HPC Answers

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1 Question 8

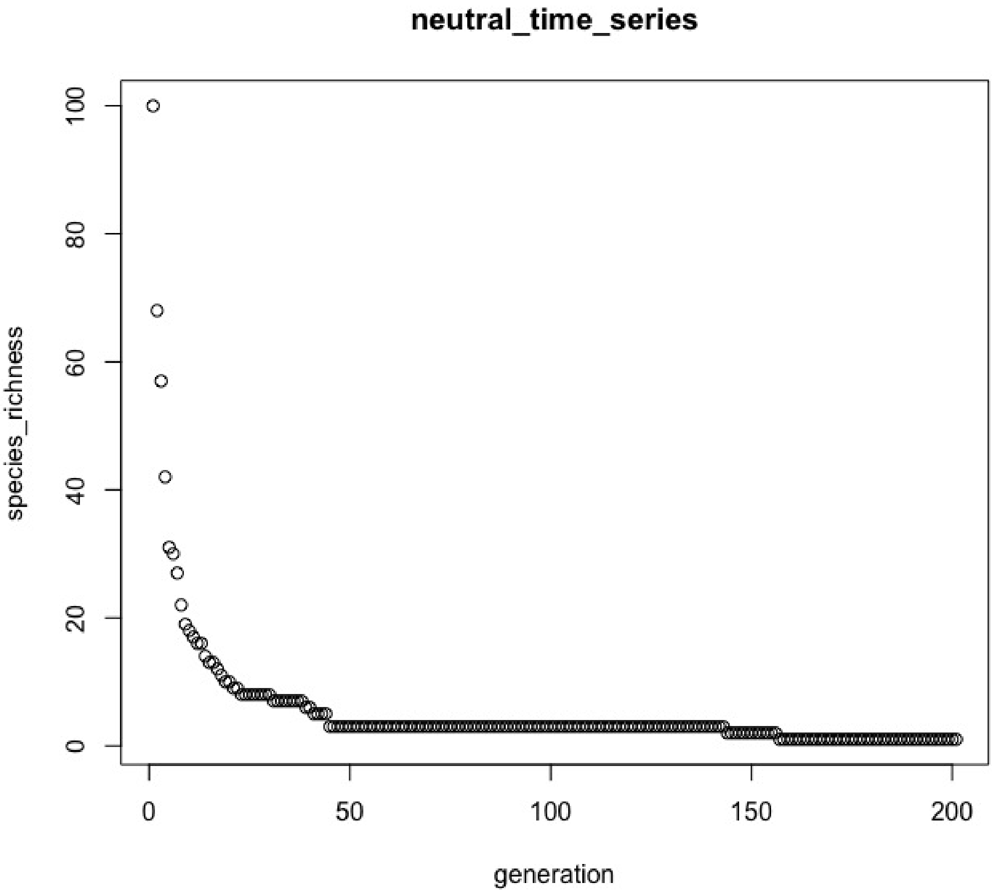

Figure 1: The species richness changes in 200 generation

The species richness always converges to 1 in long term because some species die and are replaced by other species while no new species is generated. As a consequence, only one species will remain.

2 Question 12

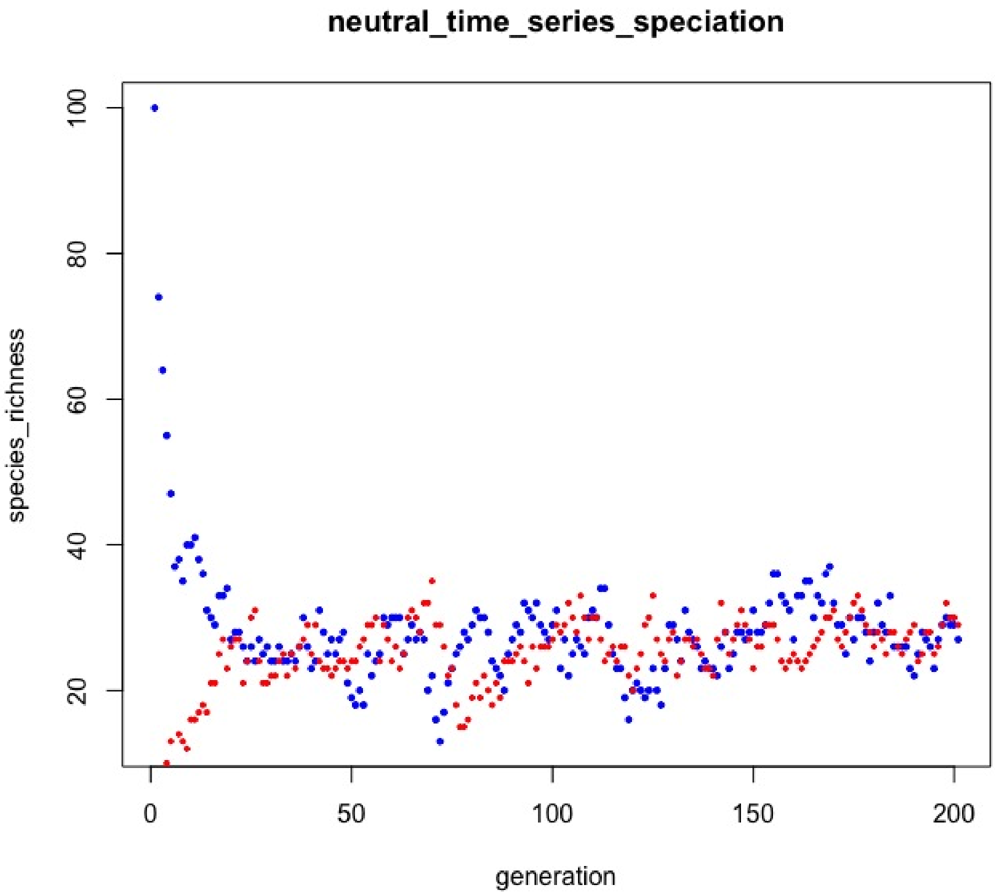

Figure 2: The species richness changes in 200 generation with two different initial states and speciation

No matter what initial state is, the species richness will fluctuate around the same value, reaching dynamic equilibrium. This is because without speciation, species richness always converges to 1 according to question 8. So all of initial states can be seen equally as minimum one in the long term. And the species richness is relatively centralized because the speciation rate is small, only 0.1, if not, the species richness will be more scattered.

3 Question 16

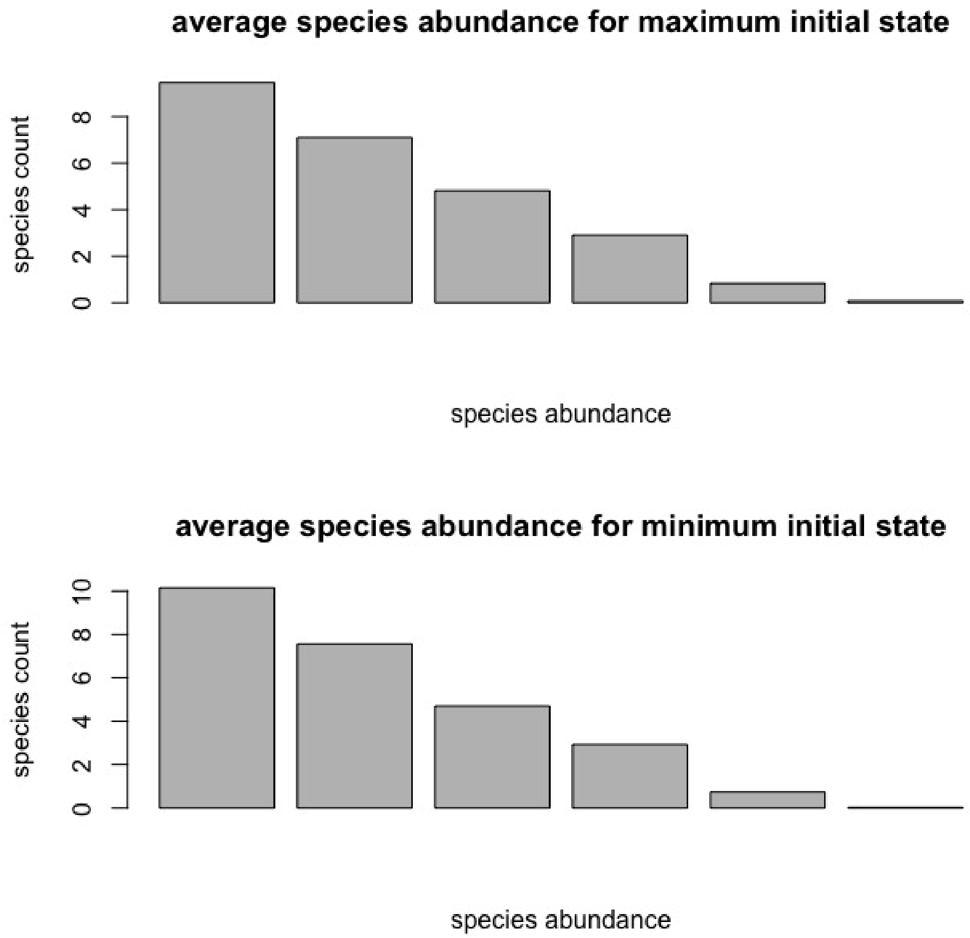

Figure 3: The average species abundance distribution

The initial condition is not matter. The reason are roughly the same as question 12. Initial condition does not affect long term result. As long as the system has the same speciation rate as well as same initial size. The status of species abundance distribution will be relatively stable.

4 Challenge question A

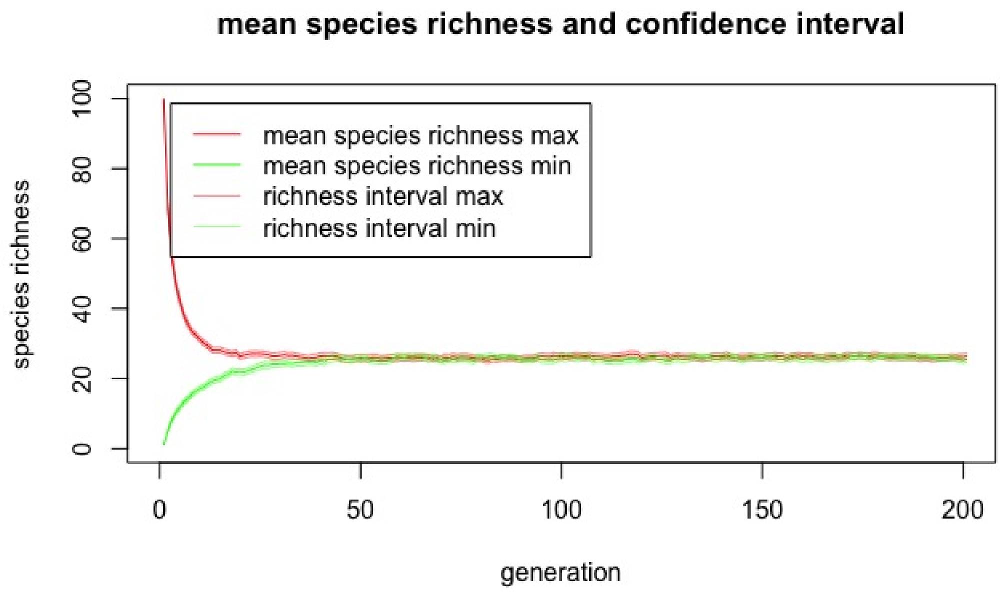

Figure 4: Mean species richness and 97.2% confidence interval for high initial diversity and low initial diversity

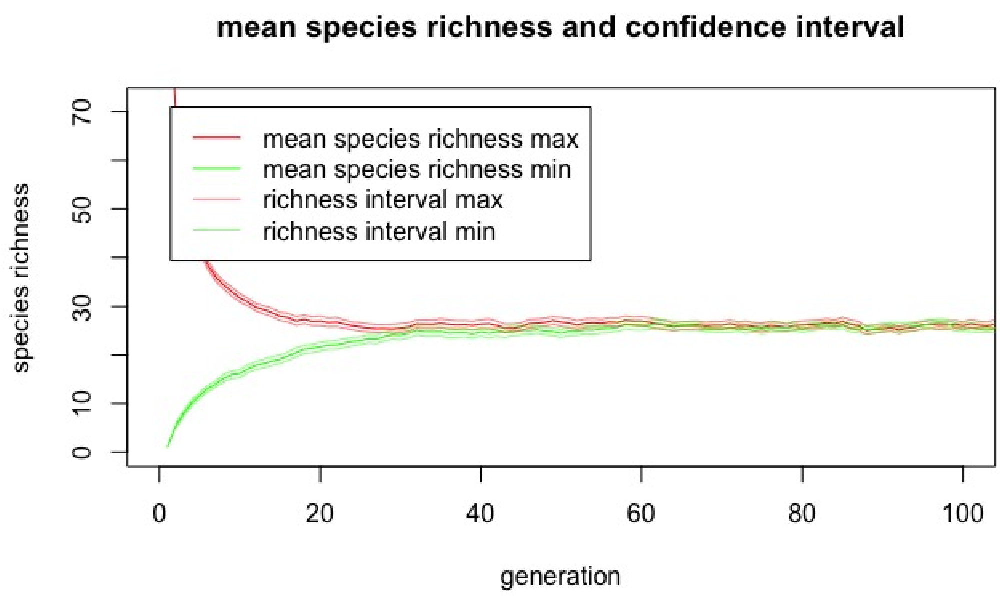

Figure 5: Zoom in for figure 4

50 generations may needed for reaching dynamic equilibrium

5 Challenge question B

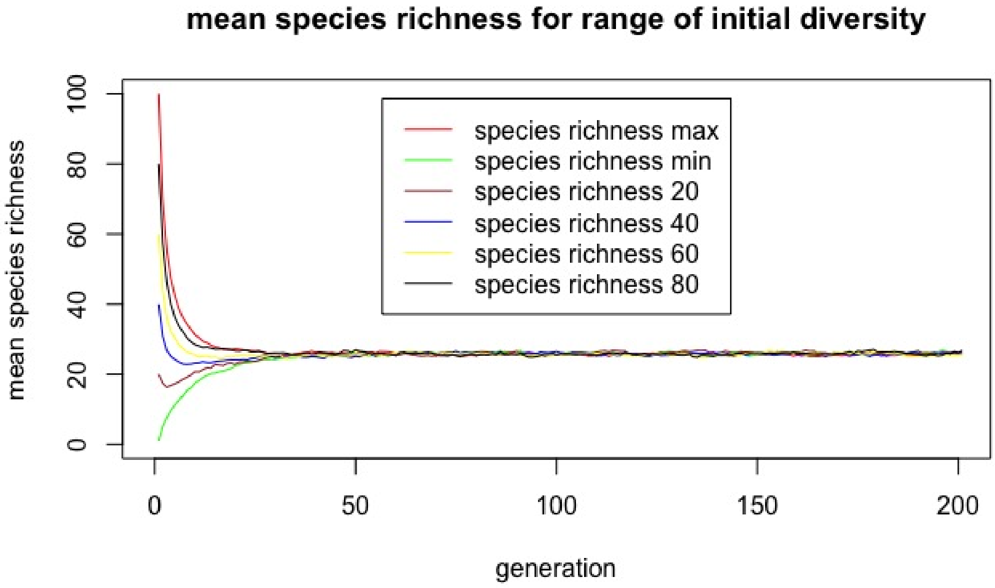

Figure 6: Mean species richness with initial species richness at 1 (min), 20, 40, 60, 80, 100 (max)

6 Question 20

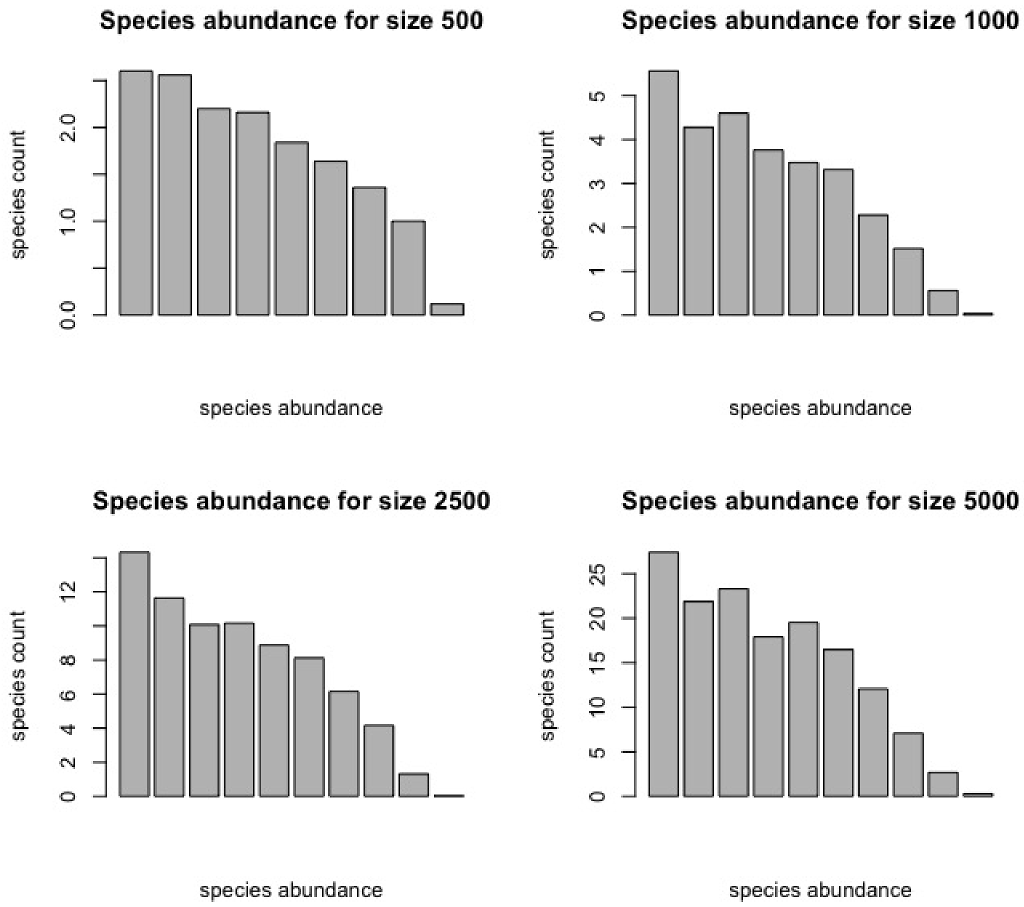

Figure 7: The average species abundance distribution for 4 different size

size 500:

2.60, 2.56, 2.20, 2.16, 1.84, 1.64, 1.36, 1.00, 0.12

size 1000:

5.56, 4.28, 4.60, 3.76, 3.48, 3.32, 2.28, 1.52, 0.56, 0.04

size 2500:

14.32, 11.64, 10.08, 10.16, 8.88, 8.12, 6.16, 4.16, 1.32, 0.04

size 5000:

27.40, 21.88, 23.32, 17.92, 19.52, 16.48, 12.08, 7.08, 2.68, 0.32

speciation rate:

0.005579

7 Challenge question C

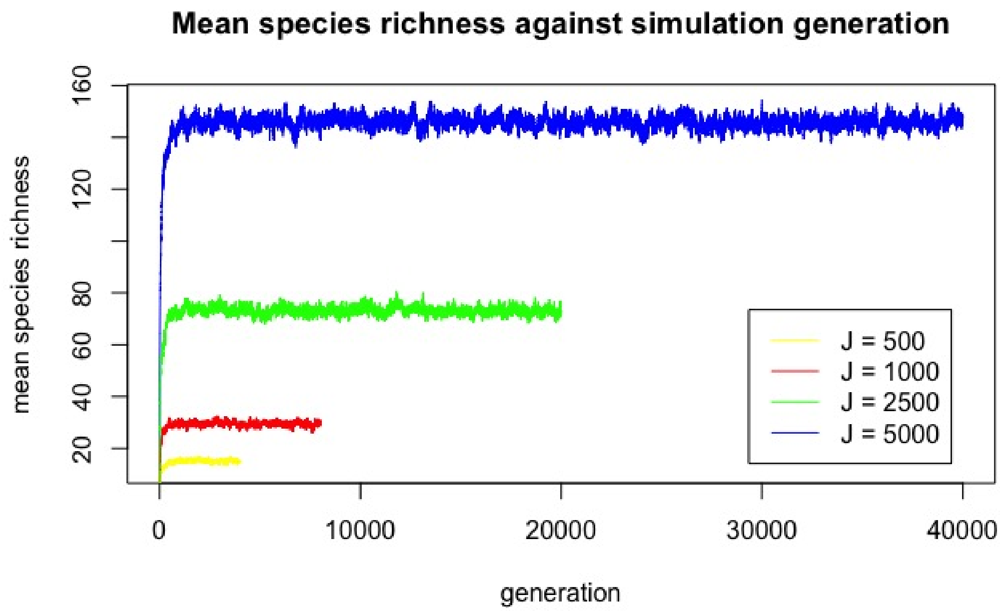

Figure 8: Mean species richness against simulation generation with size of 500, 1000, 2500, 5000

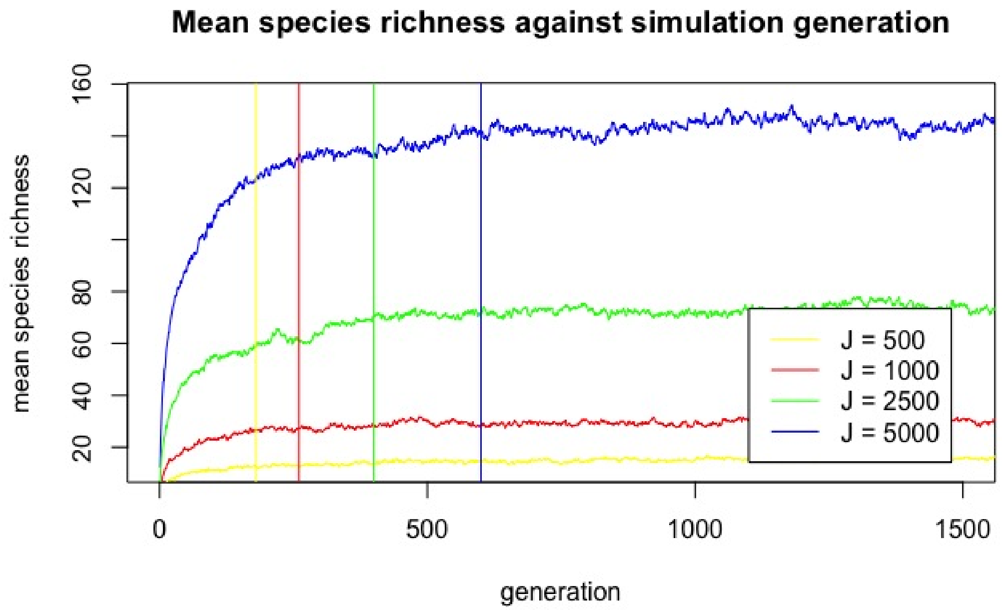

Figure 9: Using figure 8 to decide burn-in period for different J value

The burn-in period for J = 500 is around 180 generation, for J = 1000 is around 260 generation, for J = 2500 is around 400 generation, for J = 5000 is around 600 generation.

8 Challenge question D

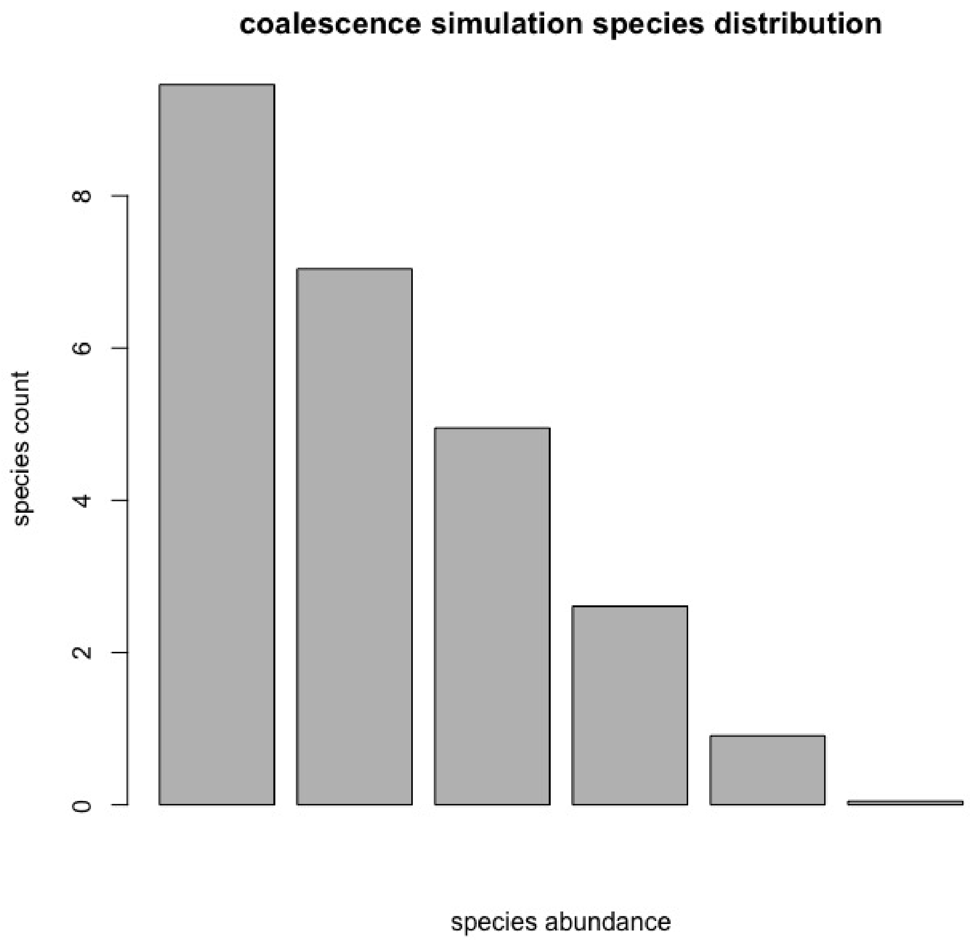

Figure 10: species distribution for coalescence simulation

0.779s was used on the cluster, and 0.112 was used on coalescence. The coalescence dose not need burn-in period because it is always in equilibrium. And it calculates species abundance reversely to mitigate iteration so it is much faster.

9 Question 21

The fractal dimension of left object is log3(8). When the length becomes 1/3 of original one, 8 small figure are needed to form the original one. So the dimension of left one is log3(8). The fractal dimension of right one is log3(20) because of the same reason.

10 Question 22

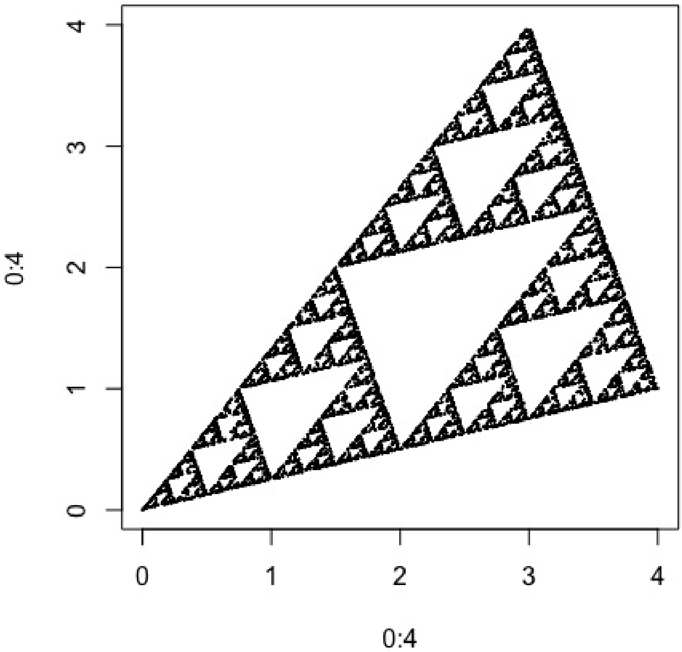

Figure 11: Sierpinski Gasket

11 Challenge question E

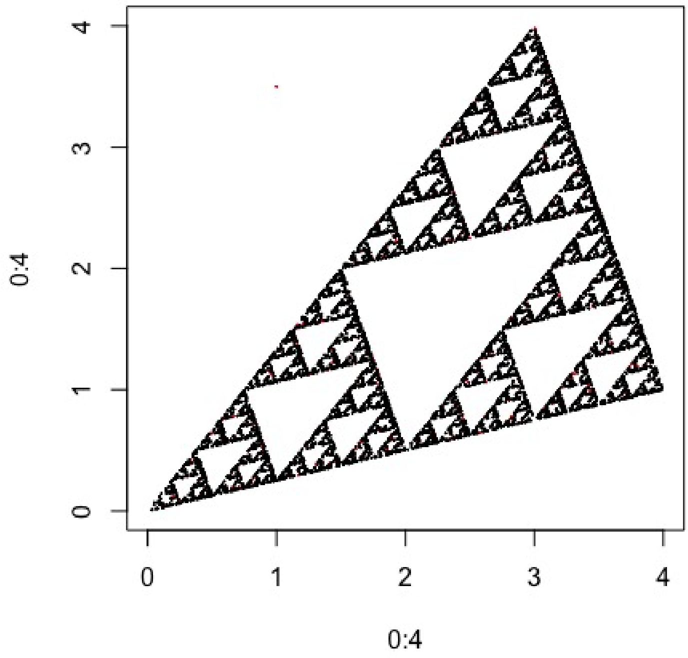

Figure 12: Sierpinski Gasket from different initial position

When the initial point is out of Sierpinski Gasket, it will soon get back into the figure(if you see carefully, you can see a red point out of the figure). This is because no matter where initial point is, it will march towards three points(A, B, C). Once it get into the triangle area of three points, it will never get out.

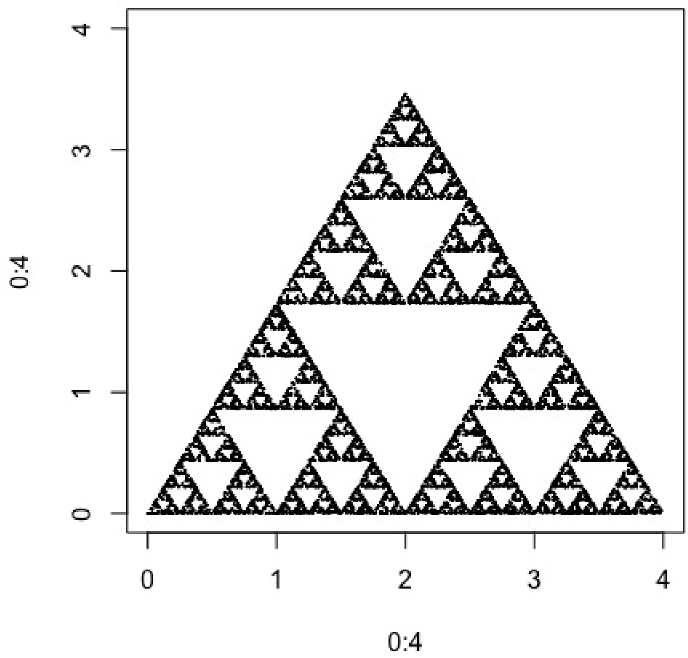

Figure 13: Classic Sierpinski Gasket

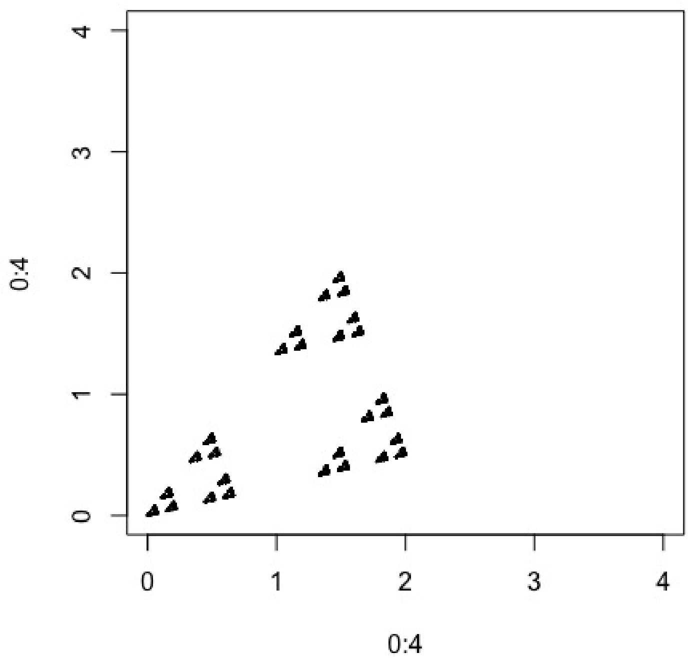

Figure 14: one-third distance instead of a half distance

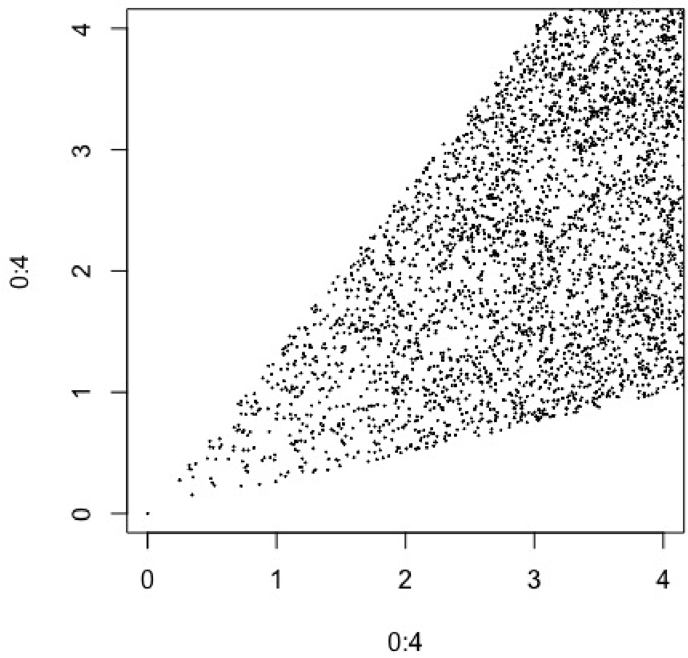

Figure 15: two-thirds distance instead of a half distance

Why it is like chaos when choosing two-thirds towards the next point as a distance of movement?

12 Question 25

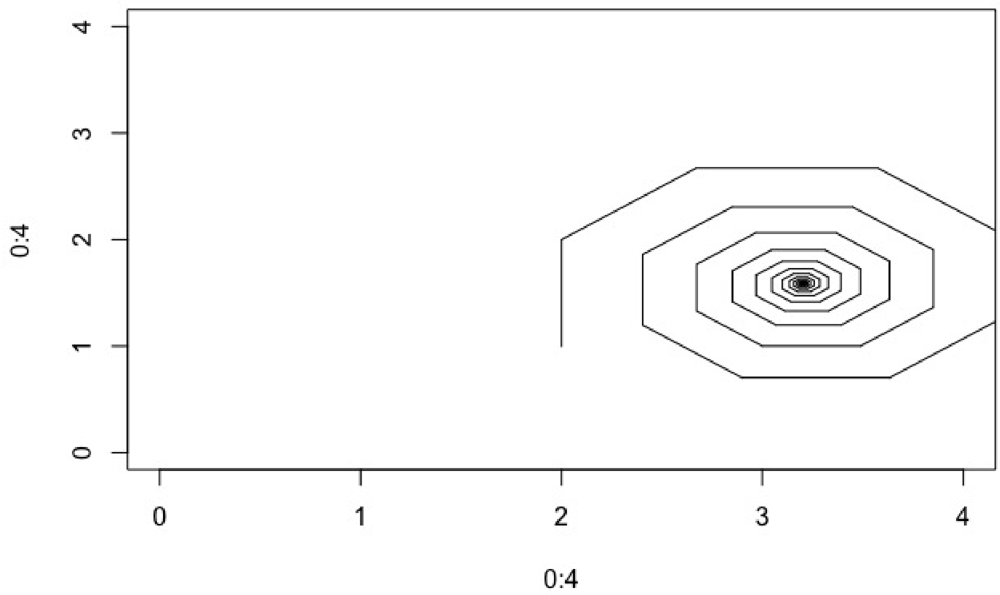

Figure 16: spiral

Error: C stack usage 7970384 is too close to the limit

It is because I do not give threshold to line length, so the iteration will do again and again until the stack is nearly full.

13 Question 26

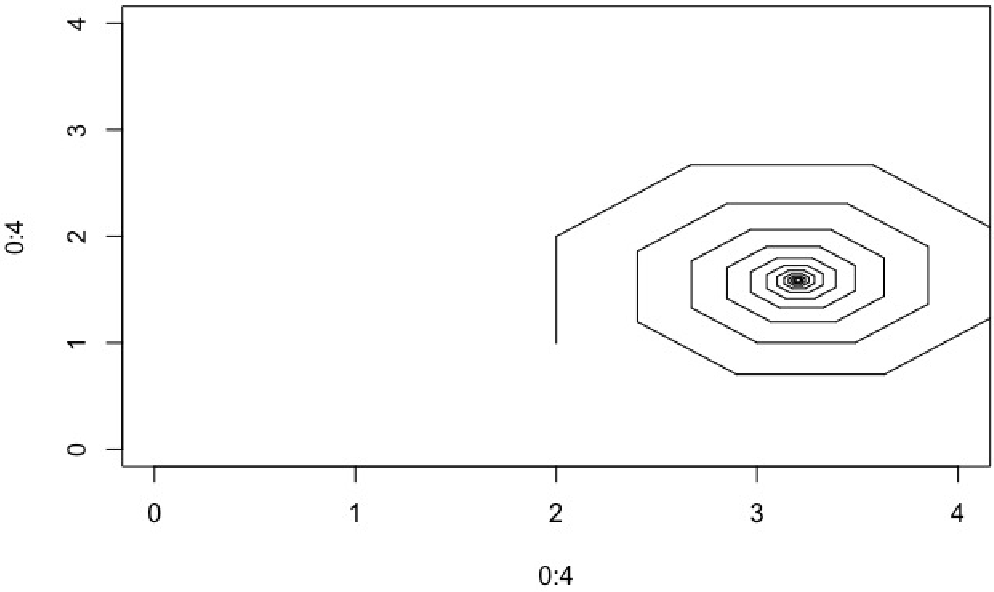

Figure 17: Spiral with threshold of 0.01

14 Question 27

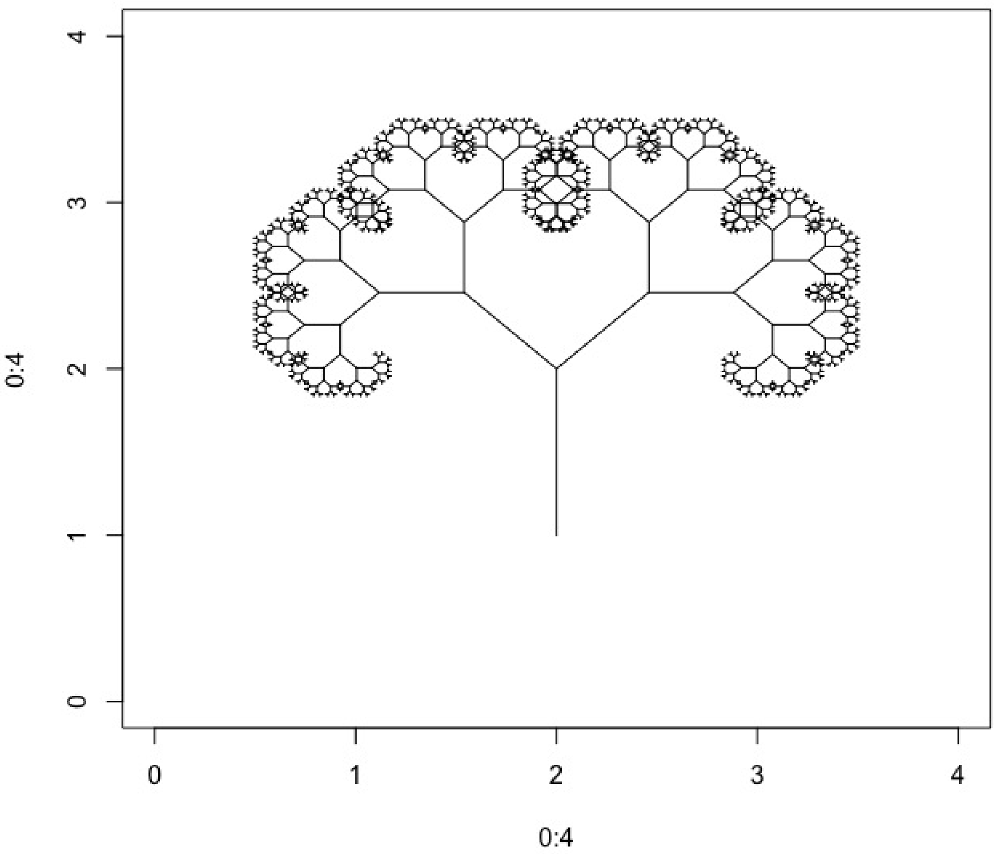

Figure 18: Tree

15 Question 29

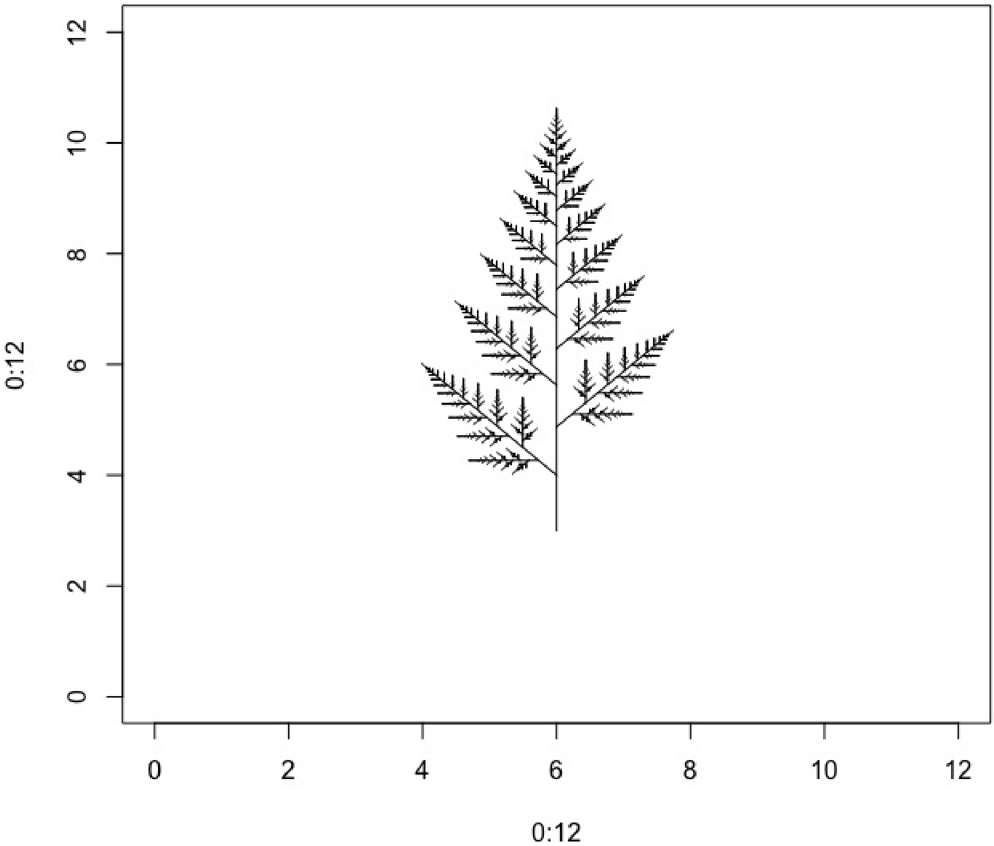

Figure 19: Fern

16 Challenge question F

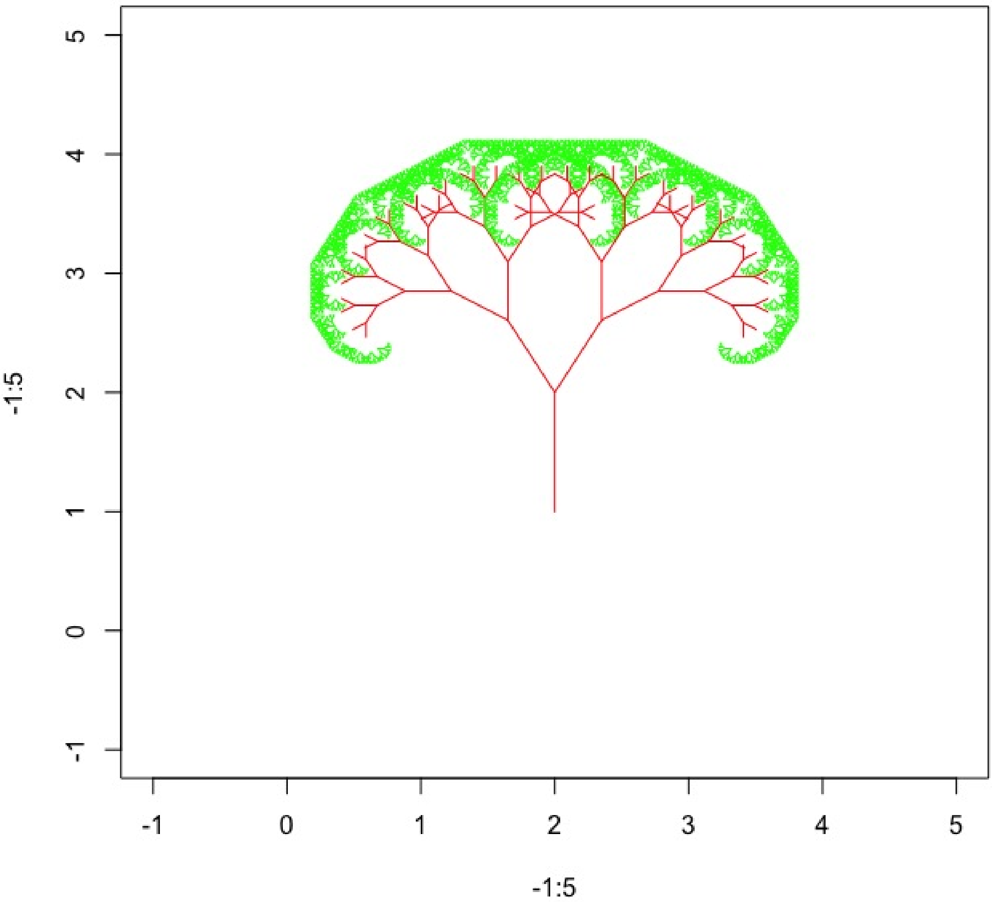

Figure 20: Color tree

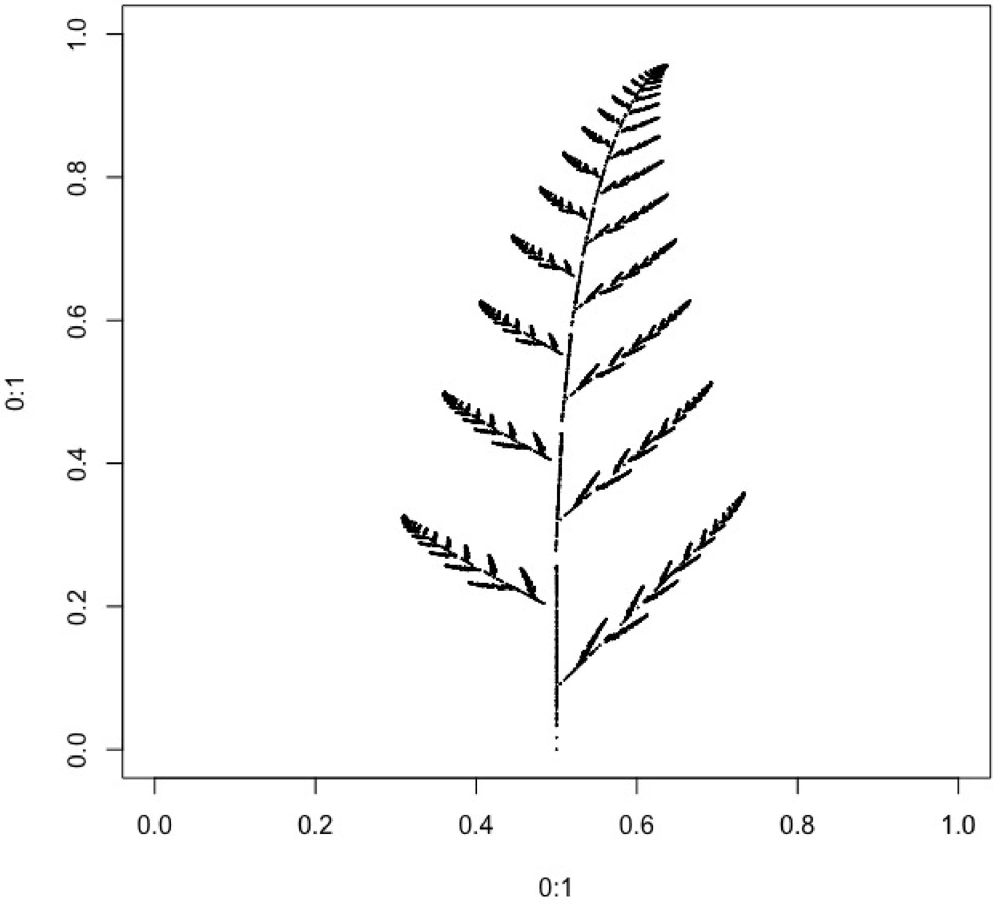

Figure 21: Barnsley fern

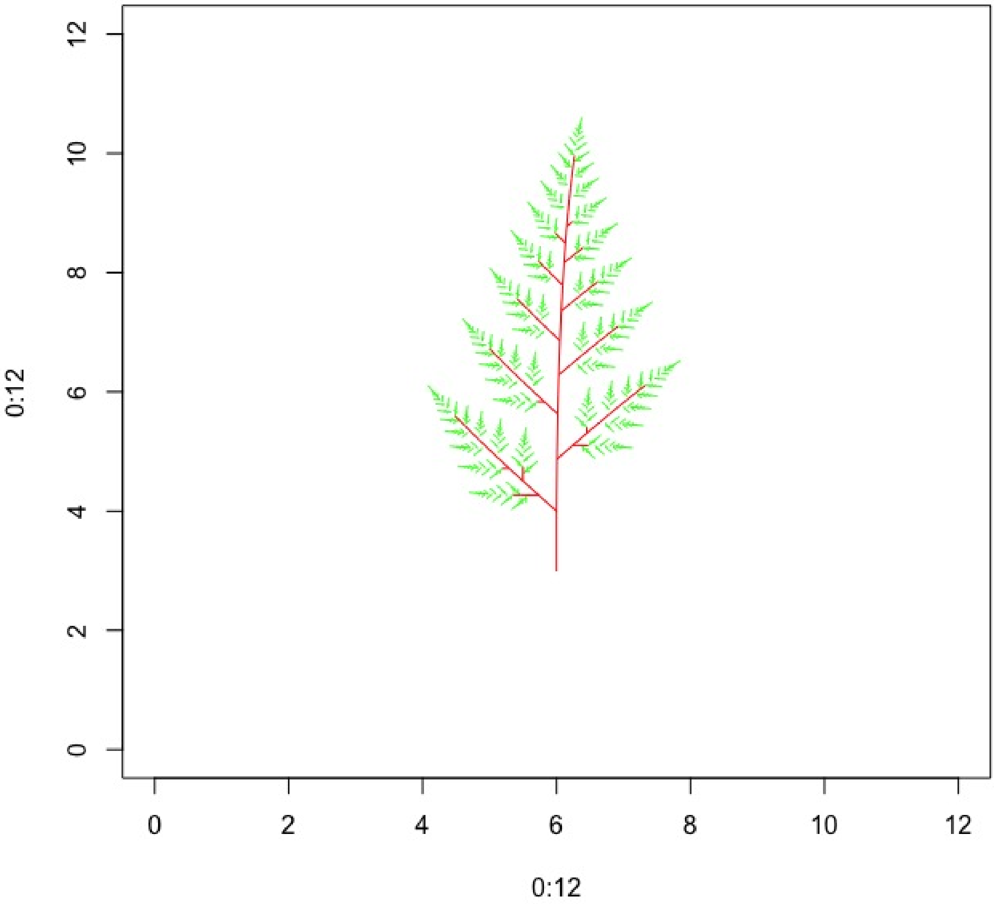

Figure 22: Color fern