

PyQB Monga

Programming in Python¹

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Gray-Scott systems

Systems driven by the Gray-Scott equation exhibit Turing patterns $(D_u, D_v, f, k \text{ are constants})$.

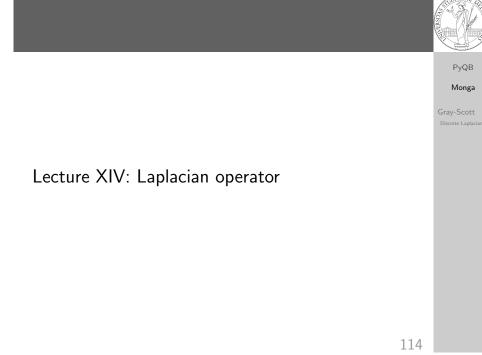
Monga Gray-Scott

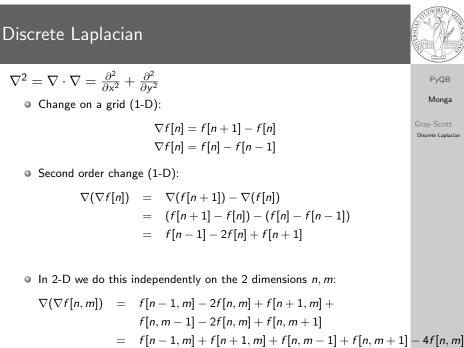
PyQB

$$\frac{\partial u}{\partial t} = D_u \nabla^2 u - u v^2 + f \cdot (1 - u)$$

$$\frac{\partial v}{\partial t} = D_v \nabla^2 v + u v^2 - (f + k) \cdot v$$

- These give the **change** of *u* and *v* over time
- The diffusion term can be approximated on a grid by computing the discrete Laplacian





116

Vectorization

0	0	0	0	0	0
0	13	14	15	16	0
0	9	10	11	12	0
0	5	6	7	8	0
0	1	2	3	4	0
0	0	0	0	0	0

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Gray-Scott Discrete Laplacian

X[1:-1, 2:]

Ignoring the border, the right neighbour of (i, j) is (i, j + 1) in the inner white and (i, j) in the yellow: in the inner white 11 is (1,3), its neighbour 12 is (1,4), but (1,3) in the yellow.

This way one can compute the Laplacian matrix using only vectorized plus.

1 pius. 117