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Report of Homework 2

1.Code:

import numpy as np

import math

from pyspark import SparkContext

def simulation(sc, ncells, nsteps, nprocs, leftX=-10., rightX=+10., sigma=3., ao=1.,coeff=.375):

x = np.linspace(leftX, rightX, ncells+1) # mesh points in space

dx = x[1] - x[0]

#dx = (rightX-leftX)/(ncells+1)

# t = np.linspace(0, 200, nsteps+1) # mesh points in time

# dt = t[1] - t[0]

u = np.zeros(ncells+1) # unknown u at new time level

u\_1 = np.zeros(ncells+1) # u at the previous time level

# Set initial condition u(x,0) = I(x)

for i in range(0, ncells+1):

u\_1[i] = ao\*math.exp(-x[i]\*x[i]/(2\*sigma\*sigma))

for n in range(0, nsteps):

# Compute u at inner mesh points

for i in range(1, ncells):

u[i] = u\_1[i] + coeff\*(u\_1[i-1] - 2\*u\_1[i] + u\_1[i+1])

# if i == 3:

# print u[i]

# Insert boundary conditions

u[0] = 0; u[ncells] = 0

# Update u\_1 before next step

u\_1[:]= u

print u

if \_\_name\_\_ == "\_\_main\_\_":

try:

sc.stop()

except:

pass

sc = SparkContext(appName="SparkDiffusion")

ss = SparkSession(sc)

simulation(sc, 100, 20, 4)

2. Results of 100 points

[ 0.00252041 0.00507329 0.00769955 0.01045456 0.01341028

0.0166535 0.02028155 0.02439725 0.02910473 0.03450702 0.04070533

0.04779942 0.05588841 0.06507119 0.07544637 0.08711148 0.10016162

0.11468763 0.13077395 0.14849626 0.16791882 0.18909191 0.21204902

0.23680423 0.26334952 0.29165241 0.32165376 0.35326595 0.38637148

0.4208221 0.45643848 0.4930106 0.53029874 0.56803528 0.60592719

0.64365928 0.6808981 0.71729654 0.75249896 0.78614681 0.81788459

0.84736598 0.87426015 0.89825783 0.91907729 0.93646977 0.95022446

0.96017275 0.96619163 0.9682063 0.96619163 0.96017275 0.95022446

0.93646977 0.91907729 0.89825783 0.87426015 0.84736598 0.81788459

0.78614681 0.75249896 0.71729654 0.6808981 0.64365928 0.60592719

0.56803528 0.53029874 0.4930106 0.45643848 0.4208221 0.38637148

0.35326595 0.32165376 0.29165241 0.26334952 0.23680423 0.21204902

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0.03450702 0.02910473 0.02439725 0.02028155 0.0166535 0.01341028

0.01045456 0.00769955 0.00507329 0.00252041 ]

3.

There’s a pattern that the heat increases and then slowly drops, then it slowly increases again.

Maybe that’s because the initial two points are considered as heat source, the heat source at the point 0 is closer so it will pass heat first, then heat will fall as it will propagate to farther points, and then this point get the heat from the heat source at the end, so it’ll rise again.