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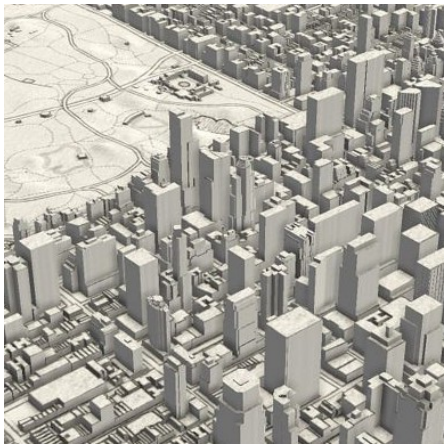


Procedural City Generation

Karl Volkenandt, Jakob Krause

Freie Universität Berlin

September 9, 2018

Motivation

Problem:

Creating high quality virtual worlds by hand has the following drawbacks:

- expensive
- cumbersome
- time consuming

Solution:

Smart Algorithms that do the work for us...

Requirements for procedural worlds

- believable
  - no obvious patterns
  - Close to the original
- attributes to parameterize
  - size
  - terrain features, snow, population …
  - architecture style
- variational
- Acceptable computation time
  - real-time in games
- editable output format

Prominent examples

- The Elder Scrolls 2: Daggerfall (1996) :487.000 km^2
  - very generic
- No Man’s Sky (2018)
  - procedural solar system and creatures
  - 18 quintillion planets
  - Algorithm is kept a secret

City Generation

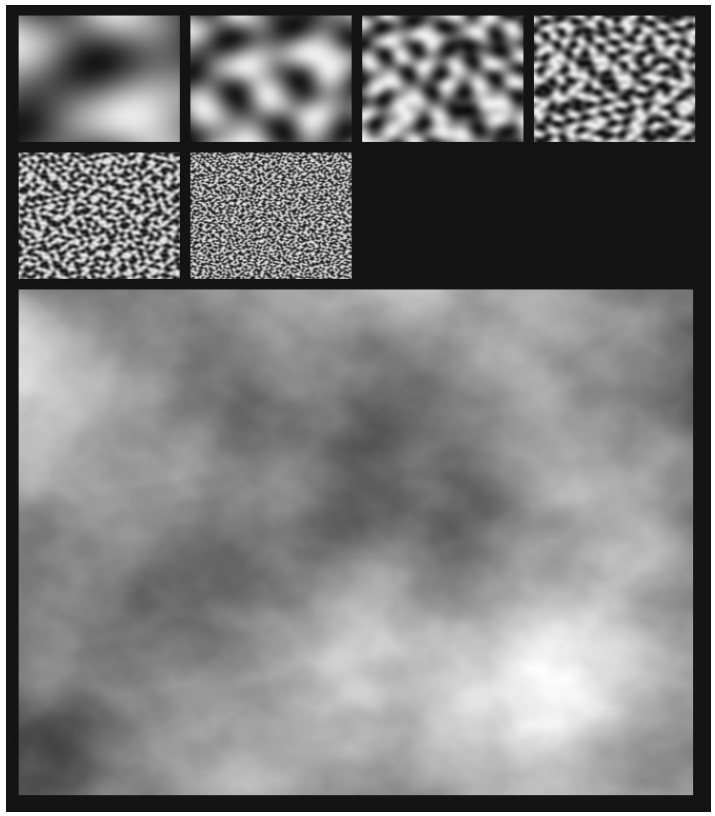
Challenges:

- realistic road systems
- public transportation
- generation of buildings
- building type distribution

Generation

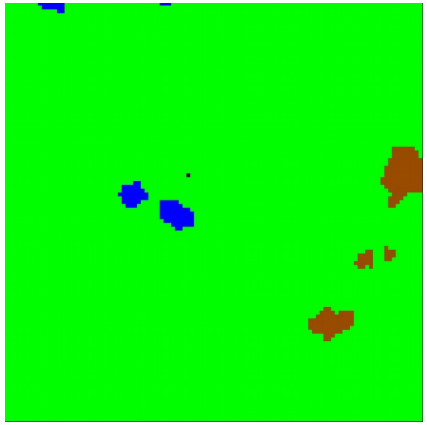
The key is to find the right abstraction:

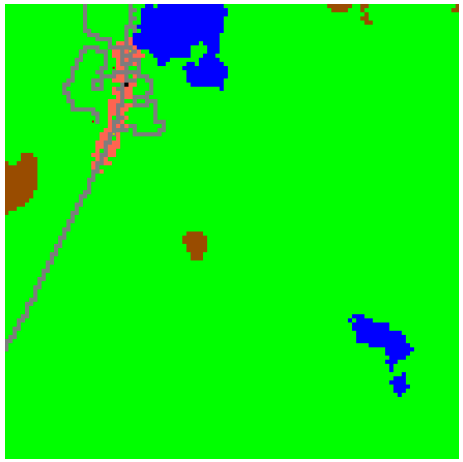
- L-Systems
  - alphabet, rules, constants, start state
  - works well for plants, roads
- Perlin Noise
  - layered by different frequencies
  - typically used for generating terrain
- Voronoi cells
- mapping basic street template to terrain maps

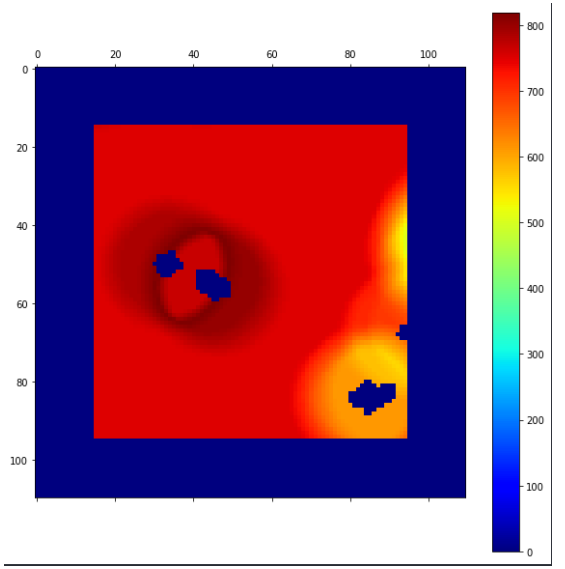


Agent-based generation

- different agents follow different goals
  - street building
  - house building
  - planning authorities
- starts in an empty terrain
- heat maps for evaluate space
- evolution can be observed
- complex





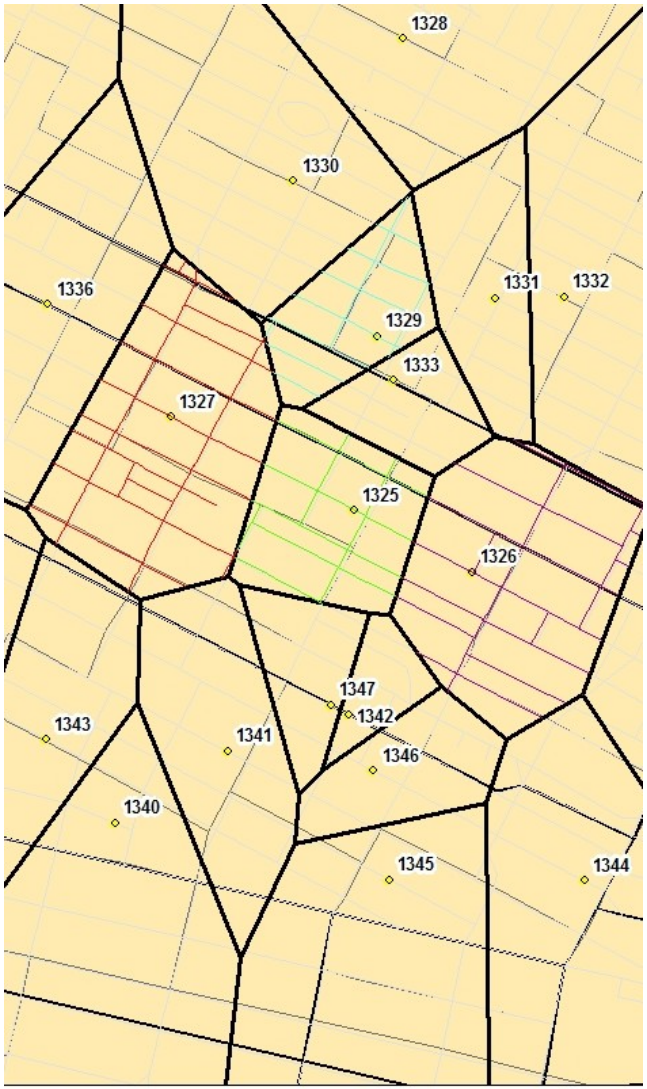


Our approach

- tile based graphic
- renderable format
  - "SSS
    HSH
    TSS"
- 1. street system based on voronoi cells
  - Every street is connected to each other
- 2. street system based on agents
- Generation pipeline: (terrain) → streets → house
- 4 Tile types (nature, street, house, tower) with randomized graphics
- higher population towards the center of the city or pole points

Demonstration ...

Improvements



- L-Systems for district streets
- Connected street tiles
- Industrial tiles
- Special buildings
- ….

Questions ?