ME573 Homework Set # 7

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1 Introduction

This coding assignment involved modeling 2D heat diffusion with the Alternating Direct Implicit Method (ADI) algorithm. The algorithm was implemented in MATLAB (see attached code).

2 Part A

The L_{inf} norm was calculated between the initial conditions ans the exact solution (evaluated at t=0). The norm was: 1.2053e-05

```
A_x =

    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0
    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0         0         0
         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0
         0         0         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000
         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000

A_y =

    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0
    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0         0         0
         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0         0
         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0         0
         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0         0
         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0         0
         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0         0
         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0         0
         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0         0
         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0         0
         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0         0
         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0         0
         0         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000         0
         0         0         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000   -0.5000
         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0    0.5000    3.0000
```

3 Part C

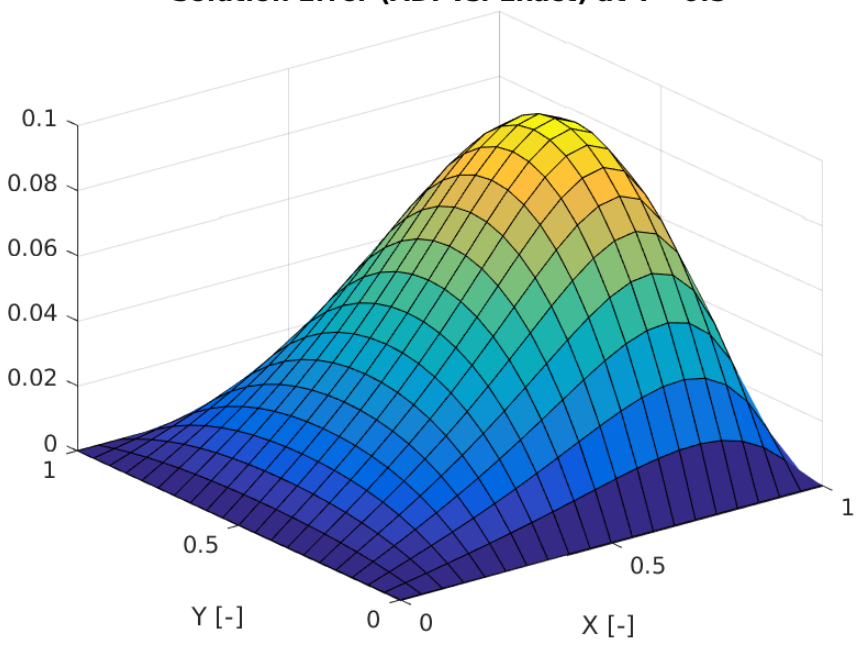
The following figures contain the b vectors used to solve the problem. They are the vectors used in the first time step (1-a) and (1-b).

```
b =

         0
    0.0048
    0.0095
    0.0143
    0.0190
    0.0237
    0.0284
    0.0331
    0.0376
    0.0420
    0.0460
    0.0497
    0.0526
    0.0546
    0.0554
    0.0544
    0.0511
    0.0449
    0.0350
    0.0204
         0
```

```
b =

  Columns 1 through 11

         0    0.0048    0.0090    0.0128    0.0160    0.0188    0.0210    0.0228    0.0240    0.0248    0.0250

  Columns 12 through 21

    0.0248    0.0240    0.0228    0.0210    0.0188    0.0160    0.0128    0.0090    0.0048         0
```

4 Part D

The following Figure 4 shows the error between the exact solution and the ADI method at the end of the time steps.


Solution Error (ADI vs. Exact) at T= 0.5
0.1
0.08
0.06
0.04
0.02
0
1
0.5
0
Y [-]
0
0.5
1
X [-]