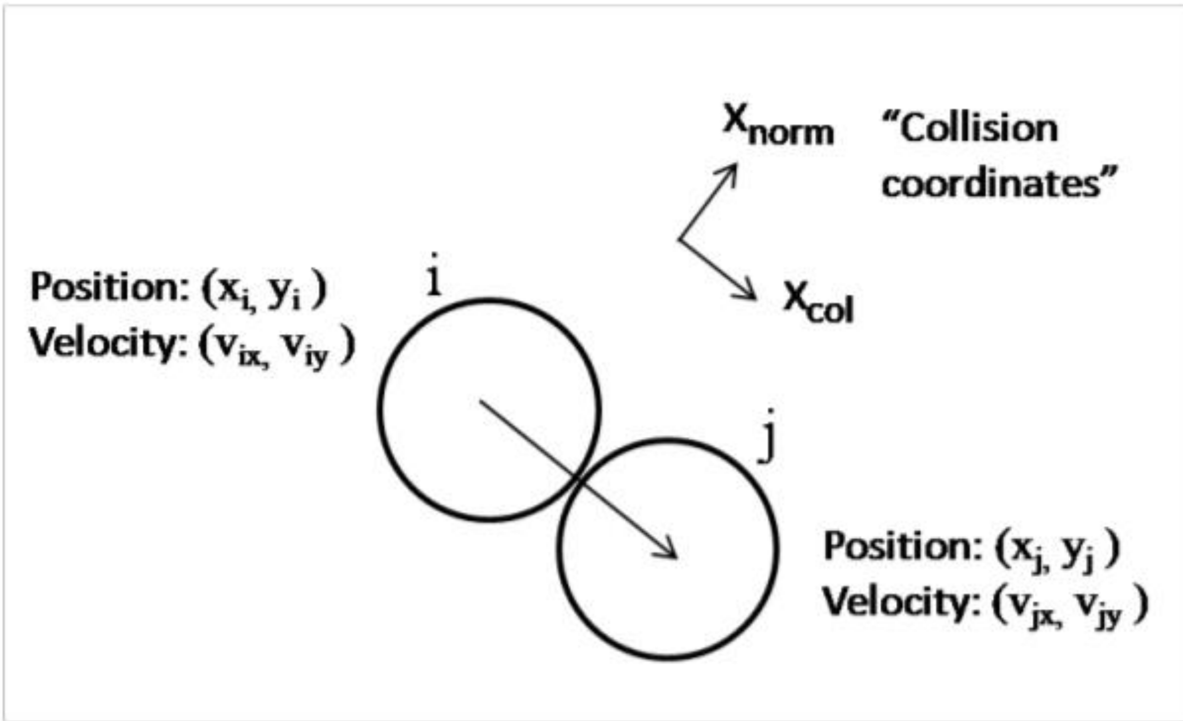
CSCI 1933, Fall 2017

Project 2: Post-collision Velocities of Two Balls in the Collide Function

In the collide function, we will need to update the velocity of both balls (ball i and ball j):



How do we find the new velocities of the balls?

The above coordinates for the positions and velocities for balls i and j are given in the x-y coordinate system we are used to dealing with. But because the Law of Conservation of Momentum dictates the post-collision velocities (which are easily calculated using the "collision coordinate" system shown in the diagram by the Xnorm and Xcol axes), we can use some linear algebra [projection] transformations to derive the post-collision velocities of balls i and j. The derivation for the following is explained in the project writeup for those interested. Finally, we get:

Ball i:

x-velocity post-collision:

$$(v_{jx}\Delta x + v_{jy}\Delta y)\Delta x - (-v_{ix}\Delta y + v_{iy}\Delta x)\Delta y$$

y-velocity post-collision:

$$\left(v_{jx}\Delta x + v_{jy}\Delta y\right)\Delta y + (-v_{ix}\Delta y + v_{iy}\Delta x)\Delta x$$

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Ball j:

x-velocity post-collision:

$$(v_{ix}\Delta x + v_{iy}\Delta y)\Delta x - (-v_{jx}\Delta y + v_{jy}\Delta x)\Delta y$$

y-velocity post-collision:

$$(v_{ix}\Delta x + v_{iy}\Delta y)\Delta y + (-v_{jx}\Delta y + v_{jy}\Delta x)\Delta x$$

Where:

$$\Delta x = \frac{x_i - x_j}{D}$$

$$\Delta y = \frac{y_i - y_j}{D}$$

$$D = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

$$x_i \; is \; the \; x - position \; of \; ball \; i$$

$$y_i \; is \; the \; y - position \; of \; ball \; i$$

$$x_j \; is \; the \; x - position \; of \; ball \; j$$

$$y_j \; is \; the \; y - position \; of \; ball \; j$$

$$v_{ix} \; is \; the \; x - velocity \; of \; ball \; i$$

$$v_{iy} \; is \; the \; y - velocity \; of \; ball \; i$$

$$v_{jx} \; is \; the \; x - velocity \; of \; ball \; j$$

$$v_{jy} \; is \; the \; y - velocity \; of \; ball \; j$$

Note:

It would be helpful to define variables in your collide function that correspond to the variables in the equations above (e.g. D, Δx, Δy, the velocities of the balls, etc.) to make your code more readable and easier to implement/debug.

Good luck!