Your software company is hired by two mad scientists to build a computer simulation of the agglomeration of water droplets in zero gravity. The desired GUI layout and functional requirements are provided in this specification. Note there is a baseline model with additional optional features that may be included, time permitting.

**Baseline Model**

The GUI must provide a mechanism to set the initial number of droplets, and their maximum starting velocities. When the simulation is started a uniformly random distribution of droplets (displayed as small circles) with random velocities are placed in a graphical display area. The droplets move in straight lines, wrapping at the edges of the display area. That is when a droplet leaves one side of the display area it reappears on the opposite side (left-to-right, or top-to-bottom) moving at the same speed.

When two droplets collide they combine into a single larger droplet whose speed is the weighted average of the two droplets and whose diameter is based on the sum of the areas of the two colliding droplets. This process continues until interrupted by the user. The total droplet count is displayed in a textbox on the main GUI screen (or as part of the graphical display).

**Optional Functions**

*Collision Monitor*- Maintain and display a list of the times between collisions in a rich textbox (with a vertical scrollbar) The units of these data should be in seconds.

*Brownian Motion*- Include a random element to the motion of each of the droplets during the simulation. The magnitude of this randomness can be set by the user. For example if the random motion parameter is set to 0.01, each droplets velocity is changed by a random 1% after each time unit (e.g. each second).
Collision Details

At the beginning of the simulation each droplet has a relative mass (i.e. area) of 1.

When two droplets $A$ and $B$ collide the mass (area) of the resulting agglomerated droplet $C$ is given by,

$$C_{mass} = A_{mass} + B_{mass}$$

The position and velocity of each droplet is expressed as a horizontal component $x$ and $v_x$ and a vertical component $y$ and $v_y$. The resulting position and velocity of the agglomerated droplet is the weighted average of the two colliding droplets.

$$C_x = \frac{(A_{mass}A_x + B_{mass}B_x)}{(A_{mass} + B_{mass})} \quad C_{vx} = \frac{(A_{mass}A_{vx} + B_{mass}B_{vx})}{(A_{mass} + B_{mass})}$$

$$C_y = \frac{(A_{mass}A_y + B_{mass}B_y)}{(A_{mass} + B_{mass})} \quad C_{vy} = \frac{(A_{mass}A_{vy} + B_{mass}B_{vy})}{(A_{mass} + B_{mass})}$$

The radius of a droplet is proportional to the square-root of the mass (area) of the droplet. For example when a droplet with mass 10 (radius = 3.16) collides with a droplet with mass 6 (radius = 2.44) the resulting agglomerated droplet has mass 16 (radius = 4).

Animation

As the user will need to interrupt this simulation, you will need to use a timer or multi-threading to implement the graphical simulation while providing interaction capability. You may choose to include a slider bar to allow the user to adjust the timer tick value in real-time to slow down or speed up the simulation.

Project Scoring

This is an 80 point project with 10 additional points possible for each of the two optional features.

Submission

Submit your project folder (zipped, zapped, and shipped) via email.