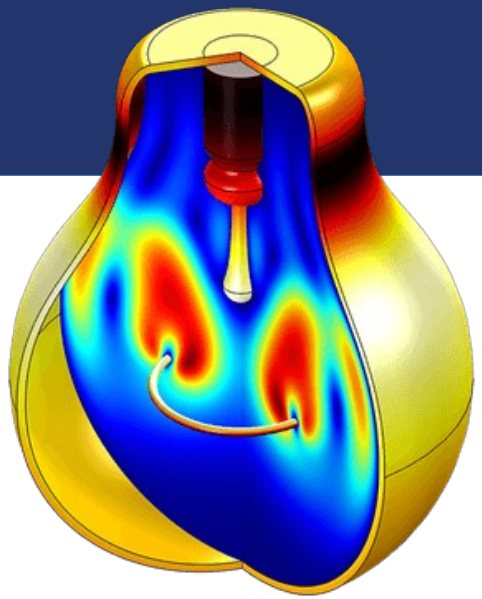
Parallel programming

HW2 assignment



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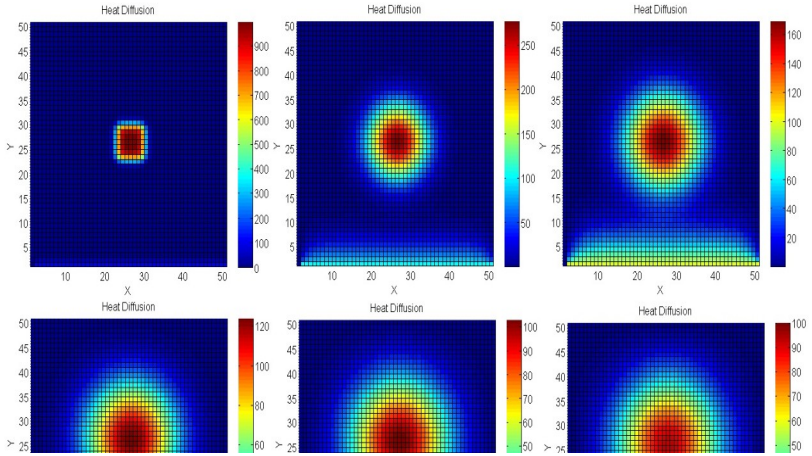
What is a heat diffusion

- Heat diffusion/transfer
  - exchange of thermal energy between physical systems
  - rate of heat transfer is dependent on the temperatures of the systems



Simplified model

- Discretization of the space into **cells** (i.e., matrix) with constant temperature
- The new temperature in the given coordinates (i,j) is equal to the average of old temperatures of all 9 spots in neighborhood

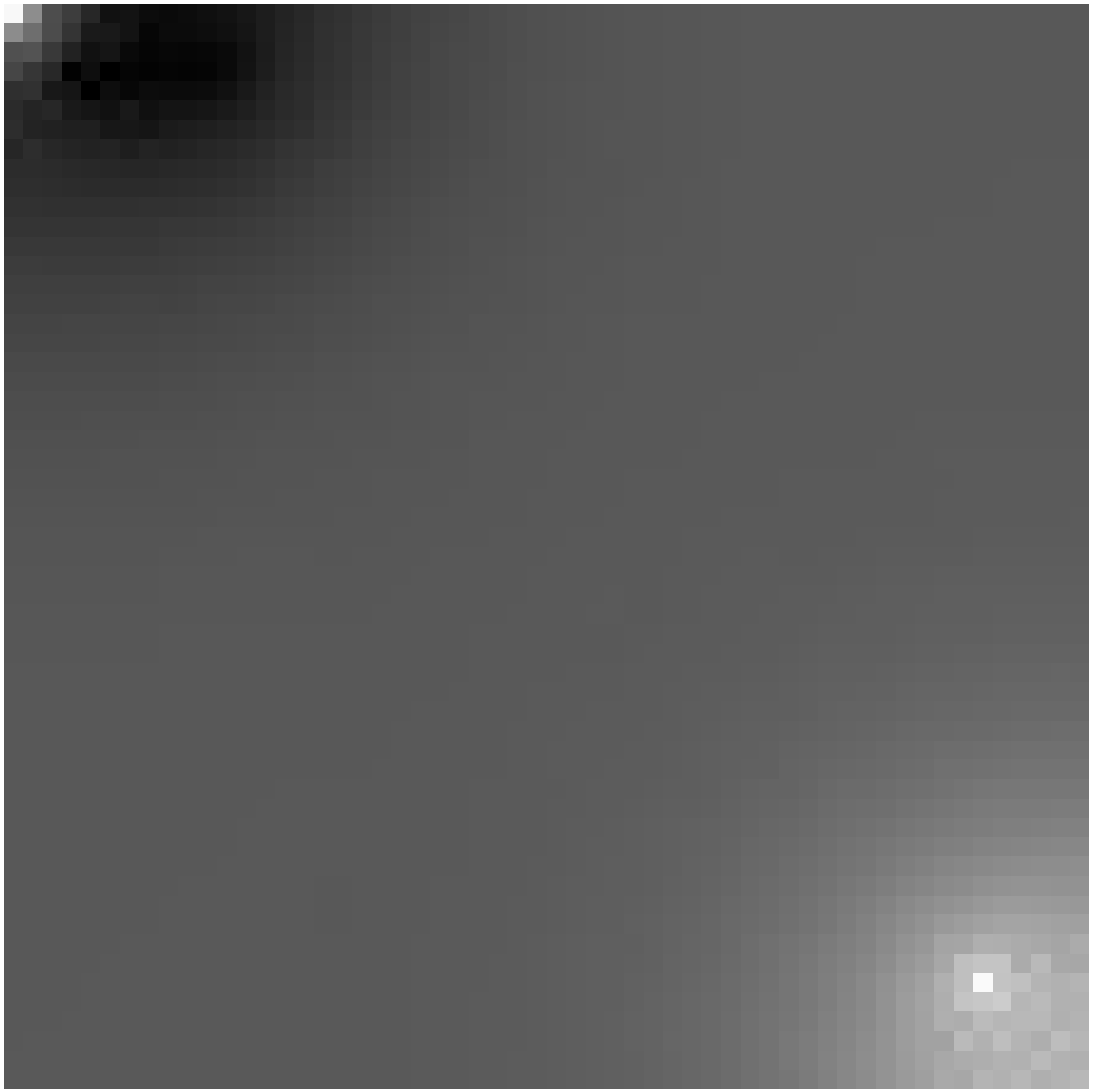
$t[i-1][j-1]$	$t[i-1][j]$	$t[i-1][j+1]$
$t[i][j-1]$	$t[i][j]$	$t[i][j+1]$
$t[i+1][j-1]$	$t[i+1][j]$	$t[i+1][j+1]$

For coordinates on borders, compute the average from a smaller neighborhood

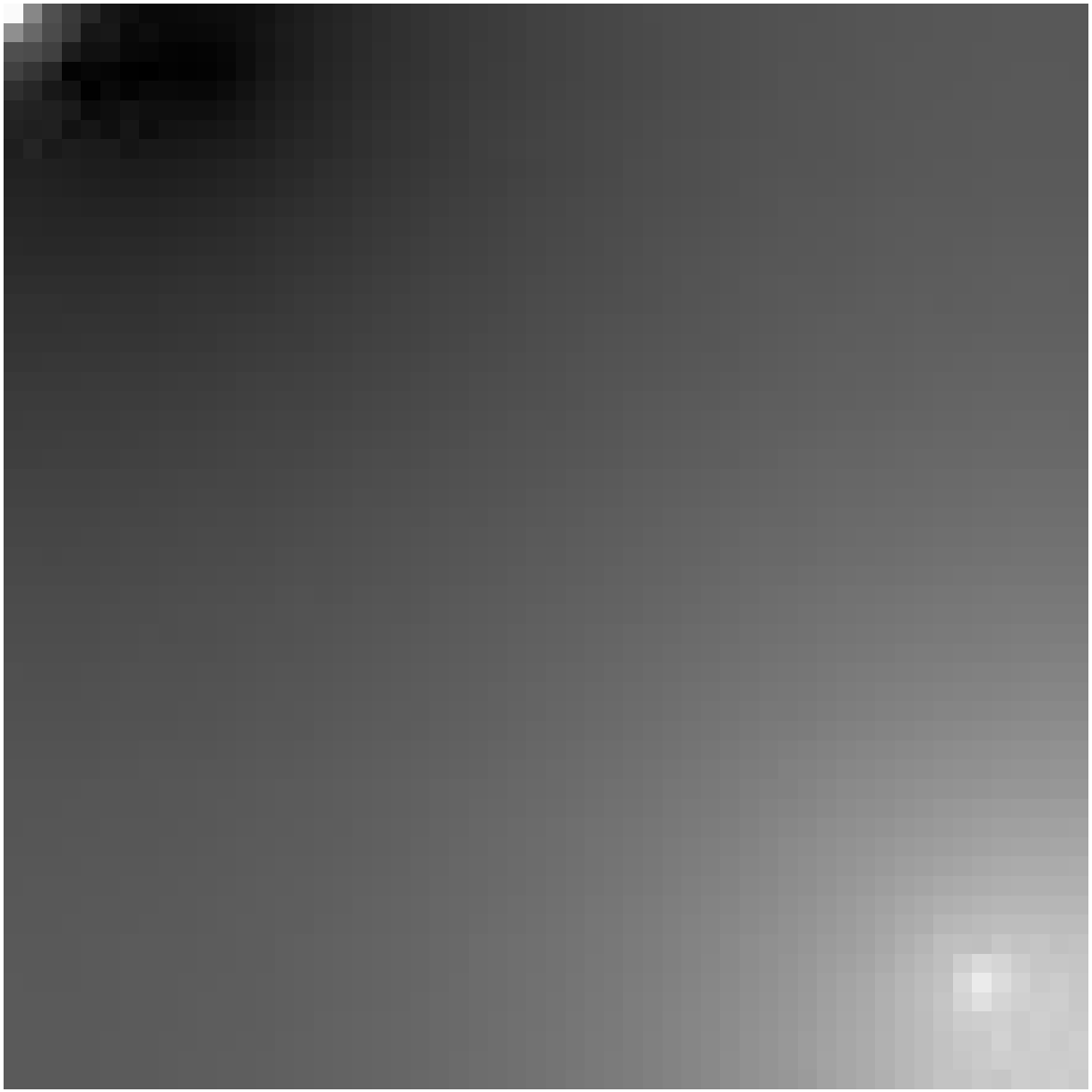
- **Spots with permanent temperature** (part of input)
- Iterative algorithm: repeat the computation until the difference between two consecutive iterations is negligible

$$\forall i, j : \left| t_{prev}[i][j] - t_{old}[i][j] \right| \leq 0.00001$$

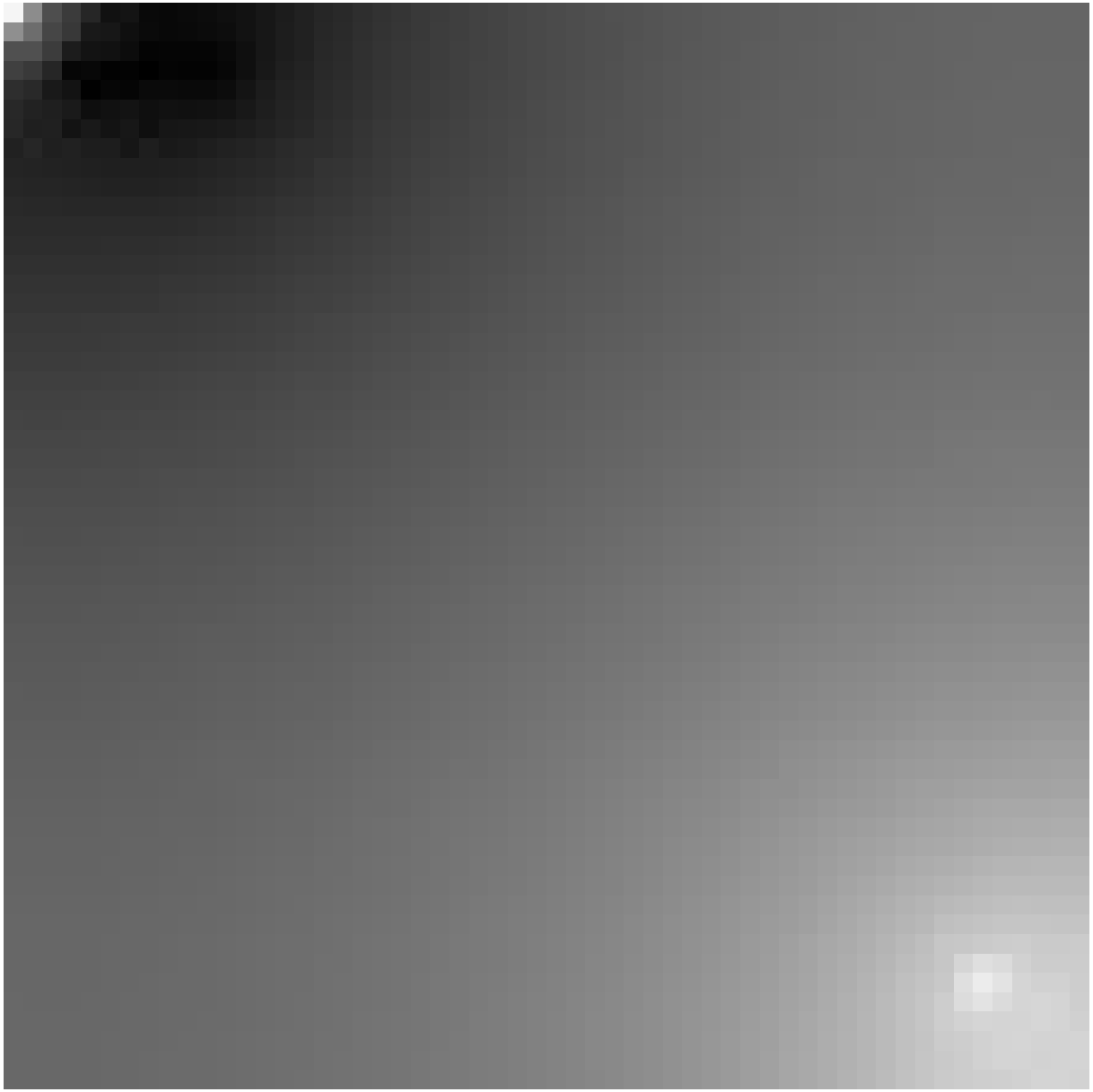
Example of evolution – 1



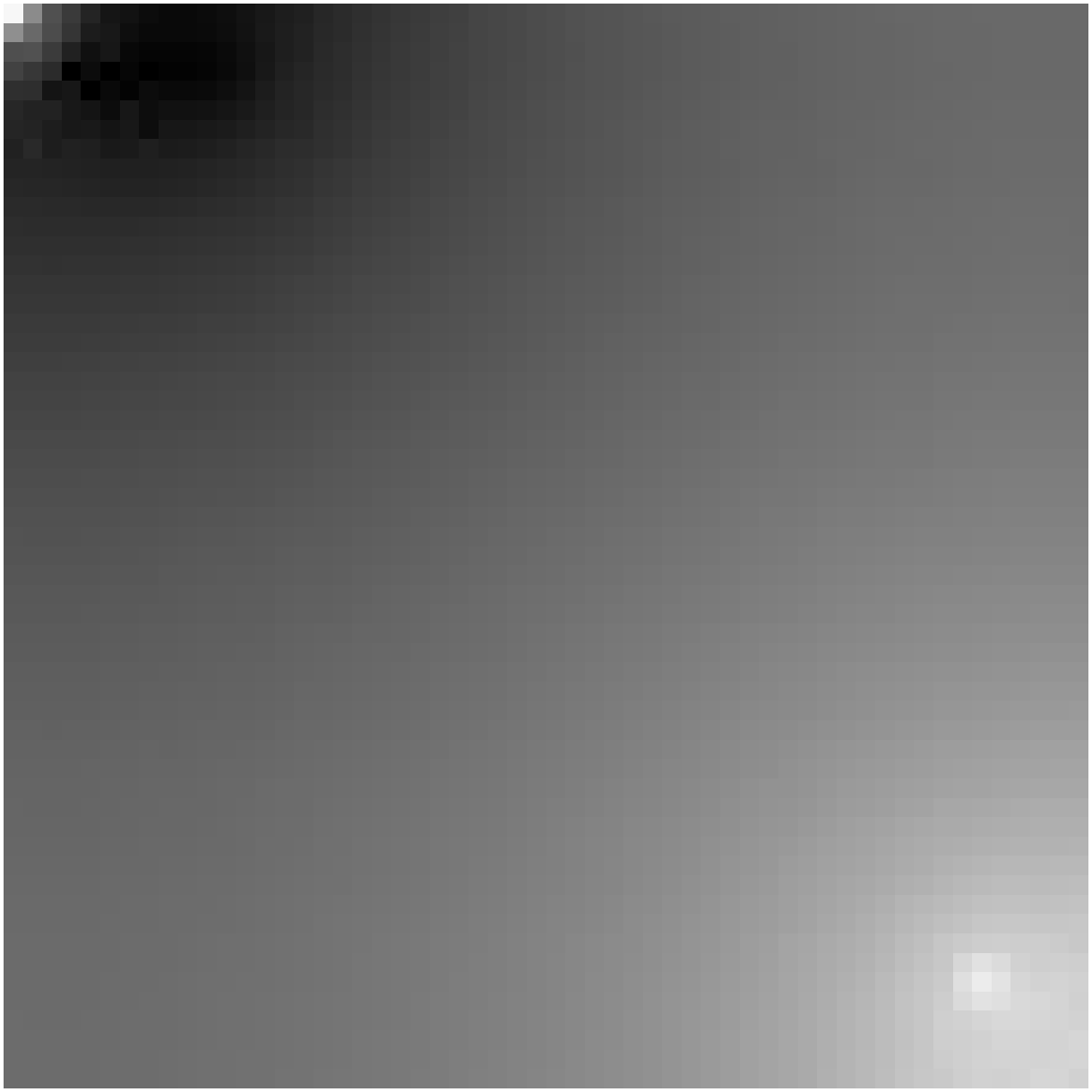
Example of evolution – 2



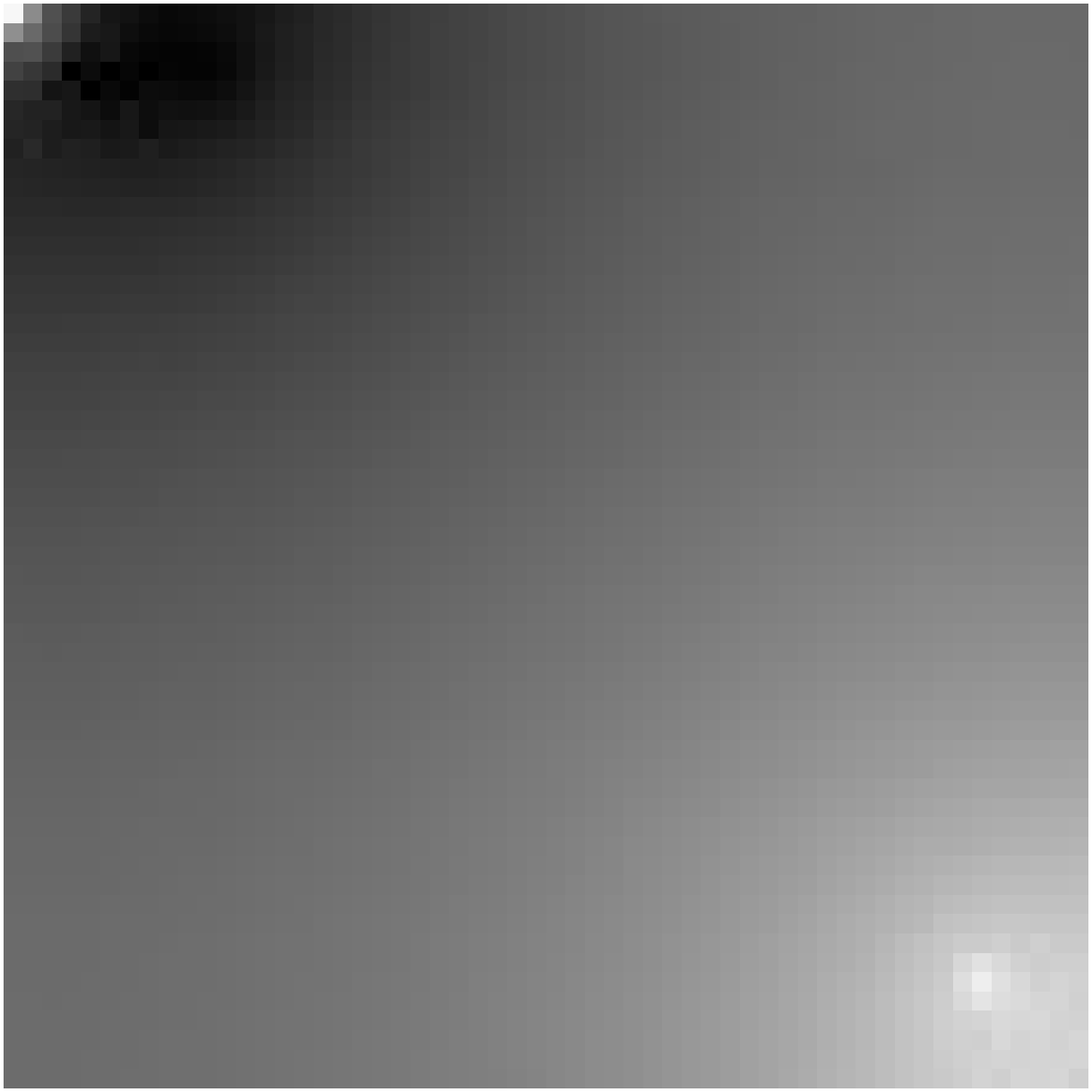
Example of evolution – 3



Example of evolution – 4



Example of evolution – 5



HW2 assignment

- Use the **code skeleton**
  - ➔ reads test problems, measures runtime
  - ➔ The program outputs an image in Netbpm format
- **Assignment:**
  - ➔ implement the Simple 2D Heat Diffusion simulator
  - ➔ use MPI
  - ➔ upload your solution to UploadSystem
- **Flags for g++ (used by UploadSystem)**
  - `-Ofast -std=c++17 -march=native`

Tricky issues

- Think about the partition of the input matrix among processes.
- Use floats for temperature computation.
- Initialize the cells having non-permanent temperature with 128