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High Fidelity Algorithmics Group
CS Dept. Stanford University

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CS448J: CASVC 2015 @ Stanford
Exercise Sheet 5: Heat Equation

Exercise 1 *(Heat Equation, 15 Points)*

Let

$$G = \{0, \Delta x, \ldots, (n-1)\Delta x\} \times \{0, \Delta y, \ldots, (m-1)\Delta y\}$$

be a $(n \times m)$-grid and let $u(x, y, t)$ be the temperature at $(x, y) \in G$ at time t. The temporal evolution of the temperature is described by the (two-dimensional partial differential) heat equation

$$\partial_t u(x, y, t) = \nabla \cdot J = \partial_x J_x + \partial_y J_y,$$

in which $J = (J_x, J_y)^\mathsf{T}$ denotes the rate of the heat flow. If the heat flow is purely resulting from a diffusion effect, we obtain $J = \nabla u$, which simplifies the heat equation to the diffusion equation

$$\partial_t u(x, y, t) = \triangle u = \partial_x^2 u(x, y, t) + \partial_y^2 u(x, y, t).$$

Implement a diffusion equation solver using the finite difference method and compute a simple diffusion process. Extract your initial temperature values from a simple image.

Notes

- The Homework is due by 10:30am on Nov. 3. Written solutions should be handed in before the lecture. Programming assignments must be submitted by email to your tutor David Hyde <dabh@stanford.edu>.
- In case you have any questions about the assignments, please contact your tutor David Hyde <dabh@stanford.edu> or the instructor Prof. Dominik L. Michels <michels@cs.stanford.edu> directly via email.
- Office hours are every Friday, 10-12 in 208/209 Gates CS Bldg. or by appointment.
- The university expects both faculty and students to respect and follow Stanford's Honor Code; see https://communitystandards.stanford.edu/.