

Computational Physics II

Homework 4

Submission: November 25 (Monday), 2019

Cahn- Hilliard equation (10 points)

- Write a program to obtain the time evolution of the order parameter on a two dimensional square lattice (take $L = 128$) via numerical simulation of the Cahn-Hilliard equation for the following two cases:

$$\frac{\partial \psi(\vec{r}, t)}{\partial t} = -\nabla^2 [\psi(\vec{r}, t) - \psi^3(\vec{r}, t) + \nabla^2 \psi(\vec{r}, t)] \quad (1)$$

where $\psi(\vec{r}, t)$, whose values $\psi \in (-1, 1)$ is space-time dependent coarse-grained order parameter.

(For ∇^2 you can use the following Euler discretization formula:

$$\nabla^2 u = \frac{u_{i+1,j} + u_{i-1,j} + u_{i,j+1} + u_{i,j-1} - 4u_{i,j}}{h^2} \quad (2)$$

where $h = 1$. Take $\delta t = 0.01$.)

- Case 1: Plot the snapshots for 4-5 different times starting with 50 : 50 ratio of the positive and negative ψ .
- Case 2: Plot the snapshots for 4-5 different times starting with 20 : 80 ratio of the positive and negative ψ .