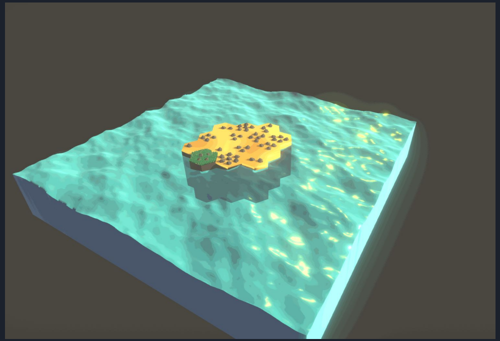
Procedural Map Generation

By Pablo Galve

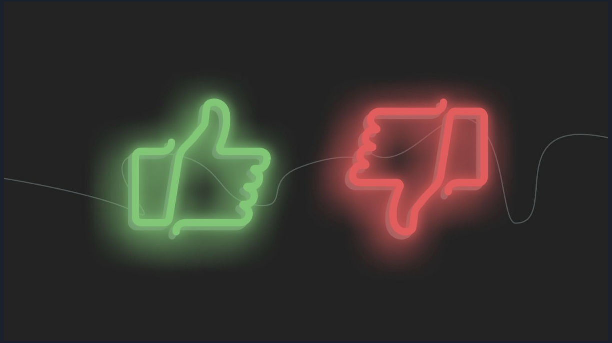
What is procedural map generation?

- A map generated by a computer, not a human



Why to use procedural map generation?

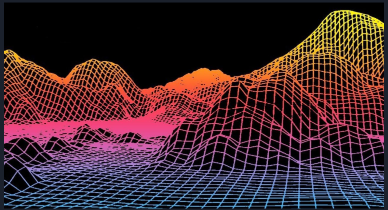
- **Pros**
  - Each map is mathematically unique
  - Saves development time
  - Monetization can dramatically increase
    - Users play for years
  - Perfect for creating a lot of maps
- **Cons**
  - Hard to make it visually unique
    - Computers are not creative
  - You can’t design it 100% as you want
  - Bad for narrative games
  - Bad for building only one map



Different type of maps

- Outdoor maps

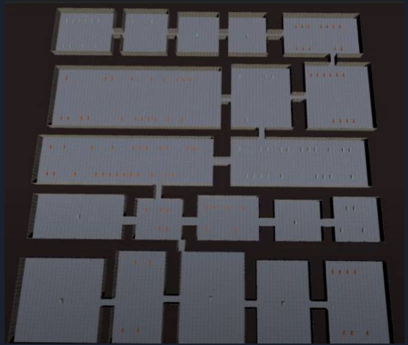
  Using Perlin Noise



In this tutorial, we'll see how to generate outdoor maps

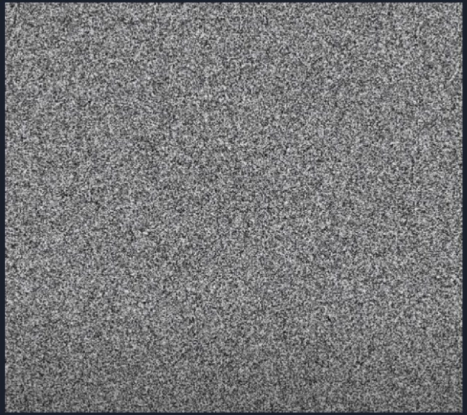
- Indoor / Dungeon maps

  Explained in my website

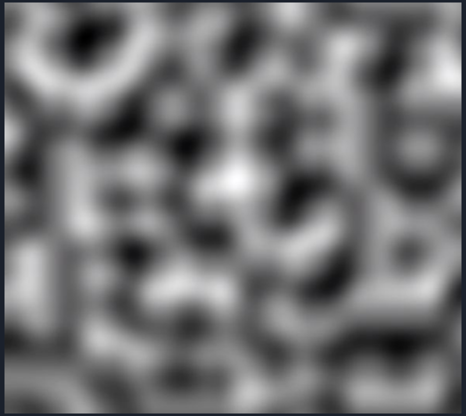


What is Perlin Noise?

Normal Noise

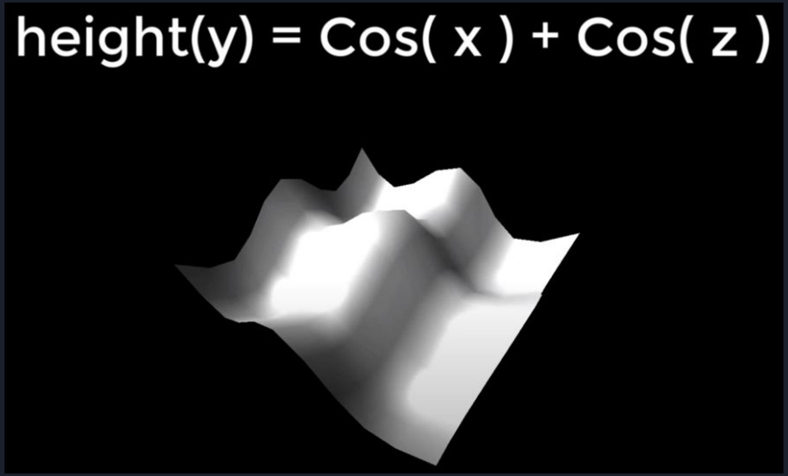


Perlin Noise

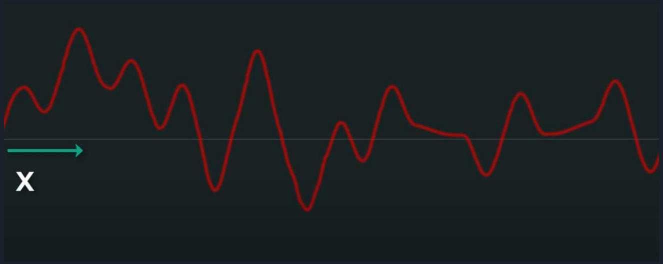


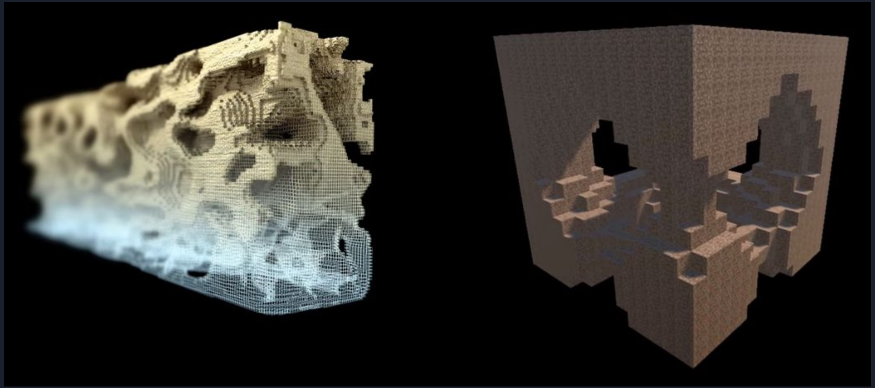
How to create infinite worlds

- We only need to store
  - Coordinates
  - A math formula
  - Changelog made by player
- Same seed = Same world



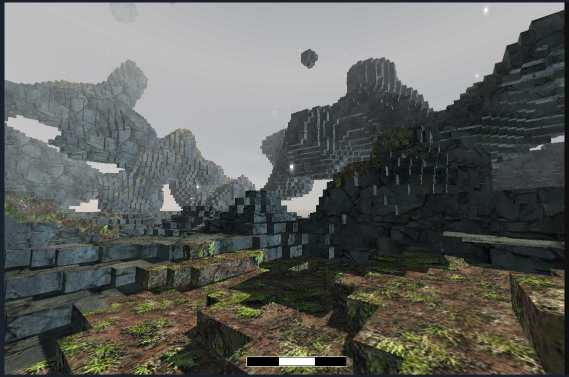
Perlin Noise - 1D, 2D & 3D





Games using procedural generation

Minecraft



Spore

Move your damaged vehicles near one of your cities to repair them
Spore

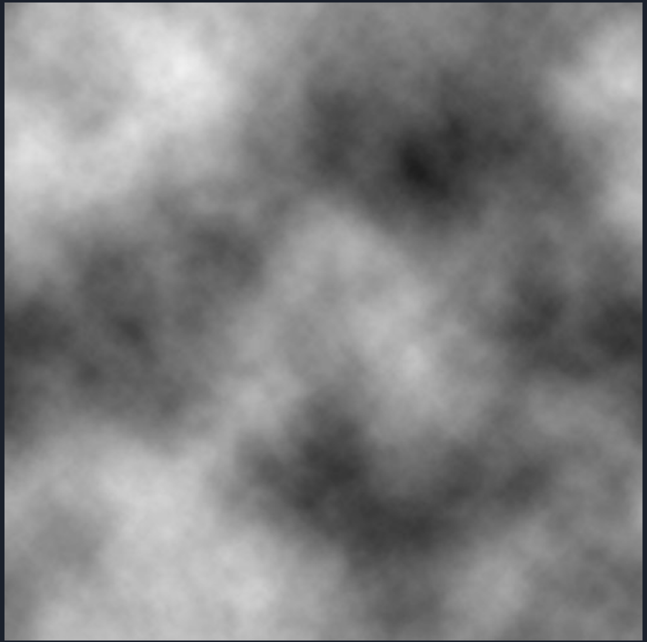
No Man's Sky

TODO 1: Generate Perlin Noise

- Create a FastNoise object
- Set noise type to “Perlin”
- Set frequency to 0.03
- Uncomment myObject.SetSeed(seed)

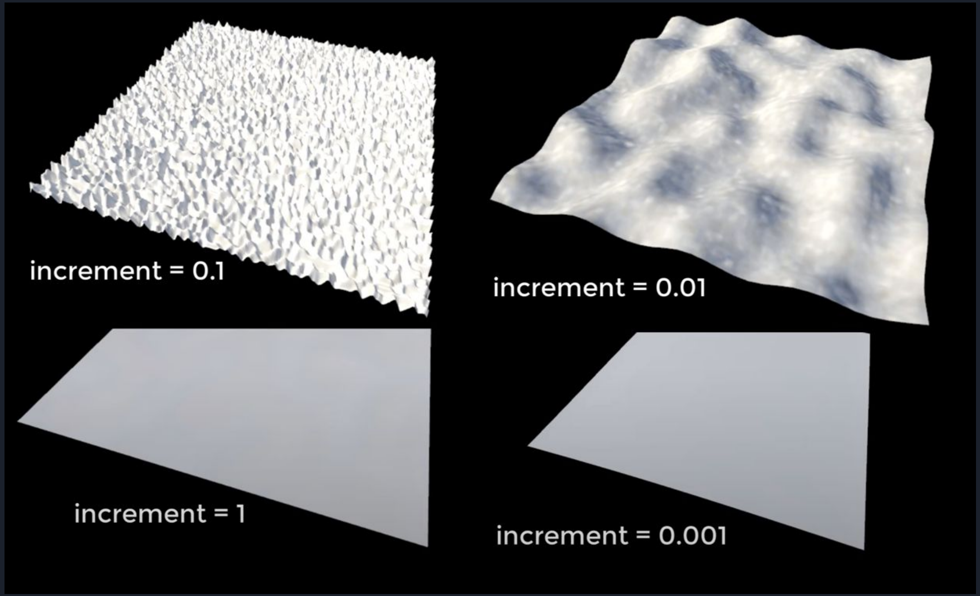
Output:

You won’t see anything on screen yet



Why set frequency as 0.03?

- To avoid problems like that
- Frequency is the same as Increment

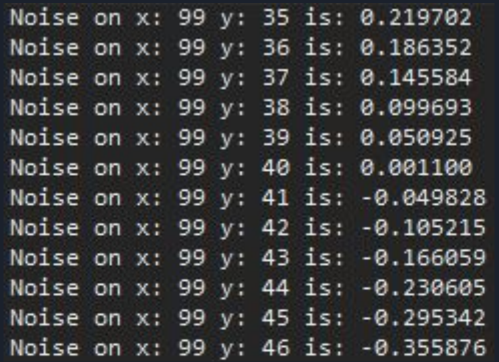


TODO 2.1: Store Perlin Noise

- We have a loop from 0-100 both in x and y
- Get noise at your desired coordinates
- Store values in “height_map” variable

Output:

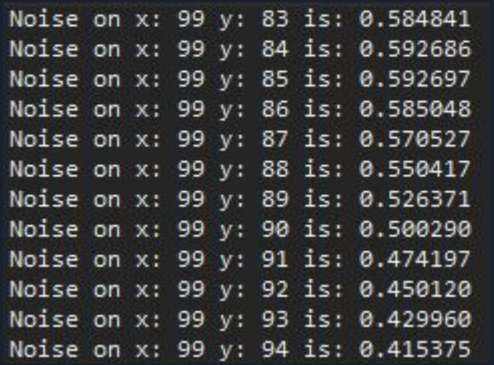
You should have an output in console with values



```
Noise on x: 99 y: 35 is: 0.219702
Noise on x: 99 y: 36 is: 0.186352
Noise on x: 99 y: 37 is: 0.145584
Noise on x: 99 y: 38 is: 0.099693
Noise on x: 99 y: 39 is: 0.050925
Noise on x: 99 y: 40 is: 0.001100
Noise on x: 99 y: 41 is: -0.049828
Noise on x: 99 y: 42 is: -0.105215
Noise on x: 99 y: 43 is: -0.166059
Noise on x: 99 y: 44 is: -0.230605
Noise on x: 99 y: 45 is: -0.295342
Noise on x: 99 y: 46 is: -0.355876
```

TODO 2.2: Adjust Perlin Noise to 0-1

- We have a problem:
  - Some results are negative
- We need to fix that!
  - Use that formula: (Noise + 1) * 0.5



```
Noise on x: 99 y: 83 is: 0.584841
Noise on x: 99 y: 84 is: 0.592686
Noise on x: 99 y: 85 is: 0.592697
Noise on x: 99 y: 86 is: 0.585048
Noise on x: 99 y: 87 is: 0.570527
Noise on x: 99 y: 88 is: 0.550417
Noise on x: 99 y: 89 is: 0.526371
Noise on x: 99 y: 90 is: 0.500290
Noise on x: 99 y: 91 is: 0.474197
Noise on x: 99 y: 92 is: 0.450120
Noise on x: 99 y: 93 is: 0.429960
Noise on x: 99 y: 94 is: 0.415375
```

Output:

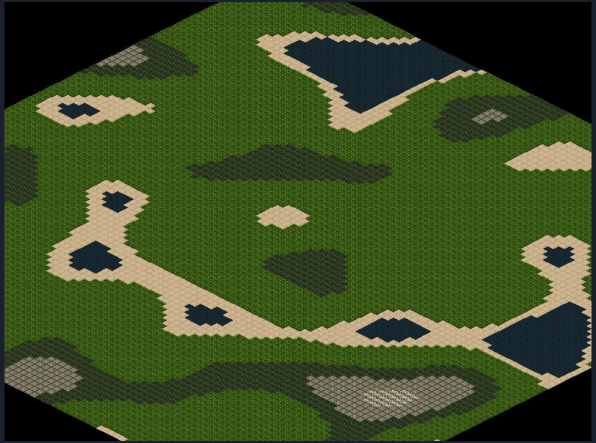
You will always have values between 0 and 1

TODO 3: Draw Map from height_map

- 0 are low areas (valleys) and 1 are high areas (mountains)
- We have different textures:
  - Water, sand, grass, forest, mountain and snowy mountain
- Blit them depending on the value
- I used
  - >= 0 water
  - > 0.35 sand
  - > 0.4 grass
  - >0.6 forest
  - >0.7 mountain
  - > 0.8 snowy mountain)

Output:

You will see exactly this same map



TODO 4: Generate a random seed

- Seeds are usually current time in milliseconds
- An example of a seed is: 1587313622000

Output:

Nothing will change

TODO 5: Use the seed

- Pass the seed as an argument to generatePerlinNoise()

Output:

The map will be different each time or if you press space

Optional Homework - Infinite Map

- Occlusion Culling - Render only what is on screen
- Generate perlin noise for all the coordinates seen in screen
    - Not only from [0][0] to [100][100] like in the TODOs
- You should be able to render an infinite map with that