Final_b11209014

Final for Numerical Analysis

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Q1

a. ODEs

💡 Answer is on the test sheet

b. Advection model with periodic B.C.

💡 t for the number of time step

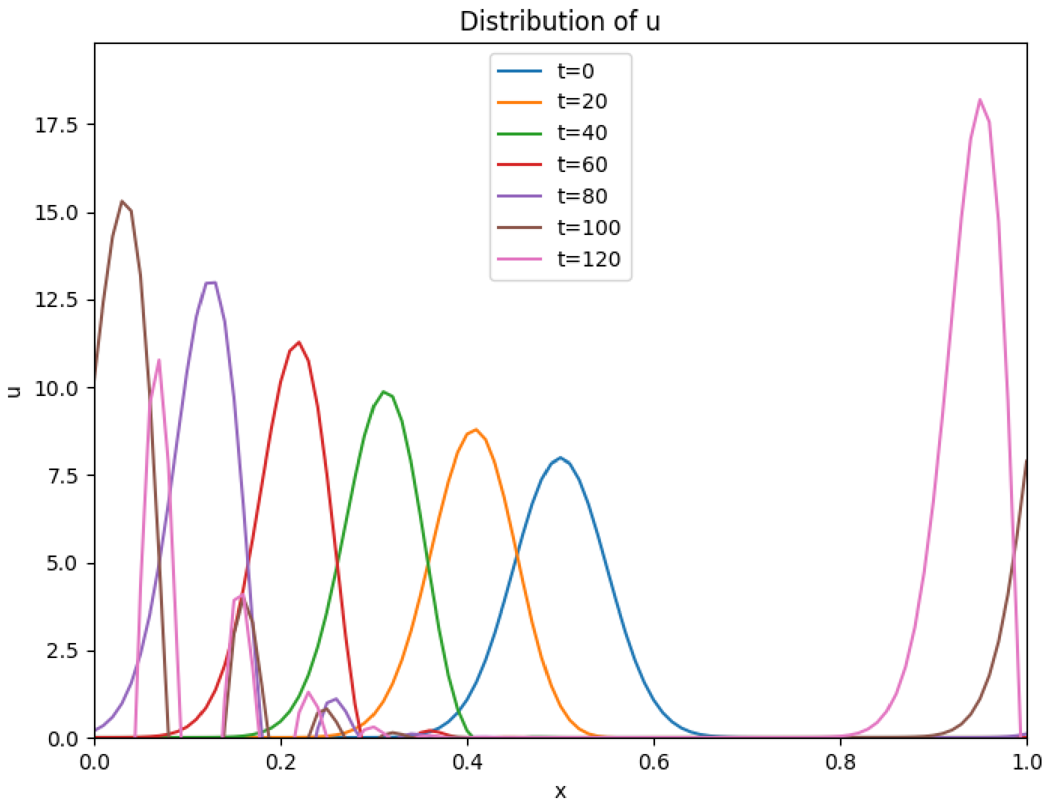

Distribution of u
t=0
t=20
t=40
t=60
t=80
t=100
t=120
u
x
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0.0
0.2
0.4
0.6
0.8
1.0

fig.1

c. CFL

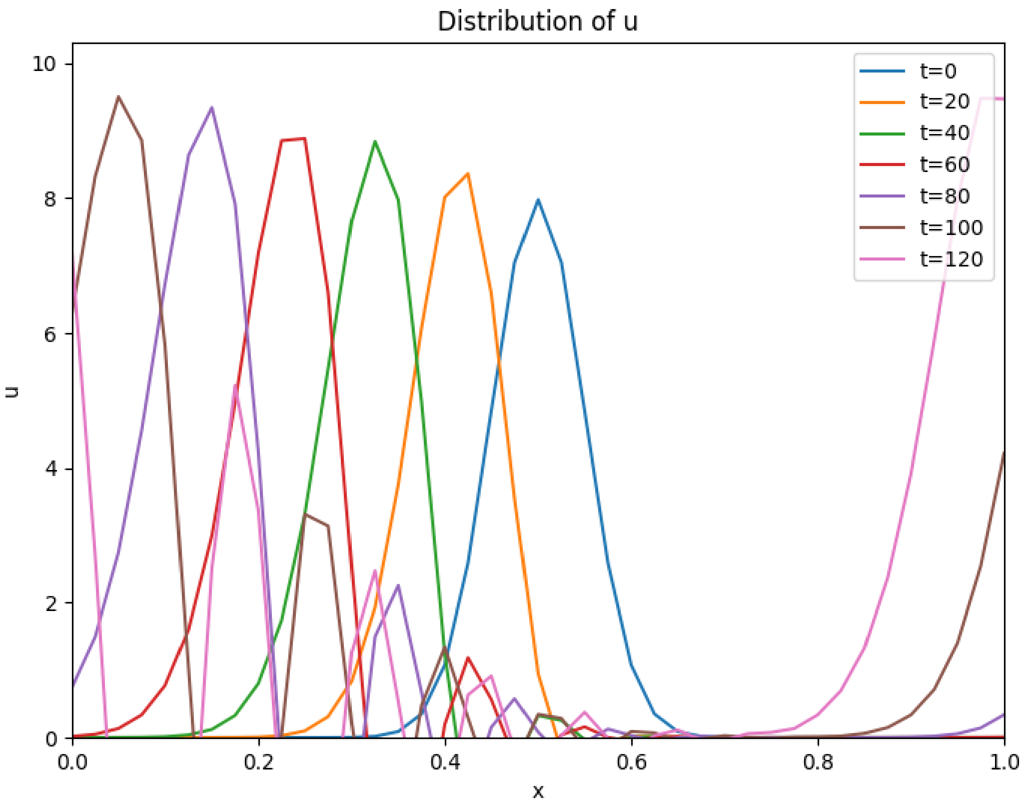


fig.2

💡 on fig.2 time step $\Delta t = 0.025$

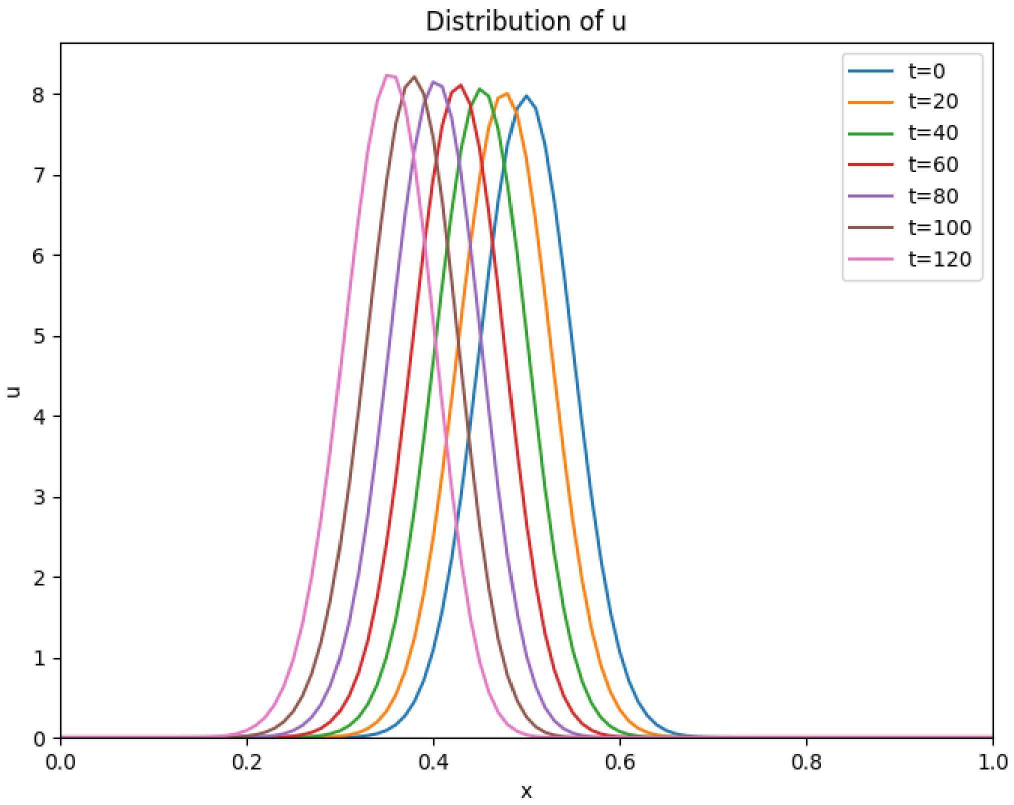


fig.3

💡 on fig.3 time step $\Delta t = 0.01$

Compare the two figure above, fig3 use the greater time step $\Delta t = 0.01$, and CFL states that if the time step is too large would cause instability, which can be proven by fig3

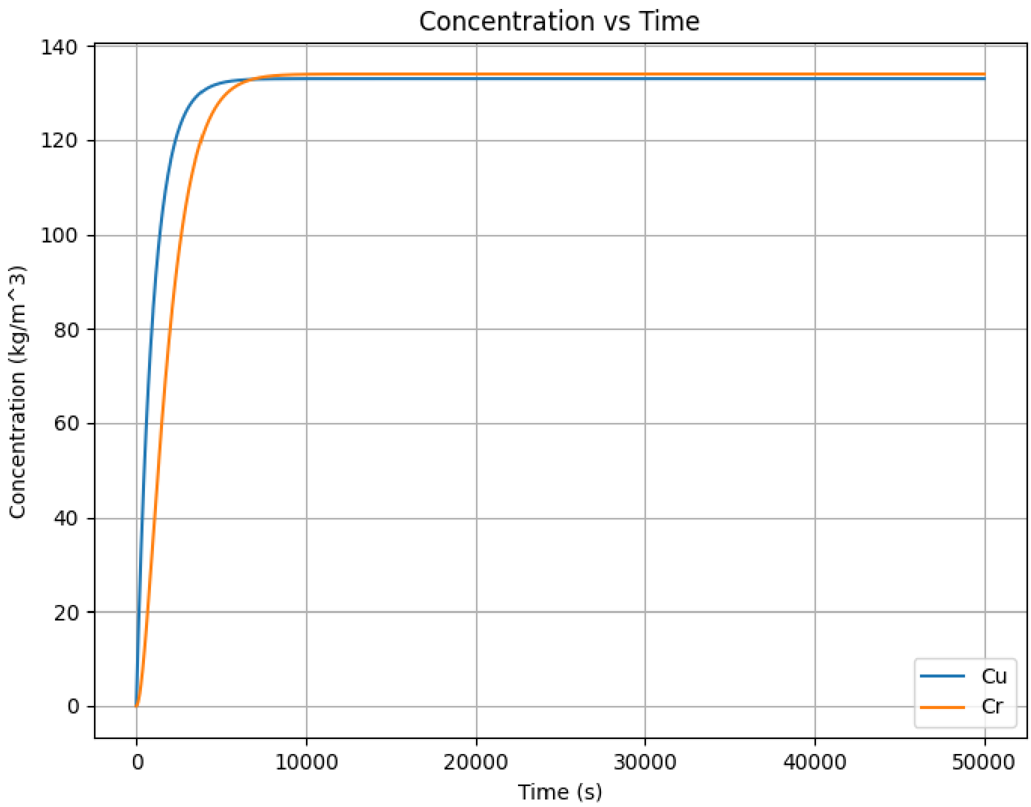
Q2

a. Analytical Solution

💡 Analytical Solution of the equilibrium concentration

$$C_U = 133[\frac{\mathrm{kg}}{\mathrm{m}^3}] \ \mathrm{C_R} = 134[\frac{\mathrm{kg}}{\mathrm{m}^3}]$$

b. RK4

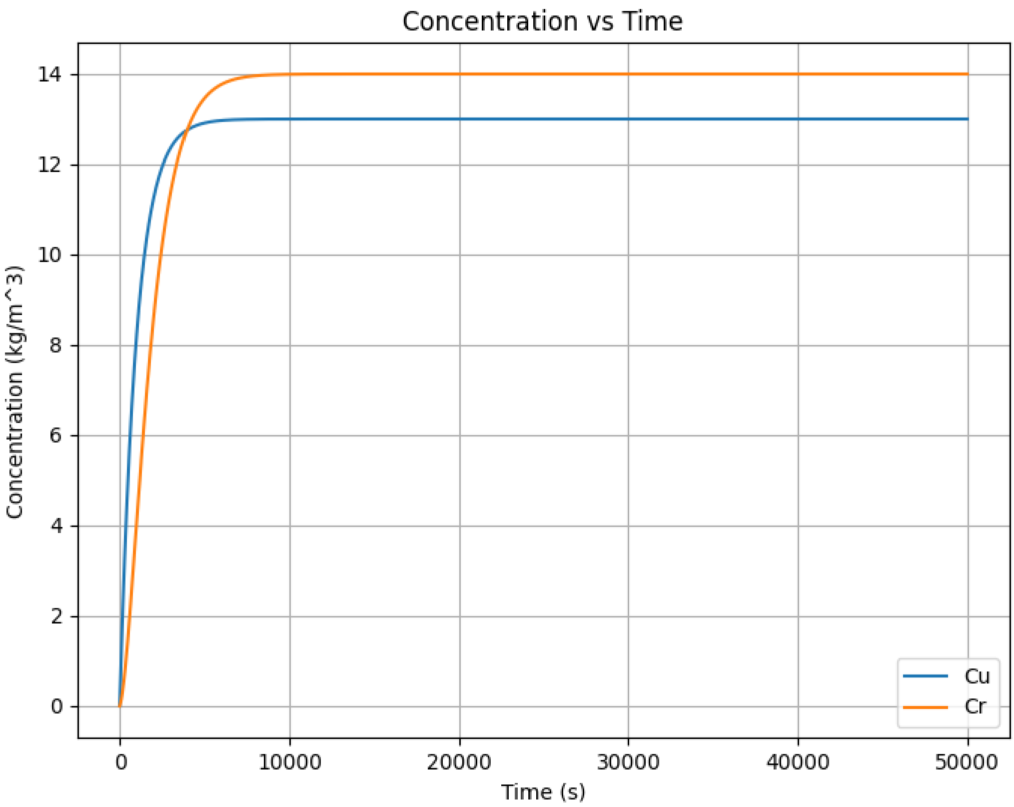


c. Numerical Solution

💡 Numerical Solution of the equilibrium concentration

$C_U \approx 133[\frac{\mathrm{kg}}{\mathrm{m}^3}]$ $\mathrm{C_R} \approx 134[\frac{\mathrm{kg}}{\mathrm{m}^3}]$

d. Reducing Eu



Reduce Eu to 8

💡 By reducing E_U to 8 [kg/m^2s], C can be lower than 20 [kg/m^3]

Q3

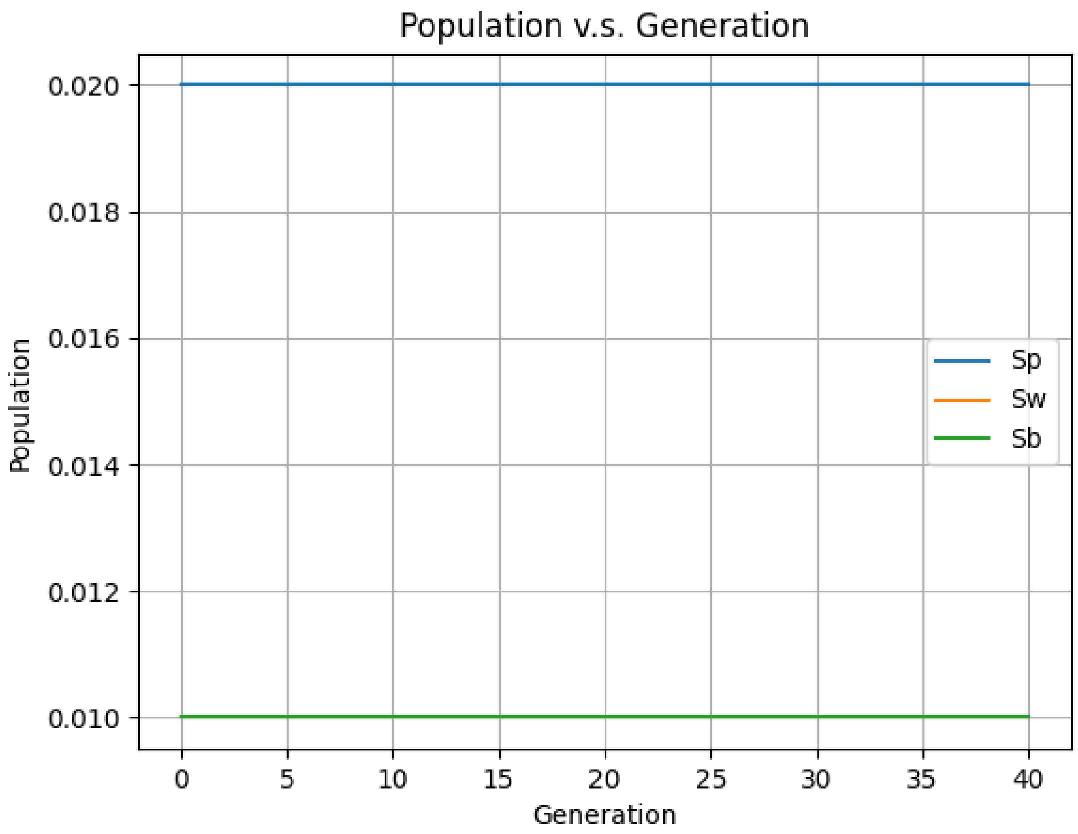
a. Solve Albedo

💡 When $(S_u,\ S_b,\ S_w) = (0.2,\ 0.3,\ 0.5)$ albedo is $A_p = 0.51$

b. Solve Temperature

💡 In the code Q3 (b.)

c. Population evolution



Q4