



Billiard Balls!

By Jack and Will



Idea

- Every ball has a *velocity* (vector), *position* (vector), and *radius* (scalar).
- If two balls collide, we want them to deflect off each other.
- We also want to have “walls” which do not move but still deflect balls.
- Balls should be able to have arbitrary initial positions.

Problem 1: What timestep (dt) to use?

If timestep is too large, the simulation may be inaccurate. If timestep is too small, simulation is very slow.

Solution: use large timesteps, and if a collision will happen next frame, switch to small timesteps to get a “finer” result for the collision.

Problem 1: What timestep (dt) to use?

Pseudocode

> for each big timestep:

> check next timestep, see if there will be a collision

> if not, save the state and go to next timestep

> if there is collision, start back at current state and

iterate over small

timesteps:

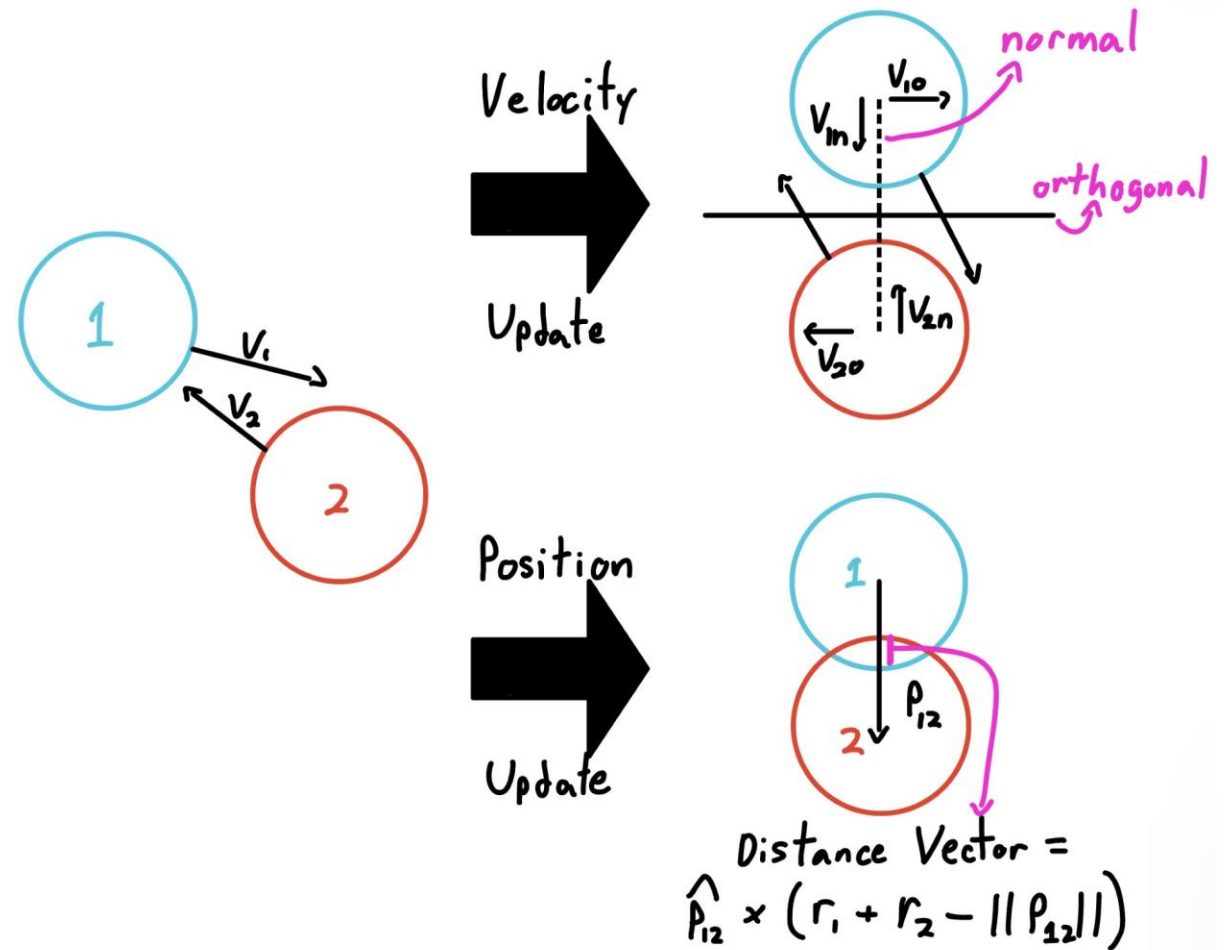
> for each small timestep:

> perform steps until collision occurs

> update position and velocities of balls accordingly

Problem 2: How to handle collisions?

To tell if two balls collided, we check if they overlap. But then they need to be moved apart before they can bounce (because in real life balls don't overlap).

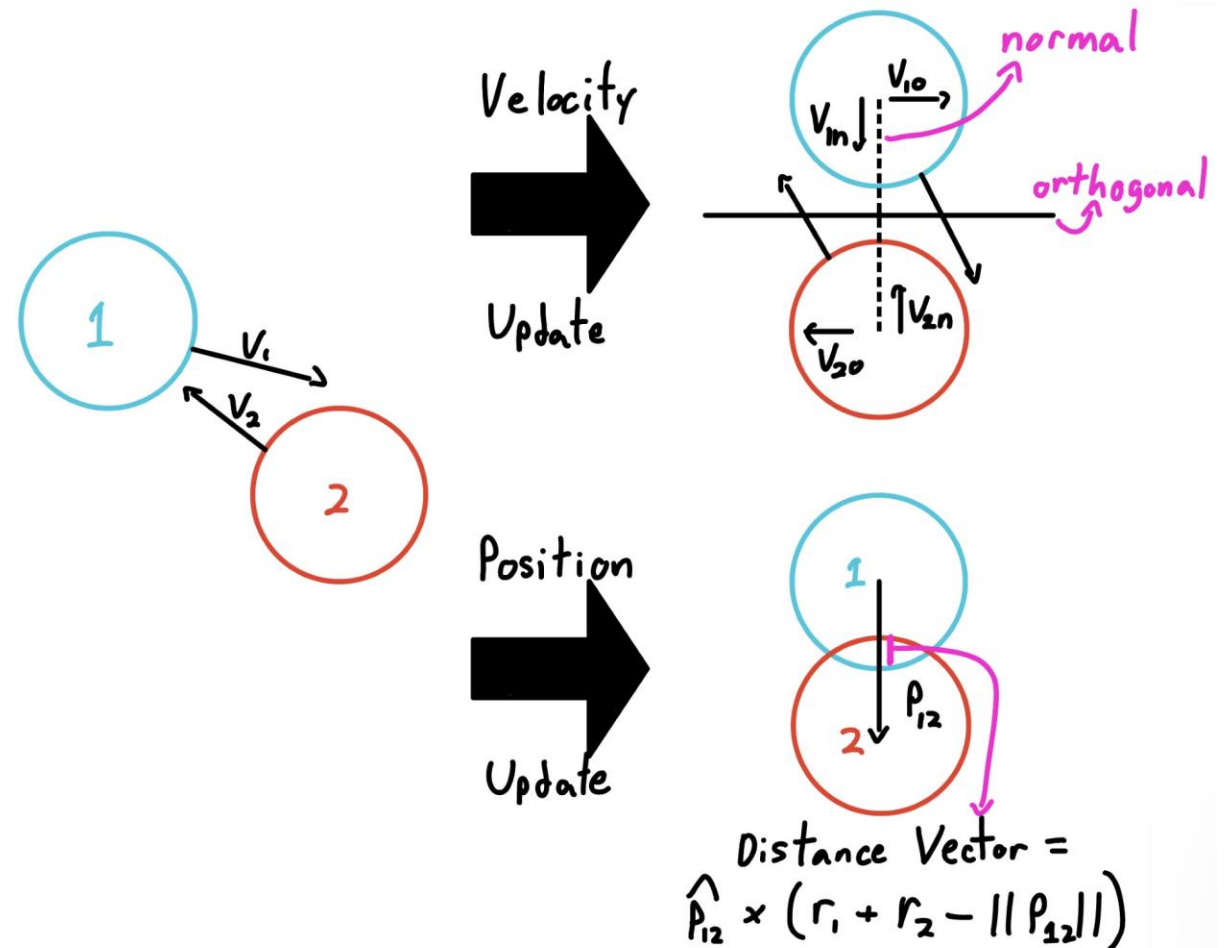


Problem 2: How to handle collisions?

Method 1: Move back only the fastest ball

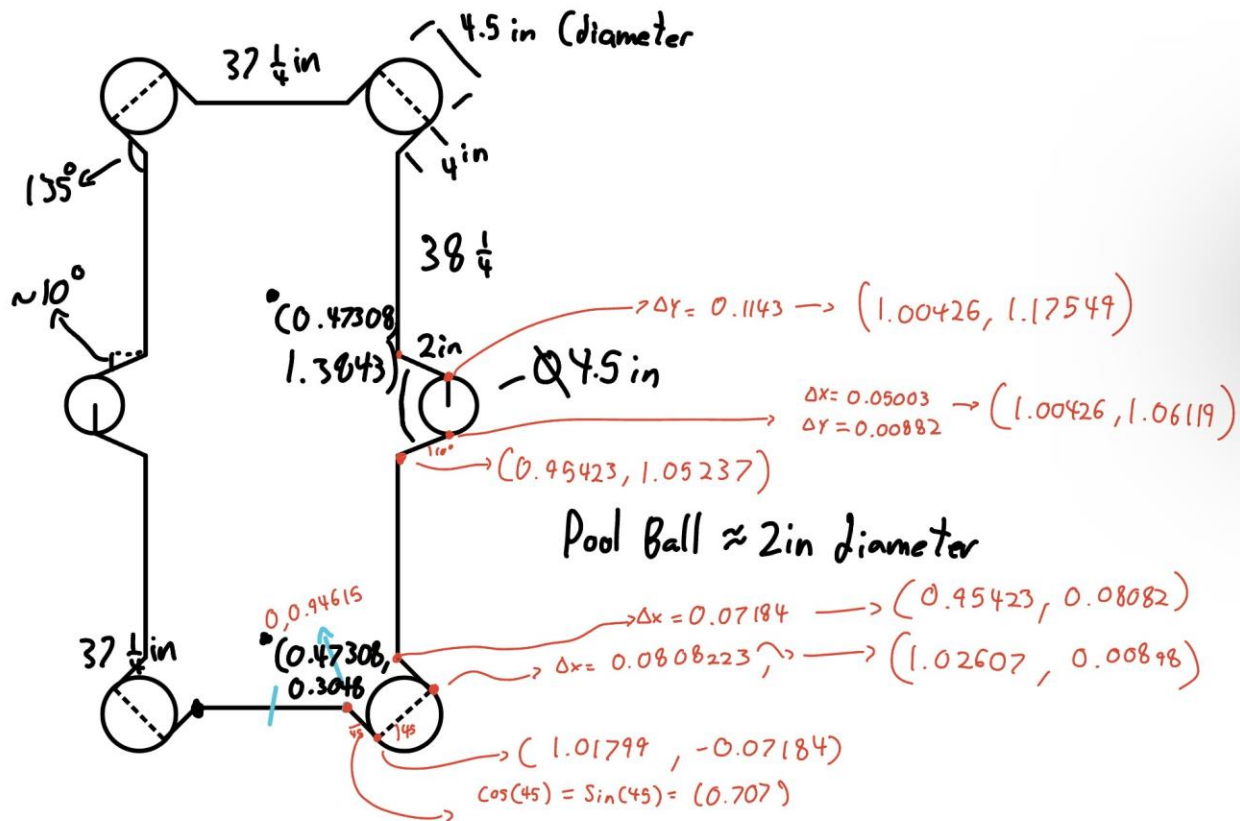
Method 2: Move both balls an equal distance apart from where they meet

Method 3: Move both balls apart from where they meet according to the ratio of their velocities



Problem 3: How to represent walls?

We tried a lot of stuff, but we settled on a list of points connected by line segments.



Problem 3: How to animate the balls?

Matplotlib has a thing for that.

- > Calculate all the states
- > for each state in the system's history:
 - > clear the plot
 - > draw dots where the balls are
 - > scale the balls to be the right size
 - > draw arrows to represent balls' velocities
 - > draw the walls
 - > pause (to control framerate)

Approximations/Assumptions used

- Perfectly spherical balls, no air resistance
- Balls have no spin
- Perfect friction
- Perfectly elastic collisions

Program Structure

