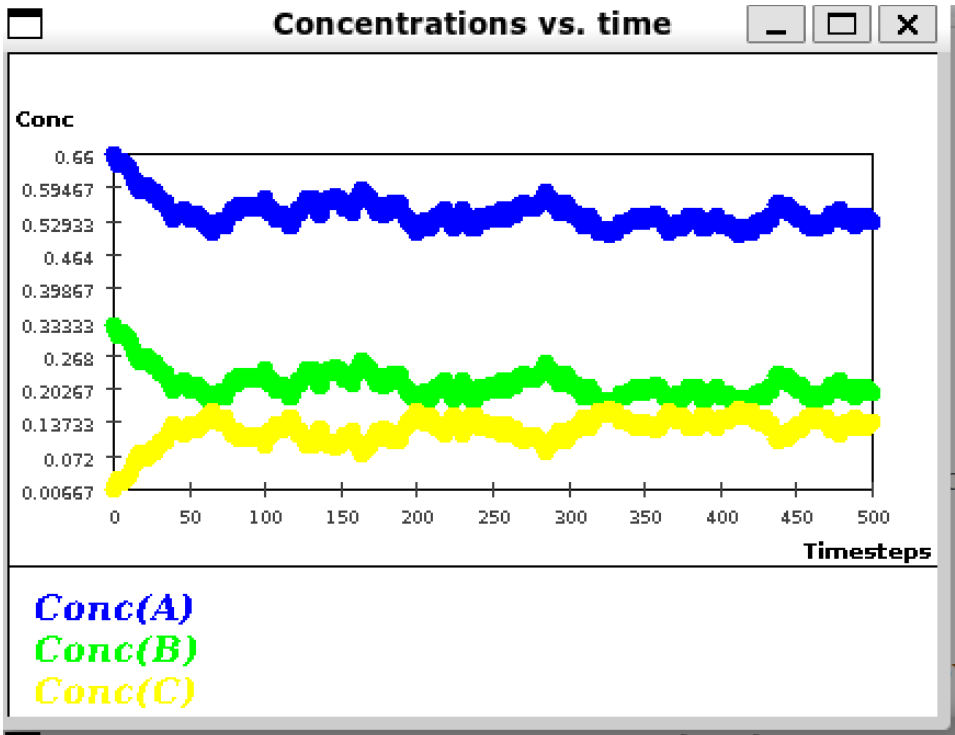
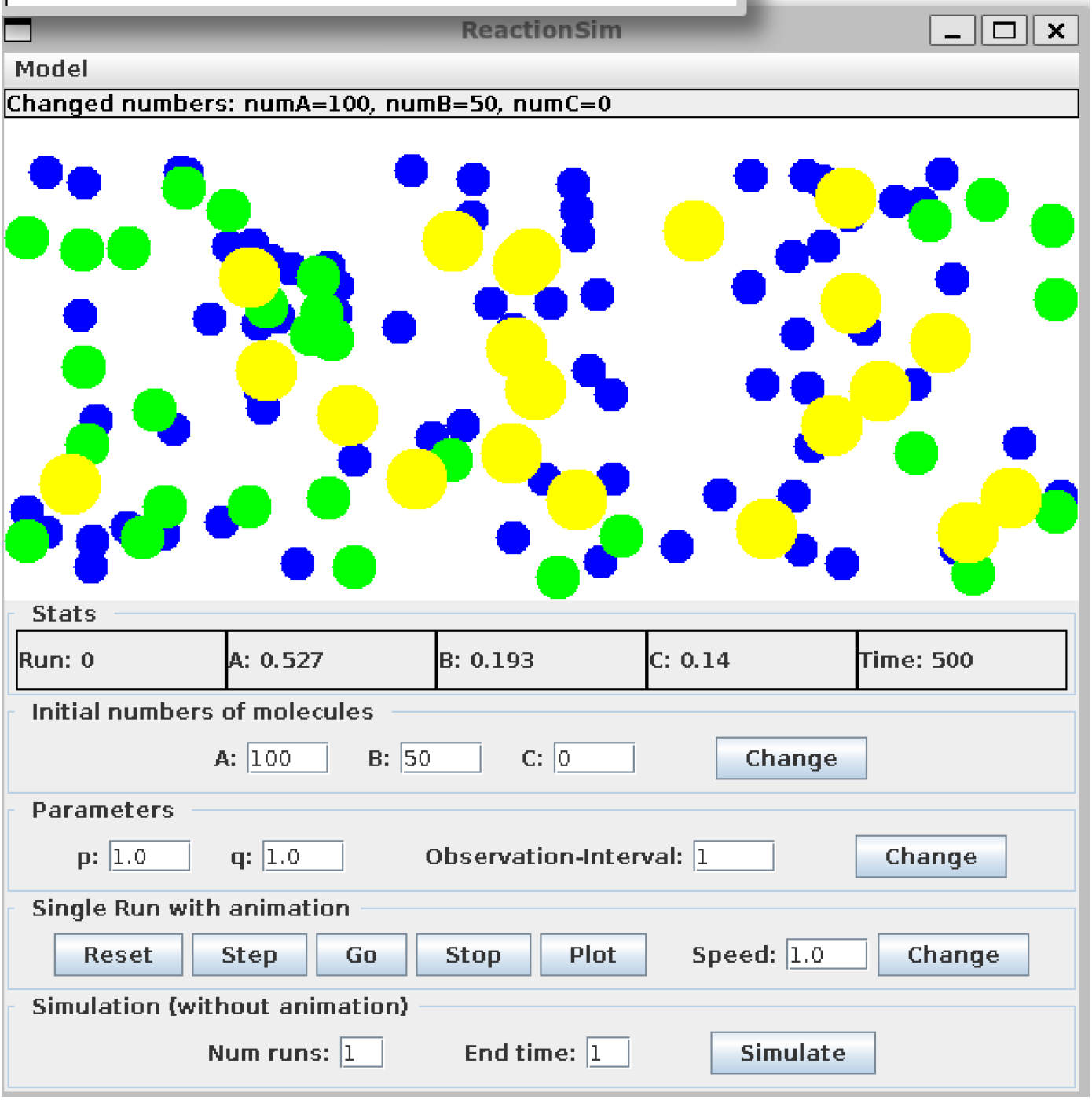
Exercise 1:



ctor. Go into that

w.



- Simulating 10000 particles seems to take three times than 100 particles to reach Time 100.

Exercise 2:

$N_A = 10$

$N_B = 5$

$V_{total} = 10 + 5 = 15$

$E_A = \frac{N_A}{V_{total}} = 0.67$

$E_B = \frac{N_B}{V_{total}} = 0.33$

- Second reaction happed at time 1
- At time1:
  - $N_A = 8$
  - $N_B = 3$
  - $N_C = 2$
  - $V_{total} = 8 + 3 + 2 * 2 = 15$
  - $E_A = \frac{8}{15}$
  - $E_B = \frac{3}{15}$
  - $E_C = \frac{2}{15}$
  -

Exercise 3:

- It settles after time 100, but small fluctuation still happening
- No they are still changing a little bit for there are in the state of dynamic balance
- $E_A \approx 0.55$
- $E_B \approx 0.25$
- $E_C \approx 0.13$

Exercise 4:

- uniform generate a random number between [0,1], if it's larger than the prob of A, then B will happen. or A will happen. So this functions well as appropriate probabilities
- It just use the distance to choose which pair of A,B particles to remove when generation a particle C

Exercise 5:

- I see that the concentration of C is higher than the non-spatial model, more fluctuation maybe caused by more randomness introduced by the spatial information.
- The curve become more smooth
- It become much more smooth
- In standard simulation, increasing num runs also make the curve smoother

Exercise 6:

55.667

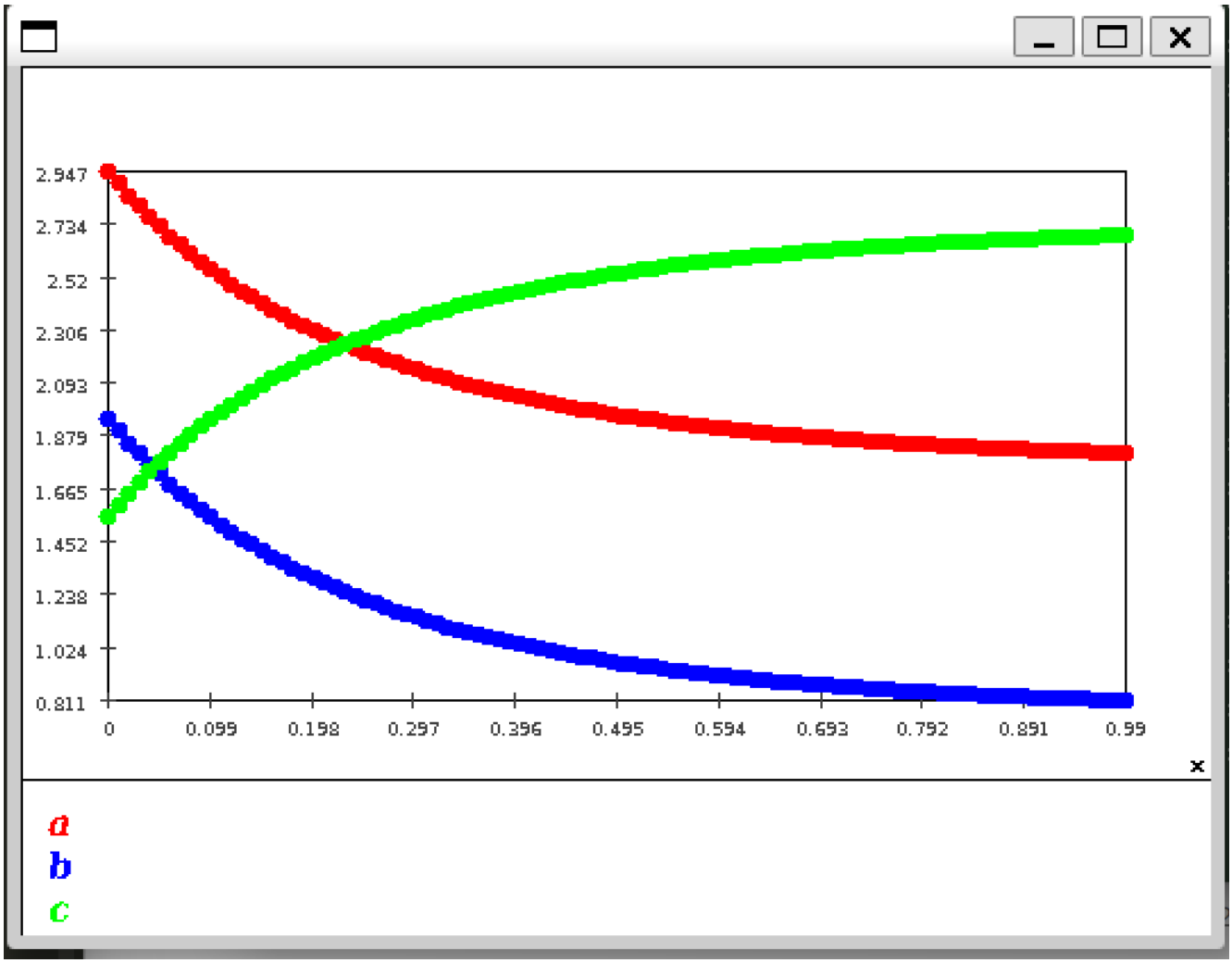
Exercise 7:

- the concentration is actually the distance between particles, so it works just fine using this setup
- `closenessDistance` is set for the spatial model. Doubling this parameter functions the same as doubling the concentration of particle A and B.

Exercise 8:

- A(0.01) = 2.947 B(0.01)=1.948 C(0.01) = 1.552
- A(0.02) = 2.898 B(0.02)=1.898 C(0.02) = 1.602
- A(0.03) = 2.851 B(0.03)=1.851 C(0.03) = 1.649

Exercise 9:

- final concentration
  - A(1) = 1.811
  - B(1) = 0.811
  - C(1) = 2.689
- 

Exercise 10:

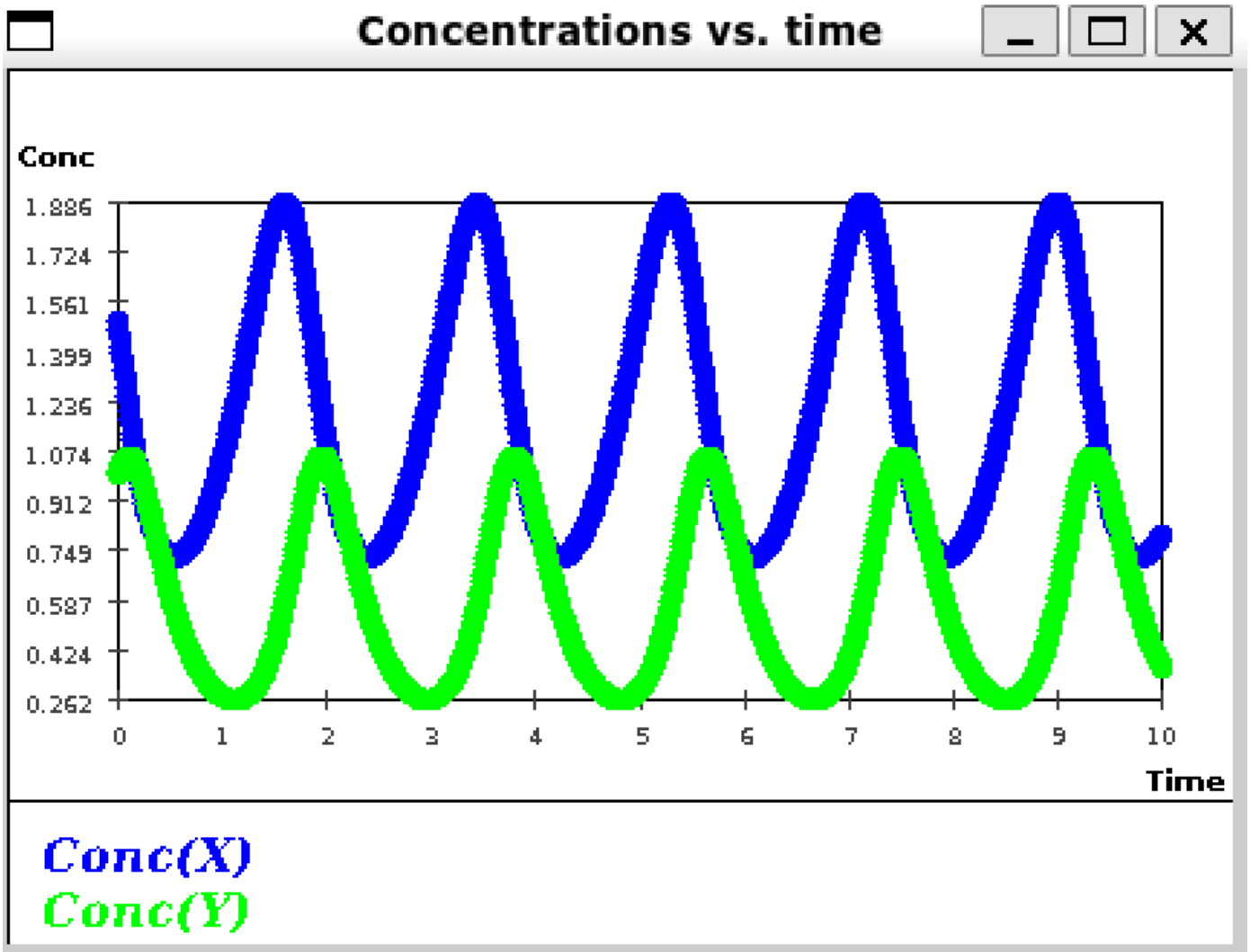
see `ConcCalc2.java`

The need for arithmetic operation is on the same level as the iterative one.

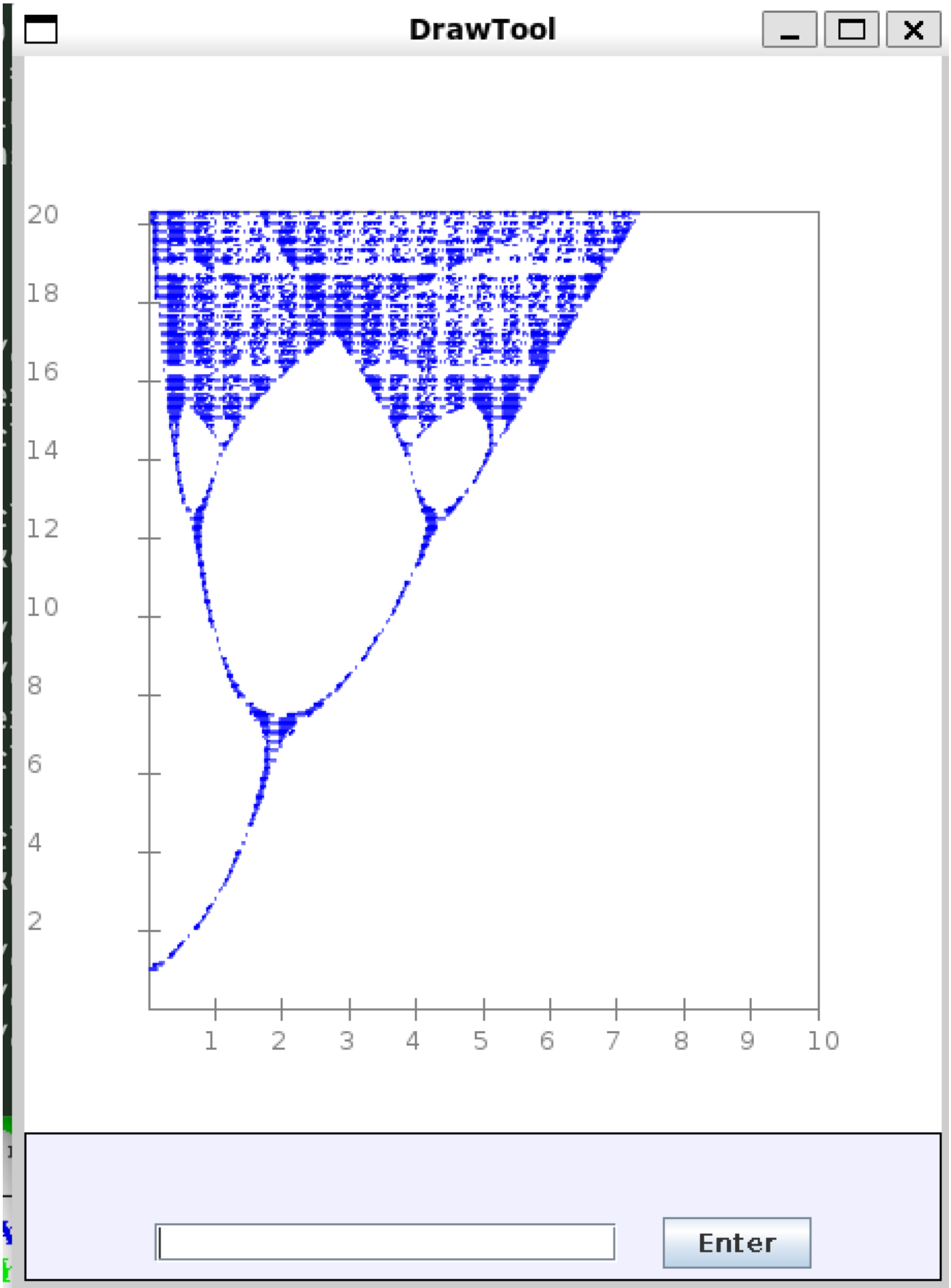
Exercise 11:

- Angular momentum makes ball goes a little east wards
- Coriolis force makes the ball goes a little south(AS it happens in the northern part of the earth)
- So it should be south-east

Exercise 12:



Exercise 13:



Exercise 14:

- TragetX = 10
- $M_x^{'} = vy = 20$
- $M_y^{'} = MissileAY = 3$

- Involved variables
    - TargetVx
    - MissileVx
    - MissileAy

Exercise 15:

For a small Δt, $CC' = \frac{1}{2}(AA' + BB') = \frac{1}{2}R(w_L + w_R)\Delta t$

And if we want to sperate CC' into difference of x and y,

Then we can simply apply cos(θ)CC' to get it's difference on x axis and apply $sin(\theta)CC'$ to get it's difference on y axis. Then we get the differential equations same as above.

Exercise 16:

$w_L R\Delta t$ is the distance difference on the circle. And L is the current radius(for the other wheel is not moving. So If we want the $\Delta\theta$ we can simply divide difference on the circle by radius.

Thus we get $\Delta\theta = \frac{w_L R\Delta t}{L}$

Exercise 17:

```
func simulate_next(x double,y double, t double, theta double, va double, vb double){
    //cal new x,new y, new theta based on old values
    new_x = x + 0.5*R*(va+vb)*cos(theta) * t;
    new_y = y + 0.5*R*(va+vb)*sin(theta) * t;
    new_theta = theta + (va-vb)*R/L*t;
    return new_x,new_y,new_theta;
}
```

Exercise 18:

For accelerative version, We will need the equations for $w_L \; and \; w_R$ For we don't know current angular speed if we just look at acceleration of these two wheels.

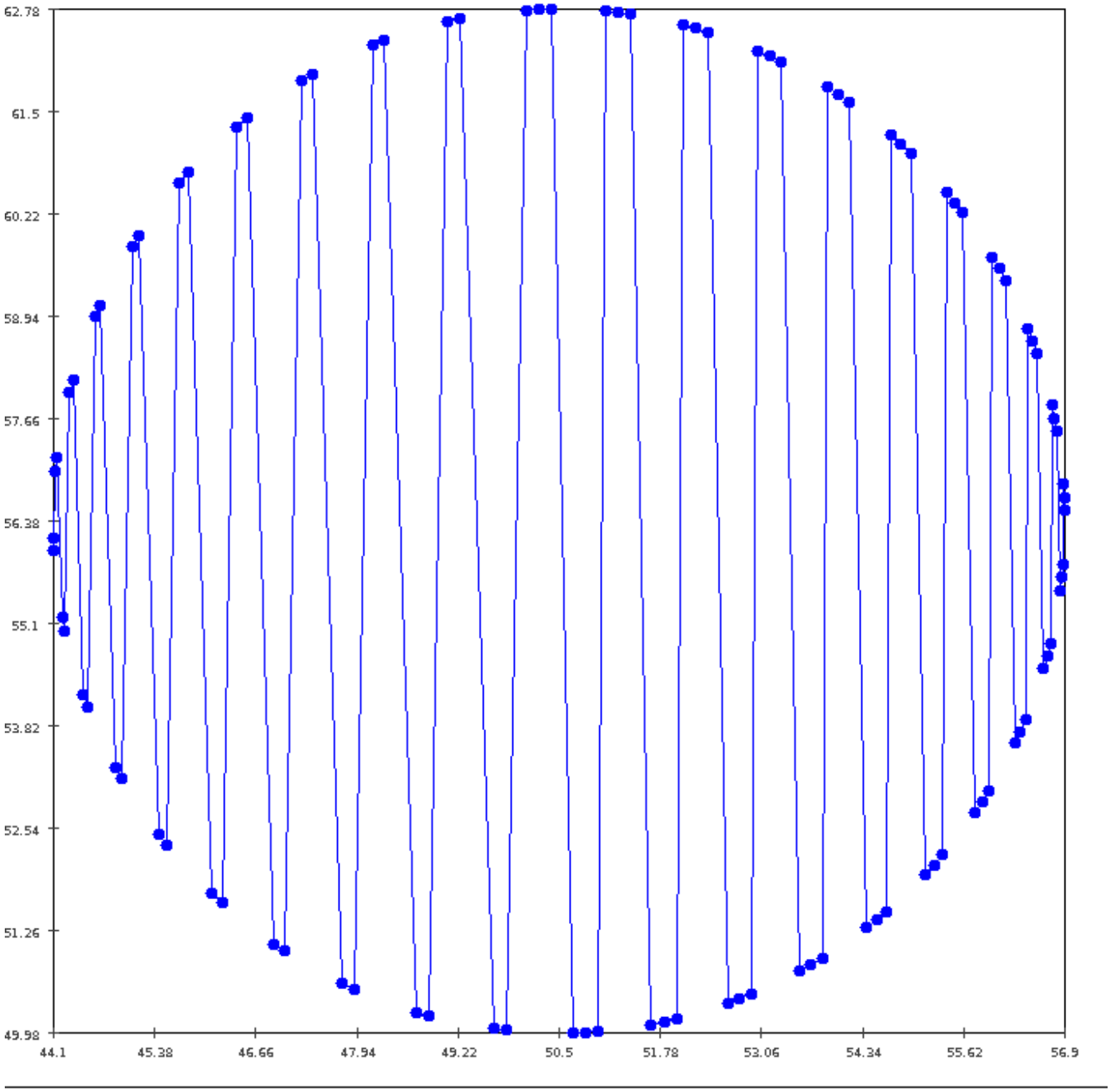
Exercise 19:

$x'(t) = v\; cos(\theta)$

$y'(t) = v\; sin(\theta)$

$\theta'(t) = \phi$

Implementation see `SPTest.java`, `SimpleCarSimulator.java`



Exercise 20:

Angular acceleration * Radius = linear acceleration

Exercise 21:

- `angularAcc = (torque - m*g*R) / (m*R*R + mw*R*R);`
- No there isn't, any positive torque will cause the load to collide with the winch.

Exercise 22:

The load were frictionless so any positive torque will be able to pull the load.