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REPORT PROJECT TWO CSE306
Free-surface 2D fluid solver using incompressible Euler's equations

In this report, we will use N to represent the number of points. I will now outline the progress made on the second project of CSE306. The entire code presented here is my original work. However, I encountered some challenges, and in those instances where I sought assistance from a specific individual or referred to a particular resource, I have provided the citation alongside the relevant code.

I. Voronoï Parallel Linear Enumeration

I have implemented the naive polygon clipping algorithm by Sutherland-Hodgman. This initial lab was mostly completed during class and should follow the professor's solution closely. It resulted in the implementation of a Polygon class, a Voronoi diagram class, and a polygon clipping function.

Here are two diagrams I generated.

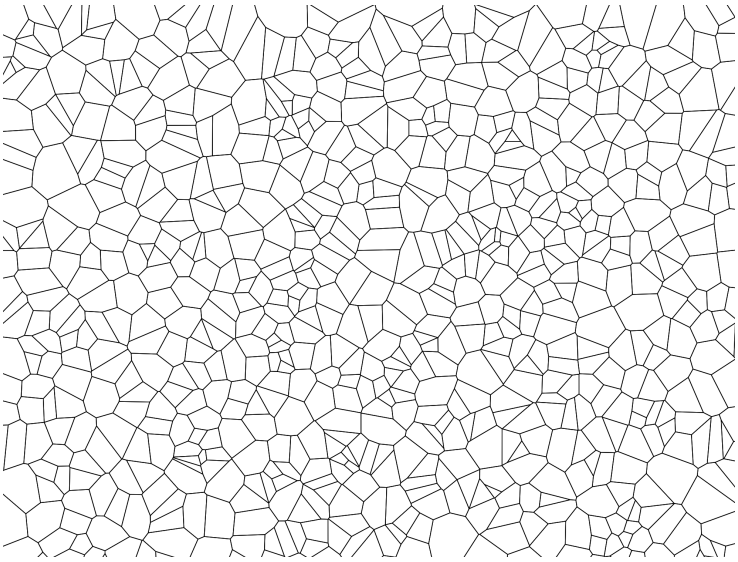


Figure 1: Voronoï Diagram generated with N= 1000 points. The generation took 3432.78 milliseconds.

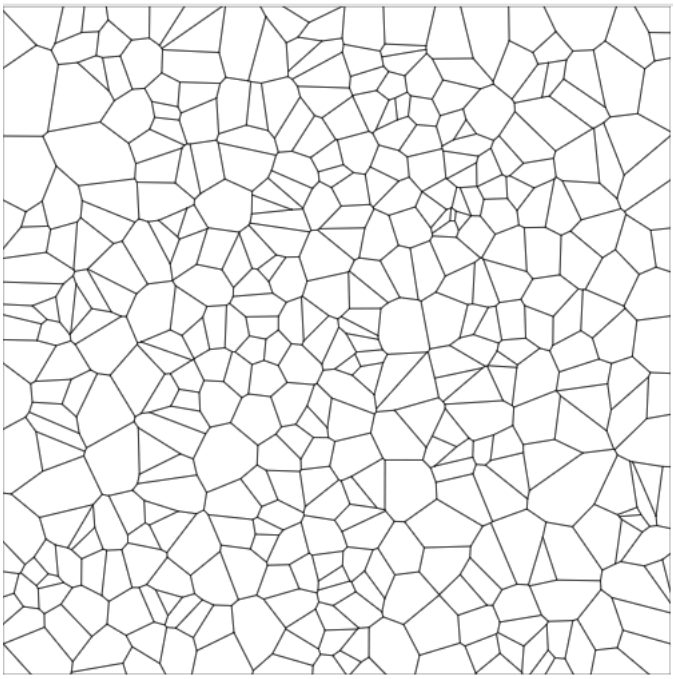


Figure 2: Voronoï Diagram generated with N= 400 points. The generation took 667.876 milliseconds.

II. Semi-Discrete Optimal Transport

I've added Power diagram functionality to my Voronoi Diagram by making some changes to the Sutherland-Hodgman algorithm. Then, I included all the necessary files for the lbfgs to function, which are located in the lbfgs folder. As a result, I implemented an "optimize" function with an evaluate function to perform the gradient descent. To test my code, I decided to set the weights as 1/N.

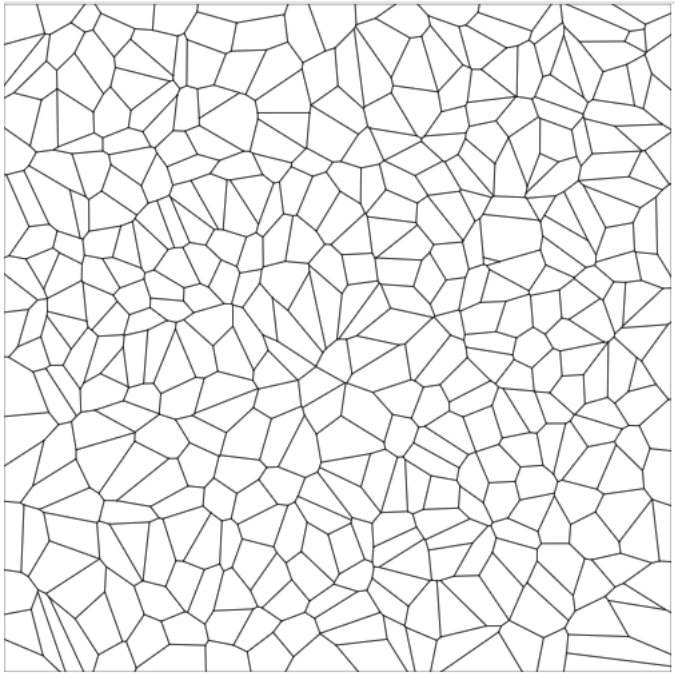
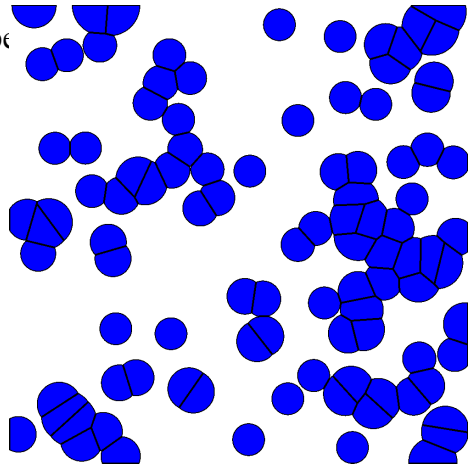


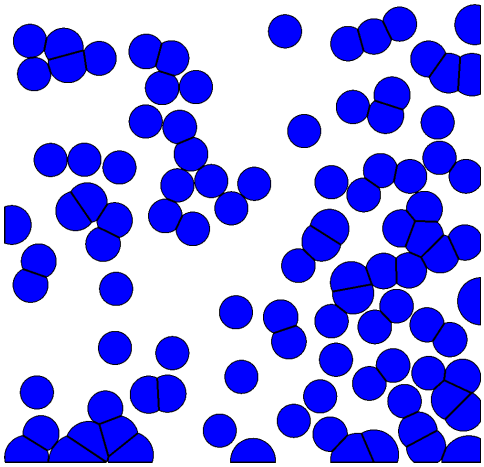
Figure 3: For weights : 1/N , N = 400, the generation took 7654.35 milliseconds

III. Fluid visualiser

I implemented a semi-discrete optimal transport fluid simulator with free surfaces. I thus changed the evaluate, compute, and optimize functions. The versions before implementing the fluid visualizer are put as comments in the code.

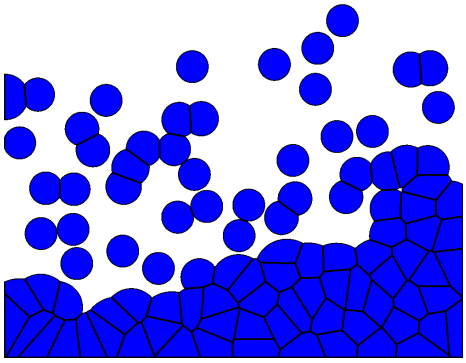
Pénélope

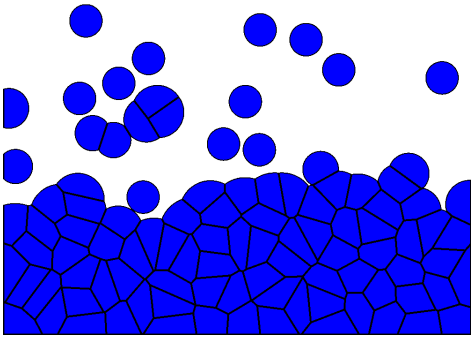




frame n1

frame n10





frame n 20

frame n40

N = 100, dt = 0.01, number of steps = 50, mass of the particles = 50, epsilon = 10^-5, volume of the air: 0.4, volume of the fluid: 0.6.
Elapsed time: 1.23657e+06 milliseconds
The corresponding GIF can be found in the repository. It is called “gen1.gif”