Advanced Numerical Techniques

Assignment - 8

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Question 1

Solve using Cubic Spline Interpolation :-

$y'' + 2y' + y = 30x$

$y(0) = 0, y(1) = 0$

$h = ½$

$y_1 = ??$

Solution:

```
yy =

  Columns 1 through 9

         0   -0.0336   -0.0669   -0.0998   -0.1324   -0.1647   -0.1966   -0.2282   -0.2594

  Columns 10 through 18

   -0.2904   -0.3209   -0.3512   -0.3811   -0.4106   -0.4399   -0.4688   -0.4973   -0.5255

  Columns 19 through 27

   -0.5534   -0.5810   -0.6082   -0.6351   -0.6616   -0.6878   -0.7137   -0.7392   -0.7644

  Columns 28 through 36

   -0.7893   -0.8138   -0.8380   -0.8618   -0.8854   -0.9085   -0.9314   -0.9539   -0.9761

  Columns 37 through 45
```

-0.9979 -1.0195 -1.0406 -1.0615 -1.0820 -1.1022 -1.1220 -1.1415 -1.1607

Columns 46 through 54

-1.1795 -1.1980 -1.2162 -1.2340 -1.2516 -1.2687 -1.2856 -1.3021 -1.3182

Columns 55 through 63

-1.3341 -1.3496 -1.3648 -1.3796 -1.3941 -1.4083 -1.4221 -1.4357 -1.4488

Columns 64 through 72

-1.4617 -1.4742 -1.4864 -1.4983 -1.5098 -1.5210 -1.5318 -1.5424 -1.5525

Columns 73 through 81

-1.5624 -1.5719 -1.5811 -1.5900 -1.5986 -1.6068 -1.6147 -1.6222 -1.6294

Columns 82 through 90

-1.6363 -1.6429 -1.6491 -1.6550 -1.6606 -1.6658 -1.6707 -1.6753 -1.6795

Columns 91 through 99

-1.6835 -1.6870 -1.6903 -1.6932 -1.6958 -1.6981 -1.7001 -1.7017 -1.7030

Columns 100 through 108

-1.7039 -1.7045 -1.7048 -1.7048 -1.7045 -1.7038 -1.7027 -1.7014 -1.6997

Columns 109 through 117

-1.6977 -1.6953 -1.6927 -1.6896 -1.6863 -1.6826 -1.6786 -1.6742 -1.6695

Columns 118 through 126

-1.6644 -1.6591 -1.6533 -1.6473 -1.6409 -1.6341 -1.6270 -1.6196 -1.6118

Columns 127 through 135

-1.6037 -1.5952 -1.5864 -1.5772 -1.5677 -1.5579 -1.5477 -1.5371 -1.5262

Columns 136 through 144

-1.5150 -1.5033 -1.4914 -1.4791 -1.4664 -1.4534 -1.4400 -1.4263 -1.4122

Columns 145 through 153

-1.3978 -1.3830 -1.3678 -1.3523 -1.3364 -1.3202 -1.3036 -1.2866 -1.2693

Columns 154 through 162

-1.2516 -1.2336 -1.2152 -1.1964 -1.1773 -1.1578 -1.1379 -1.1177 -1.0971

Columns 163 through 171

-1.0761 -1.0548 -1.0331 -1.0110 -0.9885 -0.9657 -0.9425 -0.9190 -0.8950

Columns 172 through 180

-0.8707 -0.8460 -0.8210 -0.7955 -0.7697 -0.7435 -0.7169 -0.6900 -0.6627

Columns 181 through 189

-0.6350 -0.6069 -0.5784 -0.5495 -0.5203 -0.4907 -0.4607 -0.4303 -0.3995

Columns 190 through 198

-0.3684 -0.3368 -0.3049 -0.2726 -0.2399 -0.2068 -0.1733 -0.1394 -0.1052

Columns 199 through 201

-0.0705 -0.0354 0

Question 2

Discretize using five point formula and use Gauss Seidel iteration:

$\nabla^2 u = x^2 + y^2$

$0 < x < 1$

$0 < y < 1$

$u(x, y) = 0$ on the boundary.

$\delta x = \delta y = 0.25$

Solution:

(After 14 iterations)

u(:,:,14) =

0	0	0	0	0
0	-0.0142	-0.0245	-0.0254	0
0	-0.0245	-0.0391	-0.0379	0
0	-0.0254	-0.0379	-0.0365	0
0	0	0	0	0