Project Report
FRACTALS

(Dimension of outline of maps of india and the UK)

Introduction:

What is a Fractal?

- A **Fractal** is a geometric shape containing detailed structure at arbitrarily small scales, usually having a fractal dimension strictly exceeding the topological dimension.
- The classic question "How long is the coastline of a country?" was posed by **Benoît B Mandelbrot** in 1967 who is father of fractals, revealing that natural coastlines do not have a fixed length but rather a fractal dimension between 1 and 2
- India's coastline, stretching over 7,500 km. This project aims to find the fractal dimension of India's boundary using image analysis and Python programming.

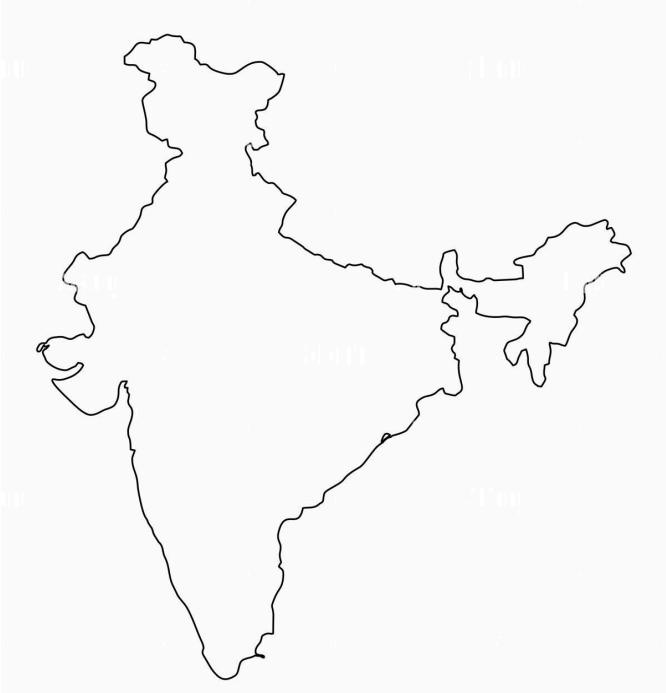
Counting dimension of fractal

Algorithm:

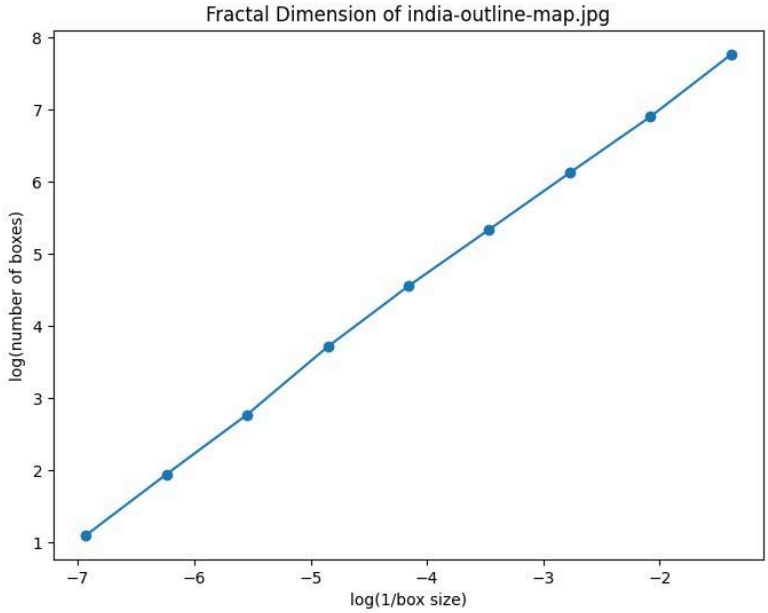
- The image was divided into non-overlapping squares (boxes) of size $k \times k$.
- For each box size, we counted how many boxes contained part of the coastline ($N(k)$).
- This process was repeated for multiple box sizes.
- $\log(N(k)) = d \log(1/k) + \log(c)$, where d is the dimension required.
- The slope of $\log(N(k))$ vs $\log(1/k)$ is required and has been plotted by code

For **INDIA**

Outline used:



Plot obtained through code:

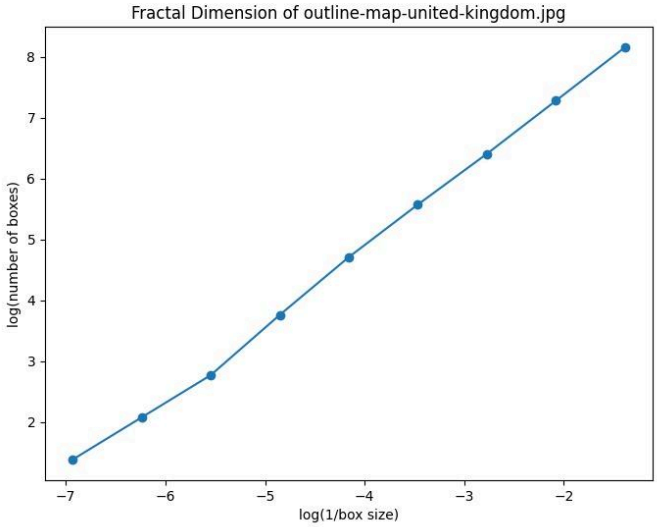


Dimension of outline of INDIA found from plot is **1.1988**

For the **United Kingdom**

Outline used:

Plot obtained through code:



Dimension of outline of UK found from plot is **1.2441**

Conclusion:

- Fractals can be found commonly in nature and outlines of countries are an example
- The outlines of India and the United Kingdom form fractals and their dimensions are:
    - Estimated fractal dimension of outline of UK : 1.2441
    - Estimated fractal dimension of outline of INDIA: 1.1988