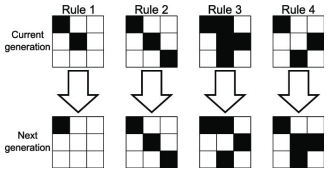
Physically-Based Simulation Project Plan: Particle level simulation of fluids with Neural Cellular Automata

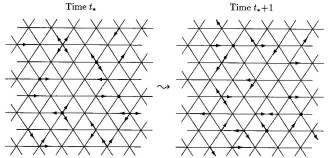
Group 14: Salimbeni Etienne Alain Jaroslav, Andrin Rehmann

Motivation

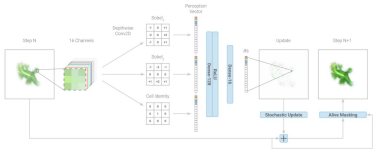
- Cellular automata are fun and interesting, they show complex behaviours through simple rules of local interactions.



- They can can simulate very simple approximations of fluids, for ex : lattice gas automata.



- We can learn the rules of such models to generate desired patterns the problem being differentiable (called Neural Cellular automata)

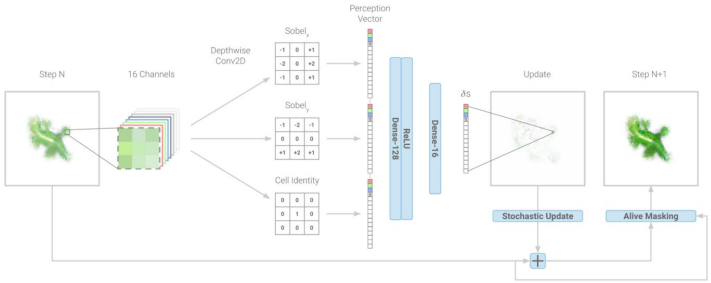


We propose for this project to learn through those neural cellular automata a simple fluid simulation (solely based on local interactions)

Simulation Methods / references

reimplement : Growing Neural Cellular Automata https://distill.pub/2020/growing-ca/

instead of using a fixed pattern, we will use precomputed 2d fluid simulations



other important related project references :

- Learning to Simulate Complex Physics with Graph Networks https://arxiv.org/pdf/2002.09405.pdf
- LAGRANGIAN FLUID SIMULATION WITH CONTINUOUS CONVOLUTIONS https://openreview.net/pdf?id=B1lDoJSYDH

Minimal Target

Teach a neural cellular automata to behave as a simplified fluid in 2d

Desired Target

Apply method to other simulations in 2d : liquids, gas, solids , etc …

Bonus Target

- Try to generalize the model s.t. different simulations can interact in the same domain
- move to 3d

Milestones

Setting up framework to generate train and test data (week 1-2)

Implement DL model (week 2-3)

Test & tweak DL model (week 4-6)

Rendering & quantitative comparision between ground truth an DL model predictions (week 6-7）