Assignment_3

November 16, 2024

Assignment 3

Due EOD Tuesday Oct 1st

#Question 1

A nuclear fuel pellet is a cylinder, 1.5 cm in lenth and 1 cm in diameter. Assume the surface temperature is 300 C everywhere. Given temperature probe data below, determine the radial temperature profile in the middle of a nuclear fuel pellet (i.e.: T(r, z = 0.75)) using radial basis functions.

[ ]:
```
import numpy as np

# 20 data points presented in columns: | x | y | z | T |

data = np.array([
    [5.1690e-02, 2.3766e-01, 6.7059e-01, 5.2645e+02],
    [1.1353e-01, 9.4708e-02, 5.3856e-01, 5.5201e+02],
    [1.6676e-01, 1.4358e-01, 4.6936e-01, 5.0802e+02],
    [1.3610e-01, 3.7207e-02, 2.1694e-01, 4.3663e+02],
    [8.9225e-02, 3.7293e-01, 1.1270e+00, 3.9234e+02],
    [1.9001e-01, 3.7240e-01, 8.4774e-01, 3.8872e+02],
    [5.4849e-02, 3.5425e-01, 5.7478e-01, 4.3784e+02],
    [1.7001e-01, 2.0241e-01, 1.2960e+00, 4.0159e+02],
    [2.0606e-01, 3.1594e-01, 6.4077e-01, 4.2652e+02],
    [2.5382e-01, 2.5859e-01, 4.8610e-01, 4.2481e+02],
    [5.6038e-02, 8.2231e-02, 4.2029e-01, 5.3244e+02],
    [3.1242e-01, 8.0489e-02, 1.1530e+00, 4.2453e+02],
    [6.0186e-02, 4.4891e-01, 3.9941e-01, 3.4207e+02],
    [1.5070e-01, 3.4794e-01, 1.5595e-01, 3.4750e+02],
    [1.8215e-01, 3.4388e-01, 1.0478e+00, 3.9963e+02],
    [1.1633e-01, 4.1011e-01, 5.5001e-01, 3.7611e+02],
    [1.2377e-01, 3.3703e-01, 3.7672e-02, 3.1423e+02],
    [4.6378e-02, 3.3653e-01, 1.4434e+00, 3.2345e+02],
    [2.9063e-02, 3.2584e-02, 2.3977e-01, 4.5993e+02],
    [2.1162e-02, 3.8590e-01, 2.5905e-01, 3.6901e+02]
])
```

Consider what you know about this system. What extra information do you have in terms of

0.0.1 a) type(s) of symmetry?

{answer}

0.0.2 b) Boundary conditions?

{answer}

0.1 c) Plot the best guess of the radial temperature gradient

WARNING: RBFs will fail with a linear solver error if two data points exactly overlap.

{Method, implementation, answer (2 points)}

1 Question 2

You run an experiment and obtain the following data:

x	y1	y2	y3	y4	y5
0.00	-29.49	-2.14	15.88	22.69	28.53
1.11	2.83	18.02	-25.45	-32.45	7.50
2.22	1.97	-10.49	-0.18	-32.10	-40.31
3.33	-38.09	-46.16	-7.87	-33.97	-38.39
4.44	-3.97	-32.22	-33.95	-11.07	-32.47
5.56	4.45	-10.88	20.43	6.57	-8.49
6.67	50.22	51.29	80.02	66.15	84.90
7.78	164.11	190.26	160.94	182.35	163.18
8.89	331.75	306.51	278.40	302.13	335.44
10.00	517.06	483.20	476.73	512.16	500.64

[ ]:
```
import numpy as np

# Define the table as a list of lists
d = np.array([
    [0.00, -29.49, -2.14, 15.88, 22.69, 28.53],
    [1.11, 2.83, 18.02, -25.45, -32.45, 7.50],
    [2.22, 1.97, -10.49, -0.18, -32.10, -40.31],
    [3.33, -38.09, -46.16, -7.87, -33.97, -38.39],
    [4.44, -3.97, -32.22, -33.95, -11.07, -32.47],
    [5.56, 4.45, -10.88, 20.43, 6.57, -8.49],
    [6.67, 50.22, 51.29, 80.02, 66.15, 84.90],
    [7.78, 164.11, 190.26, 160.94, 182.35, 163.18],
    [8.89, 331.75, 306.51, 278.40, 302.13, 335.44],
    [10.00, 517.06, 483.20, 476.73, 512.16, 500.64]
])
```

1.1 a) Determine the best cubic polynomial fit to this data with the uncertainty

{method, implementation, answer}

1.2 b) Your manager thinks this should be a quadratic. Which do you think it should be and why?

{Answer}