While working on Fourier Series or some other Mathematical Problem, you might sometime have to work with Periodic Functions.

Periodic Functions are those that give the same value after a particular period.
So we will use this definition to define a periodic function in PYTHON.

Let's say that there is a function *f(x)* which is defined in the interval [li,lf] and is periodic with a period of *T=lf-li*.

Then the function should have the same value at: *f(x), f(x+T), f(x+2*T), ...*

i.e. *f(x)=f(x+T)=f(x+2*T)=*..... since period=T.

But I said that the function is defined only in the interval [li,lf]. So how is the computer supposed to calculate it's value at x>lf?
That's easy. Since the value of the function at *f(x+T)* is simply *f(x)*, therefore we can generalize that whenever *x>lf*: then,
f(x)=f(x-T). Note: We have to keep taking *x* back by *T i.e (x-T)* until it lies within [li,lf] where the function is well-defined.

Similarly what about the value of function at *x* less than *(li)* cause the function is not defined for values less than (li)?
Again, this time we use:*f(x)=f(x+T)*. Note: We keep translating *x* forward by *T i.e (x+T)* until it lies within [li,lf] where the function is well-defined.

Using the above two arguments we can create a function which will make any given function defined within [li,lf] and with a period T a periodic function.

Here is the code for that:

```
# Function that will convert any given function 'f' defined in a given range '[li,lf]'
to a periodic function of period 'lf-li'
def periodicf(li,lf,f,x):
    if x>=li and x<=lf :
        return f(x)
    elif x>lf:
        x_new=x-(lf-li)
        return periodicf(li,lf,f,x_new)
    elif x<(li):
        x_new=x+(lf-li)
        return periodicf(li,lf,f,x_new)
```

In the above code I have created a function 'periodicf' which takes as arguments the limits [li,lf] for which the function 'f' (third argument) is originally defined and the fourth argument is the value of x at which I want the value of 'f'.

The above code assumes the function to be defined within [li,lf] therefore the function's starting point is (li). However, if you want to create a function that is defined in a different manner then you will have to define 'f' correspondingly.

Following is a program which you can use to define various periodic functions such as sawtooth wave, cycloids, square wave, and triangular wave.

```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.pyplot import *
```

```
fig = figure(figsize=(8, 8), dpi=120)



# Function that will convert any given function 'f' defined in a given range '[li,lf]'
to a periodic function of period 'lf-li'
def periodicf(li,lf,f,x):
    if x>=li and x<=lf :
        return f(x)
    elif x>lf:
        x_new=x-(lf-li)
        return periodicf(li,lf,f,x_new)
    elif x<(li):
        x_new=x+(lf-li)
        return periodicf(li,lf,f,x_new)

# The periodic version of sawtooth function
def sawtoothP(li,lf,x):
    return periodicf(li,lf,sawtooth,x)

# Non-periodic sawtooth function defined for a range [-l,l]
def sawtooth(x):
    return x

# The periodic version of square function
def squareP(li,lf,x):
    return periodicf(li,lf,square,x)

# Non-periodic square wave function defined for a range [-l,l]
def square(x):
    if x>0:
        return 5
    else:
        return 0

# The periodic version of triangle function
def triangleP(li,lf,x):
    return periodicf(li,lf,triangle,x)

# Non-periodic triangle wave function defined for a range [-l,l]
def triangle(x):
    if x>0:
        return x
    else:
        return -x

# The periodic version of cycloid function
def cycloidP(li,lf,x):
    return periodicf(li,lf,cycloid,x)

# Non-periodic cycloid wave function defined for a range [-l,l]
def cycloid(x):
```

```
    return np.sqrt(5**2-x**2)



if __name__ == "__main__":


    # plt.style.use('dark_background')
    plt.style.use('seaborn')
    plt.title('Periodic functions\nCycloid')


    li = -5
    lf = 5
    step_size = 0.05

    x_l = -20
    x_u = 50

    x = np.arange(x_l,x_u,step_size)
    y1 = [sawtoothP(li,lf,xi) for xi in x]
    y2 = [squareP(li,lf,xi) for xi in x]
    y3 = [triangleP(li,lf,xi) for xi in x]
    y4 = [cycloidP(li,lf,xi) for xi in x]

    x_plot =[]
    y_plot1 = []
    y_plot2 = []
    y_plot3 = []
    y_plot4 = []

    x_l_plot = x_l - 15
    x_u_plot = x_l_plot + 20
    plt.xlim(x_l_plot,x_u_plot)
    plt.ylim(-6,7)

    for i in range(x.size):
        x_plot.append(x[i])
        y_plot1.append(y1[i])
        y_plot2.append(y2[i])
        y_plot3.append(y3[i])
        y_plot4.append(y4[i])
        #Sawtooth
        plt.plot(x_plot,y_plot1,c='darkkhaki')
        #Square
        plt.plot(x_plot,y_plot2,c='tomato')
        #Triangular
        plt.plot(x_plot,y_plot3,c='orange')
        #Cycloid
        plt.plot(x_plot,y_plot4,c='slateblue')
        x_l_plot = x_l_plot + step_size
        x_u_plot = x_u_plot + step_size
```

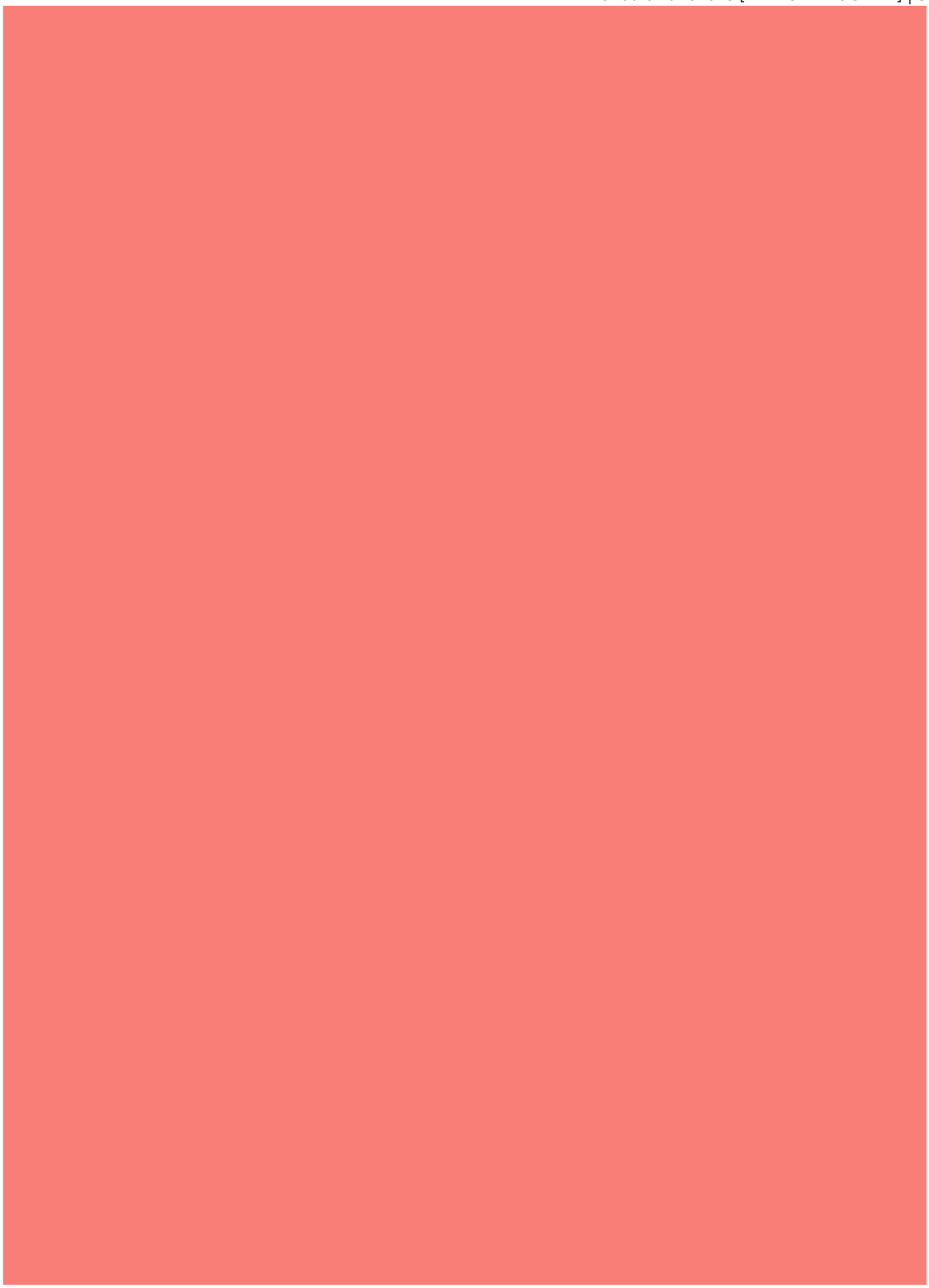
```
        plt.xlim(x_l_plot,x_u_plot)
        plt.pause(0.1)
    plt.show()
```

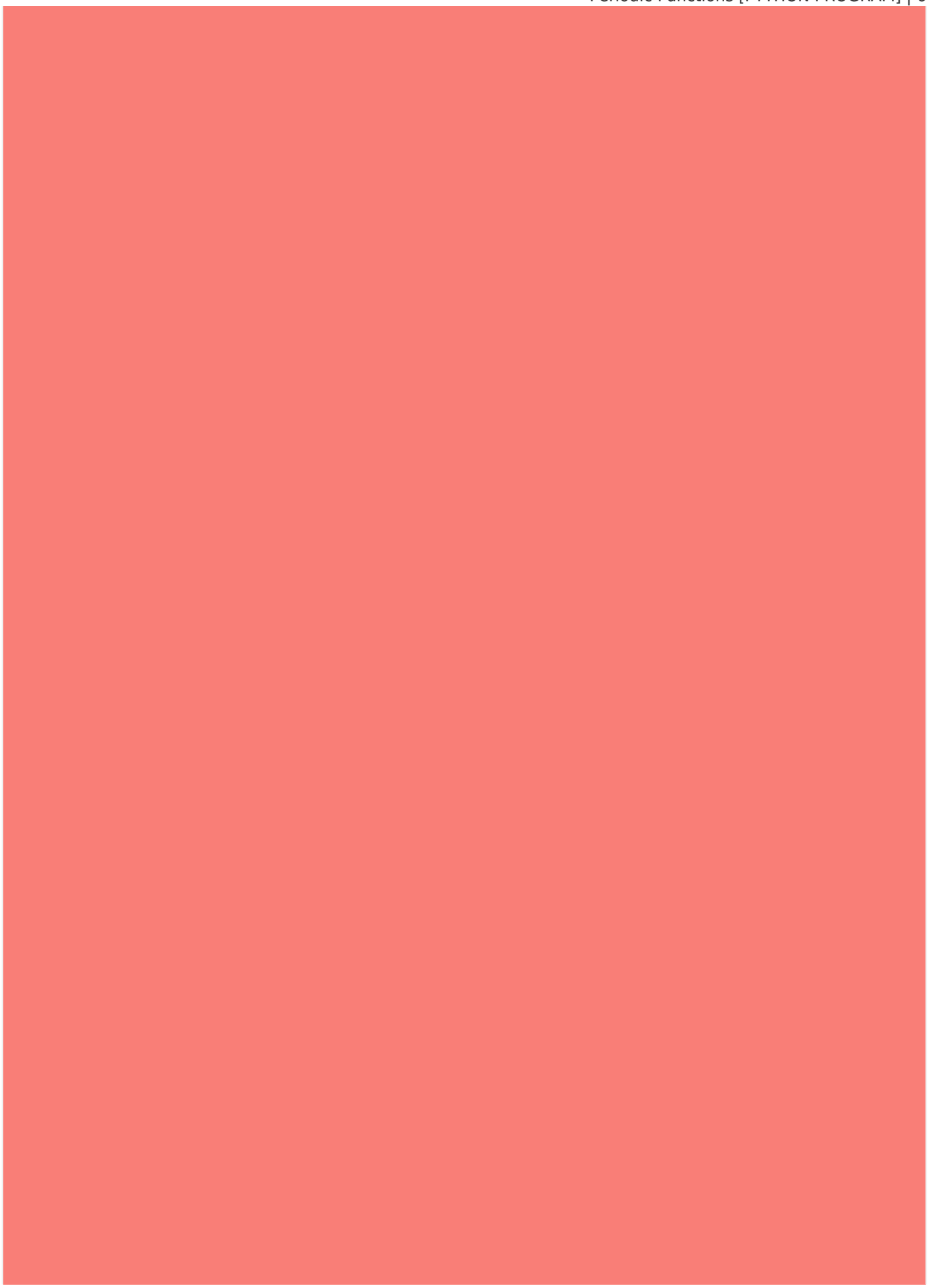
OUTPUT

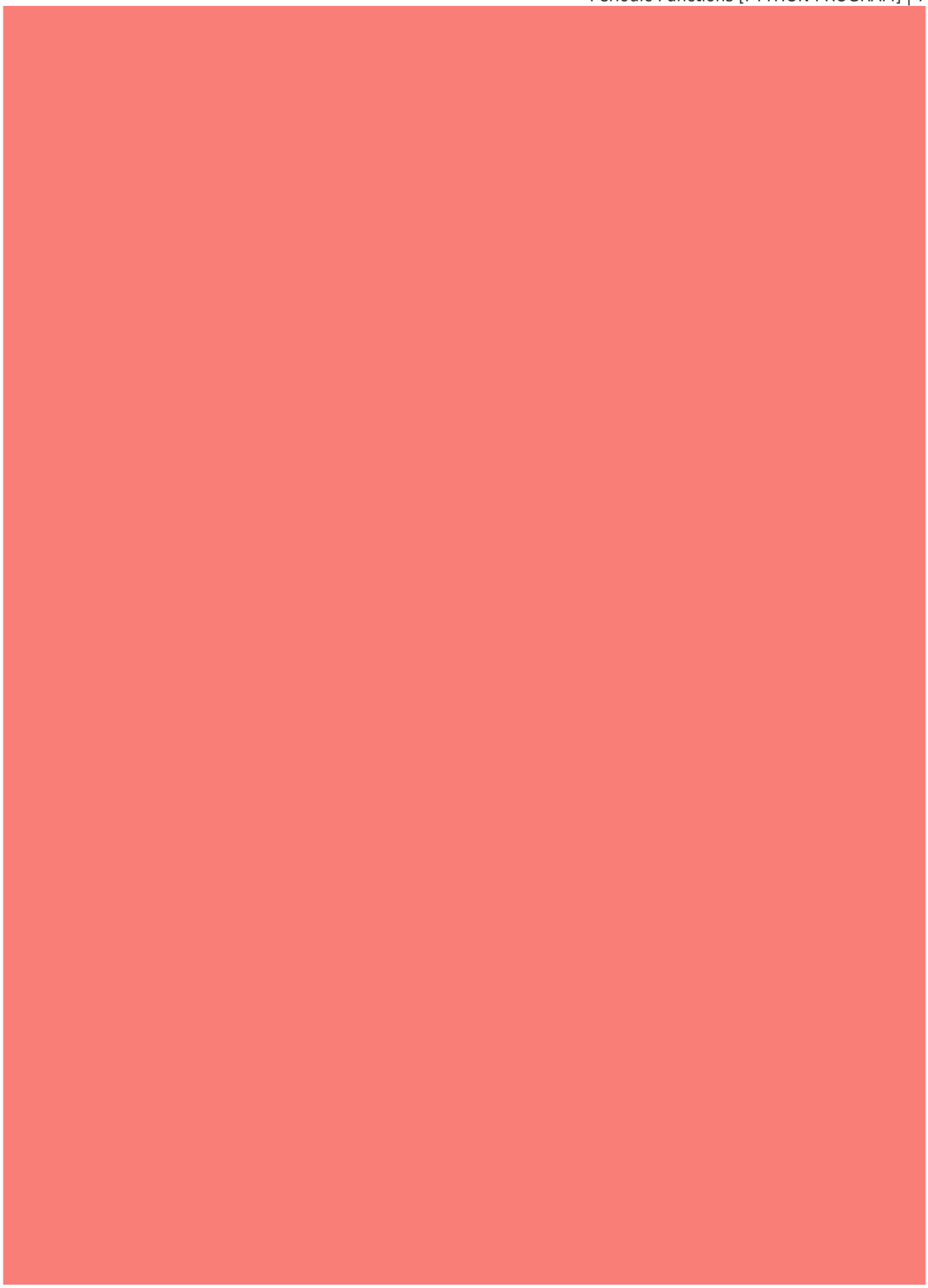
Manas Sharma

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.

manas.bragitoff.com/







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