extra hw 5

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One of the continuous, nowhere-differentiable functions is the Weierstrass function. This function is defined as

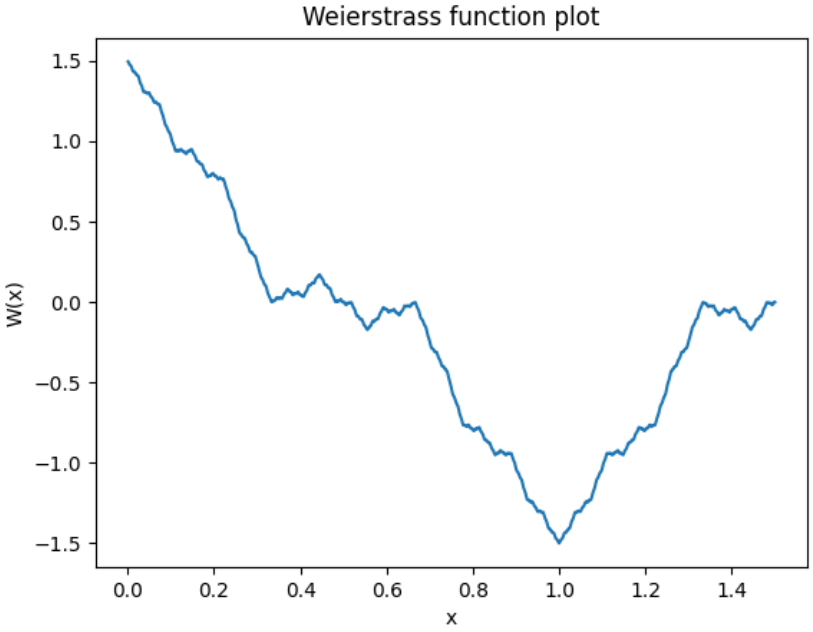
$$W(x) = \sum_{n=0}^{\infty} a^n \cos\left(b^n \pi x\right), \text{ where } a = \frac{1}{3} \text{ and } b = 3$$

(the value of a determines the amplitude of the cosine waves, and the value of b determines the frequency of the cosine waves).

The graph of the Weierstrass function is a fractal. This means that if you zoom in on any part of the graph, it will look like the original graph.

The Weierstrass function is also nowhere differentiable. This means that its derivative does not exist at any point. This is because the function is so wiggly and jagged that it is impossible to draw a tangent line to it at any point.

To represent it, let us take the step $\frac{1}{1000}$ between elements and take the first 1500 elements. Then the graph should look like the one below:



```python
import matplotlib.pyplot as plt
import math


1 usage  new *
def W(x: float) -> float:
    a = 1  # a initialized with 1
    b = 1  # b initialized with 1
    s = 0  # sum initialized with 0
    n = 100  # number of terms

    for i in range(n):
        s += a * math.cos(b * math.pi * x)
        a /= 3
        b *= 3
    return s


indexes = []
crt = 1/1000
for i in range(1500):
    indexes.append(crt)
    crt += 1/1000


ImW = []
for x in indexes:
    ImW.append(W(x))

plt.plot( *args: indexes, ImW)
plt.title("Weierstrass function plot")
plt.xlabel("x")
plt.ylabel("W(x)")
plt.show()
```