

Map (Room/Terrain) Synthesis for Low-Poly 3D Scenes

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Supervisor:

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Research Group:

Interactive Graphic and Simulation Group

Introduction

- Procedural Content Generation (PCG)

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 - Manual creation can be tedious

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- Machine Learning
 - Generative Adversarial Networks (GAN)

Goal

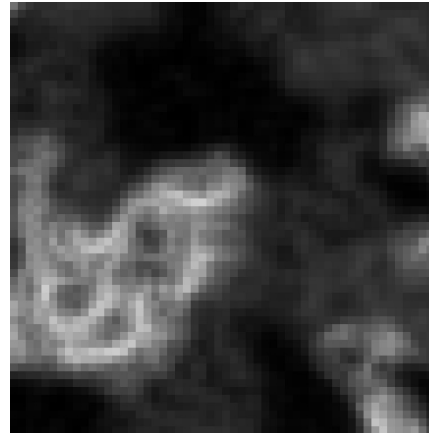


Input:
'Traversability'-Sketch

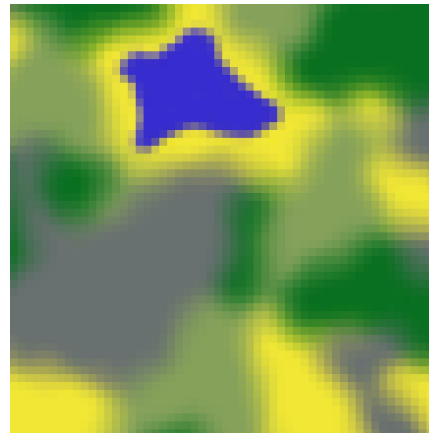
Goal



Input:
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Height-Map

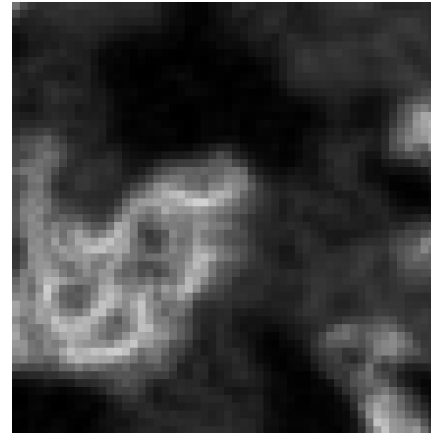


Biome-Map

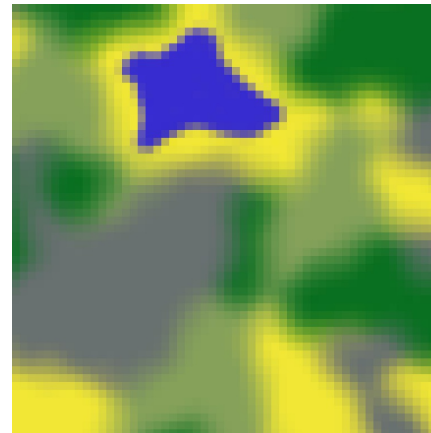
Goal



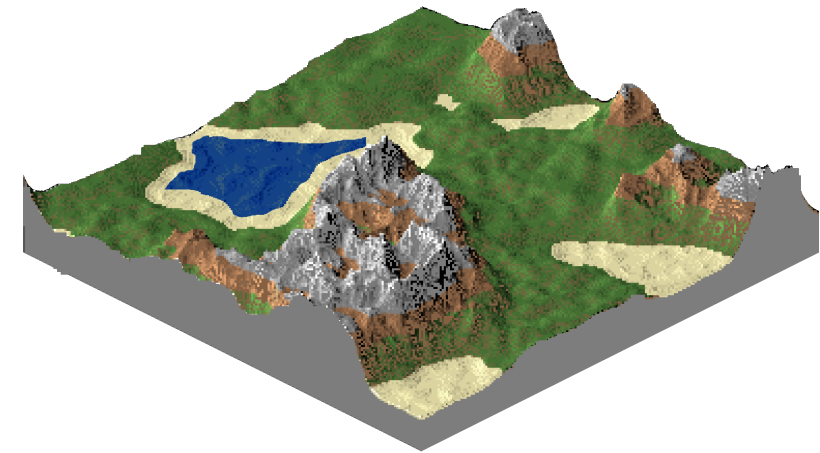
Input:
'Traversability'-Sketch



Height-Map



Biome-Map



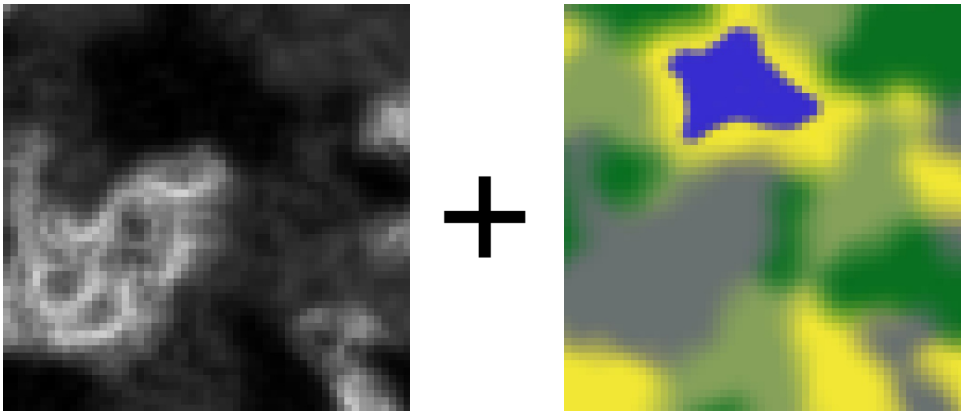
Playable Game Map

Main Tasks

- Dataset Creation

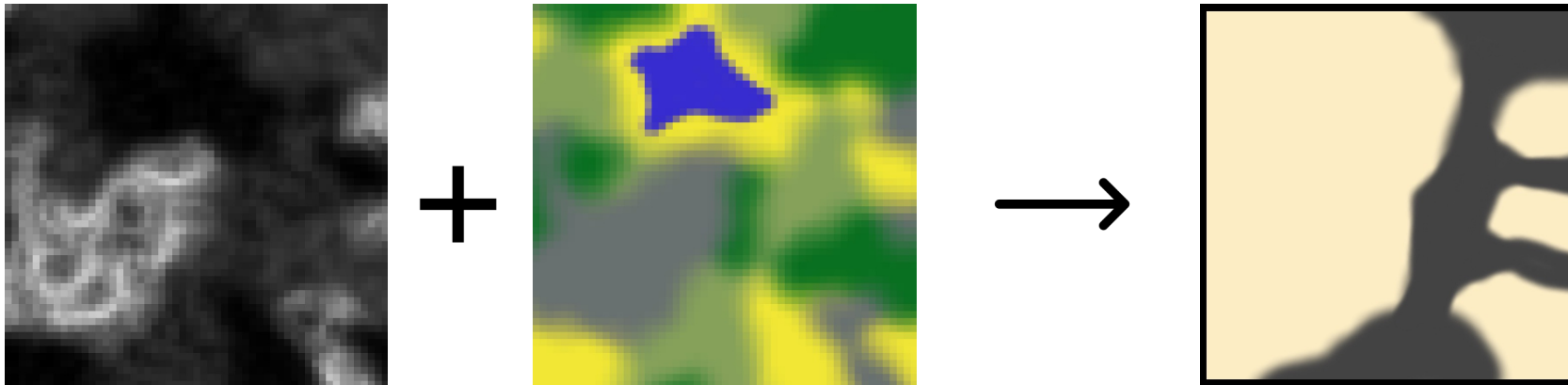
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 - Height map with a corresponding biome map



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 - Create 'traversability-map' representing training data



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- Generative Adversarial Networks (GAN)
 - Conditional GAN (cGAN)
 - Pix2Pix
- 3D Rendering of the Map

Generative Adversarial Networks

Generative Adversarial Networks

- Invented by Ian Goodfellow in 2014

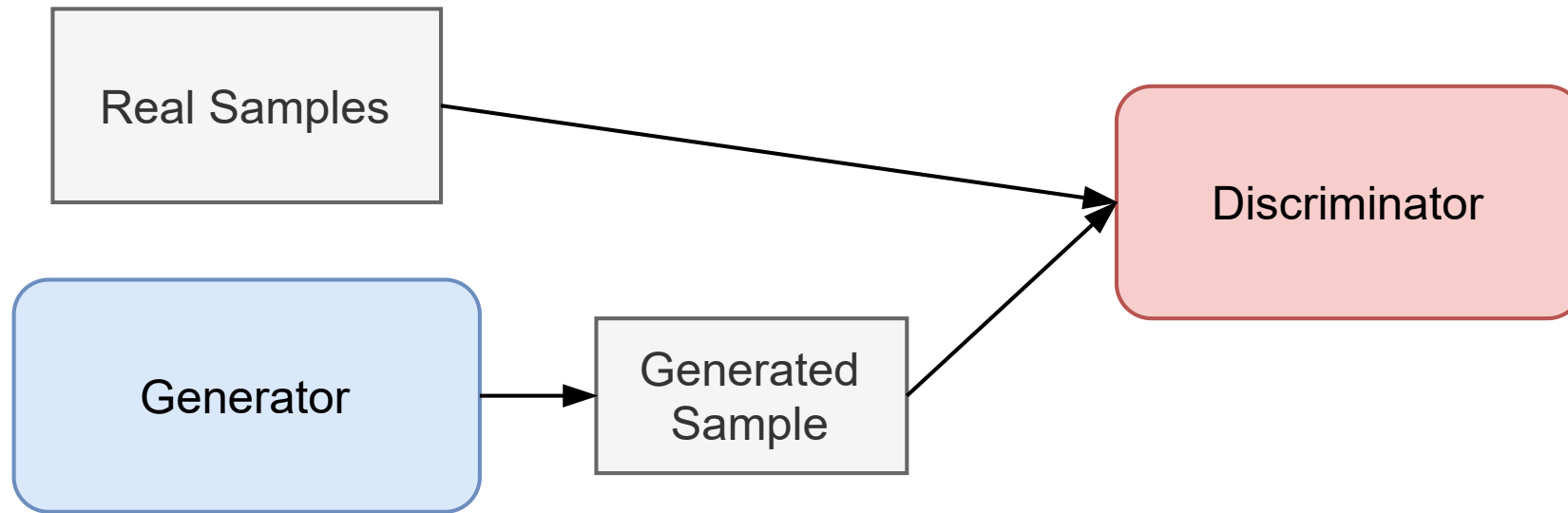
Generative Adversarial Networks

- Invented by Ian Goodfellow in 2014
- Idea: create similar but novel data

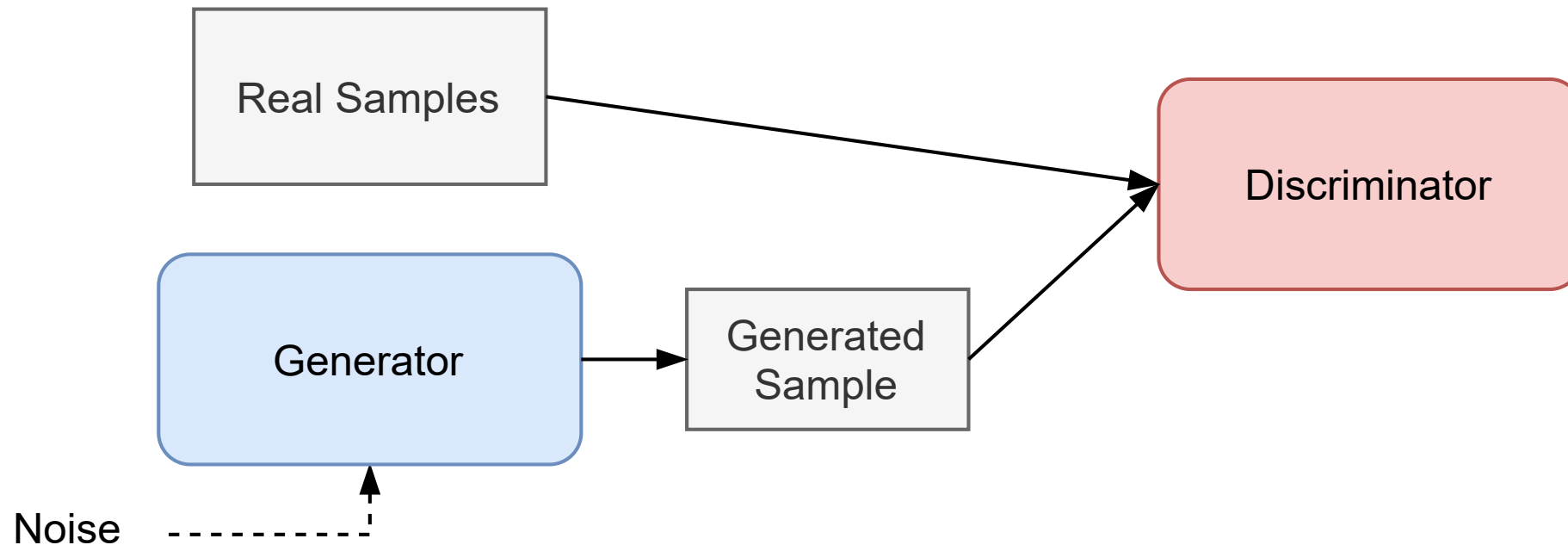
Generative Adversarial Networks

Discriminator

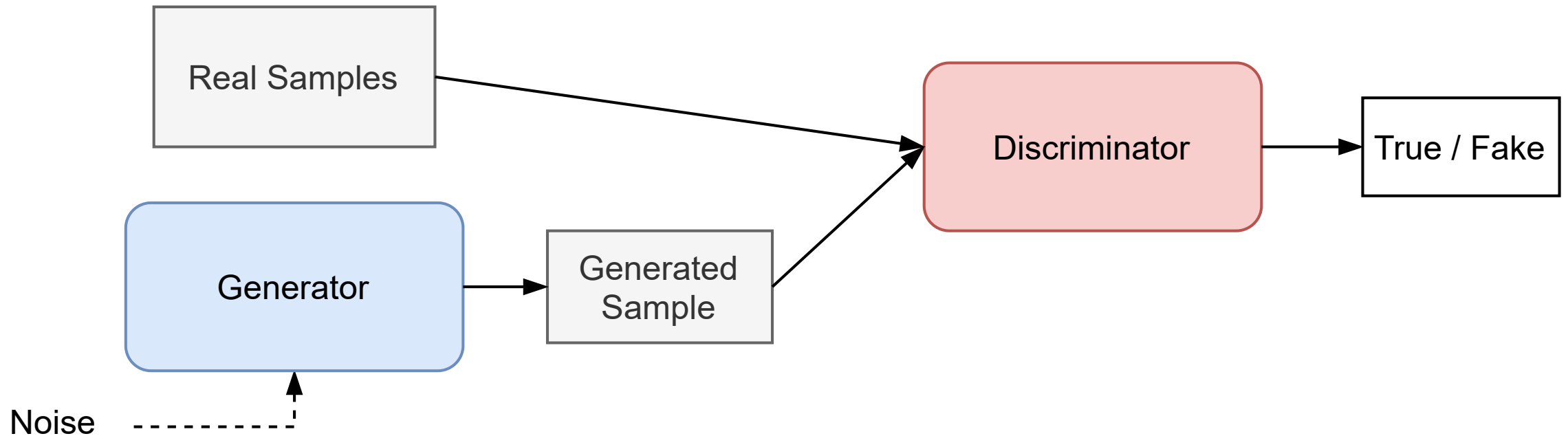
Generative Adversarial Networks



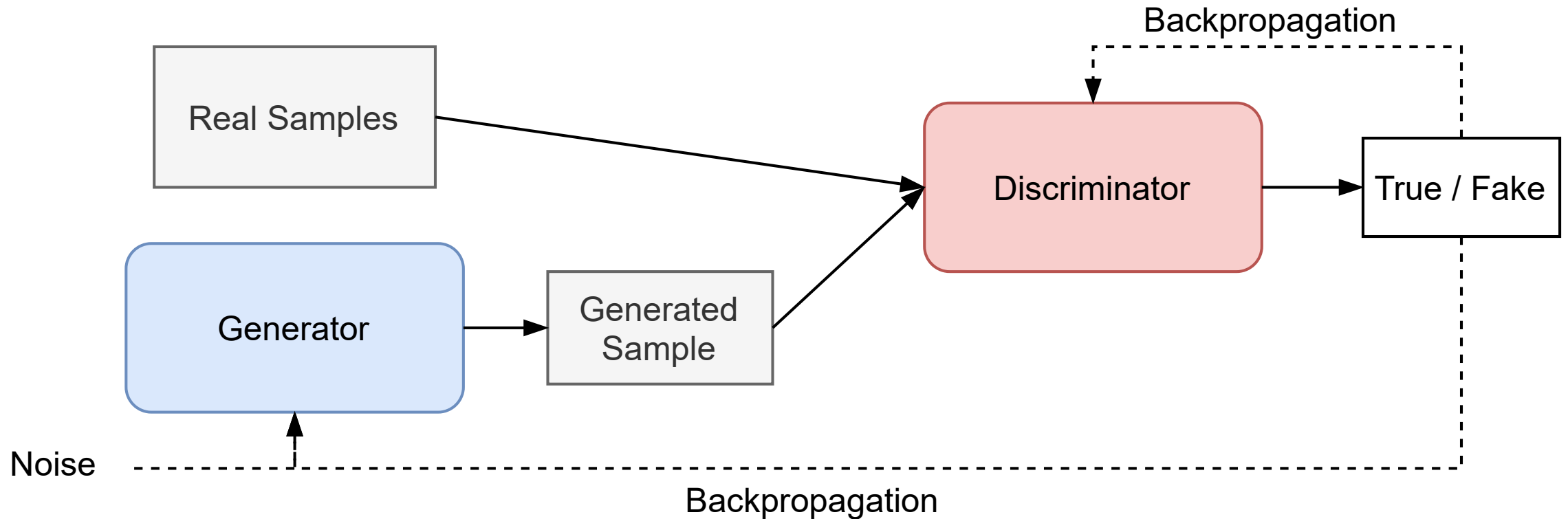
Generative Adversarial Networks



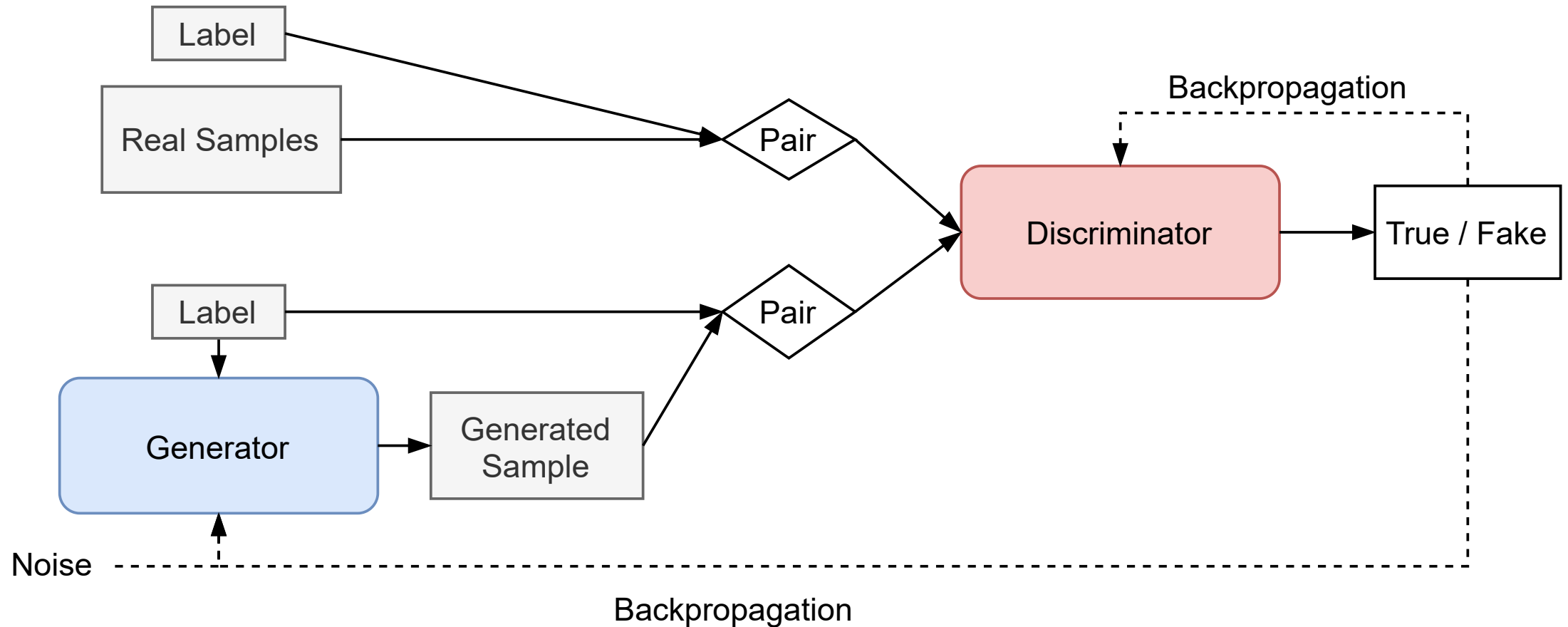
Generative Adversarial Networks



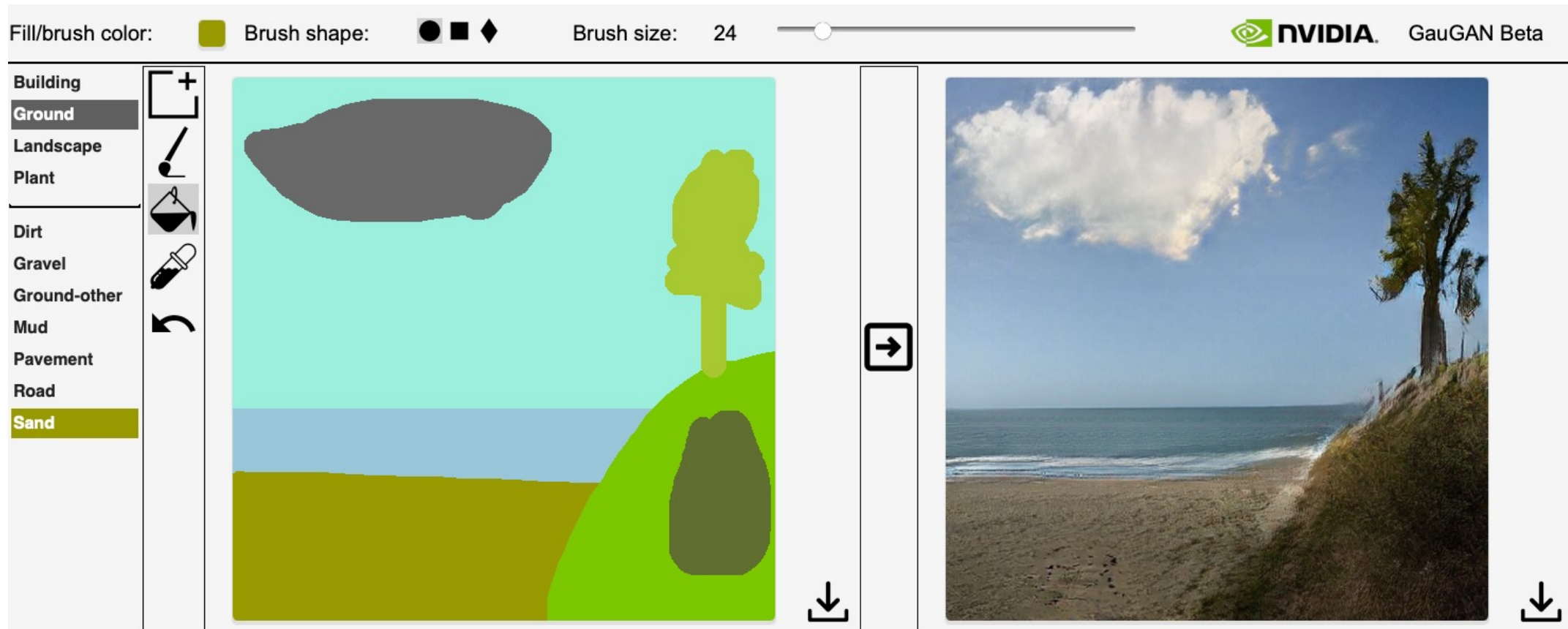
Generative Adversarial Networks



Conditional Generative Adversarial Networks

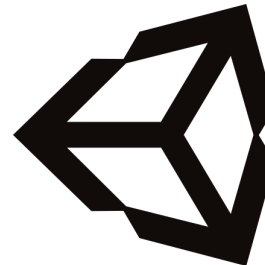


Example – Nvidia GauGAN Beta

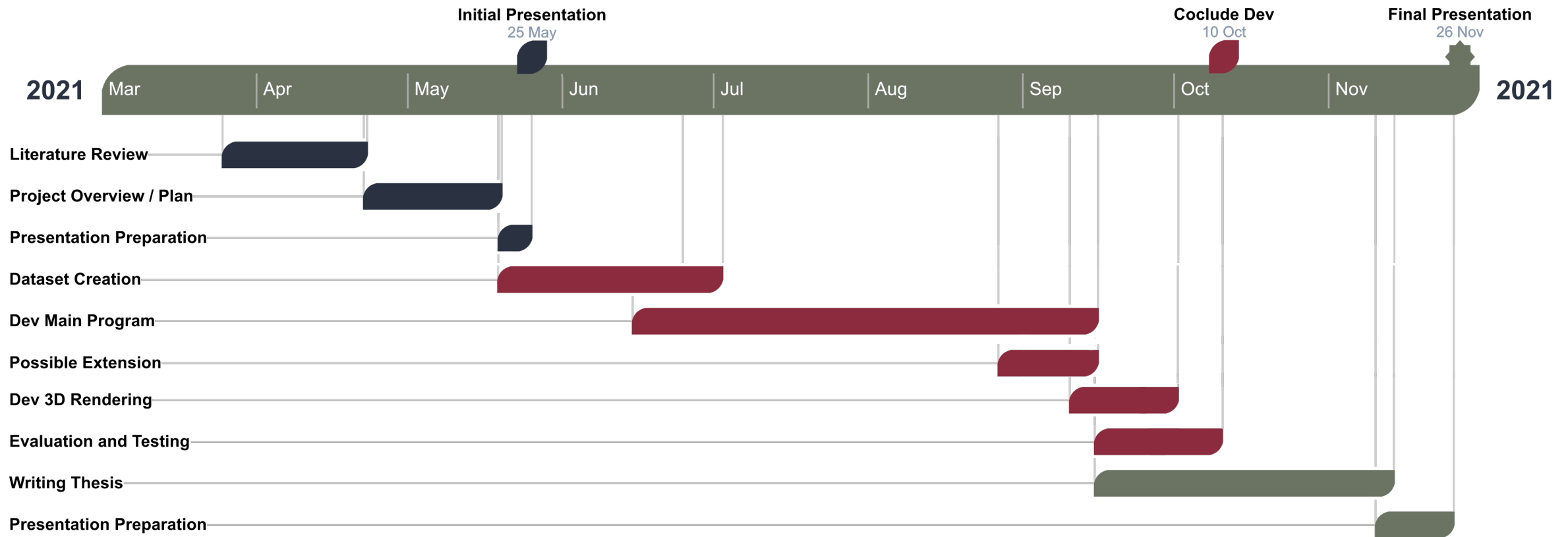


Technologies

- Programming Language
 - Python
- Frameworks
 - PyTorch
 - Tensorflow
- Rendering Software
 - Unity Engine



Timeline

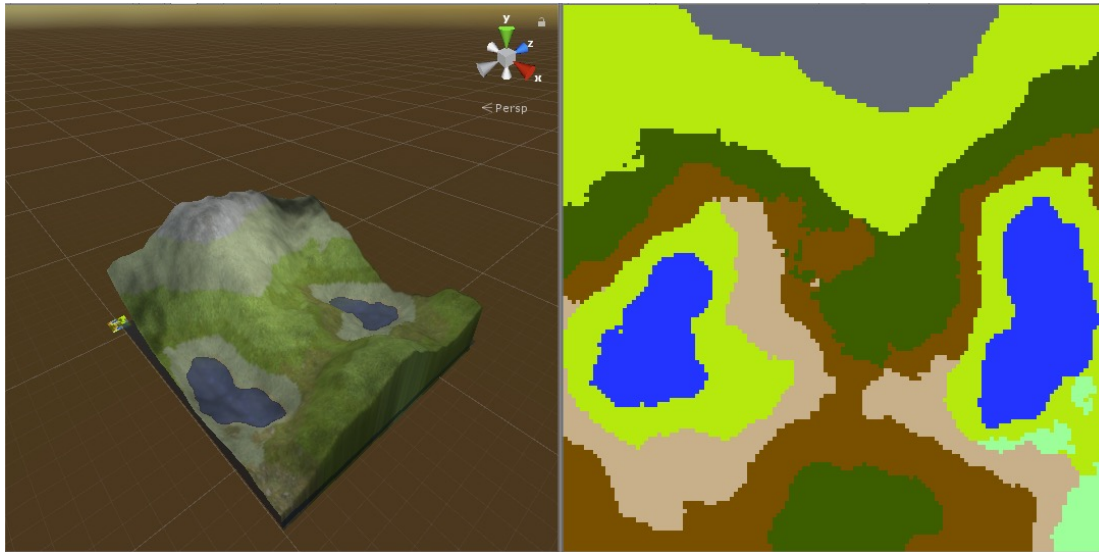


References

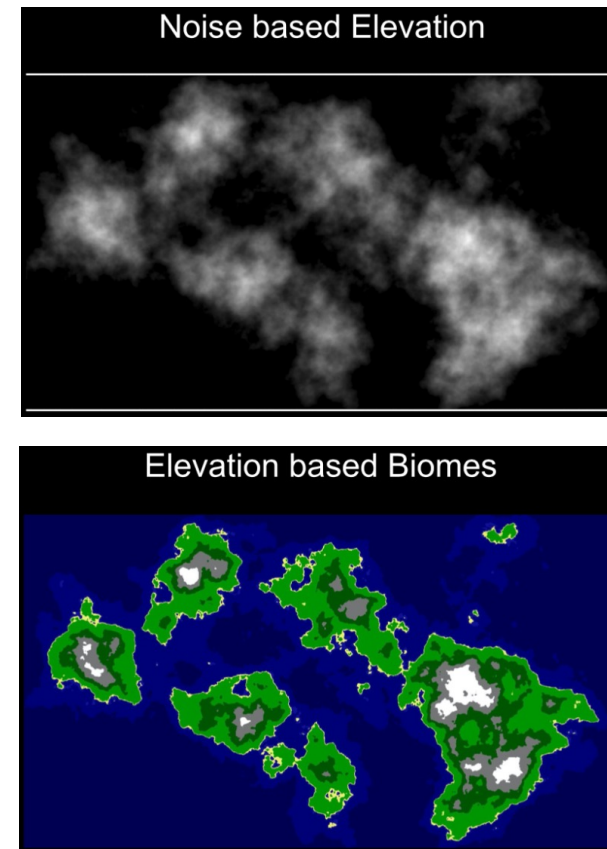
- [Liapis A., Yannakakis G.N., Togelius J. 2013] - Sentient World: Human-Based Procedural Cartography. In: Machado P., McDermott J., Carballal A. (eds) Evolutionary and Biologically Inspired Music, Sound, Art and Design. EvoMUSART 2013.
- [Ping K., Dingli L. 2020] - Conditional Convolutional Generative Adversarial Networks Based Interactive Procedural Game Map Generation. In: Arai K., Kapoor S., Bhatia R. (eds) Advances in Information and Communication. FICC 2020. Advances in Intelligent Systems and Computing, vol 1129
- [NoisePosti.ng] – A Procedural Generation and Game Development blog, *link:* <https://noiseposti.ng/posts/2021-03-13-Fast-Biome-Blending-Without-Squareness.html>
- [Nvidia GauGAN] – *link:* <http://nvidia-research-mingyuliu.com/gaugan/>
- [Tensorflow] – *link:* <https://www.tensorflow.org>
- [Python] – *link:* <https://www.python.org>
- [PyTorch] – *link:* <https://pytorch.org>
- [Unity] – *link:* <https://unity.com>

Misc – 1 Height + Biome Map

- <https://github.com/pecarprimoz/procedural-gen-dipl>

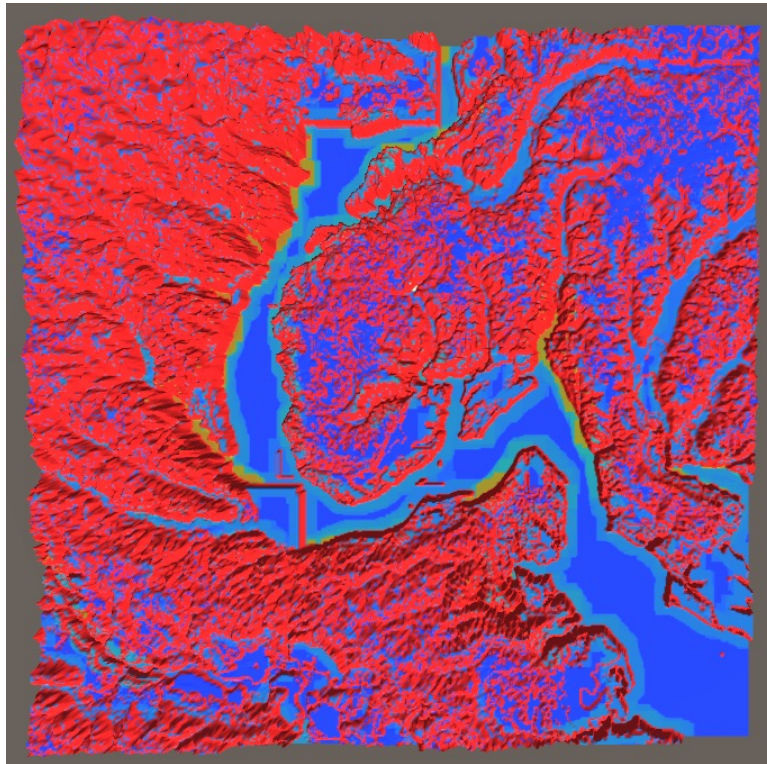


- <https://tenjix.de/projects/climate-based-biomes/>

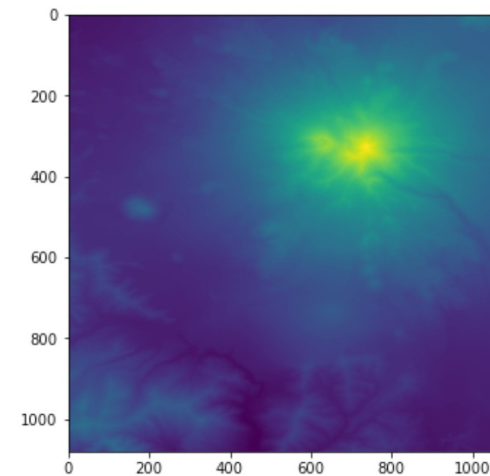


Misc – 2 Traversability Map

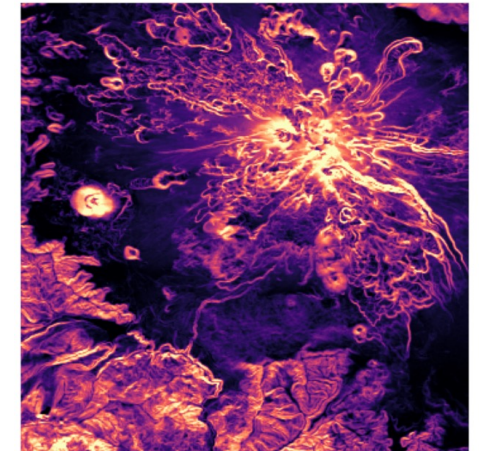
- Rough Terrain Exploration With a Legged Humanoid Robot - https://github.com/misha-savchenko/Footstep_planner



- Calculating slope and aspect from a digital elevation model in Python – Matt Oakley, Max Joseph - <https://www.earthdatascience.org/tutorials/get-slope-aspect-from-digital-elevation-model/>



Elevation (brighter = higher)



Slopes (brighter = steeper)