c. For $j = N-2$ & $j = N-1$: $\frac{\partial C}{\partial x} \approx \frac{C_j^i - C_{j-1}^i}{\Delta x}$ (backward difference for spatial deriv)

Previously, for the advection code in the lecture:

if V >= 0:

(For) dC[0] = (C[0, i-1] - C[N-1, i-1])/dx (Boundary cond.) (1st → last)

(Back) dC[1:N] = (C[1:N, i-1] - C[:N-1, i-1])/dx (Boundcond) (last → 1st)

else: ↕ No need since they're not @ boundary

(For) dC[:N-1] = (C[1:N, i-1] - C[:N-1, i-1])/dx

(For) dC[N-1] = (C[0, i-1] - C[N-1, i-1])/dx

=) Therefore for N-2 & N-1:

if V >= 0:

dC[N-2] = (C[N-2, i-1] - C[N-3, i-1])/dx

dC[N-1] = (C[N-1, i-1] - C[N-2, i-1])/dx

else:

dC[N-2] = (C[N-1, i-1] - C[N-2, i-1])/dx

dC[N-1] = (C[0, i-1] - C[N-1, i-1])/dx

=) Therefore, the value for C is: $C_{N-2}^{j+1} = \Delta t \left[5 \left(\frac{C_{N-1}^j - C_{N-2}^j}{\Delta x} \right) - \frac{C_N^j - 2}{2} \right]$

$C_{N-1}^{i+1} = 2$

PHYS 305 Quiz 2 (Redo)

1. A is Langevin dynamics since it has both velocity & position terms.
B is Brownian dynamics since it only has position (negligible velocity)

ODE for A: $m\frac{dv}{dt} = \xi_x(t)\vec{x} + \xi_y(t)\vec{y} - \xi v$; where $\xi_x = \frac{\sqrt{2k_BT\xi}}{\Delta t}\,\text{radn}(L)$

$\Rightarrow$ In term of x: $m\frac{d^2x}{dt^2} = -\xi\frac{dx}{dt} + \sqrt{2k_BT\xi}\,\underbrace{\text{radn}(L)}_{\text{random noise.}}$

$\Rightarrow$ ODE for B: Same with A but ignore velocity term

$\Rightarrow \xi\frac{dx}{dt} = \sqrt{2k_BT\xi}\,\text{radn}(L)$

2. $\frac{\partial c}{\partial t} = 5\frac{\partial c}{\partial x} - \frac{1}{2}c$ $\rightarrow$ looks like an advection equation

A. Since it is an advection equation, I think we should use backward difference to calculate spatial derivative since the particle flows from left $\rightarrow$ right in this case (positive V). Forward difference will need a negative velocity & contrac depends on the concentration on the right, which is unknown in this case. Backward also ensure the stability condition in this case.

B. Since it is a first order ODE, there's only 1 boundary condition that's needed.