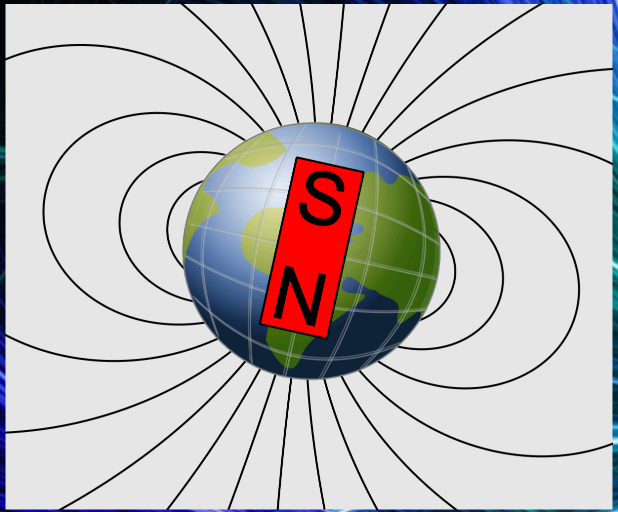
CS 184 Final Project

Tristan Cox, Isabel Daniels, Amber-Mae Skutelsky

A Two-Dimensional Magnetic Playground

We tried to simulate ferromagnetic filings interacting with a magnetic field. This proved to be incredibly difficult and computationally heavy, so instead we simulated particles reacting to a magnetic field.

Why did magnets attract us?

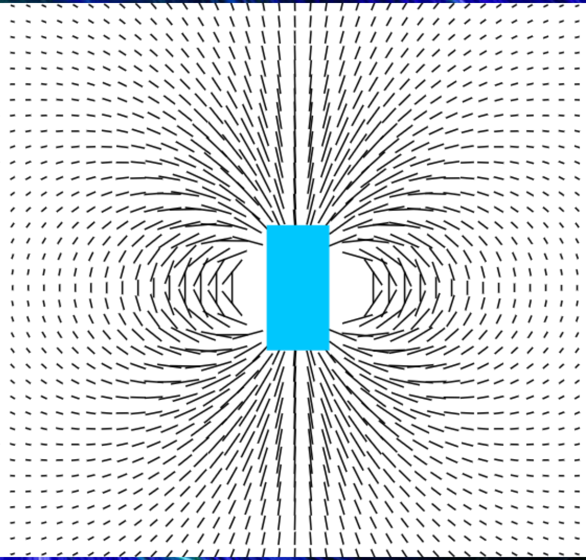


Magnetic field lines protect us and hold our world together.

A visualization of magnets and magnetic fields interacting with things around it are integral to understanding them.

We created a visualization of magnetic field lines and a simulation of particles moving through them.

We built our simulation from scratch.



DEMO

Technical Components

- Flux density and force on particles:

$$\mathbf{B}(\mathbf{r}) = \frac{\mu_0}{4\pi}\left[\frac{3\mathbf{n}(\mathbf{n}\cdot\mathbf{m})-\mathbf{m}}{|\mathbf{r}-\mathbf{r}_o|^3}\right] \quad (1)$$

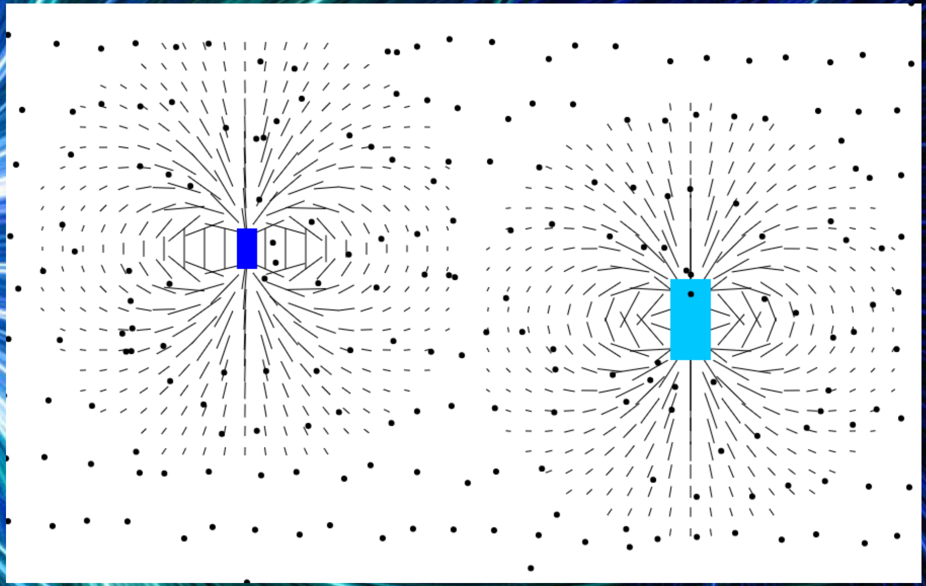
$$\mathbf{F} = \nabla(\mathbf{m}\cdot\mathbf{B}) \quad (2)$$

- Linear Interpolation to follow field lines:

$$\mathrm{lerp}(x, v_0, v_1) = v_0 + x(v_1 - v_0)$$

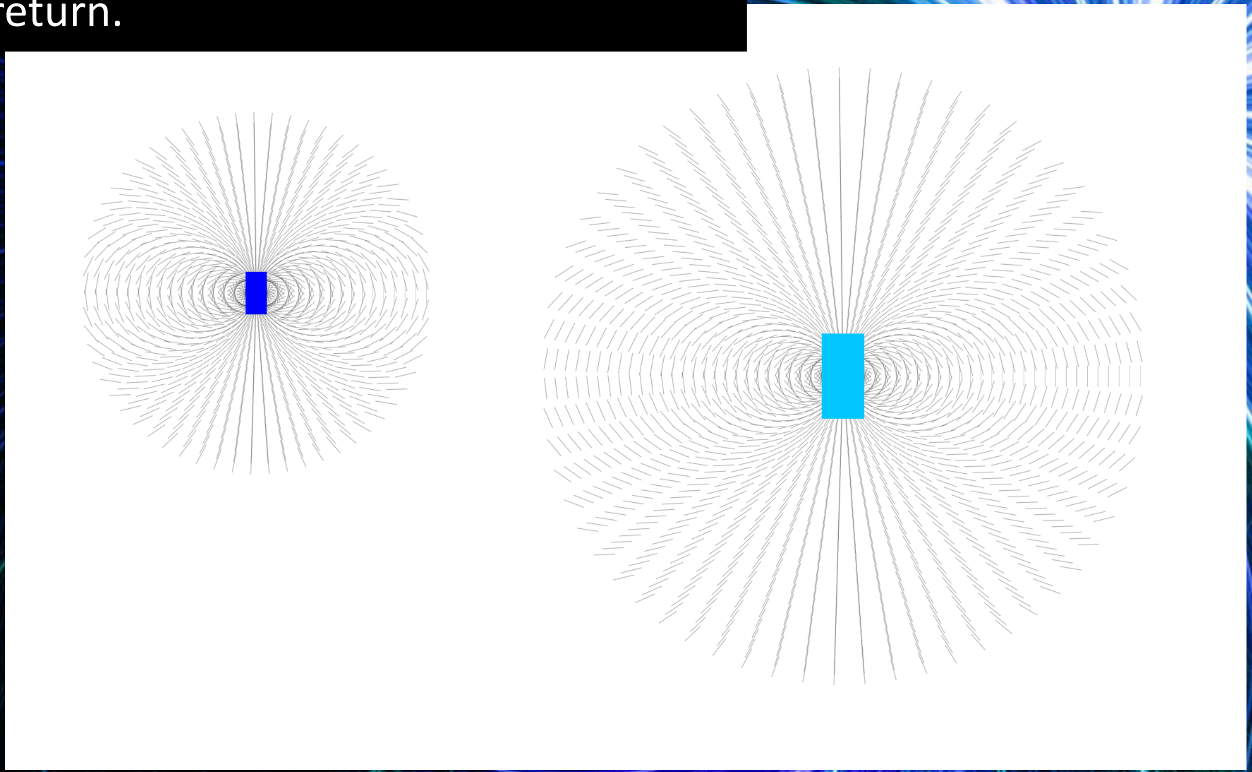
- Verlet Integration to update position:

$$x_{t+dt} = x_t + v_t * dt + a_t * dt^2$$



Optimization

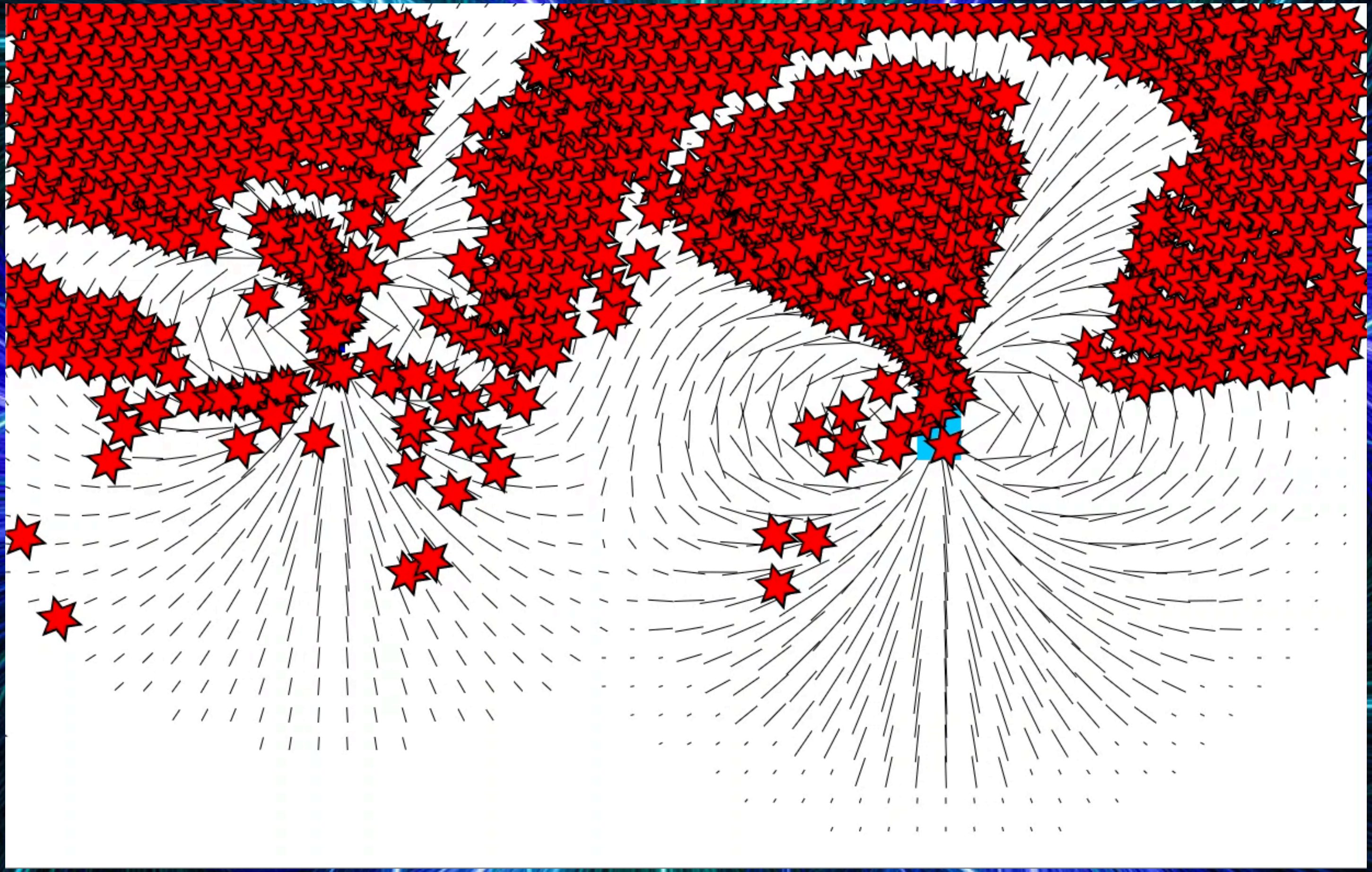
In order to speed up our code, we attempted to switch to polar coordinates. Unfortunately, our results were not as we'd hoped and we didn't get enough computational return.



Successful speedups:

- Increasing step size
- Limiting simulation to only display lines with significant strength
- Introduced a HashMap

Star-ting Point



Introducing collisions and randomizing particle starting points