

Untitled: A DirectX Game

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May 16, 2023

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1 Summary

2 User Controls

3 Features

3.1 Noise

3.2 Procedural Terrain

[Starting point: the problem of concavity!]

Introduce marching cubes as the central tenet of the modelling process...

Definitive... Paul Bourke's *Polygonising a scalar field* (1994)...

3.2.1 Case Study: Hexes

3.2.2 Case Study: Landmarks

3.3 Procedural Screen Textures

[*Untitled* uses screen textures, based on l-systems...].

In formal languages, a grammar is a tuple $G = (N, \Sigma, P, \omega_0)$. This contains two disjoint sets of symbols: nonterminals $A, B, \dots \in N$, and terminals $a, b, \dots \in \Sigma$. The production rules in P map nonterminals to strings $\alpha, \beta, \dots \in (N \cup \Sigma)^*$; applied recursively to the axiom $\omega_0 \in (N \cup \Sigma)^*$, these rules can produce increasingly complex strings of terminals and/or nonterminals.¹

The Chomsky hierarchy (Chomsky 1956) classifies grammars by their production rules:

Type-3. Regular grammars map $A \mapsto a$ or $A \mapsto aB$.

Type-2. Context-free grammars map $A \mapsto \alpha$.

Type-1. Context-sensitive grammars $\alpha A \beta \mapsto \alpha \gamma \beta$.

Type-0. Unrestricted grammars map $\alpha \mapsto \beta$, where α is non-empty.

Note that all Type-3 grammars are also Type-2, all Type-2 grammars also Type-1, and so on.

Suppose, for example, that $N = \{F, G\}$, $\Sigma = \{+, -\}$, $P = \{F \mapsto F + G, G \mapsto F - G\}$, $\omega_0 = F$. Letting ω_n denote the string generated by applying the production rules n times, it follows that

$$\begin{aligned}\omega_1 &= F + G, \\ \omega_2 &= F + G + F - G, \\ \omega_3 &= F + G + F - G + F + G - F - G, \\ \omega_4 &= F + G + F - G + F + G - F - G + F + G + F - G - F + G - F - G, \dots\end{aligned}$$

While the above definitions are rather abstract, they come with a surprising practical application. Lindenmayer (1968) introduces the L-system, ... [Introduce basics of L-systems, include the angles used for dragon curves...] produces the dragon curves in Figure 1.

3.3.1 Case Study: Runes

Parametric L-systems (?) exist as a generalisation of the above... [theory].

[Move into code... what parameters will we consider?]

[Example: various geometric runes!].

3.3.2 Case Study: Blood Vessels

Zamir (2001) uses parametric L-systems... equations for bifurcation...

Liu et al. (2010) further introduce a stochastic component...

¹In mathematical literature, $\omega_0 \in N$ (Hopcroft, Motwani & Ullman 2000), but this paper takes an informal approach.

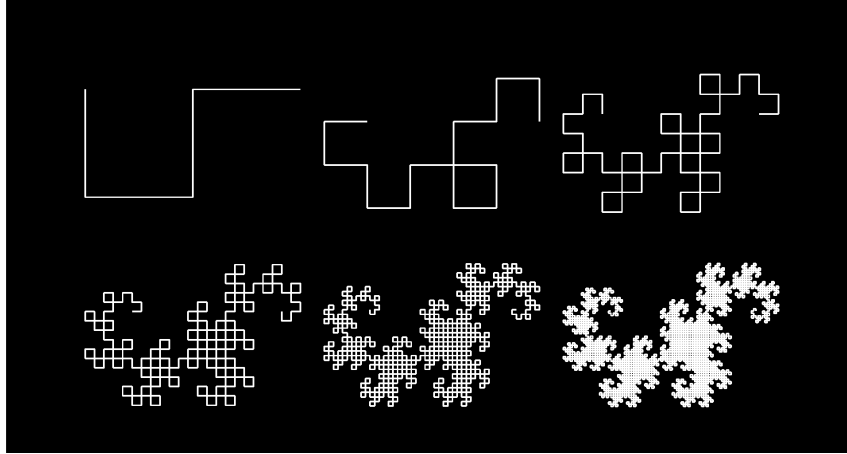


Figure 1: Dragon curves, generated by strings $\omega_2, \omega_4, \dots, \omega_{12}$.

3.4 Procedural Narrative

4 Code Organisation

4.1 Post-Processing

4.2 GUI

[Include HDRR/bloom here...]

5 Evaluation

5.1 Features

5.2 Code Organisation

6 Conclusions

References

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