CENTRO DE INVESTIGACIÓN Y DE ESTUDIOS AVANZADOS DEL IPN
UNIDAD TAMAULIPAS

Assignment #2

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Course: *Introducción al Análisis de Fourier (Sep - Dec 2022)*
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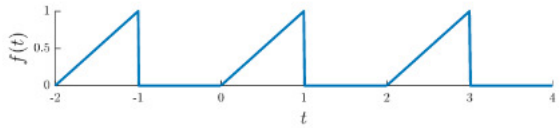
Transformada de Fourier

1. Función 1:

$$f(t) = \begin{cases} +1, & -2 < t < -1 \\ -1, & 1 < t < 2 \\ 0, & otro\ caso \end{cases}$$



$p = \frac{T}{2} = \frac{2}{2} = 1$

$$a_0 = \frac{1}{p}\int_{-p}^{p} f(t)\,dt = 1\int_{-1}^{0} 0dt + \int_{0}^{1} tdt = \frac{t^2}{2}\Big|_0^1 = \frac{1}{2}$$

$$a_n = \frac{1}{p}\int_{-p}^{p} f(t)cos(\frac{nt\pi}{p})dt =$$

$$= 1\left[\int_{-1}^{0} 0 * cos(\frac{nt\pi}{1})dt + \int_{0}^{1} t * cos(\frac{nt\pi}{1})dt\right] =$$

$$1\left[\int_{0}^{1} t * cos(nt\pi)dt\right] =$$

resolviendo la integral por partes: $u = t$; $du = dt$; $dv = cos(nt\pi)$; $v = \frac{1}{n\pi}sen(nt\pi)$

$$\frac{t * sen(nt\pi)}{n\pi}\Big|_0^1 - \int \frac{1}{n\pi} * sen(nt\pi)dt =$$

$$\frac{1}{(n\pi)^2}\left[nt\pi * sen(n\pi) + cos(n\pi) - 1\right] =$$

$$\frac{cos(n\pi) - 1}{(n\pi)^2} =$$

$$a_n = \frac{(-1)^n - 1}{(n\pi)^2}$$

. . . . . .

$$b_n = \frac{1}{p}\int_{-p}^{p} f(t)sen(\frac{nt\pi}{p})dt =$$

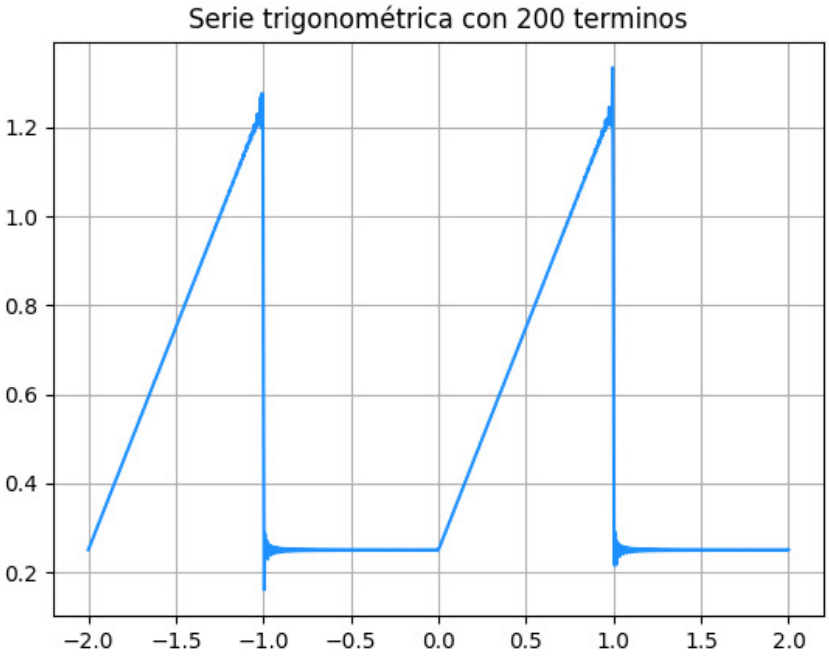
$$= 1\left[\int_{-1}^{0} 0 * sen(\frac{nt\pi}{1})dt + \int_{0}^{1} t * sen(\frac{nt\pi}{1})dt\right] =$$

$$1\left[\int_{0}^{1} t * sen(nt\pi)dt\right] =$$

resolviendo la integral por partes: $u = t$; $du = dt$; $dv = sen(nt\pi)$; $v = \frac{-1}{n\pi}cos(nt\pi)$

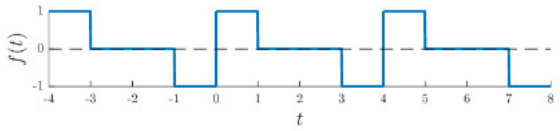
$$\frac{-t * cos(nt\pi)}{n\pi}\Big|_0^1 - \int \frac{-1}{n\pi} * cos(nt\pi)dt = \frac{sen(n\pi) - n\pi * cos(n\pi)}{(n\pi)^2} = \frac{(-1)^n * -n\pi}{(n\pi)^2}$$

Transformada de Fourier



2. Función 2:

$$f(t) = \begin{cases} t, & 0 < t < 1 \\ 0, & otro\ caso \end{cases}$$



$p = \frac{T}{2} = \frac{4}{2} = 2$

$$a_0 = \frac{1}{p}\int_{-p}^{p} f(t)\,dt = \frac{1}{2}\int_{-2}^{-1} 0dt + \int_{-1}^{0} -1dt + \int_{0}^{1} 1dt + \int_{1}^{2} 0dt = -1 + 1 = 0$$

$$a_n = \frac{1}{p}\int_{-p}^{p} f(t)cos(\frac{nt\pi}{p})dt =$$

$$\frac{1}{2}\int_{-2}^{2} f(t)cos(\frac{nt\pi}{2})dt =$$

$$\frac{1}{2}\int_{-2}^{1} 0 * cos(\frac{nt\pi}{2})dt + \int_{-1}^{0} -1 * cos(\frac{nt\pi}{2})dt + \int_{0}^{1} 1 * cos(\frac{nt\pi}{2})dt + \int_{1}^{2} 0 * cos(\frac{nt\pi}{2})dt =$$

$$\frac{2 * sen(\frac{nt\pi}{2})}{n\pi} - \frac{2 * sen(\frac{n\pi}{2})}{n\pi} = 0$$

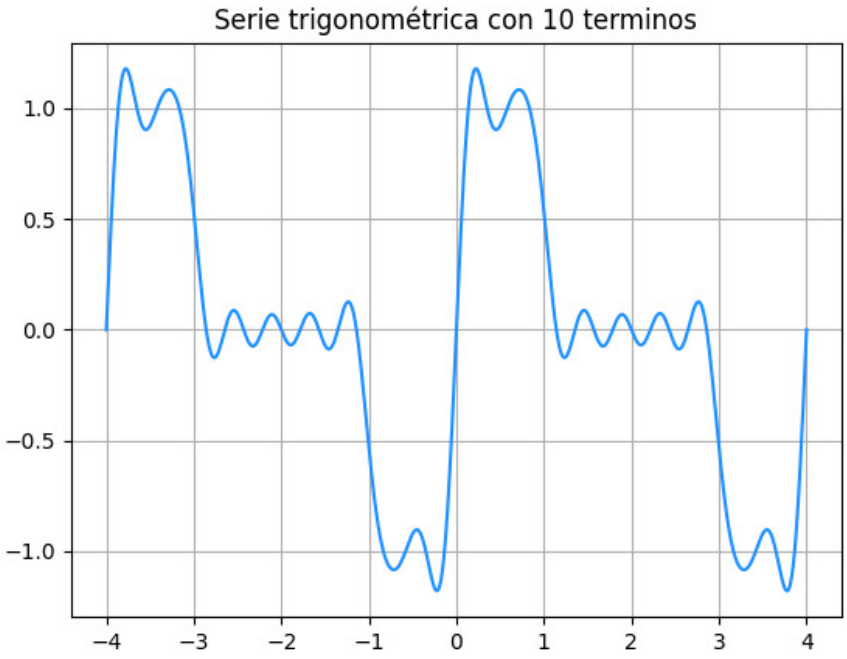
$$b_n = \frac{1}{p}\int_{-p}^{p} f(t)sen(\frac{nt\pi}{p})dt =$$

$$\frac{1}{2}\int_{-2}^{2} f(t)sen(\frac{nt\pi}{2})dt =$$

$$\frac{1}{2}\int_{-2}^{1} 0 * sen(\frac{nt\pi}{2})dt + \int_{-1}^{0} -1 * sen(\frac{nt\pi}{2})dt + \int_{0}^{1} 1 * sen(\frac{nt\pi}{2})dt + \int_{1}^{2} 0 * sen(\frac{nt\pi}{2})dt =$$

$$b_n = \frac{4 * sen^2(\frac{n\pi}{4})}{n\pi}$$

Serie trigonométrica de Fourier



Código python

Con uso de las librerias

```
import numpy as np
import math
import matplotlib.pyplot as plt
```

Coeficiente a_n

```
def an(n):
    n=int(n)
    return (pow(-1,n)-1)/pow(n*np.pi,2) #funcion1
    #return 0 #funcion3
```

Coeficiente b_n

```
def bn(n):
    n = int(n)
    return ((-n*np.pi)*pow(-1,n))/pow(n*np.pi,2) #funcion1
    #return (4*((math.sin((np.pi*n)/4))**2))/(np.pi*n)#funcion3
```

Coeficiente w_n

```
def wn(n):
    global T
    wn = (2*np.pi*n)/T
    return wn
```

Serie de Fourier

```
def serie_fourier(armonico,x):

    a0 = 1/2 #funcion1
    #a0 = 0 #funcion3
    sumas = a0

    for n in range(1,armonico):
        try:
            sumas = sumas + an(n)*np.cos(wn(n)*x) + bn(n)*np.sin(wn(n)*x)
        except Exception as e:
            print(e)
            pass

    return sumas
```