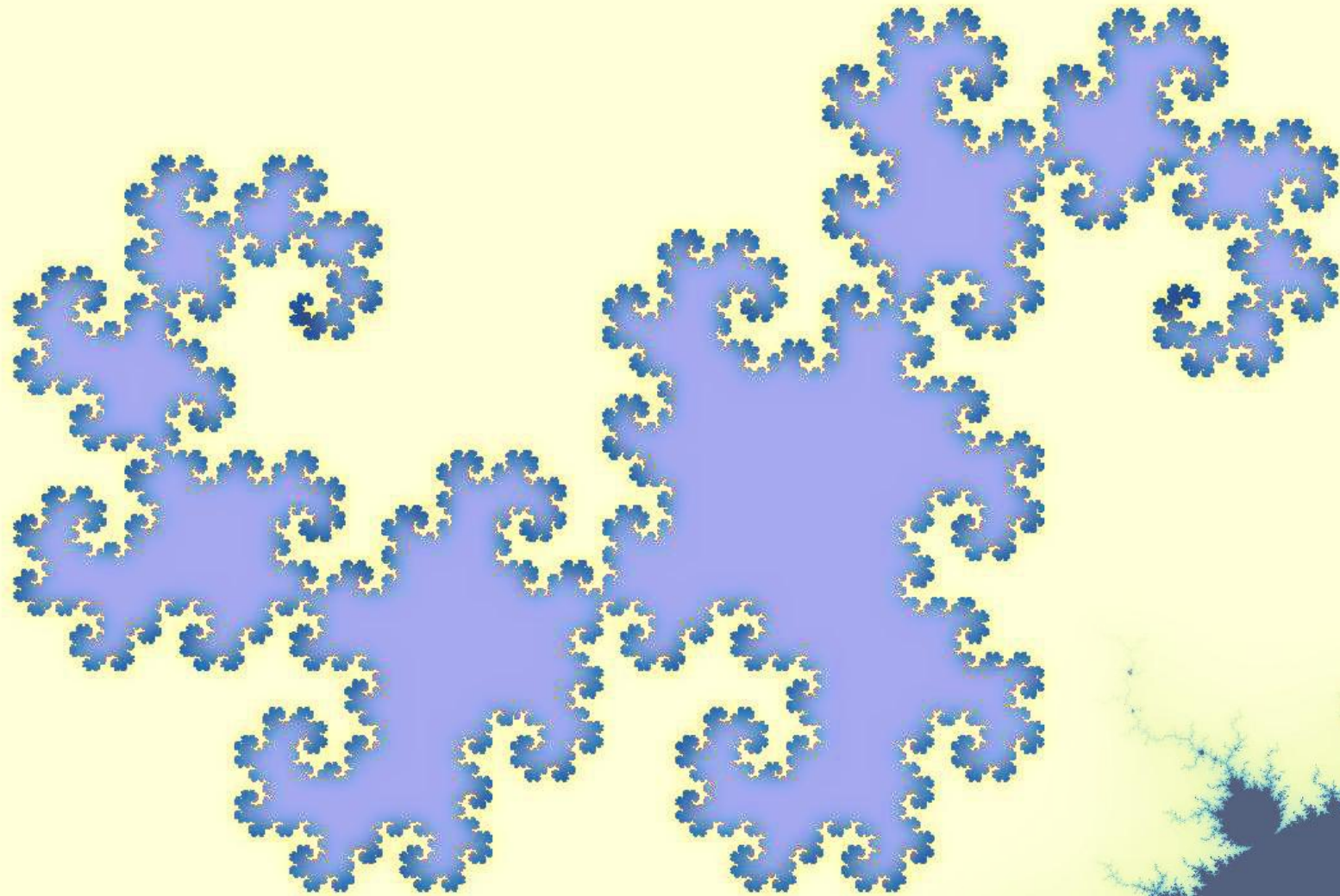


Fractalen



Bloemkool



Bloemkool



Bloemkool



Bloemkool



Wat zijn fractalen?

- Bestaat uit zelfgelykende delen
- Meetkundig complexe en fijne structuur
↔ Eenvoudig gedefinieerd

In het dagelijkse leven



In het dagelijkse leven



In het dagelijkse leven



In het dagelijkse leven



In het dagelijkse leven



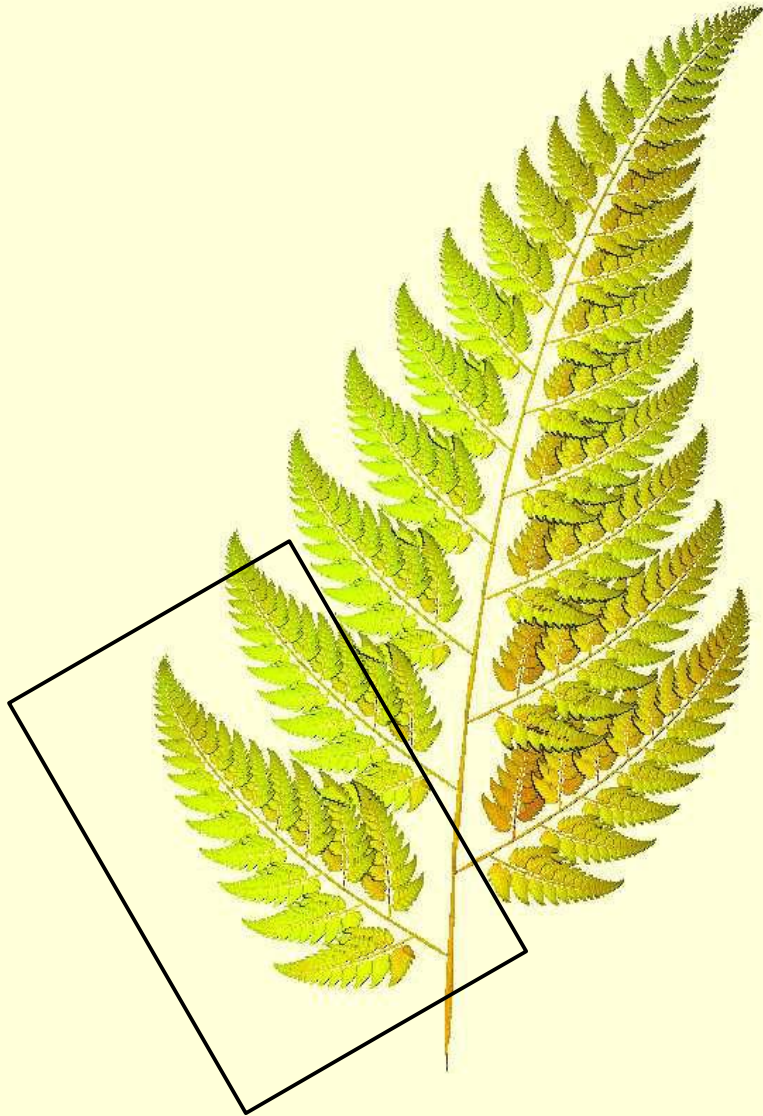
In het dagelijkse leven



In het dagelijkse leven



In de natuur



In de natuur



In de natuur



In de natuur



In de natuur



In de natuur



In de natuur



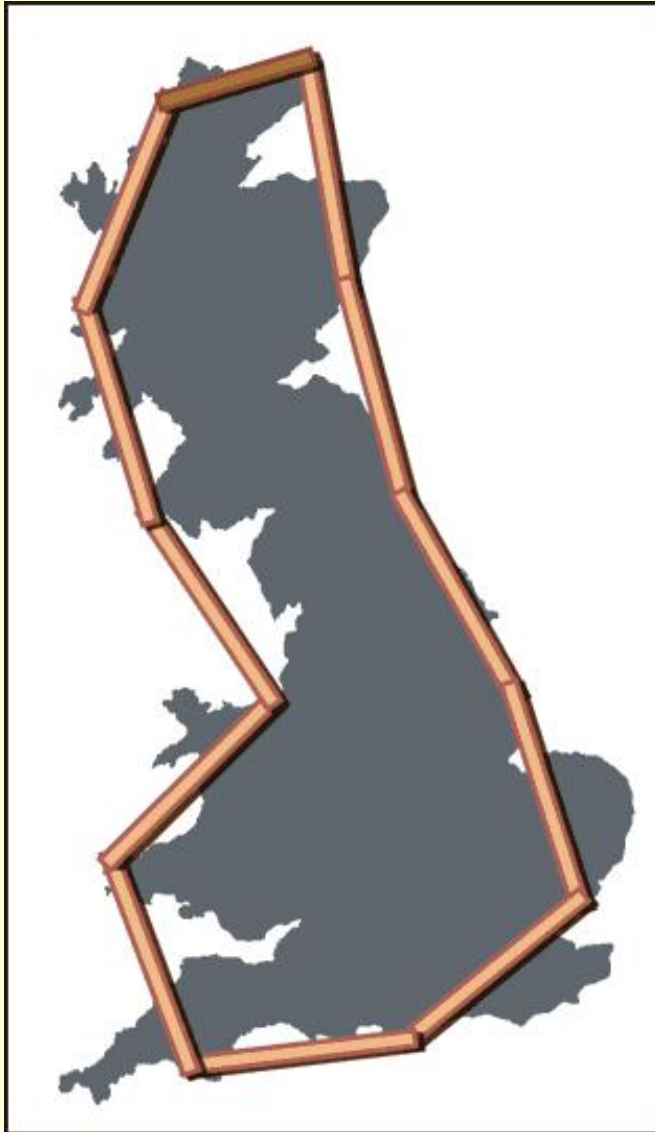
In de natuur



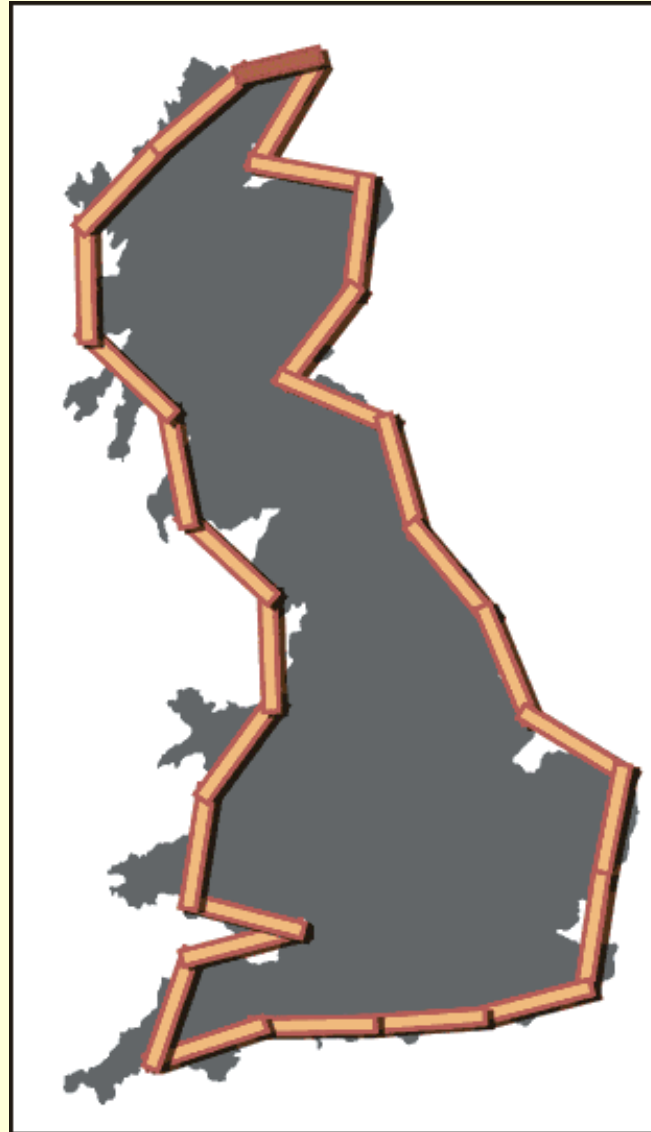
In de natuur



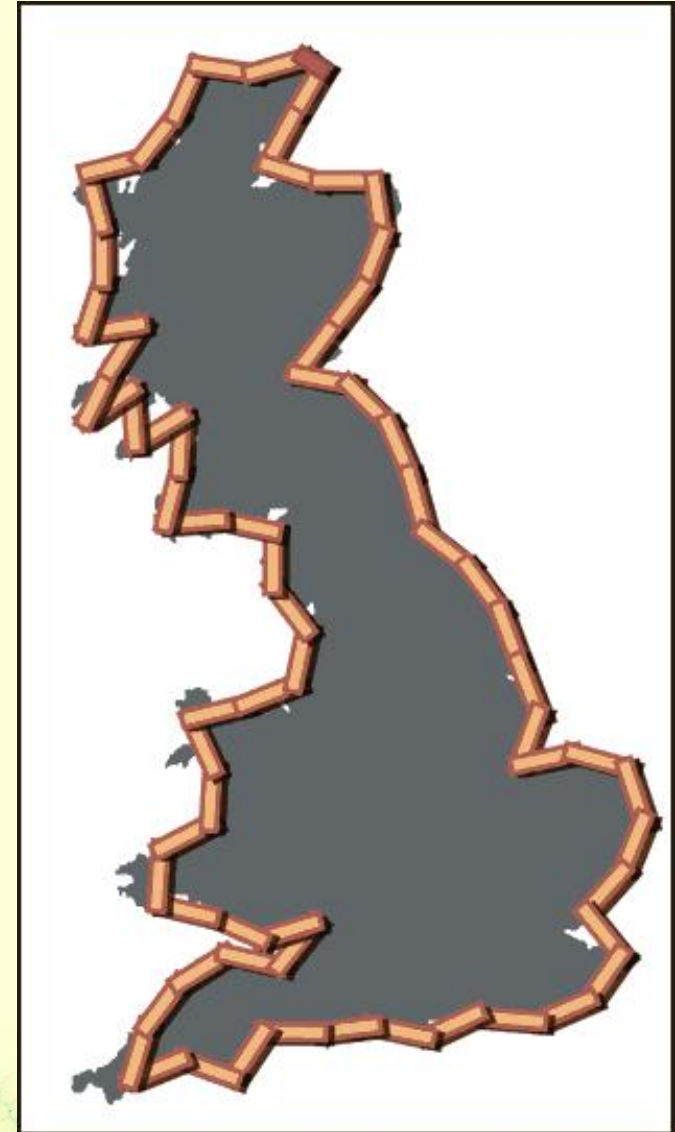
Meten van grenzen



PRIME

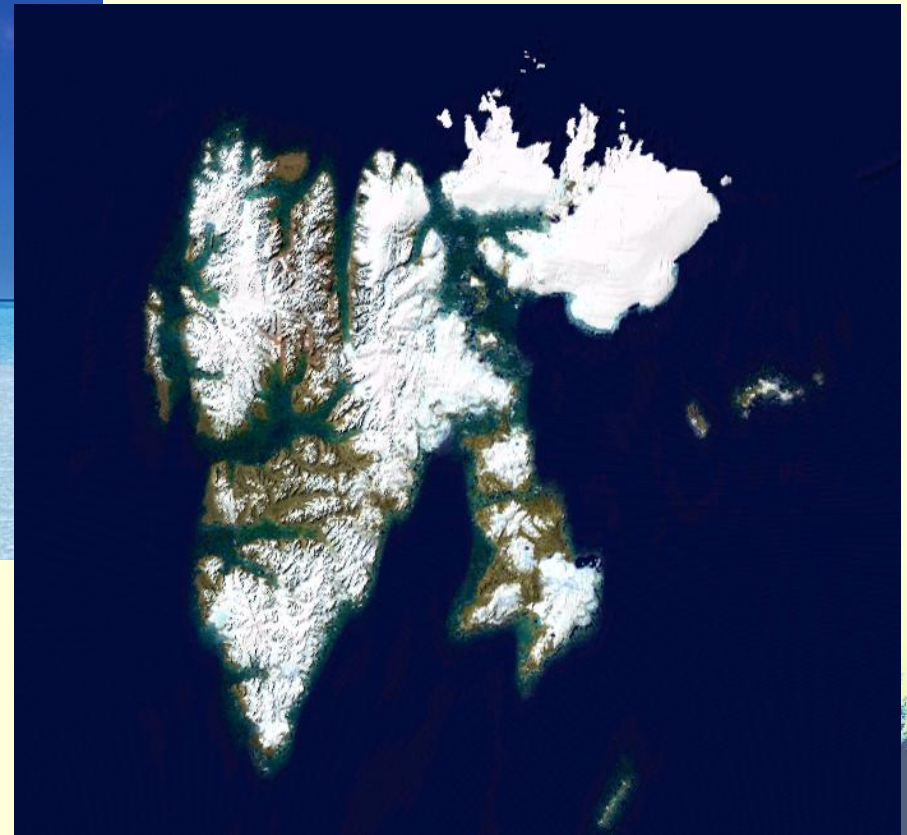


Fractalen

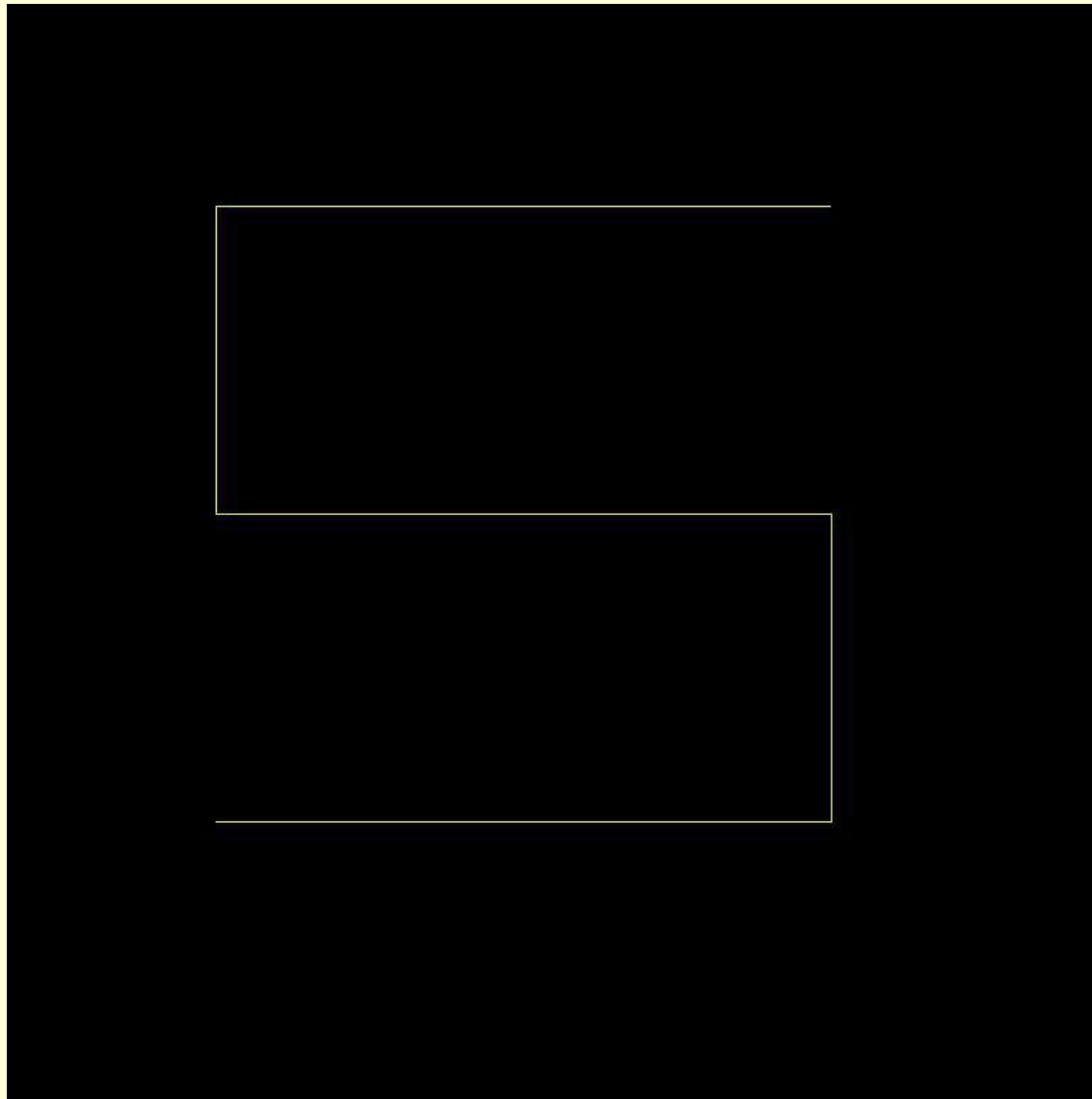


23/64

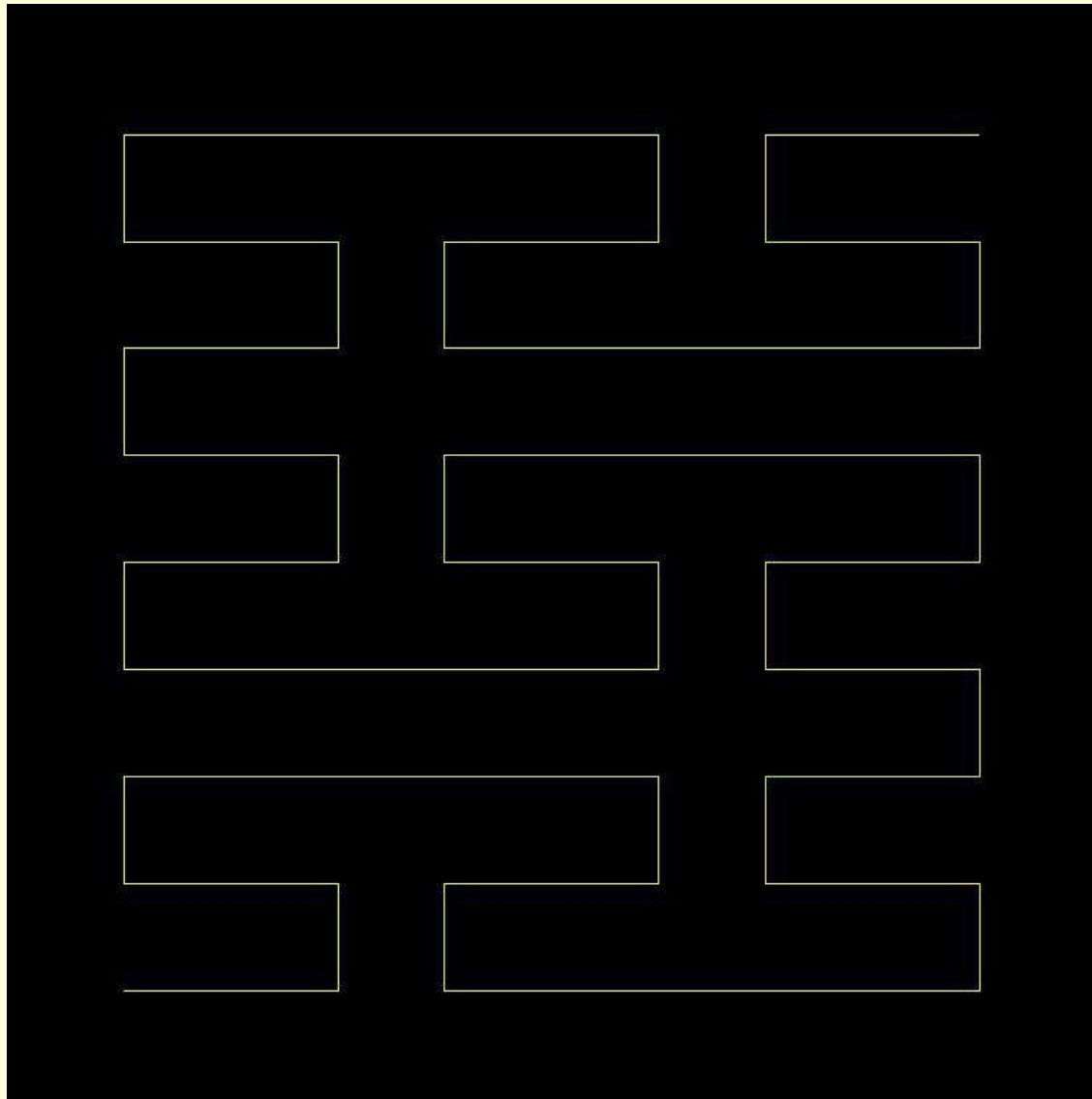
Meten van grenzen



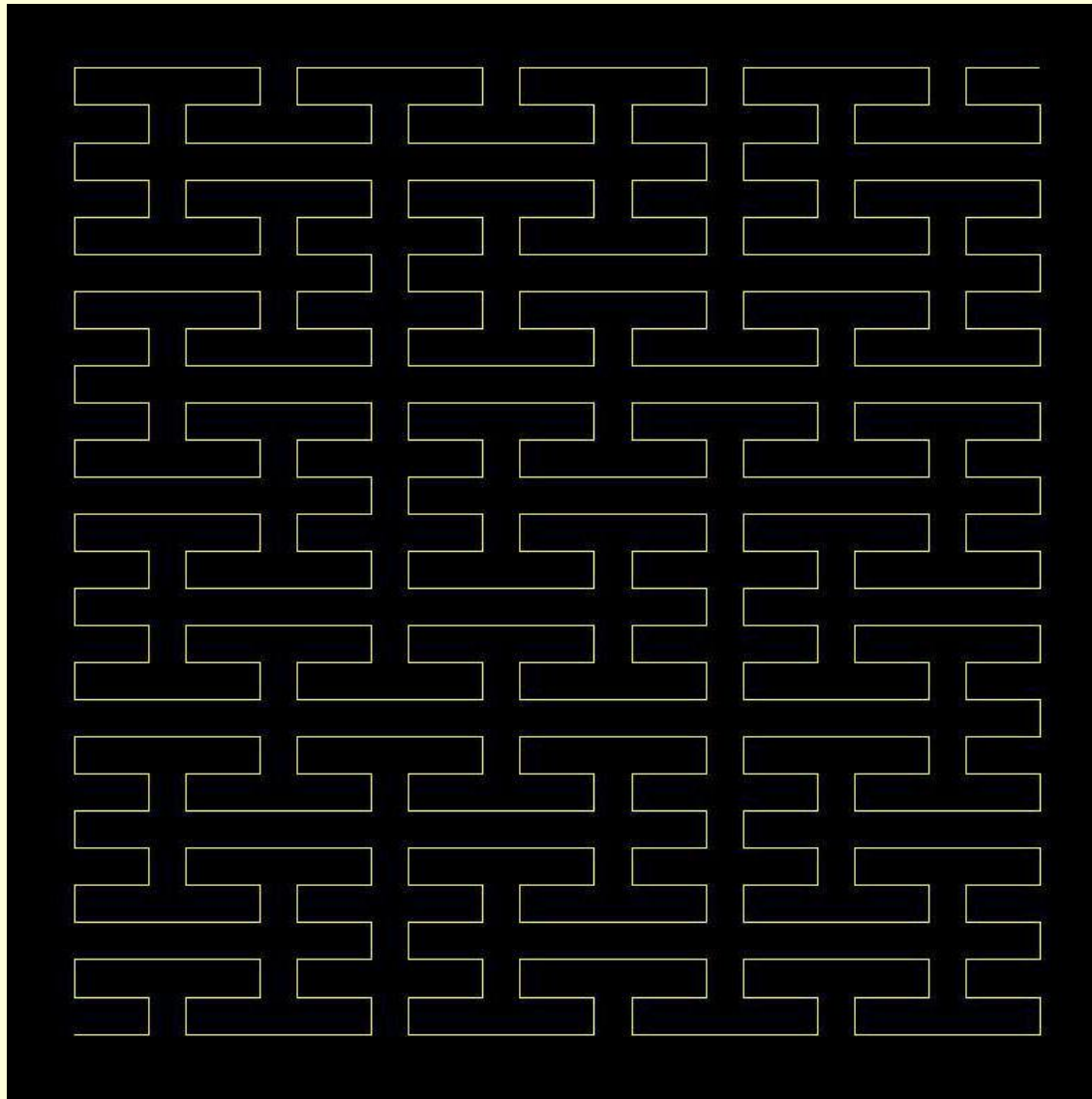
Vlakvullende kromme



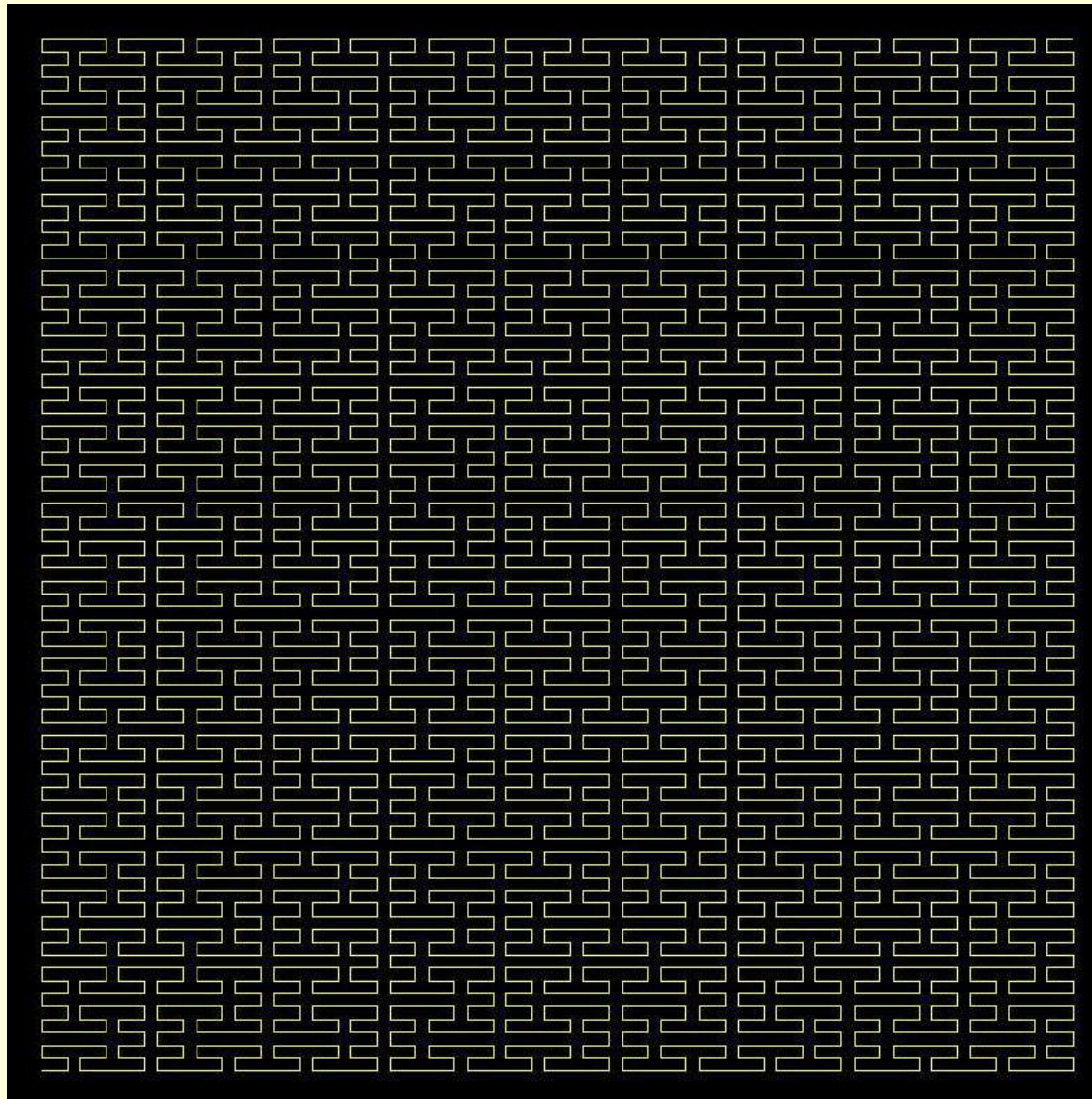
Vlakvullende kromme



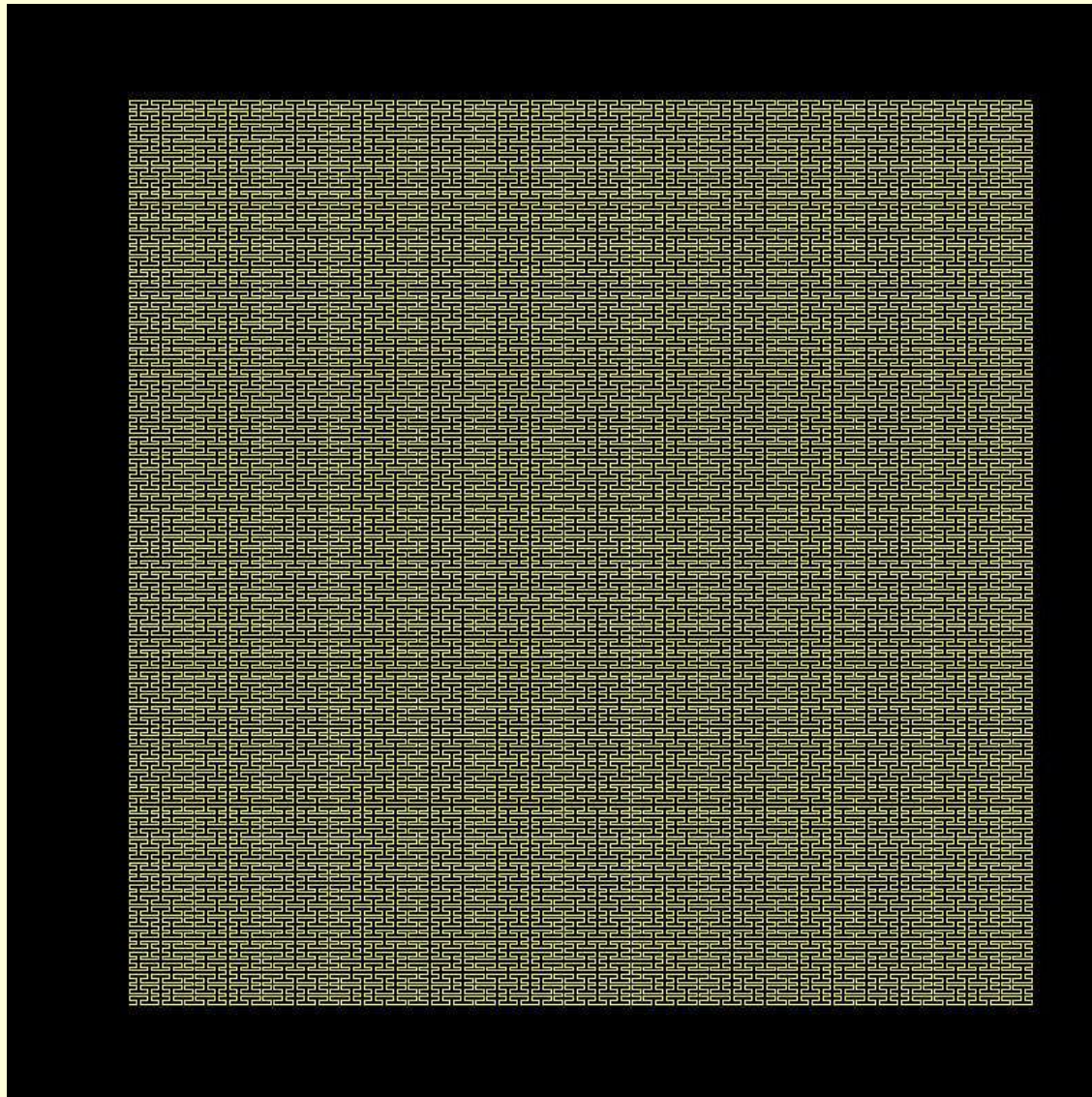
Flakvullende kromme



Vlakvullende kromme

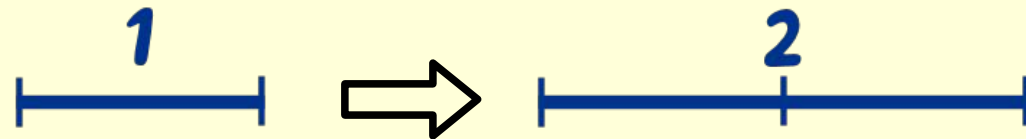


Vlakvullende kromme

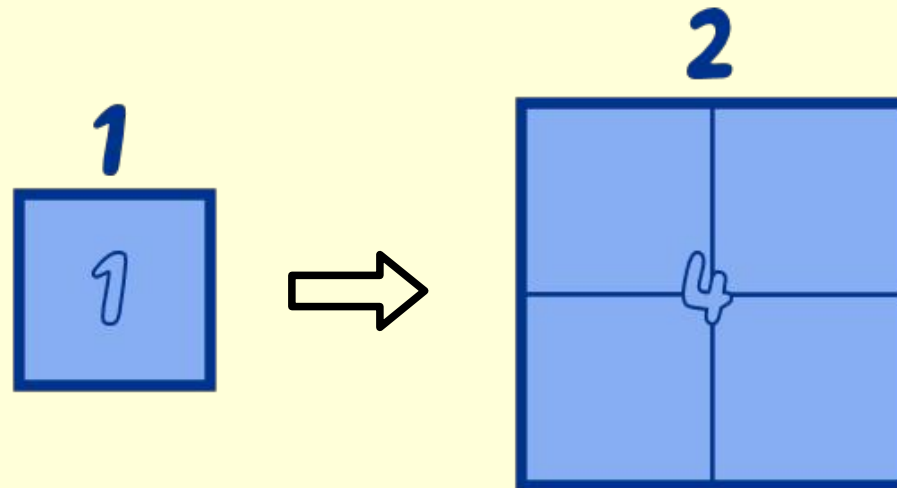


Hausdorffdimensie

- Lijnstuk: 2x 'zo groot' \Rightarrow 2x 'zo veel'



- Vierkant: 2x 'zo groot' \Rightarrow 4x 'zo veel'



Hausdorffdimensie

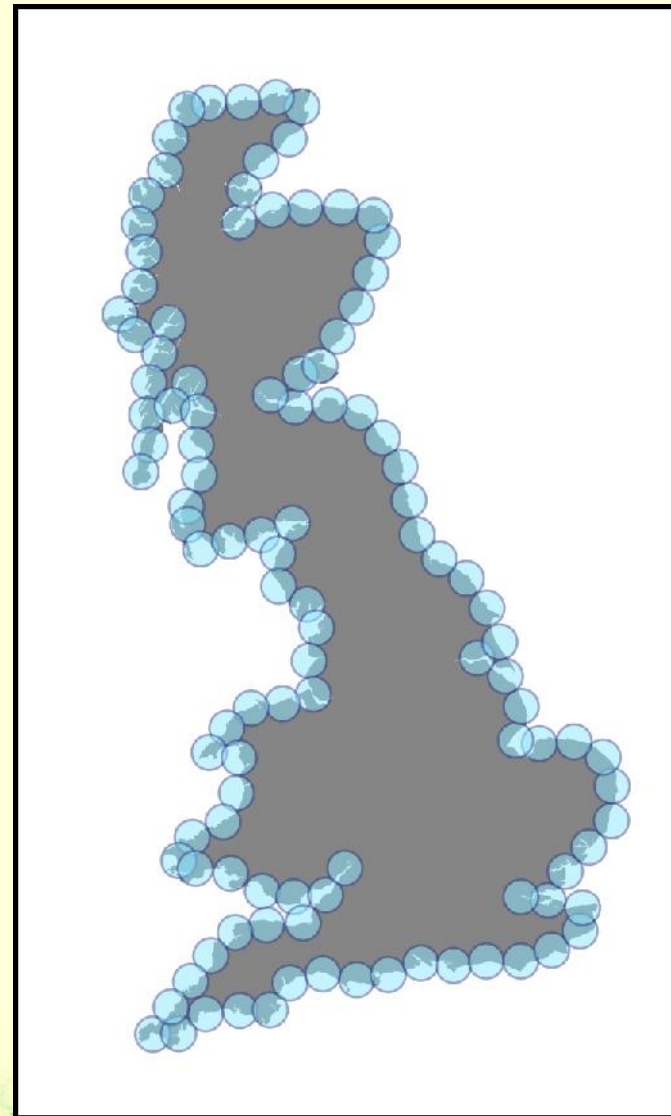
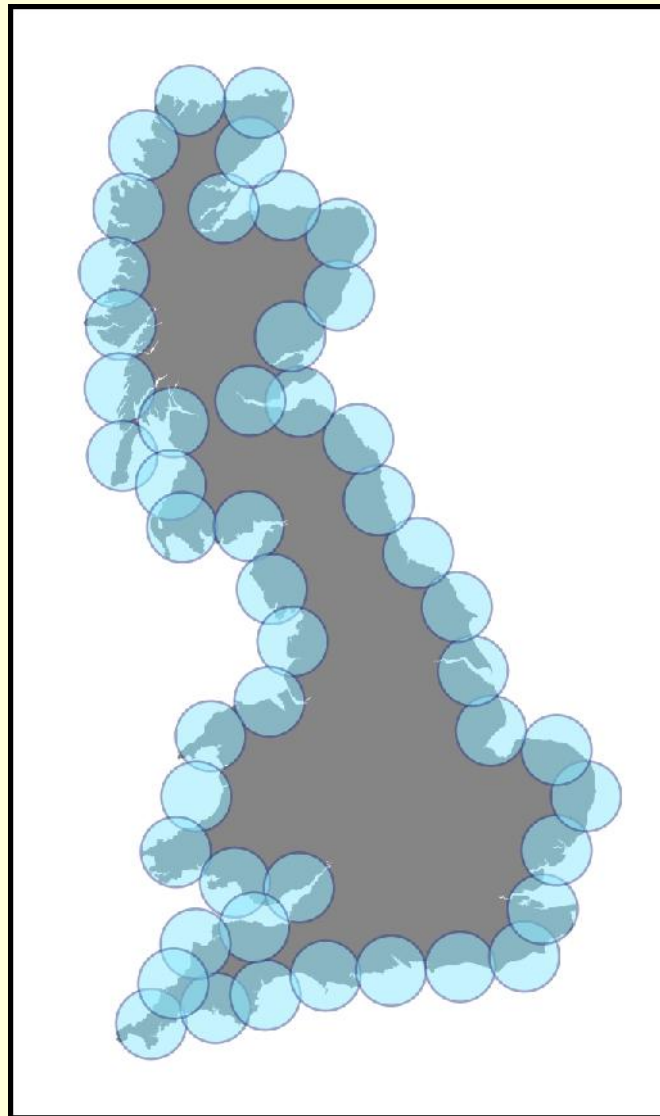
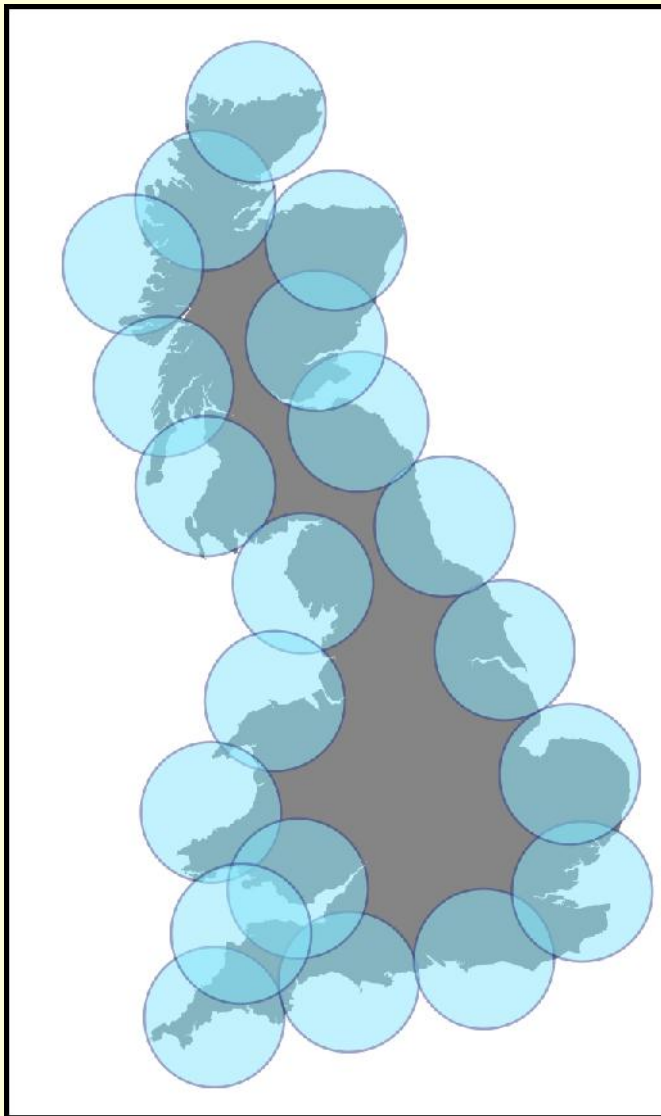
- N x 'zo groot' \Rightarrow N^d x 'zo veel'
dan: d-dimensionaal
- Maat voor 'dichtheid'
- Maat voor 'ruwheid'

Hausdorffdimensie

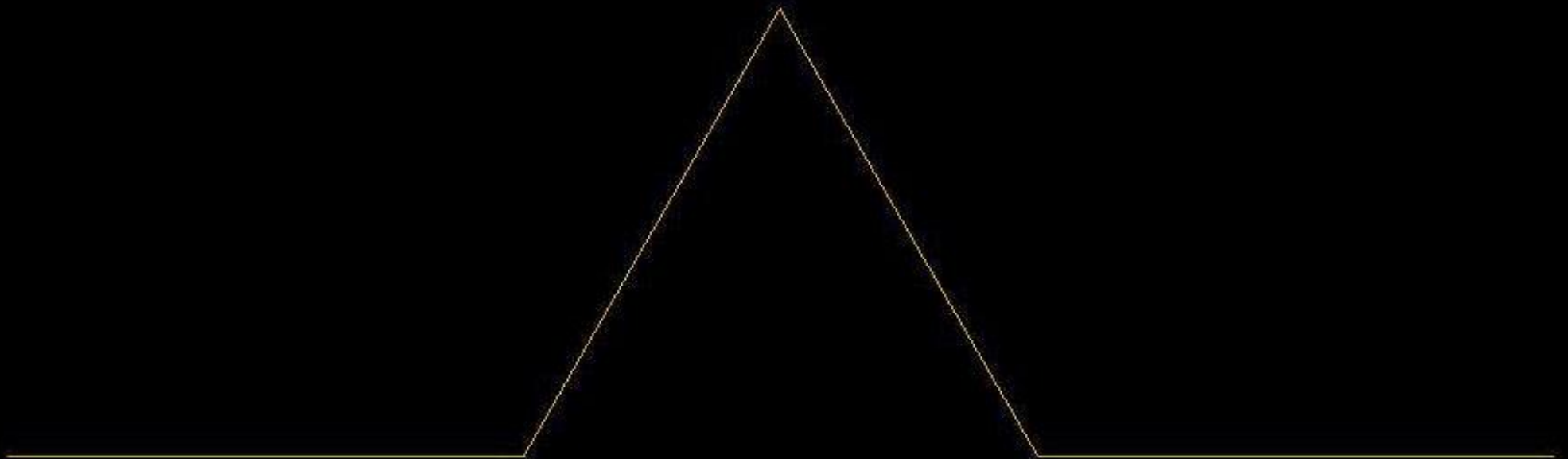
Exactere definitie

- $N(r)$: aantal bollen met straal r nodig om een object te overdekken.
- $d = -\lim_{r \rightarrow 0} \frac{\ln N(r)}{\ln r}$: de Hausdorffdimensie

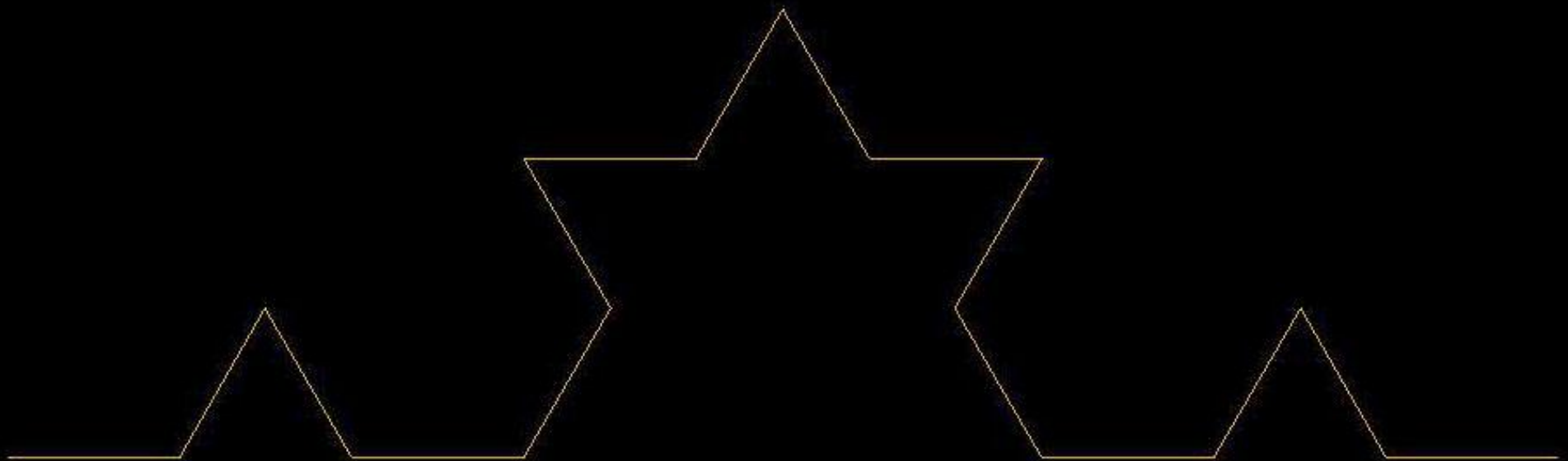
Hausdorffdimension



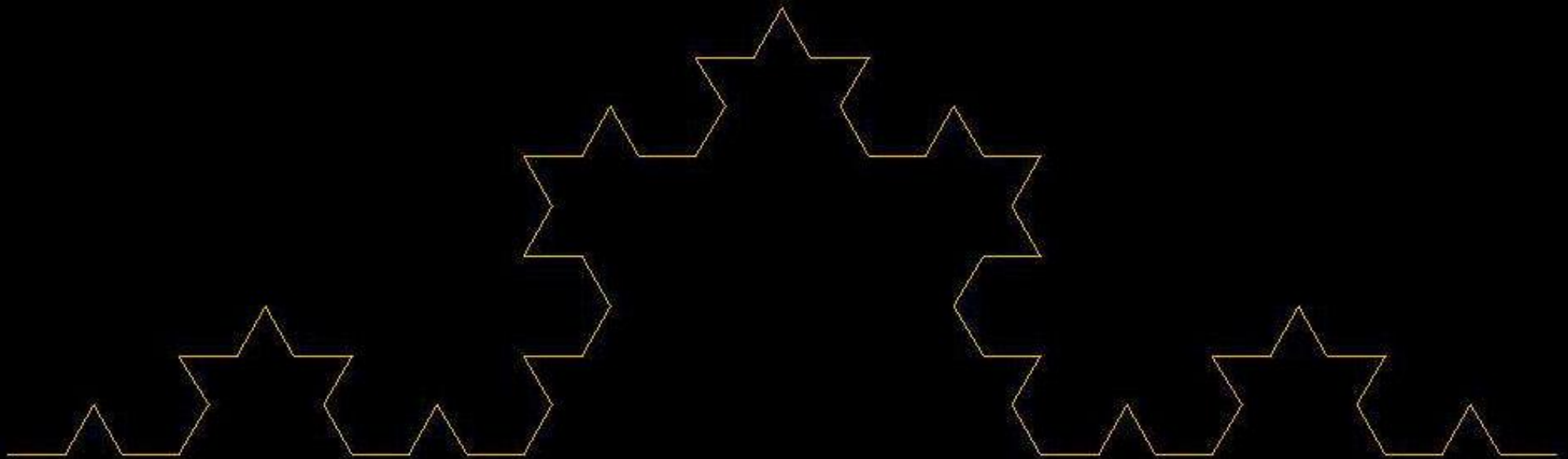
Koch-kromme



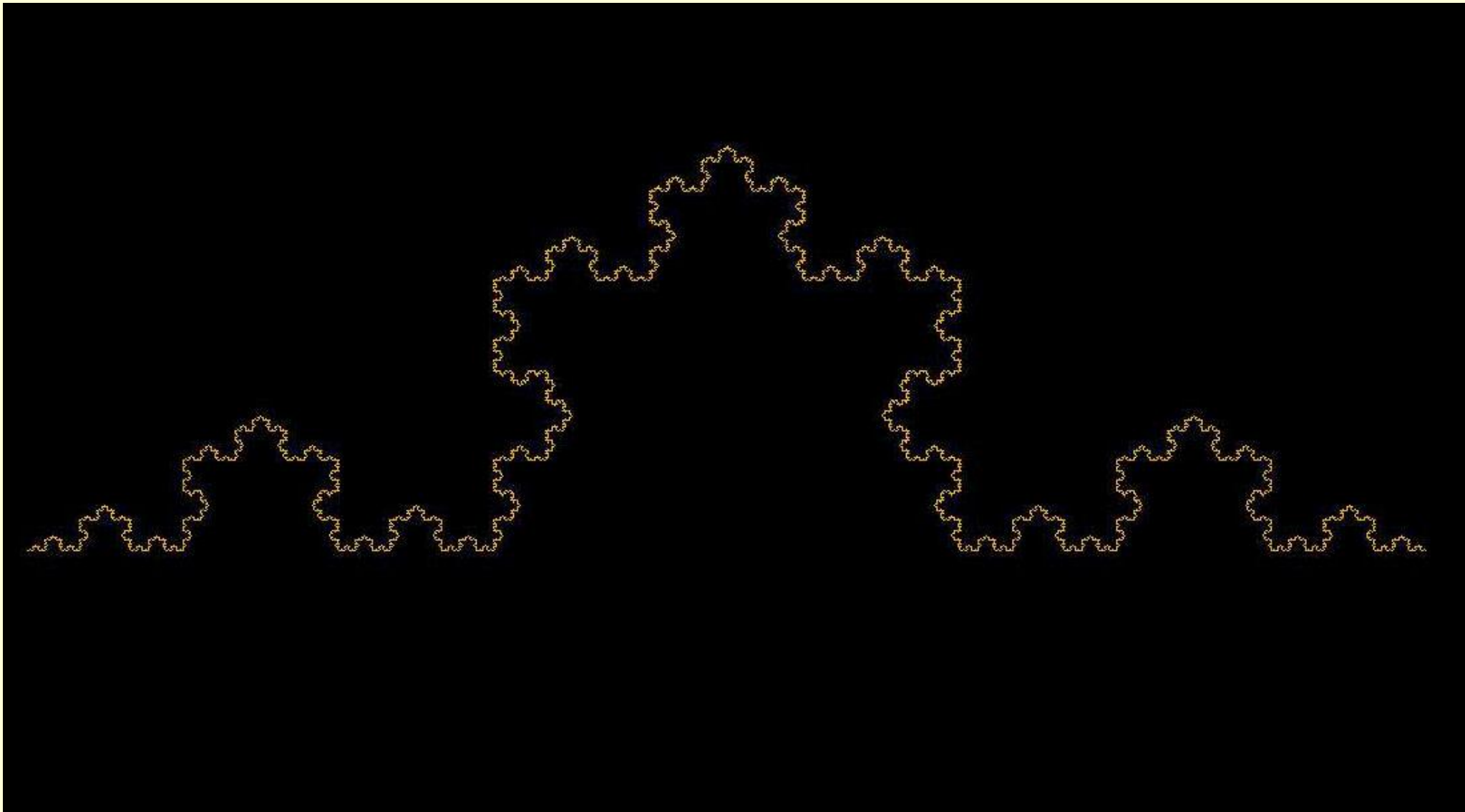
Koch-kromme



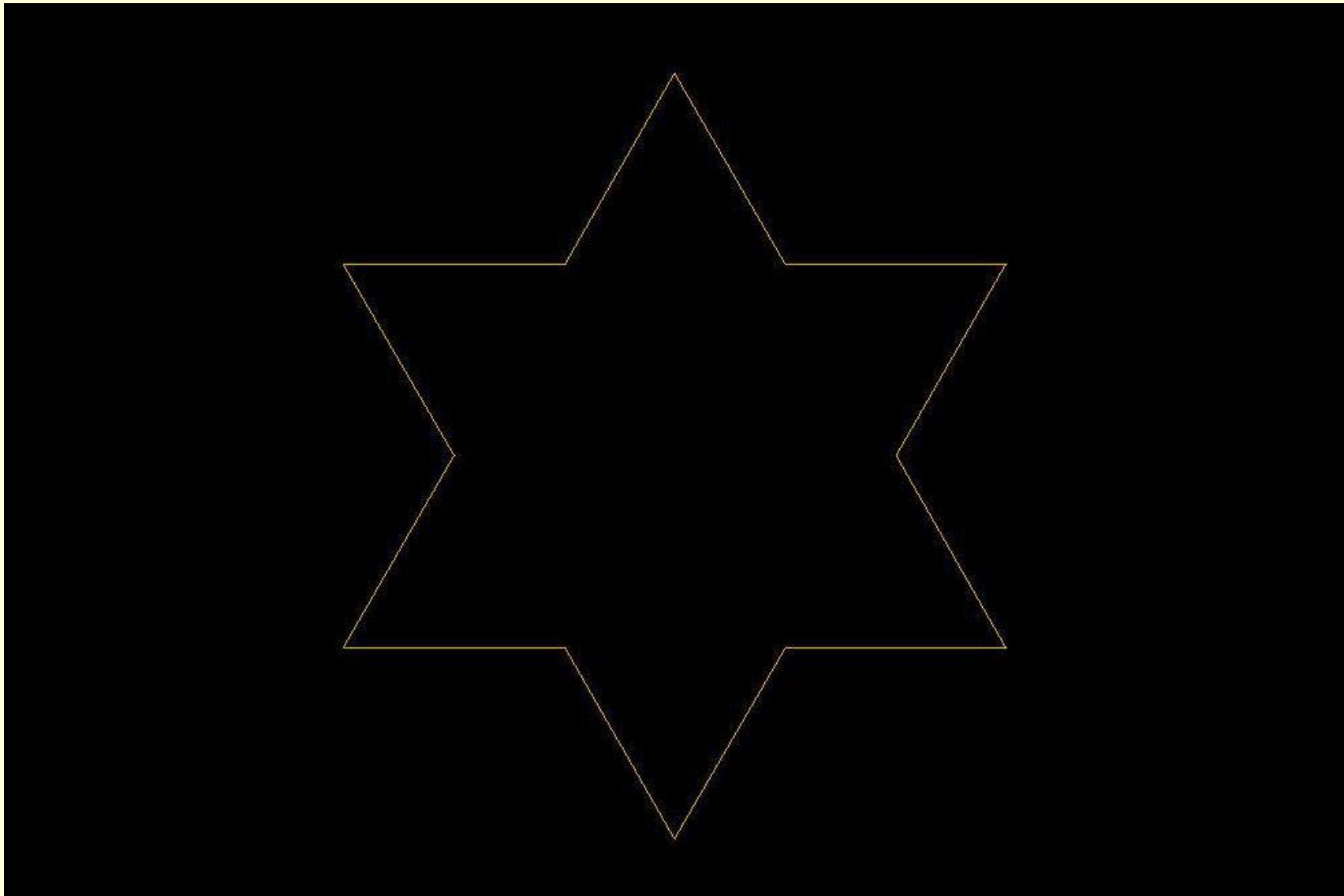
Koch-kromme



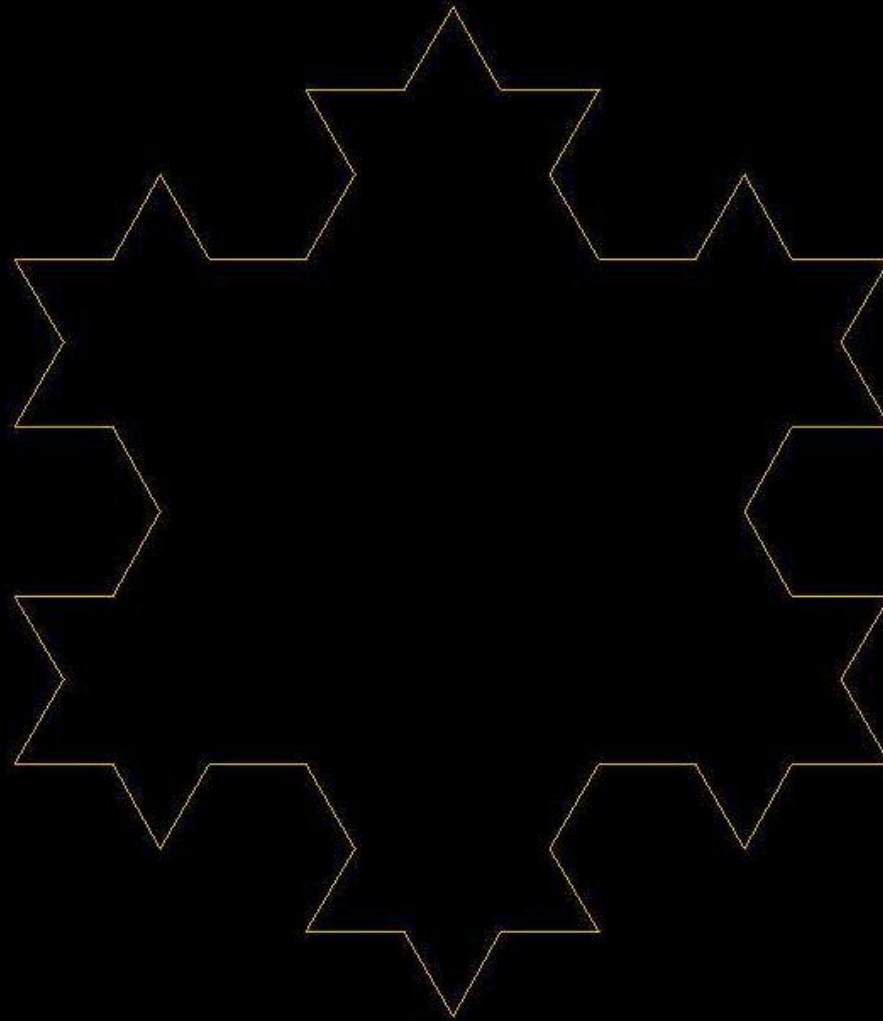
Koch-kromme



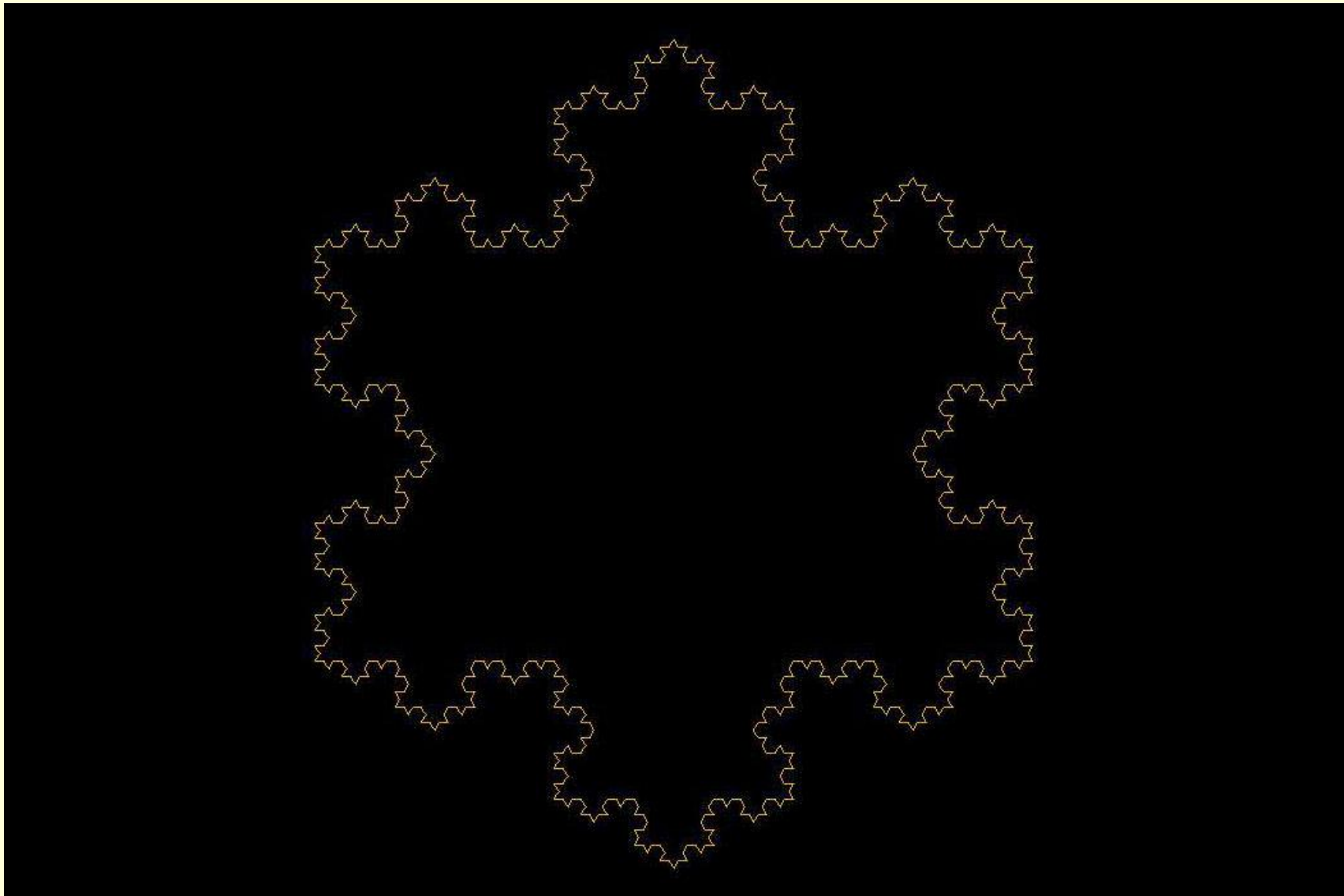
Koch-sneeuwvlok



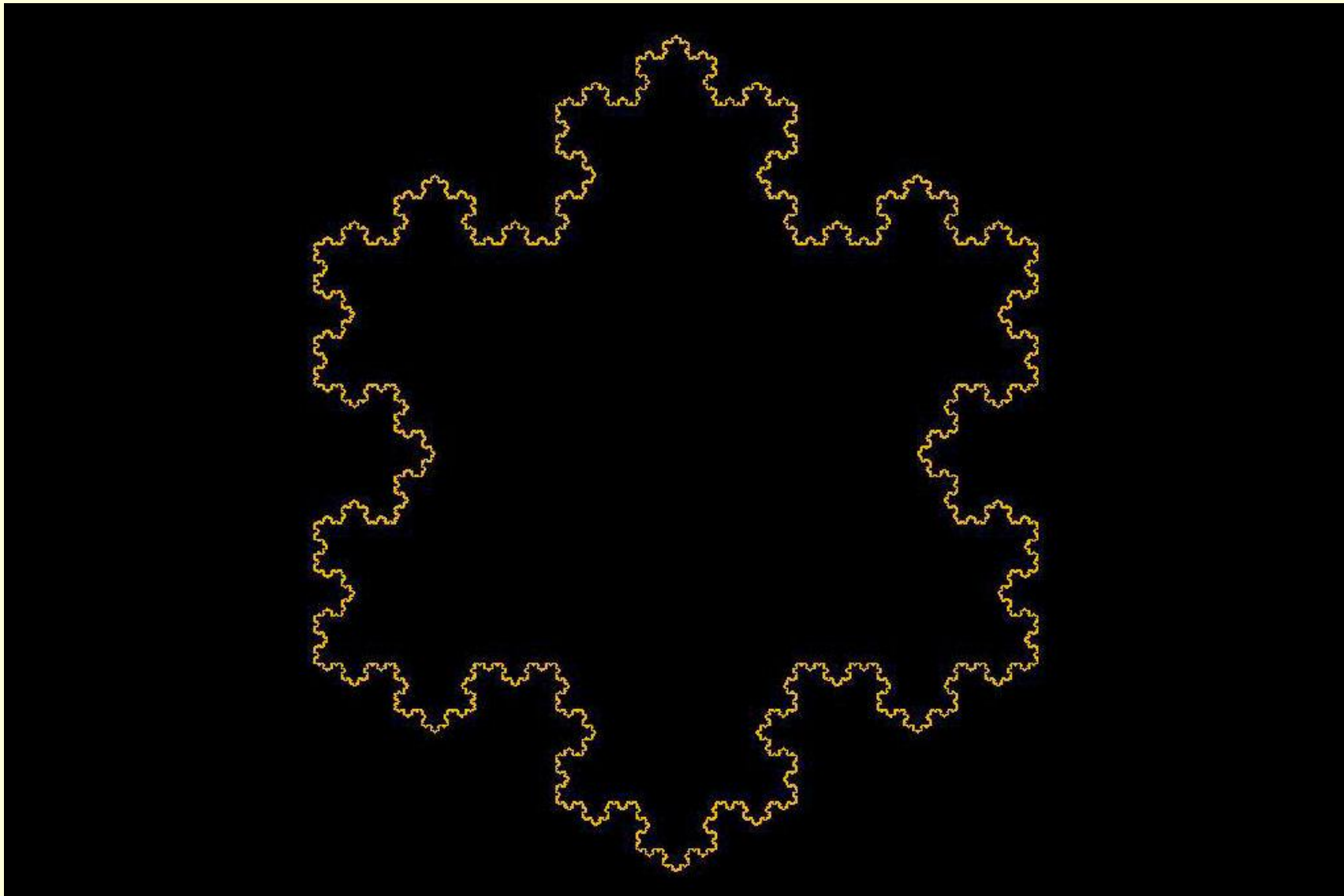
Koch-sneeuwvlok



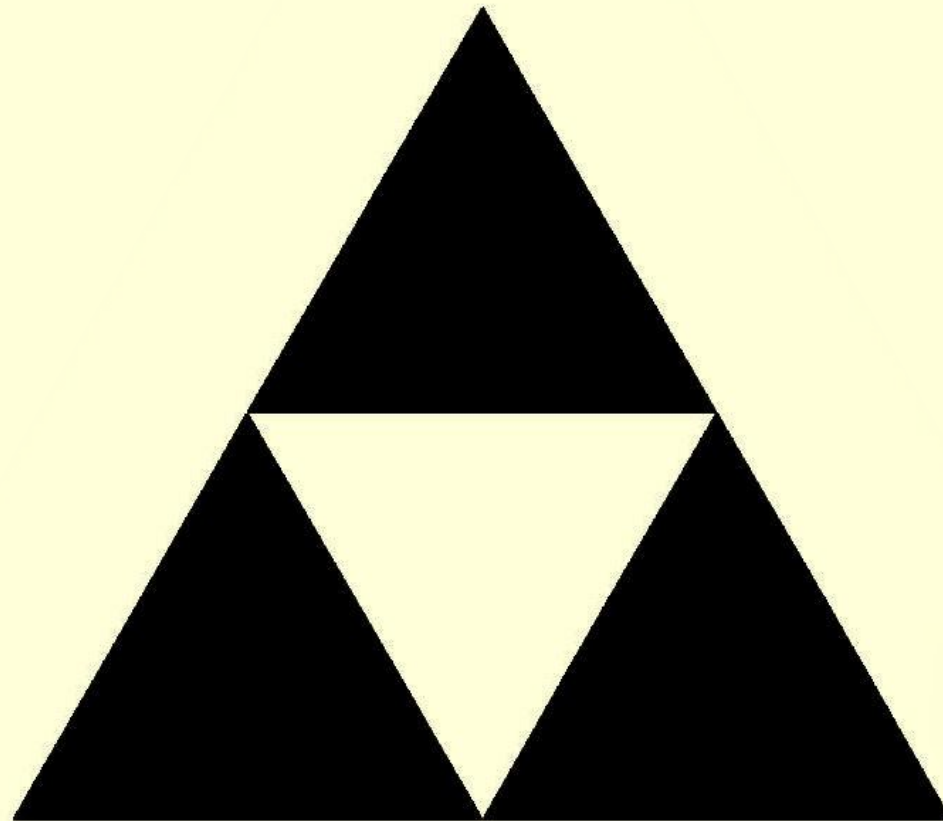
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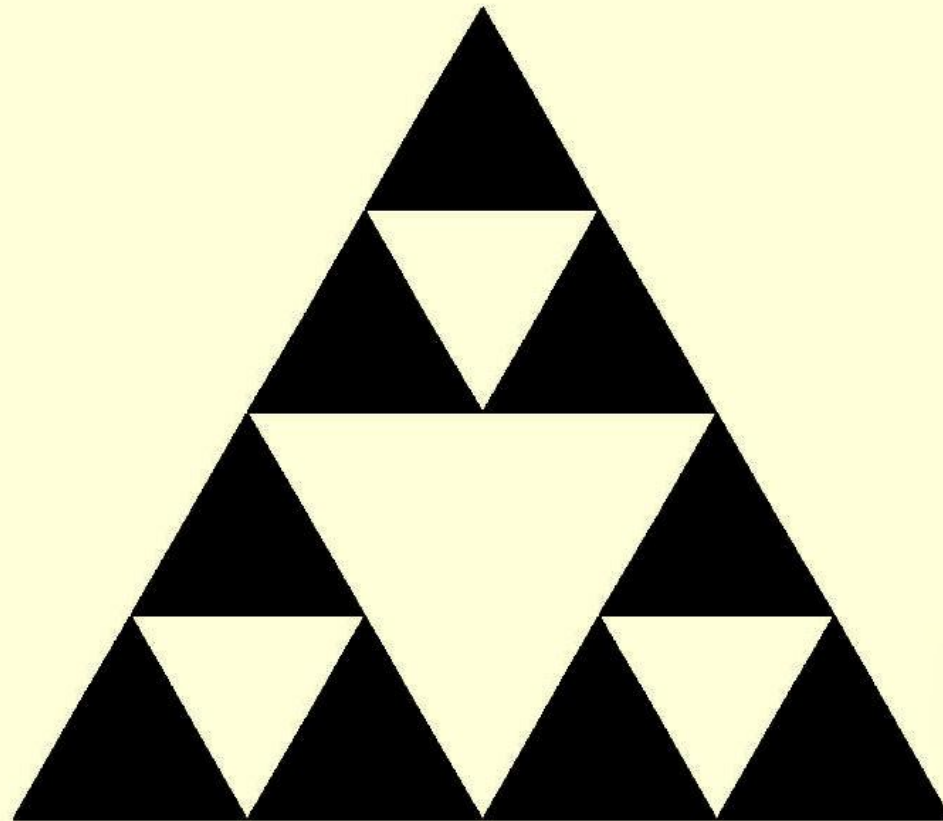
Koch-sneeuwvlok



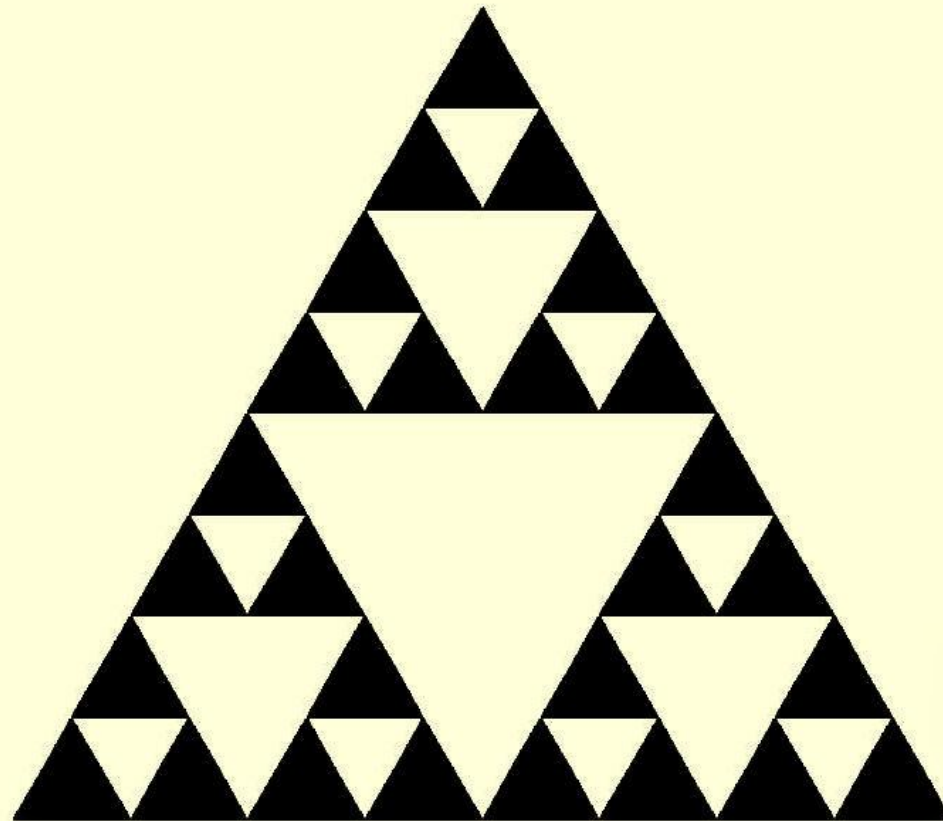
Sierpinski-driehoek



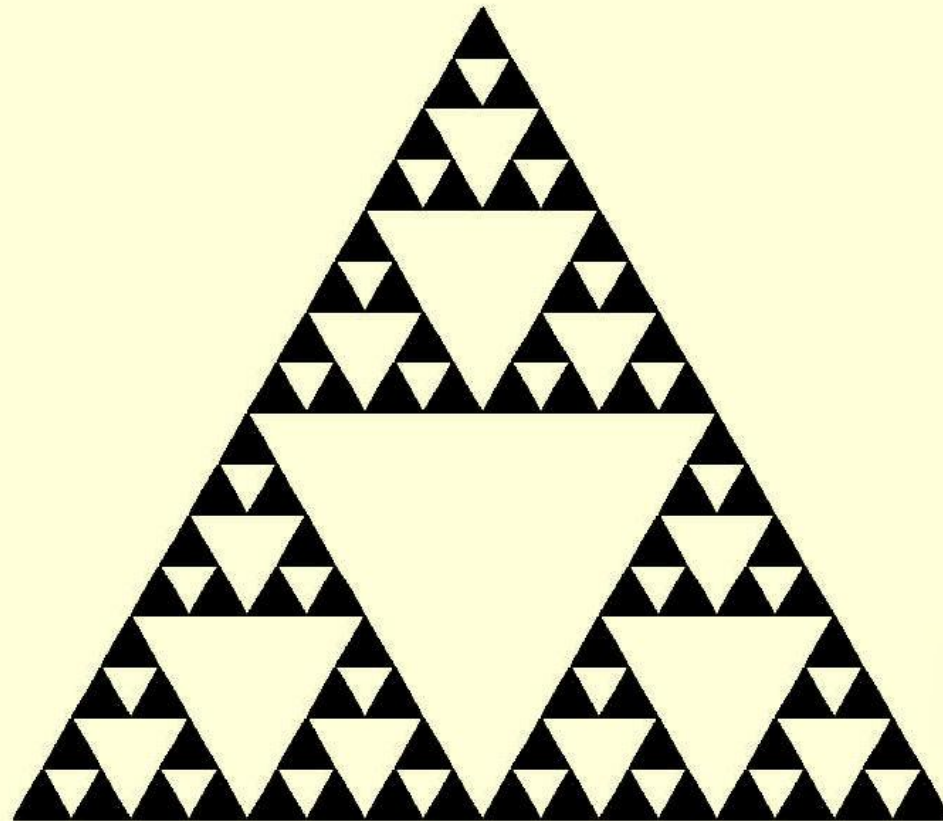
Sierpinski-driehoek



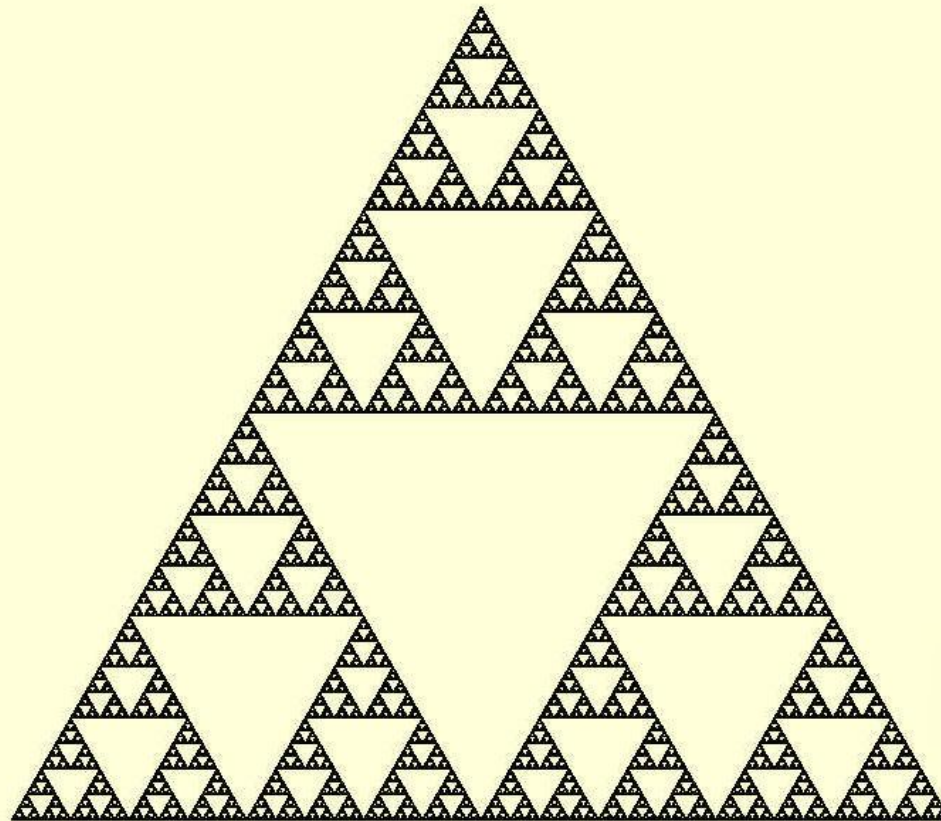
Sierpinski-driehoek



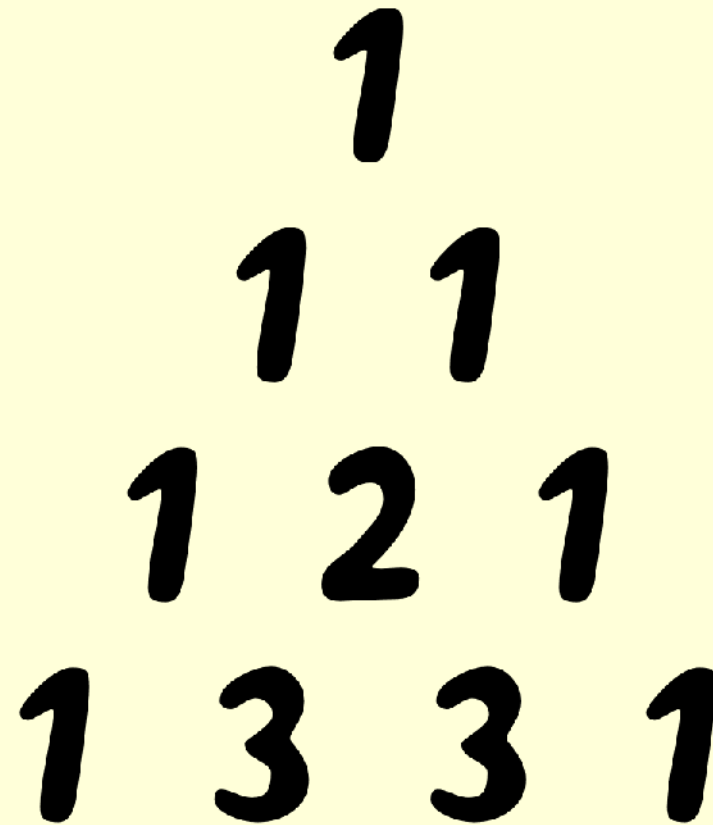
Sierpinski-driehoek



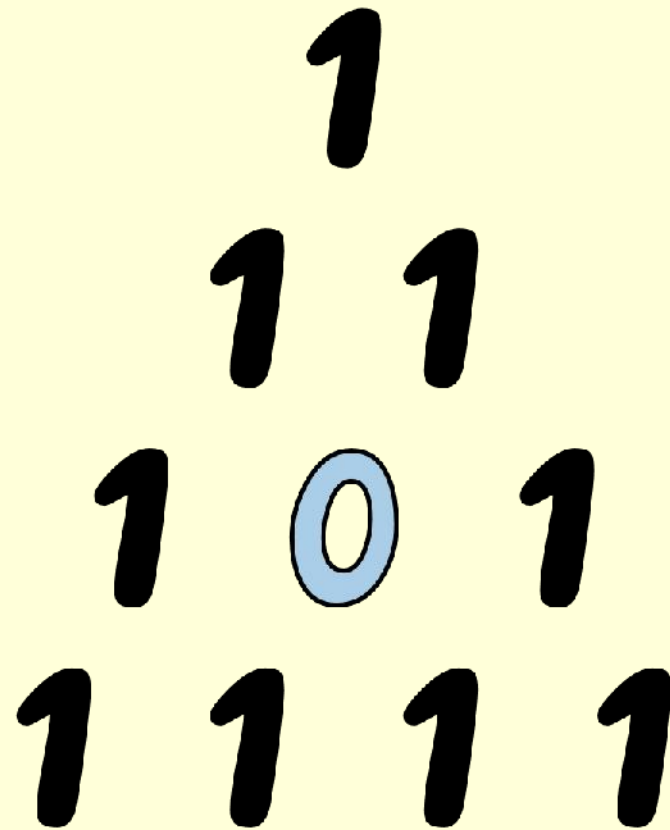
Sierpinski-driehoek



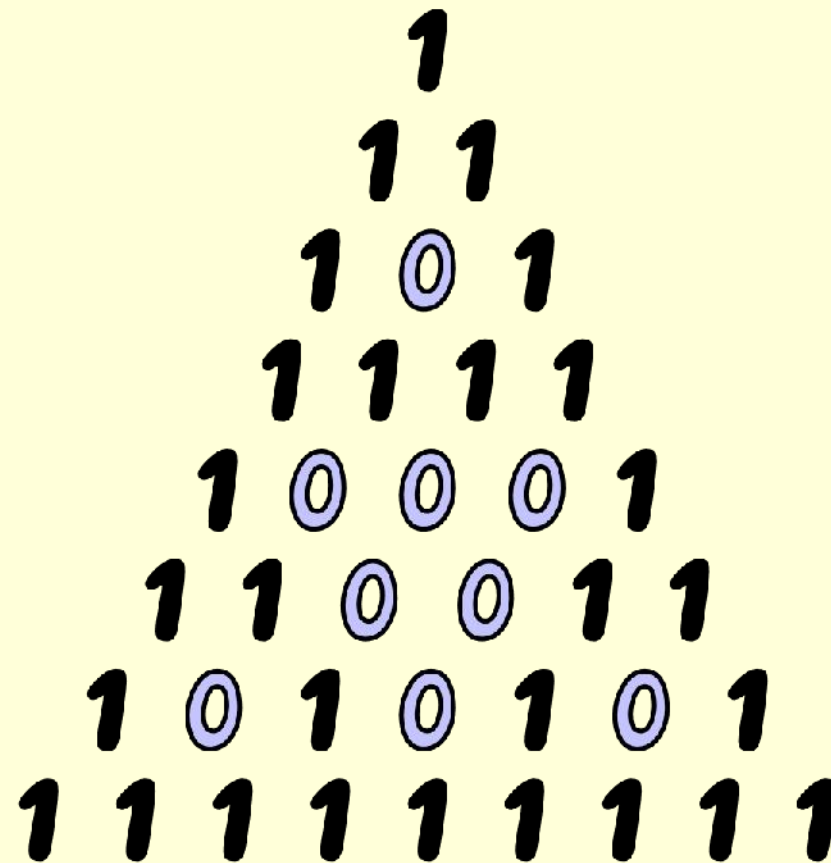
Driehoek van Pascal



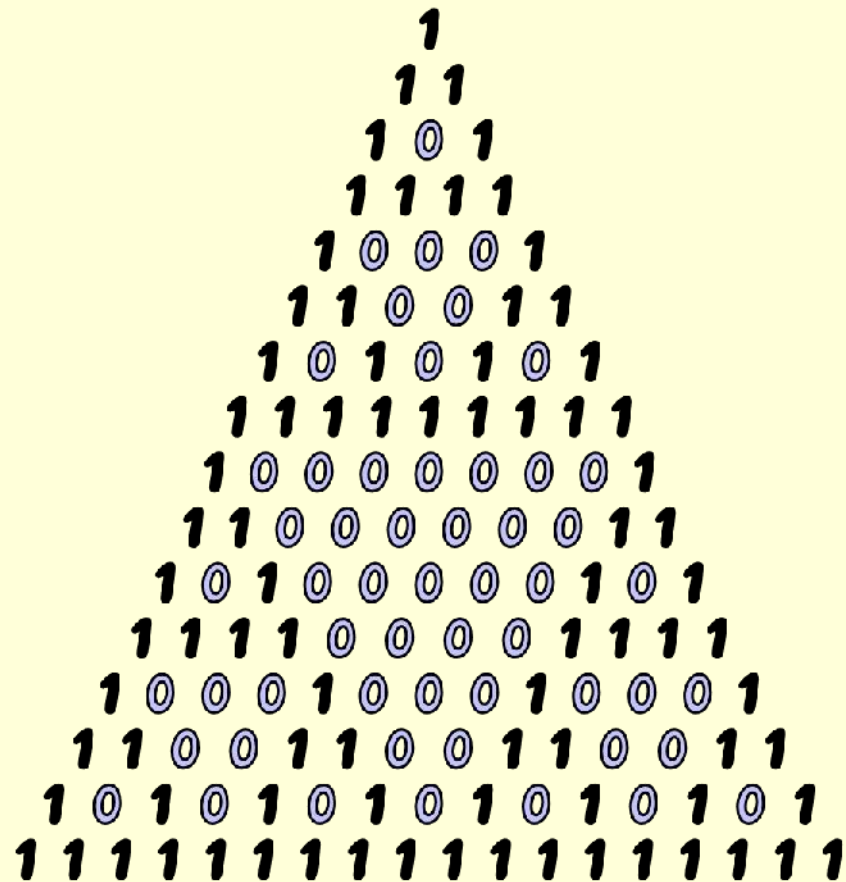
Driehoek van Pascal



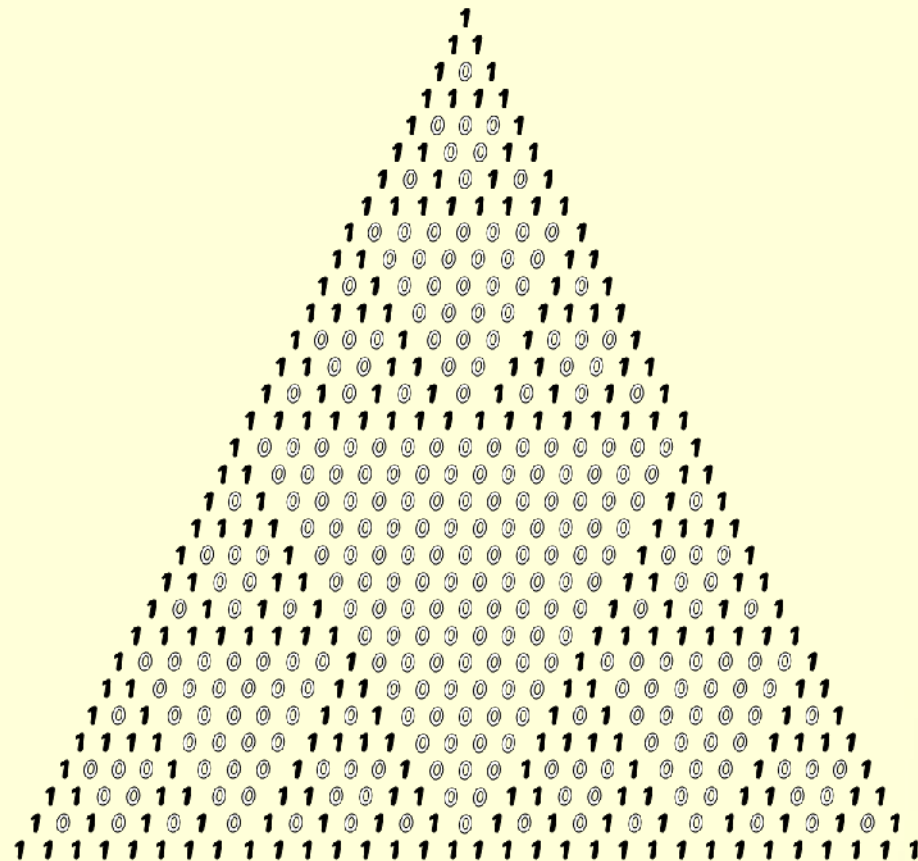
Driehoek van Pascal



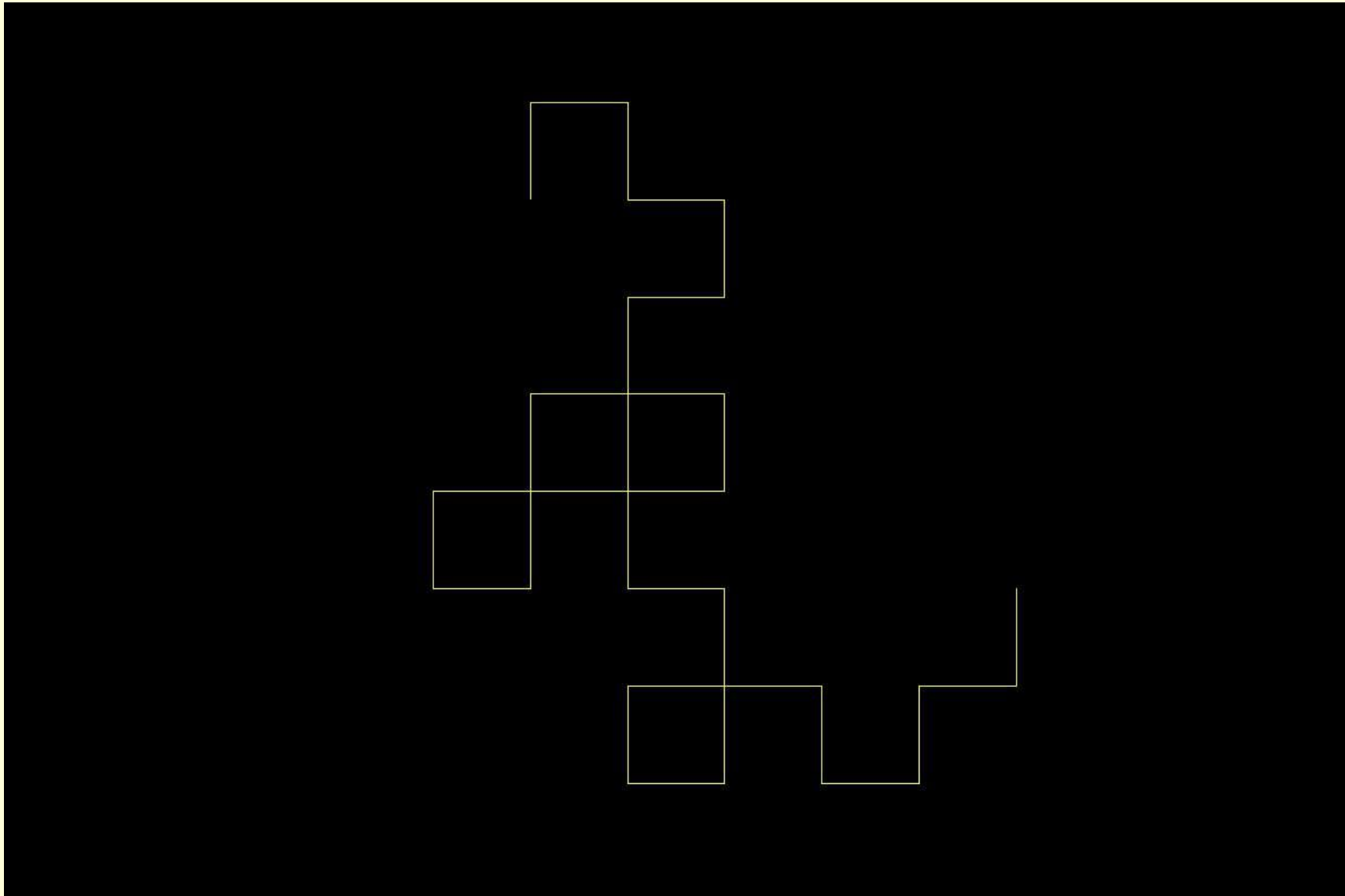
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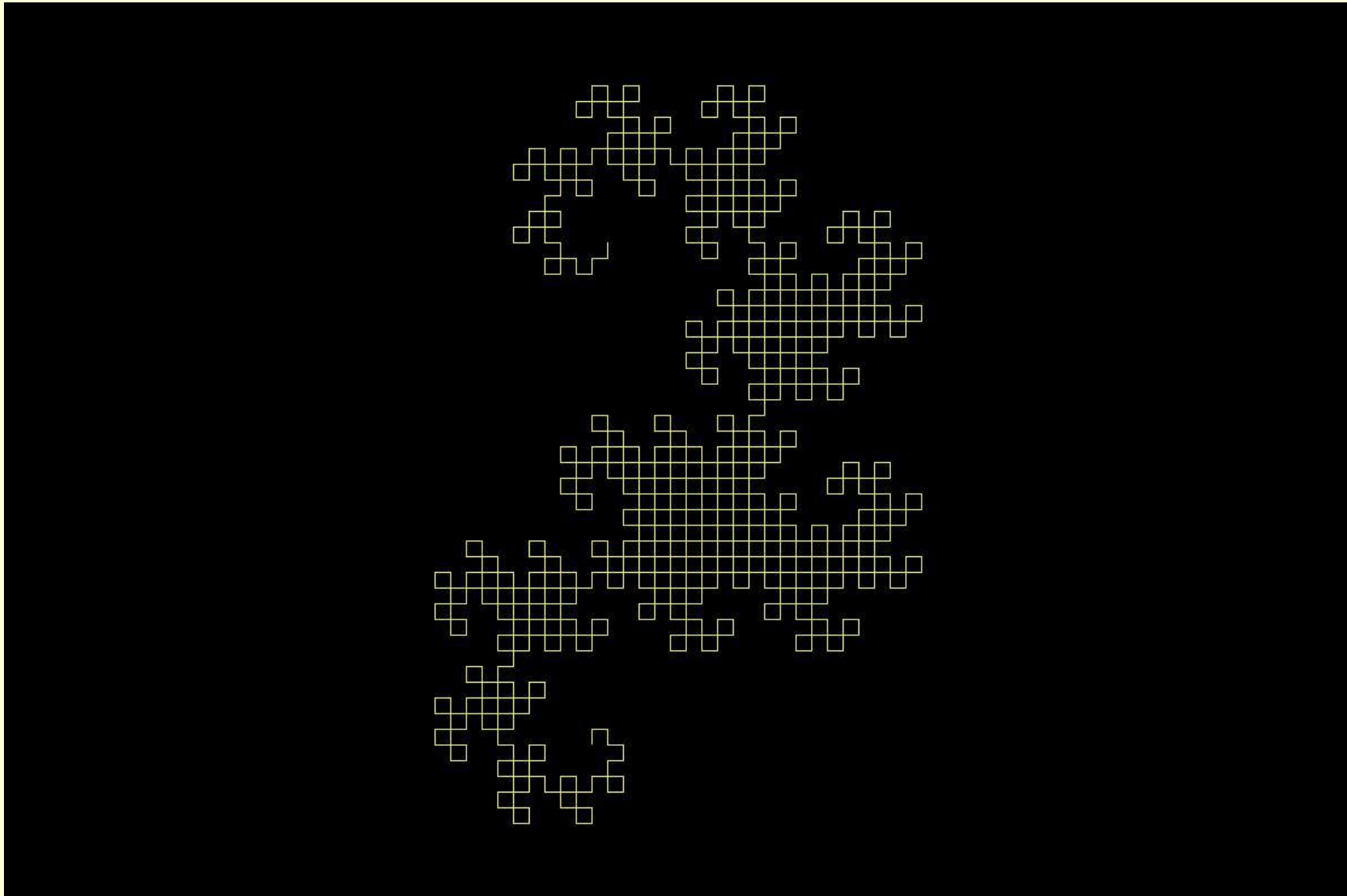
Driehoek van Pascal



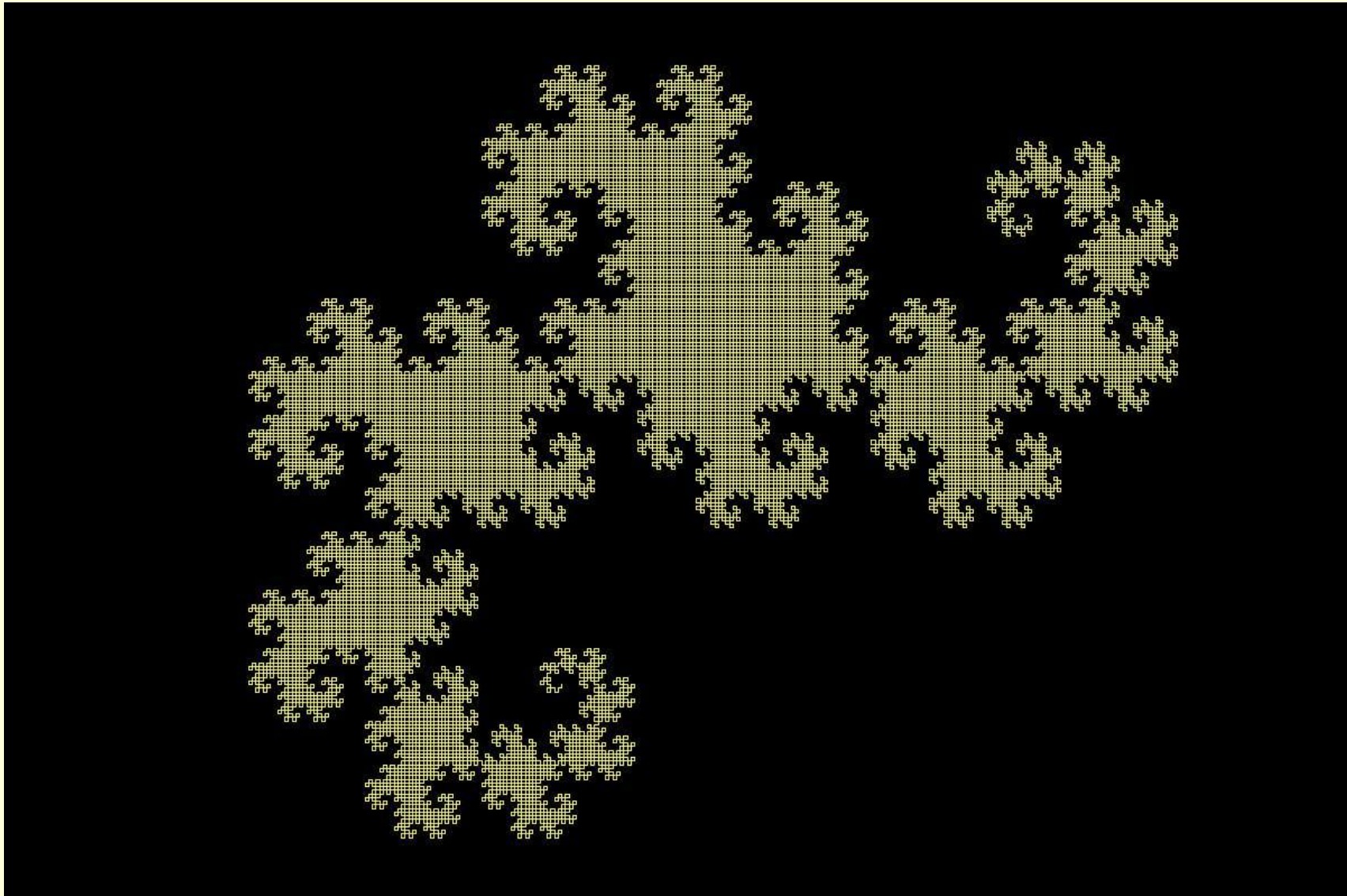
Draakkromme



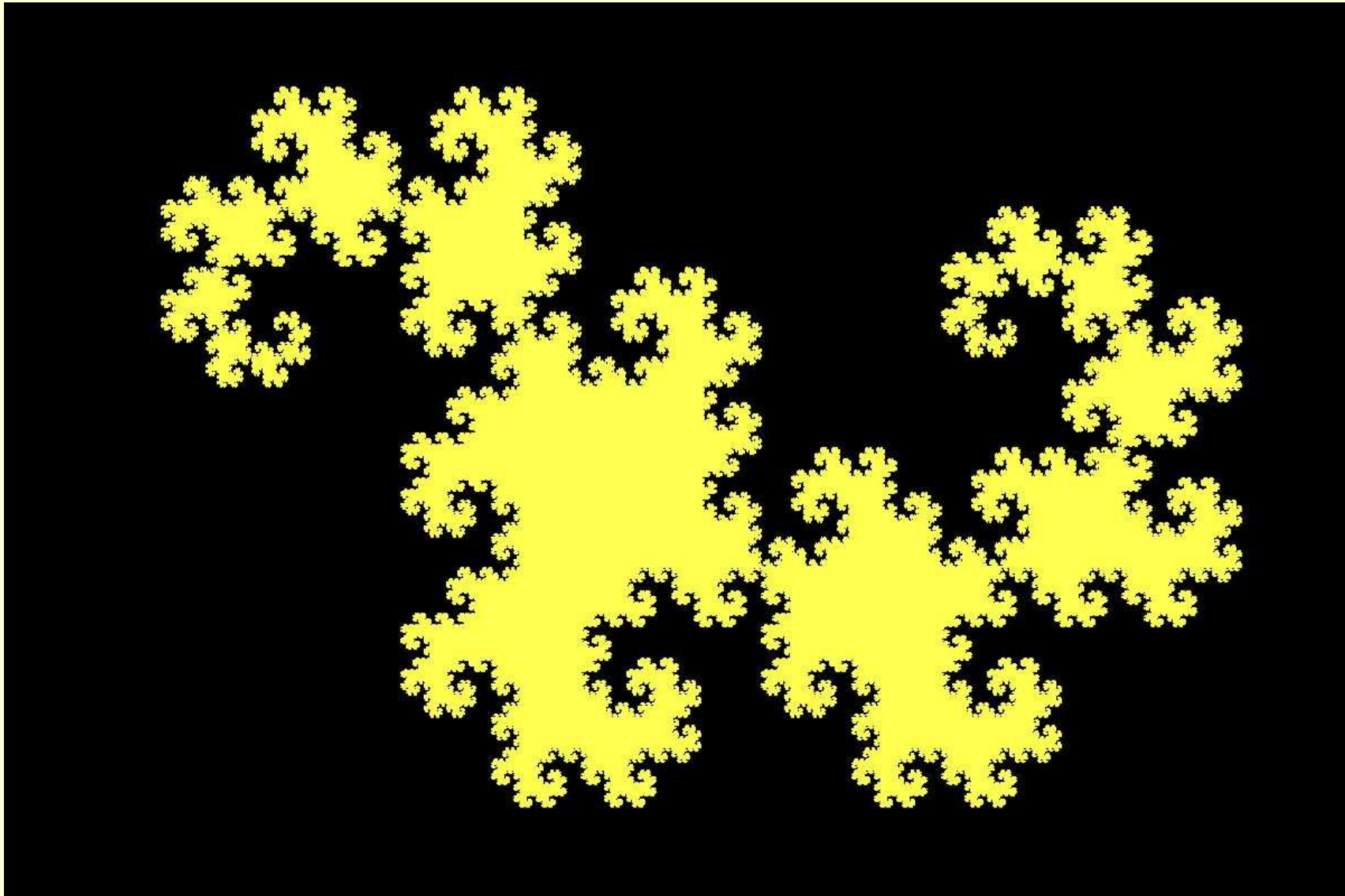
Draakkromme



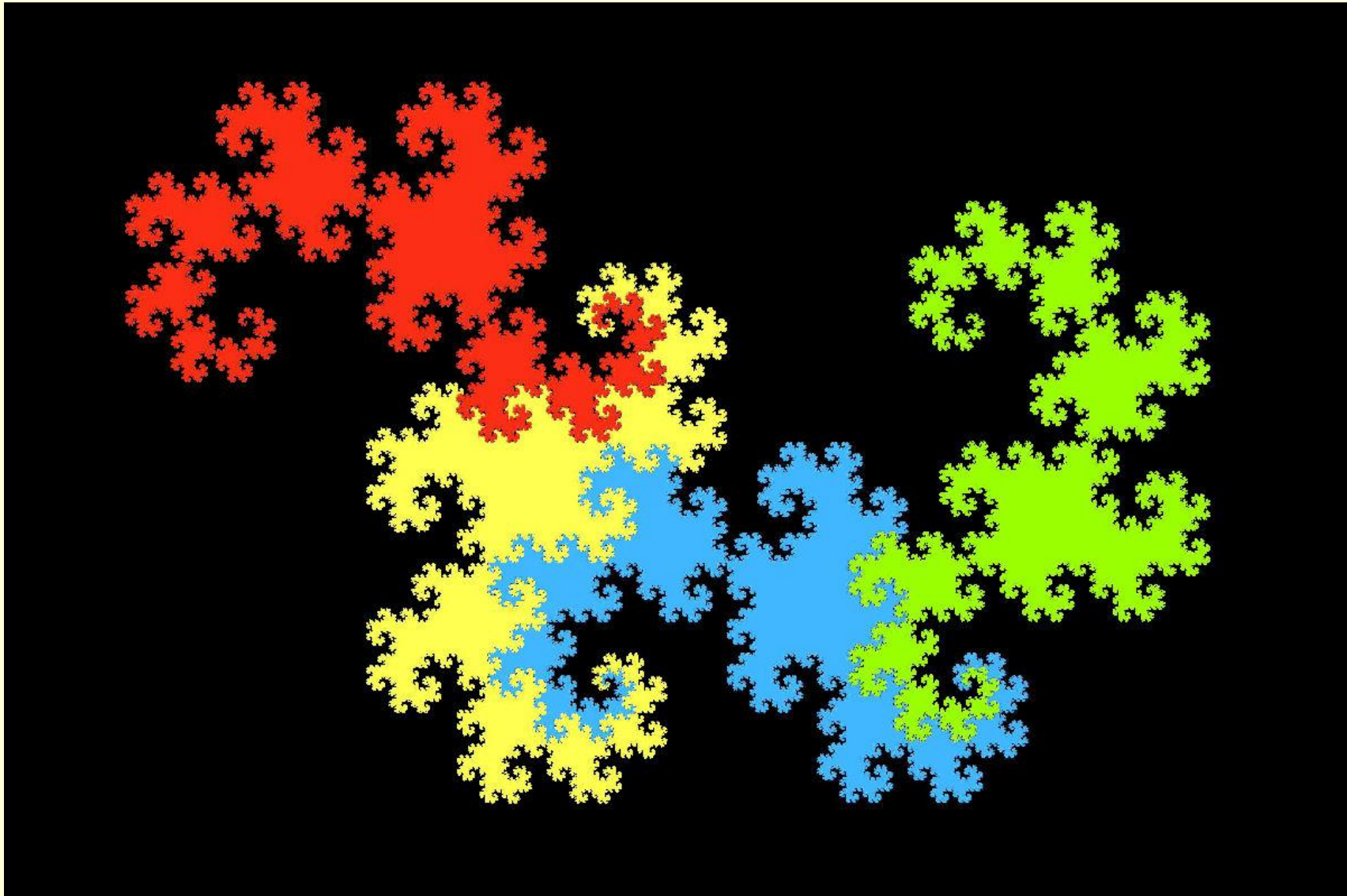
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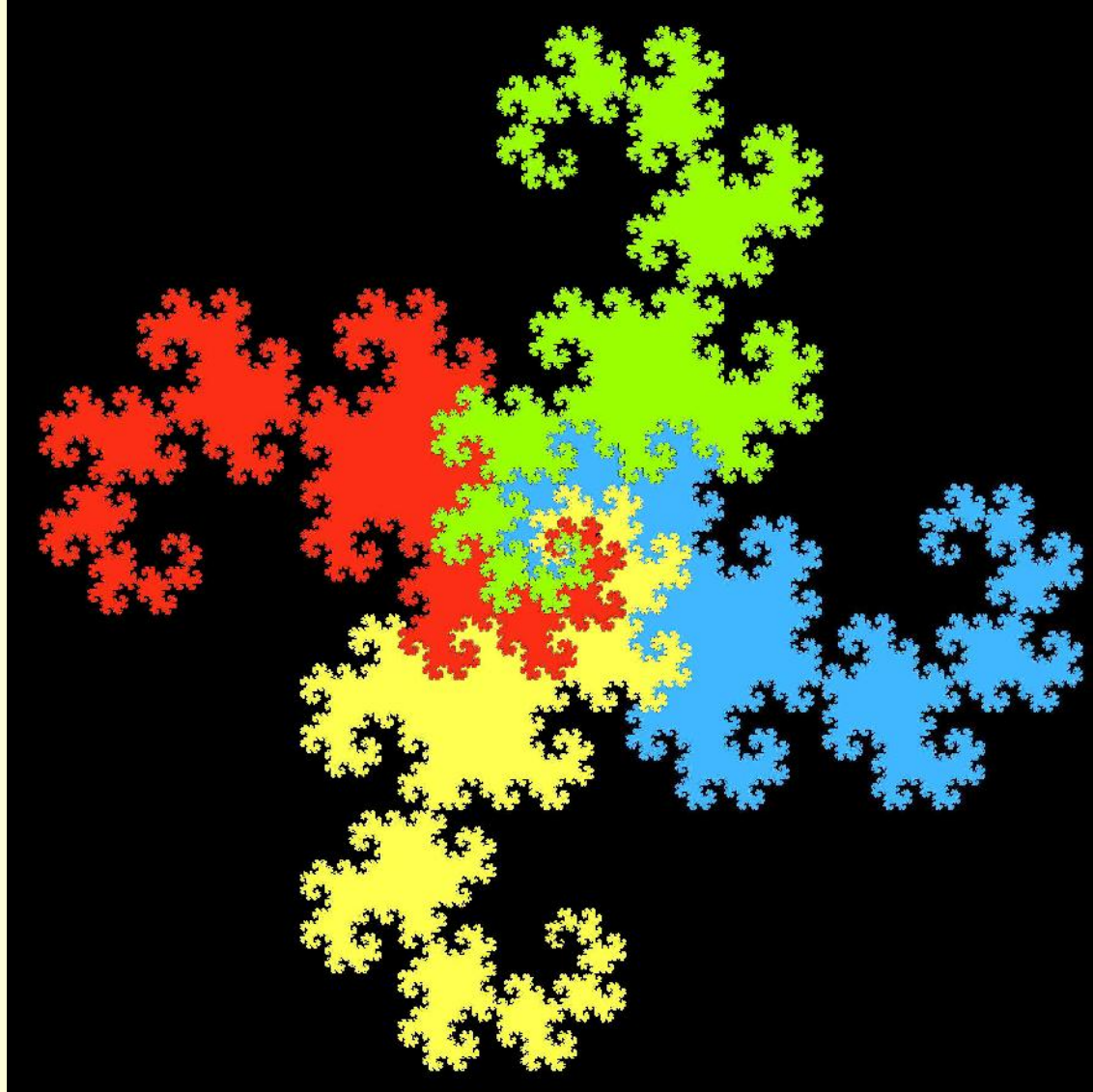
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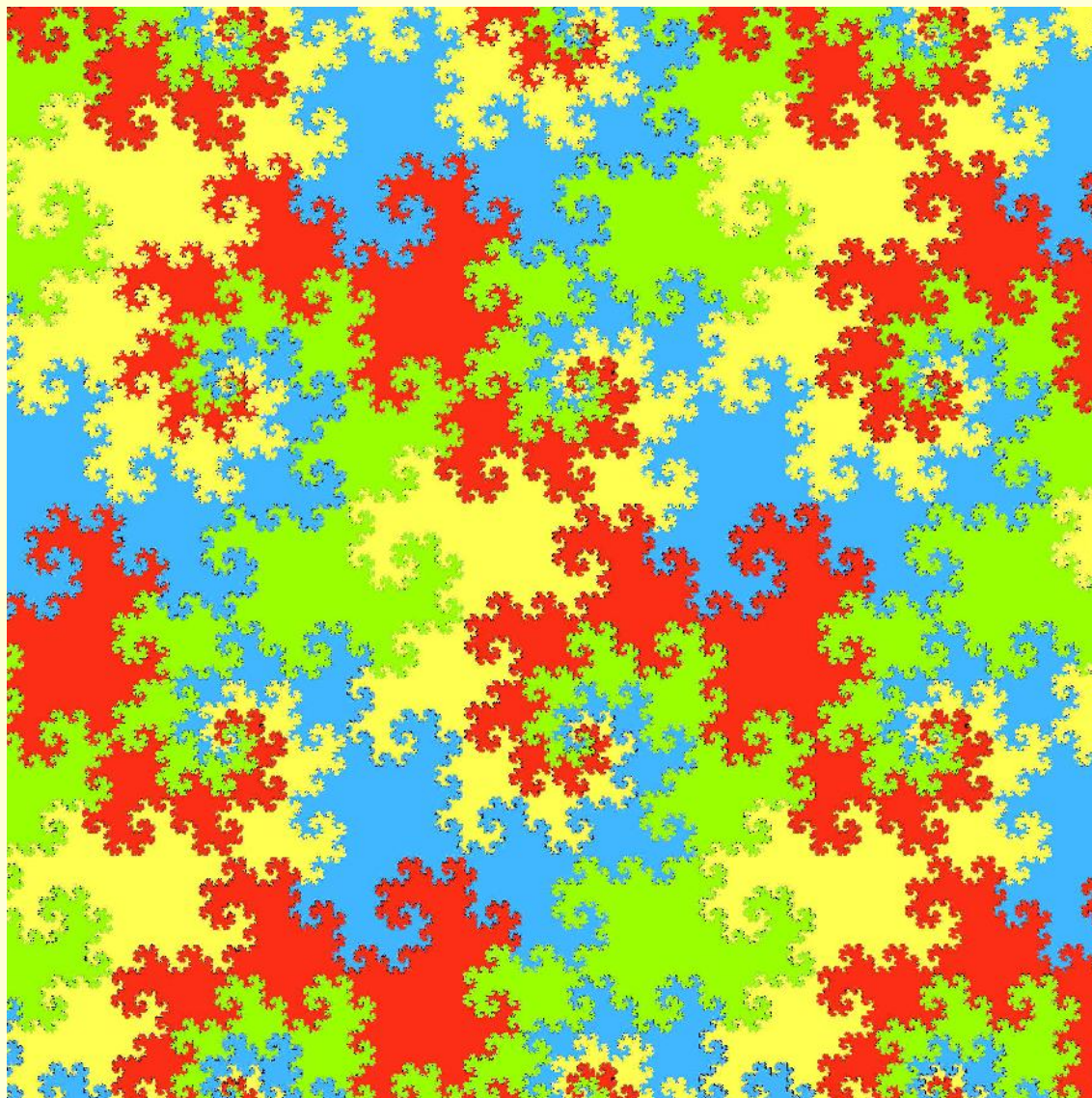
Draakkromme



Draakkromme



Draakkromme



Juliaverzameling

Fractaal op basis van begrensdsheid

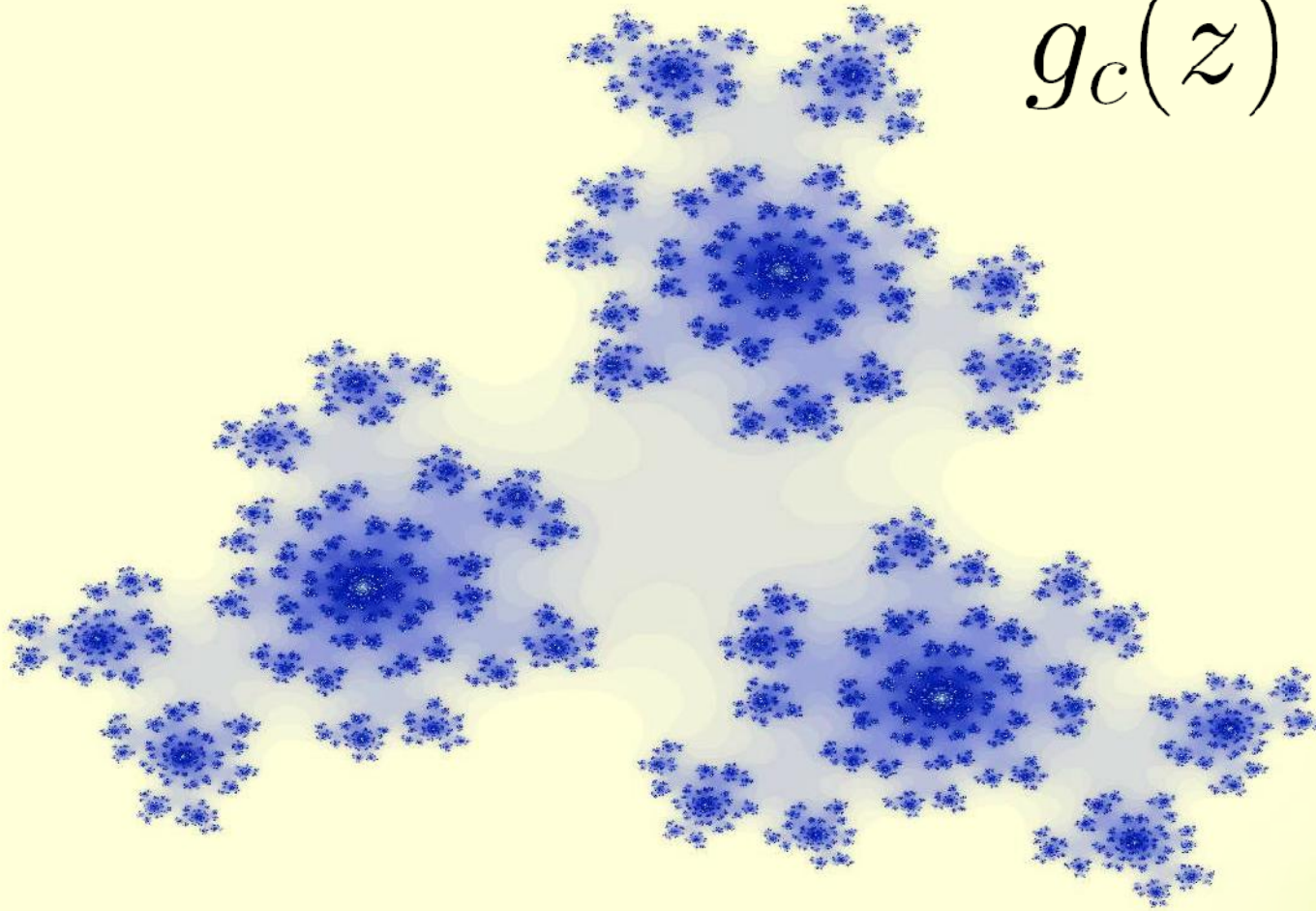
$$f_c(z) = z^2 + c \quad c \in \mathbb{C}$$

De Juliaverzameling voor c

$$K(f_c) = \{z \in \mathbb{C} \mid f_c^n(z) \not\rightarrow \infty \text{ voor } n \rightarrow \infty\}$$

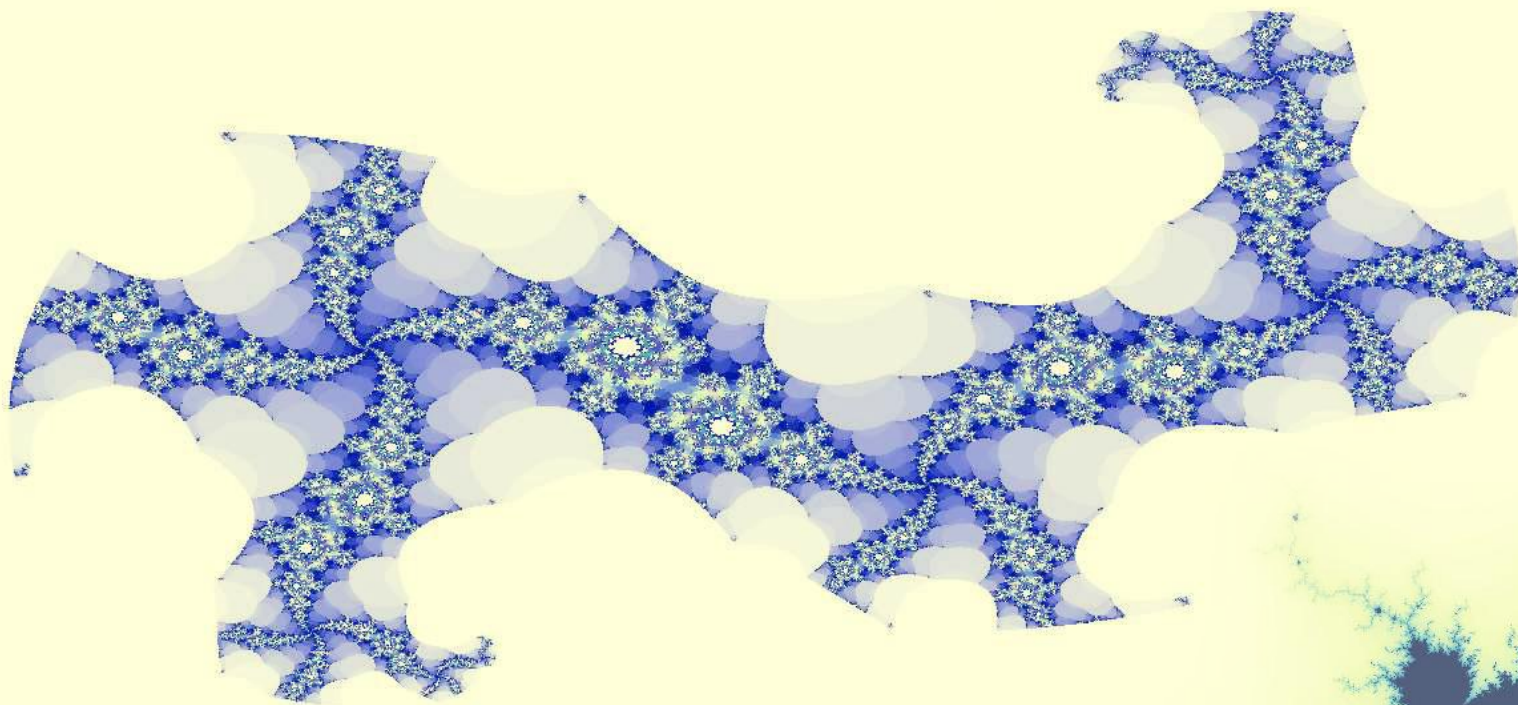
Juliaverzameling

$$g_c(z) = z^3 + c$$



Juliaverzameling

$$h_c(z) = e^z - z - c$$



Mandelbrotverzameling

Fractaal op basis van begrensdheid

$$f_c(z) = z^2 + c \quad c \in \mathbb{C}$$

De Mandelbrotverzameling

$$M = \{c \in \mathbb{C} \mid f_c^n(0) \not\rightarrow \infty \text{ voor } n \rightarrow \infty\}$$

Mandelbrotverzameling

Hoe afbeelding kleuren?

- N iteraties uitvoeren (per pixel)
- Kijken hoe groot de functiewaarden zijn
- Verdeling van de groottes bepalen
- Kleuren volgens plaats in de verdeling

Mandelbrotverzameling

