Final Assignment- 1 (Even ID)

Problem 1:

Suppose you have a 5 * 5 array. Each cell of the array is either 0 (Dead) or 1 (Alive) Now The value of a given cell at the next instant of time depends on the state of its neighbours at the previous time step. There are four rules:

1. If a cell is Alive and has fewer than two neighbours that are Alive, it dies on the next time step.
2. If a cell is Alive and has exactly two neighbours that are Alive, it remains Alive on the next time step.
3. If a cell is alive and has more than two neighbours that are Alive, it dies on the next time step.
4. If a cell is Dead and has two or three neighbours that are alive, it turns Alive on the next time step.

Example:

Time -0	Time -1	Time -2	Time-3
0 1 0 0 0 0 0 1 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 0 0	0 0 1 0 0 1 0 0 1 0 1 0 0 0 0 1 1 1 1 0 0 0 0 0 0	0 1 0 1 0 0 1 1 0 0 0 0 0 1 1 1 0 1 0 0 1 1 1 1 0	1 1 0 0 0 1 1 0 0 1 1 0 0 0 0 1 0 0 0 1 1 0 0 1 0

So use the python programming language to solve this problem. Simulate your code up to 20-time steps and print the array at each time step. Use the above array at time = 0 for initialization.

Problem 2:

You have to simulate a chemical reaction involving three agents. At the beginning of the reaction two reagents A, B are present in the system with amounts of 50 units and 25 units respectively and C is present with amounts of 20 units. A and B react together and form C. Rate of the forward and backward reactions are .035 and .02 respectively. Now simulate the reaction using Python and report the time when the chemical reaction reaches equilibrium, the delta_t (time step size) is 0.3 seconds and difference threshold is = 0.1 . The equations for the rate of changes are given below:

$\frac{dA(t)}{dt}$= kb ∗ C(t) −2* kf ∗ A(t) ∗ B(t)

$\frac{dB(t)}{dt}$= kb ∗ C(t) − 1.6* kf ∗ A(t) ∗ B(t)

$\frac{dC(t)}{dt}$ = 3* kf ∗ A(t) B(t) − 1.8* kb ∗ C(t)

where kf and kb are the rates of forward and backward reactions.

Output should be like the following:

At time= 0.3 :
C1: 23.869999999999997
C2: 4.120000000000001
C3: 59.159000000000006
At time= 0.6 :
C1: 22.159721599999997
C2: 2.8227680800000003
C3: 61.6179314
At time= 0.9 :
C1: 21.2158423377225
C2: 2.1416061878580024
C3: 62.92283801689625
At time= 1.2 :
C1: 20.639223801971063
C2: 1.7558187648771302
C3: 63.67450471209299
At time= 1.5 :
C1: 20.26025736491963
C2: 1.5290550208904965
C3: 64.12834025918836
At time= 1.8 :
C1: 19.994467393259118
C2: 1.393377051873111
C3: 64.41159420421259
At time= 2.1 :
C1: 19.795880485850354
C2: 1.3118014389911536
C3: 64.59353369575815
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