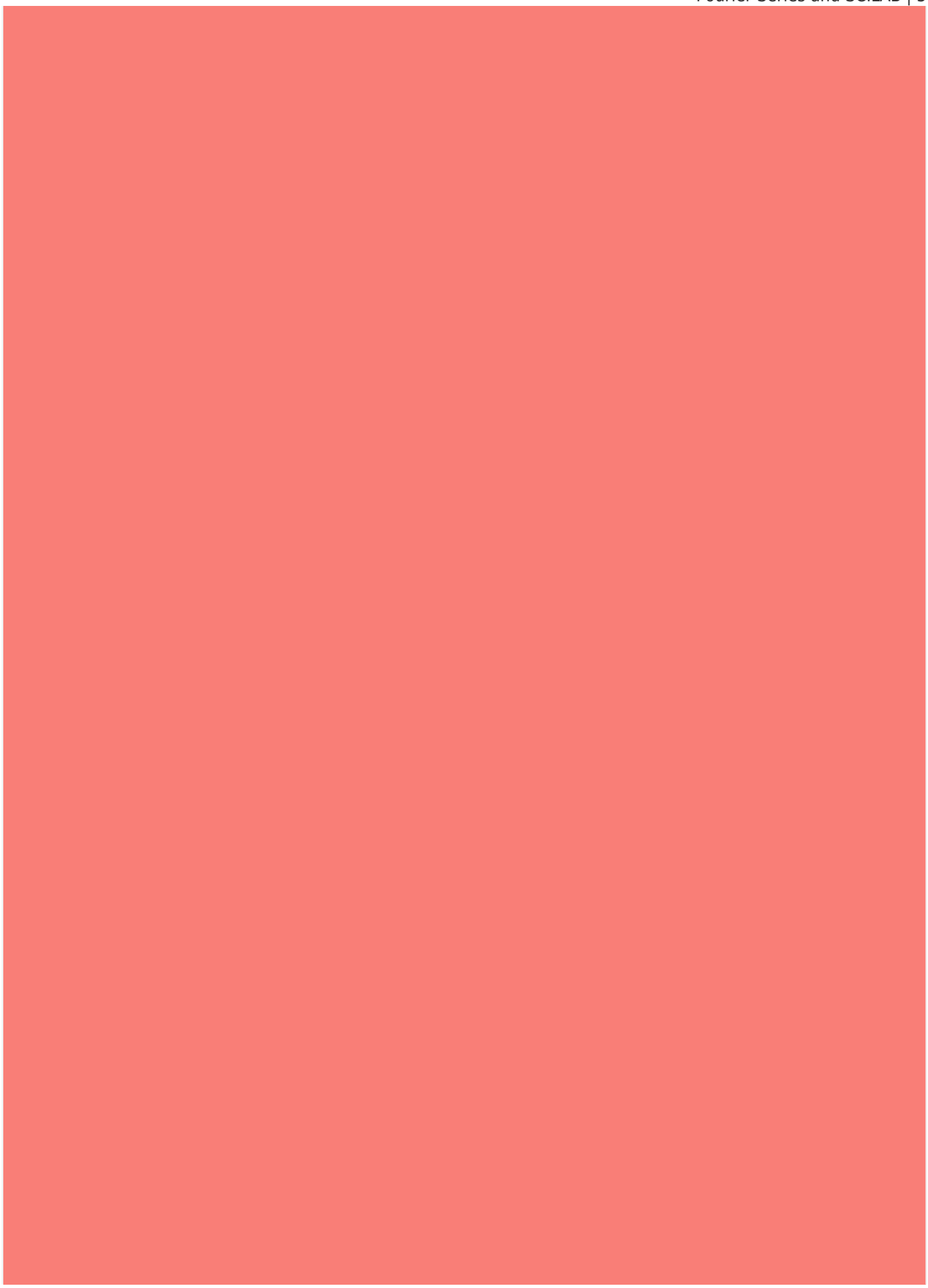
That’s it. I hope it was not too difficult to understand. If you have any questions I will be glad to answer them.

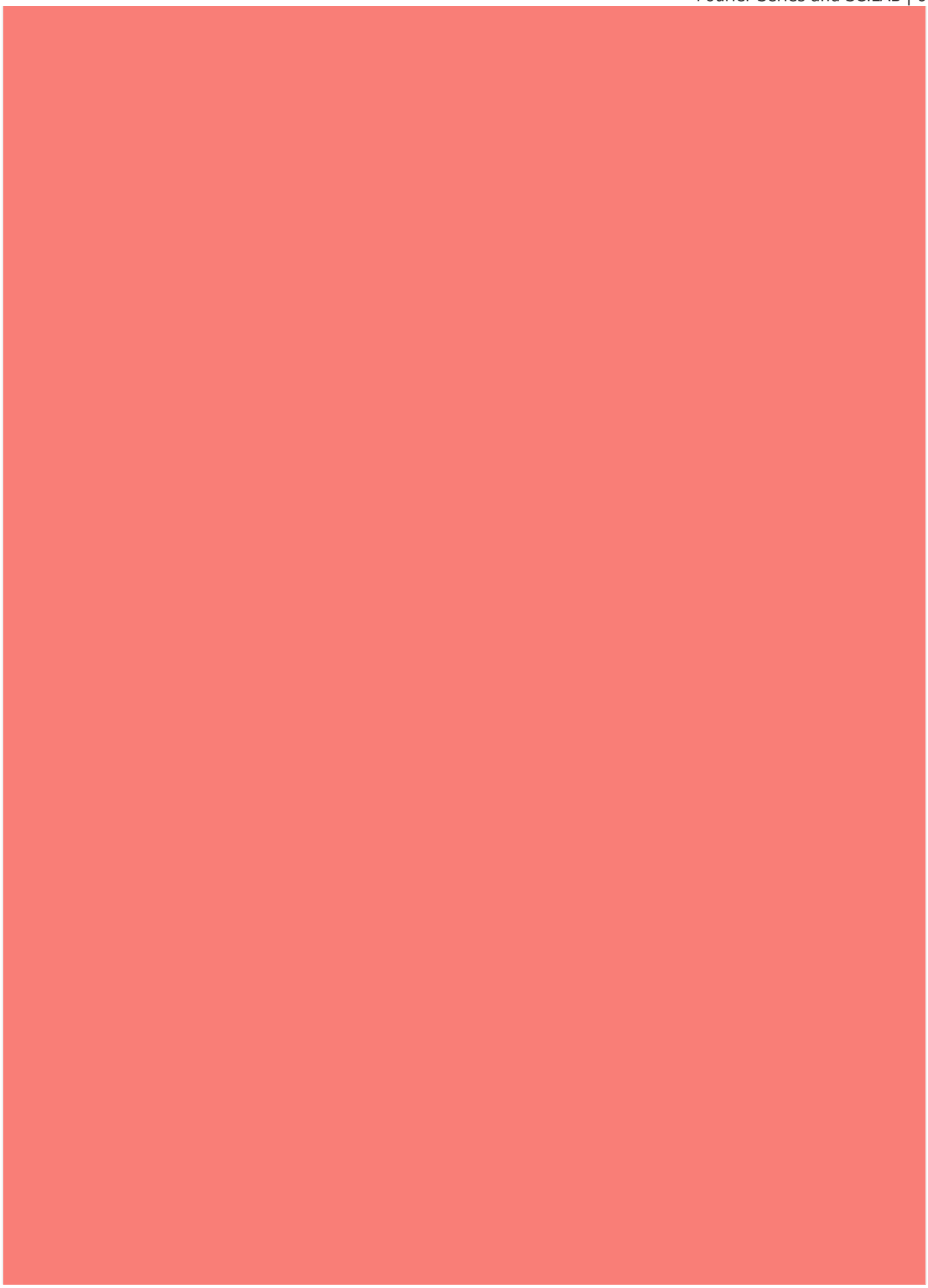


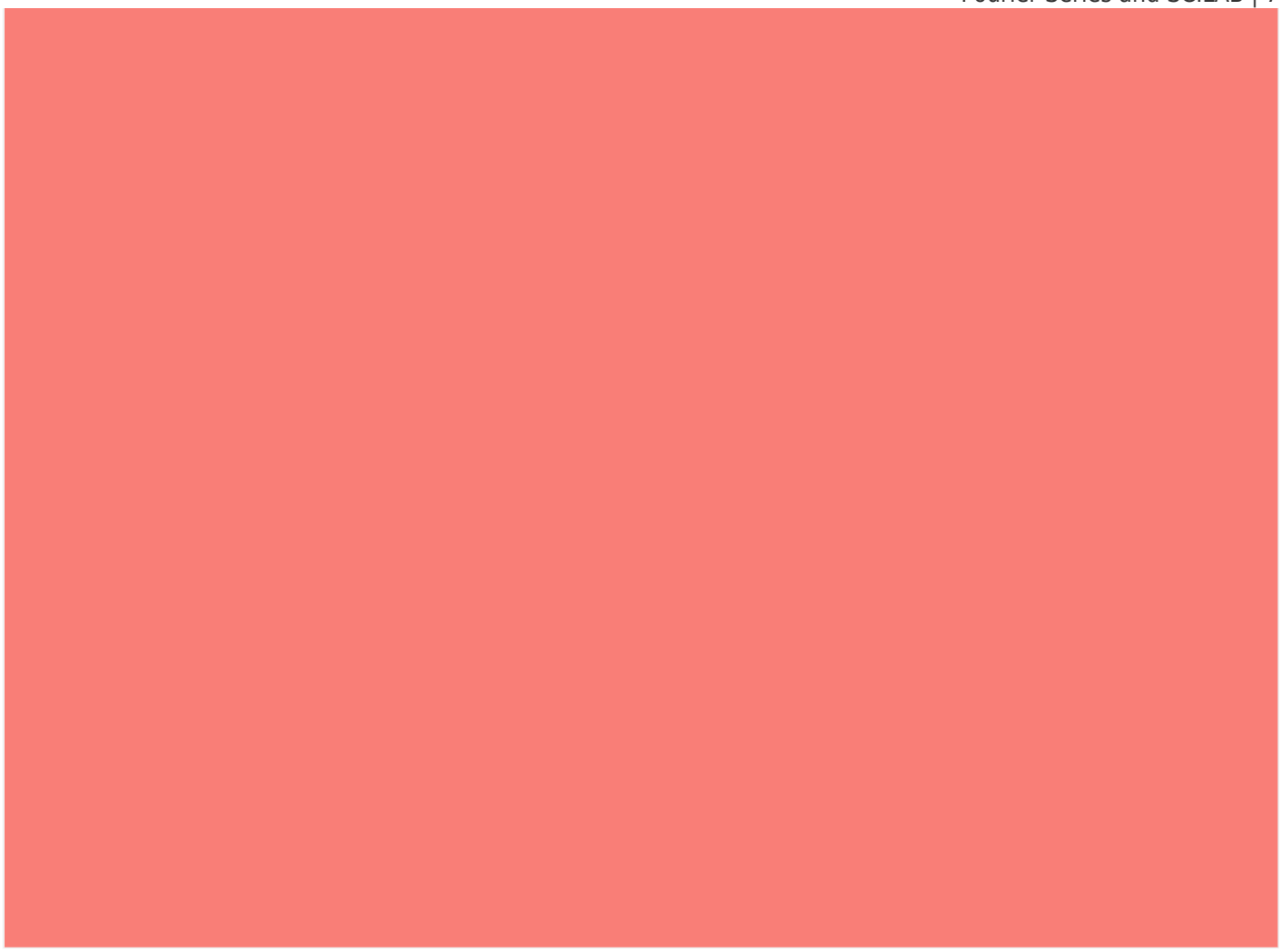
Manas Sharma

I’m a physicist specializing in computational material science with a PhD in Physics from Friedrich-Schiller University Jena, Germany. I write efficient codes for simulating light-matter interactions at atomic scales. I like to develop Physics, DFT, and Machine Learning related apps and software from time to time. Can code in most of the popular languages. I like to share my knowledge in Physics and applications using this Blog and a YouTube channel.









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