Question

- Growth rate of bacteria is a function of the available concentration of food. (Let’s say A and B)
- If given a choice, whole of the colony goes for the better food.

Differential equations

- $$\frac{dN}{dt} = \alpha N - D + \beta C(N,t)$$

$$\frac{dC}{dt} = -g(N)$$

Problem: Unknown function: g(N)

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one guess, $g(N) = \lambda N^{\gamma}$, where γ is a parameter.

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Simulation of Bacteria

- Define a NxN matrix (N = lattice size)
- Put 10 for bacteria type 1, 20 for type 2, 30 for type 3 and 40 for type 4.
- Start with four random points (Aij)

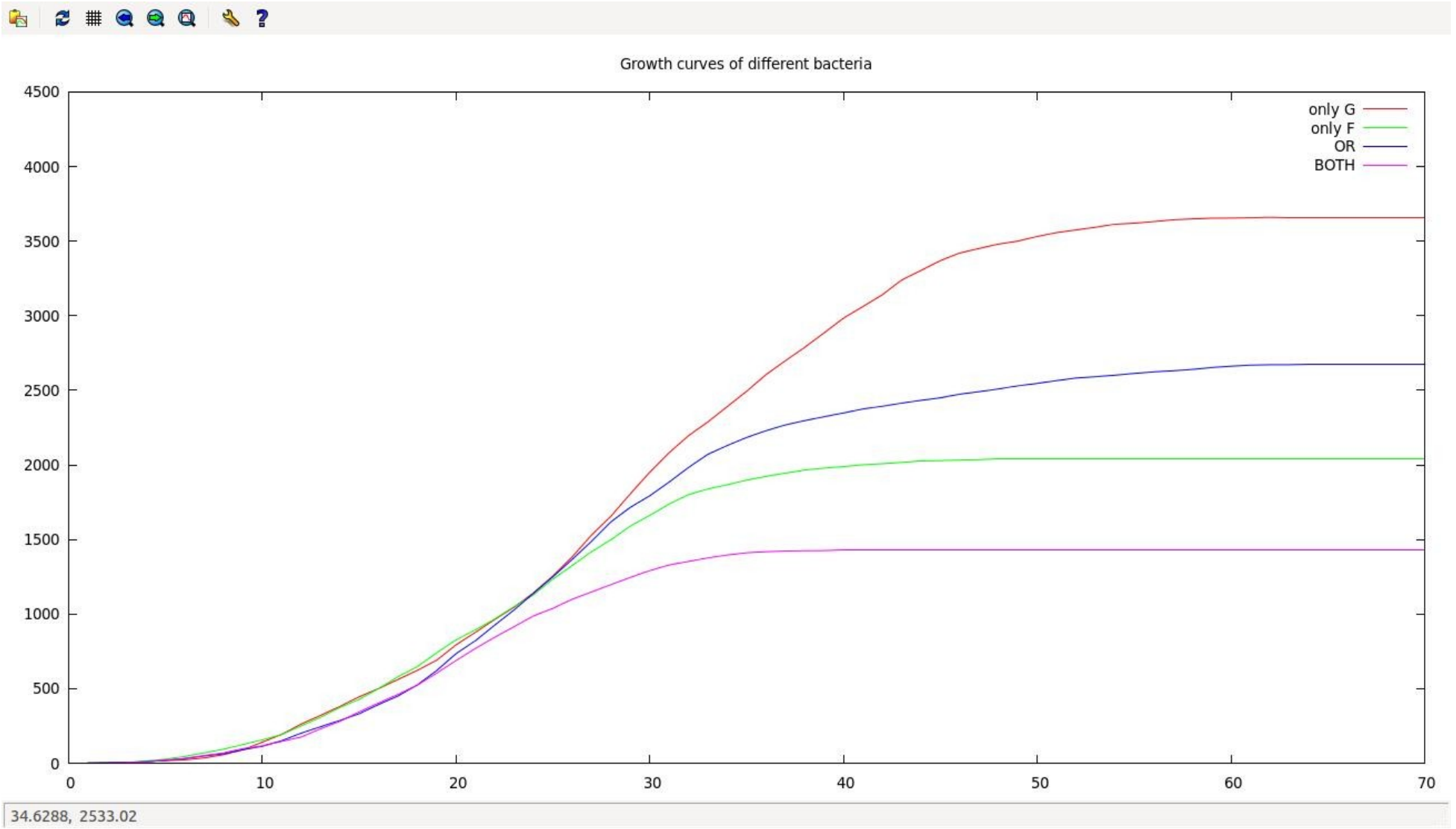
- Next?

- Food!

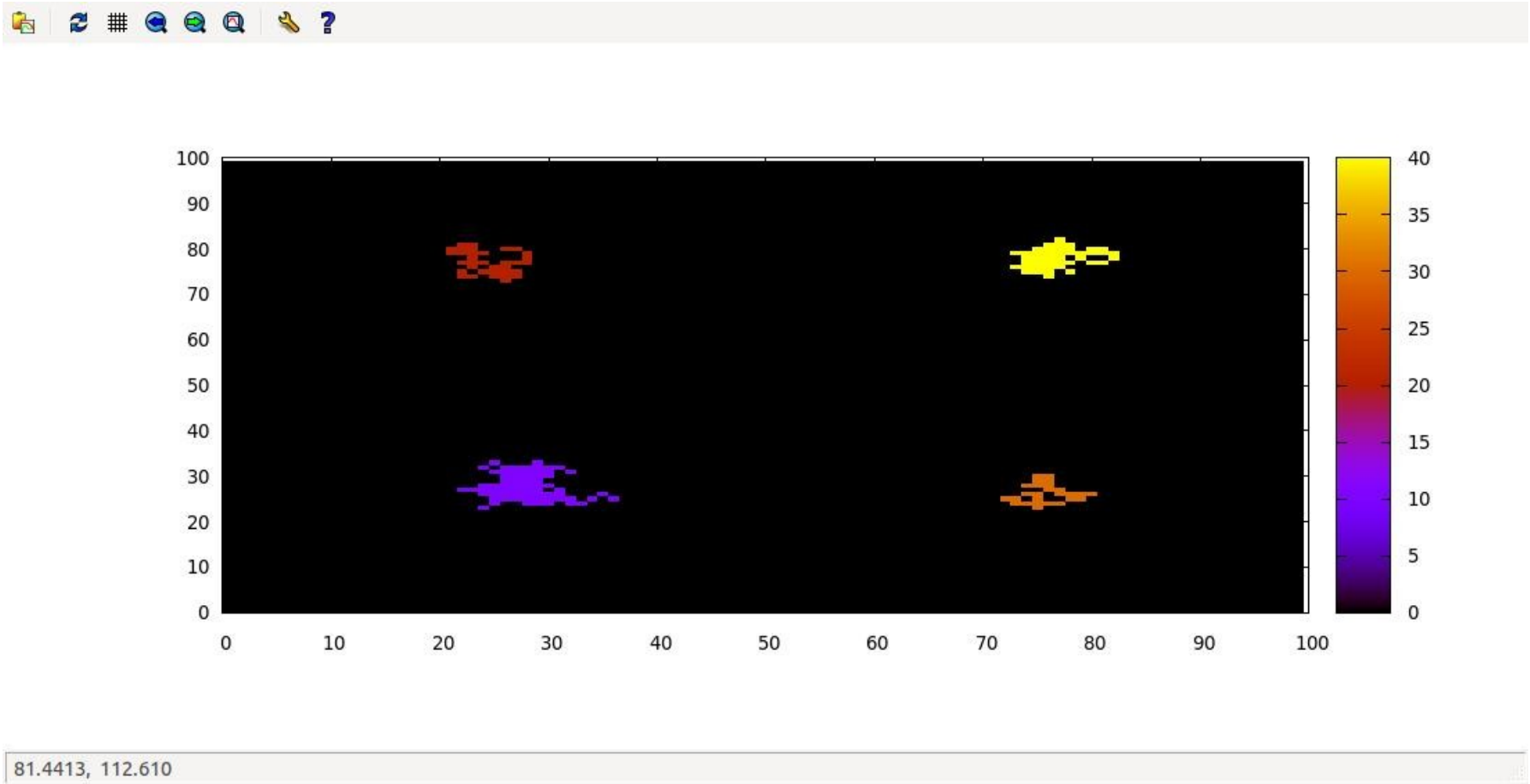
Food

- Make two matrices G and F (same NxN)
- Assign uniformly a value of 20 to each point in G and F (and assume G is twice as better as F for cell division)
- Another set of questions;
  - When will it grow?
  - When will it die?
  - How will it grow?

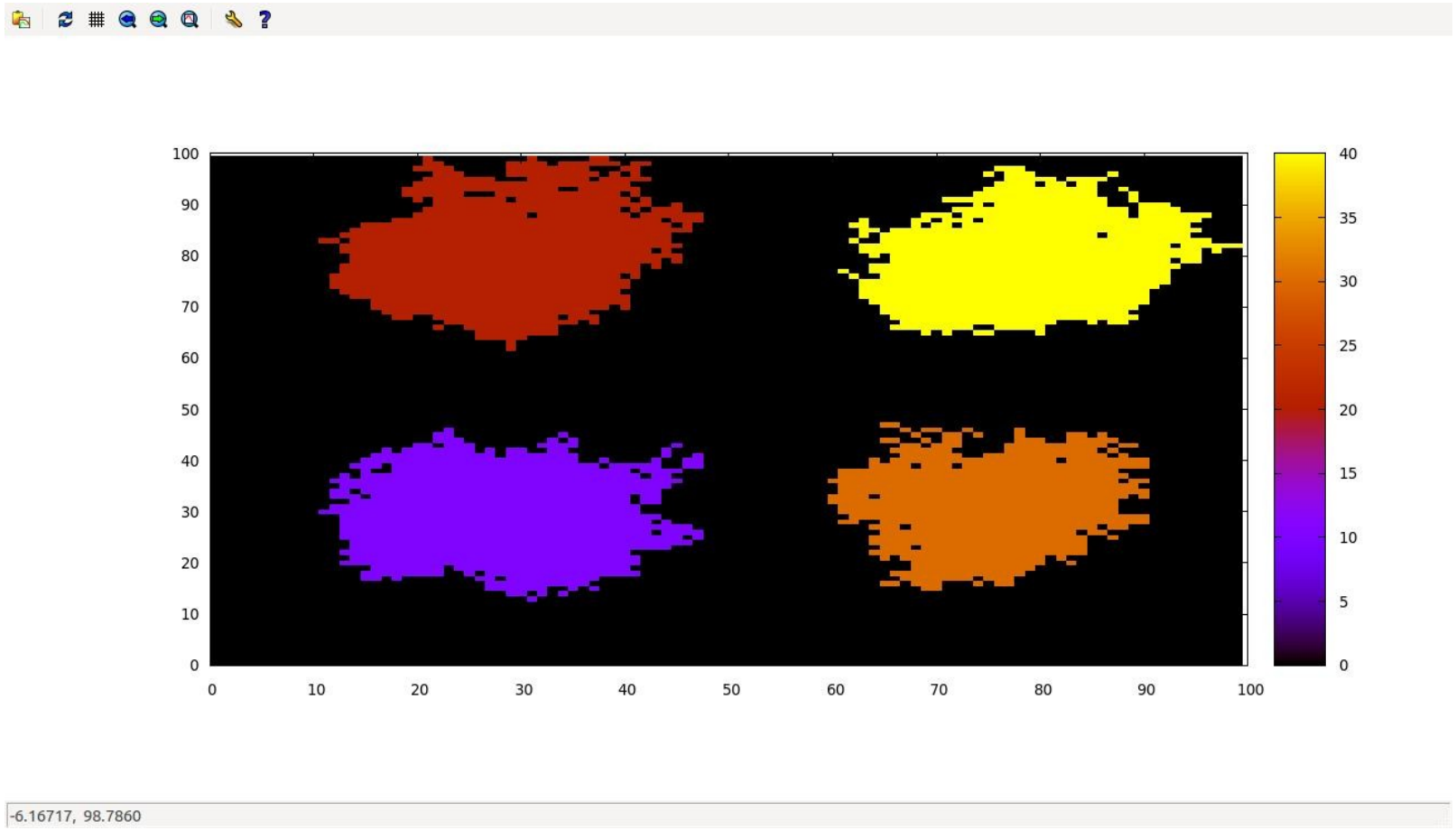
Result


Growth curves of different bacteria
only G
only F
OR
BOTH
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
60
70
34.6288, 2533.02

Gen 5


100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
40
35
30
25
20
15
10
5
0
81.4413, 112.610

Gen 20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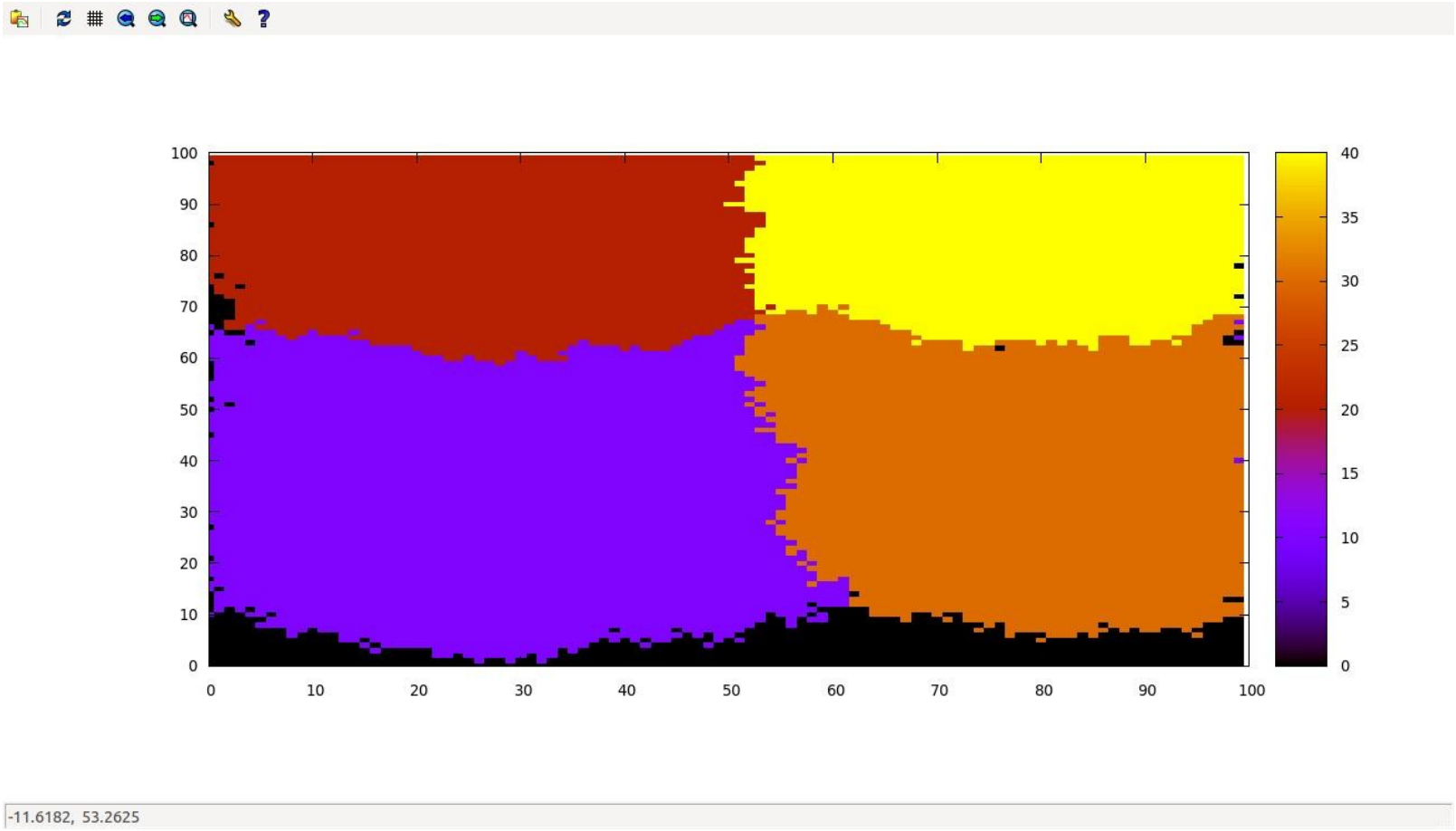
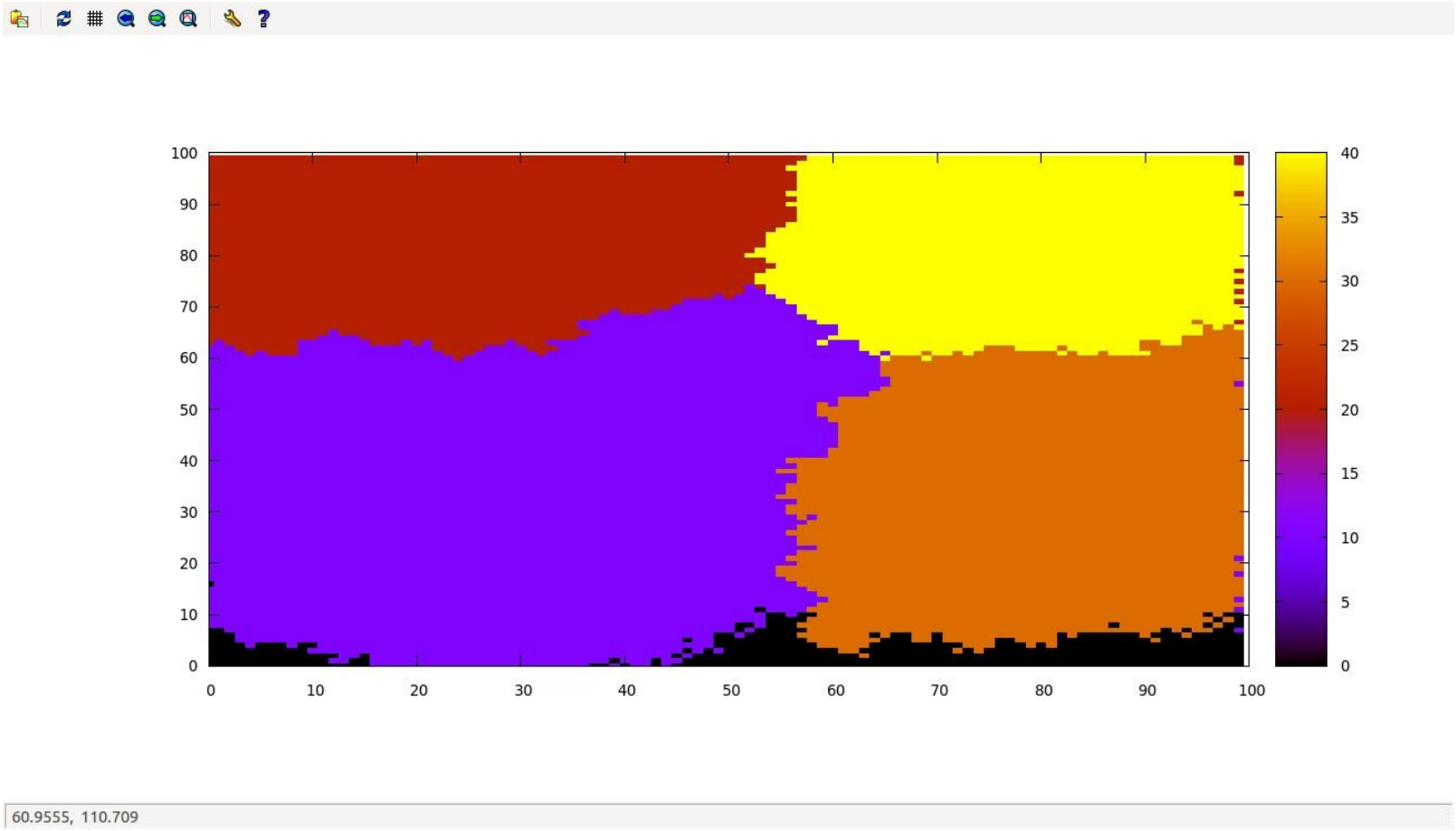
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
40
35
30
25
20
15
10
5
0
-6.16717, 98.7860

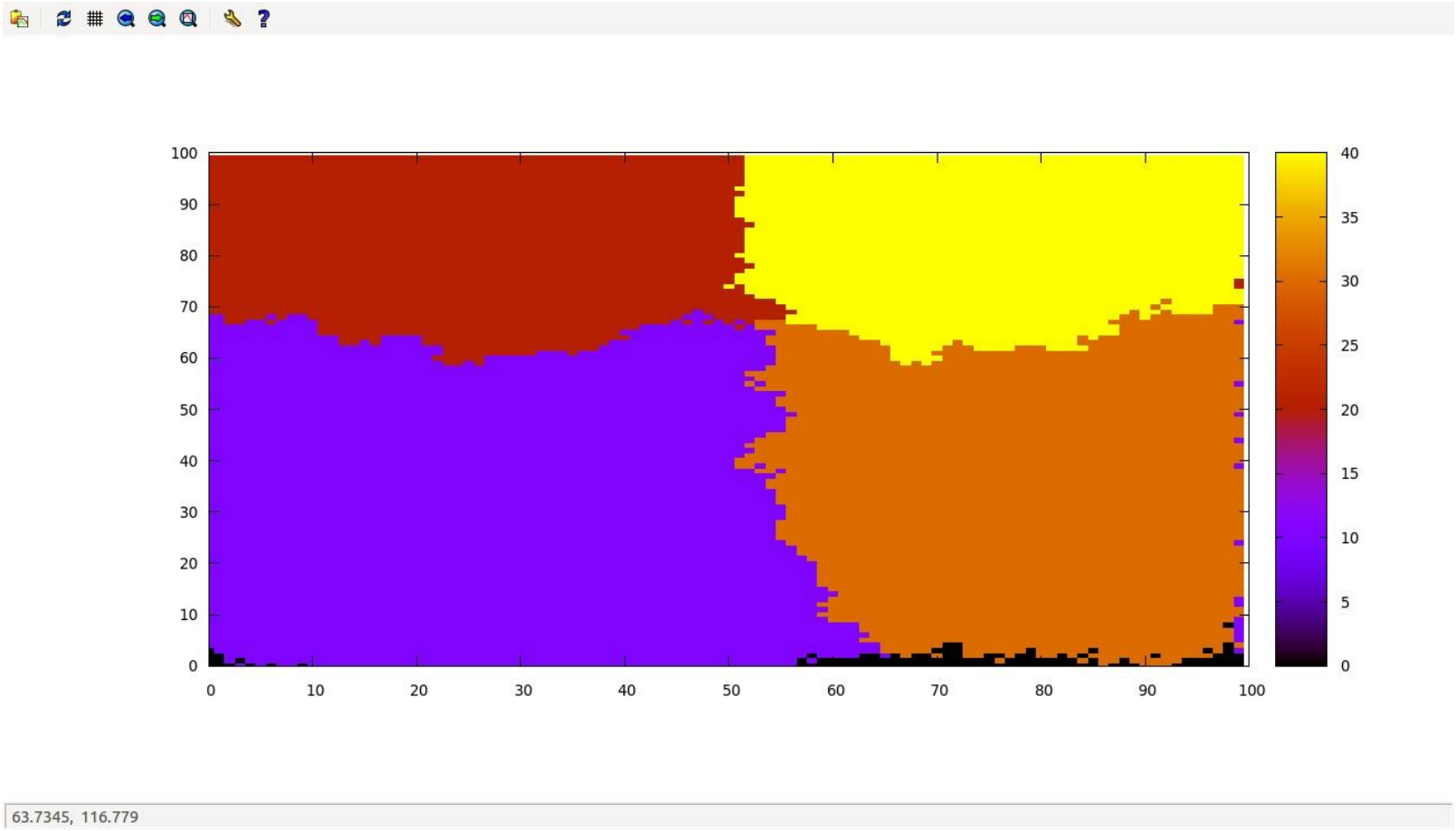
Gen 40


100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
40
35
30
25
20
15
10
5
0
-11.6182, 53.2625

Gen 50


100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
40
35
30
25
20
15
10
5
0
60.9555, 110.709

Gen 60


100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
40
35
30
25
20
15
10
5
0
63.7345, 116.779

What next?

- Something definitely can be said about the death phase, but we need a lighter simulation and a bigger processor.
- Cost matrix!
- We could have managed a bacteria that switches between the two modes but takes some time to switch.
- Also, the estimation of the γ parameter could be done.

- Thus, we can simulate all bacterial growth situations!