Homework 6

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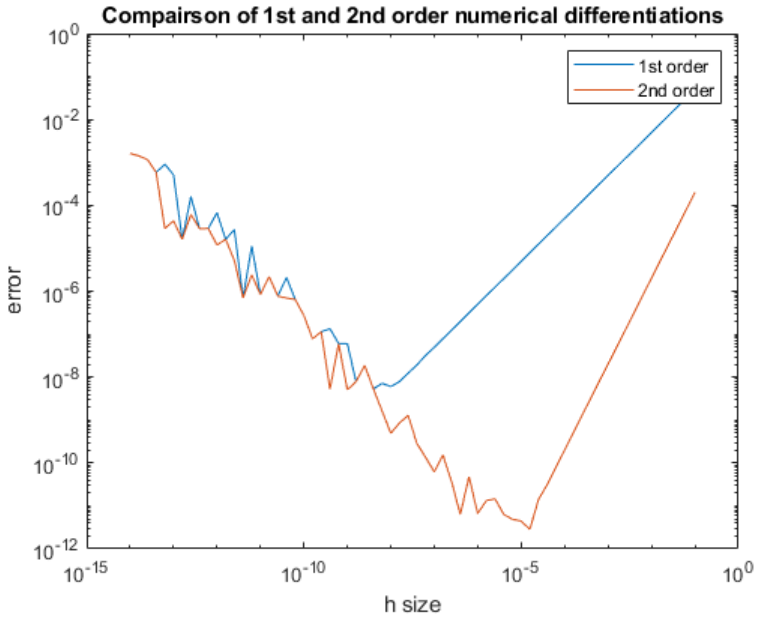
Problem 1-2

Submitted as a hand written pdf attached at the end of this report.

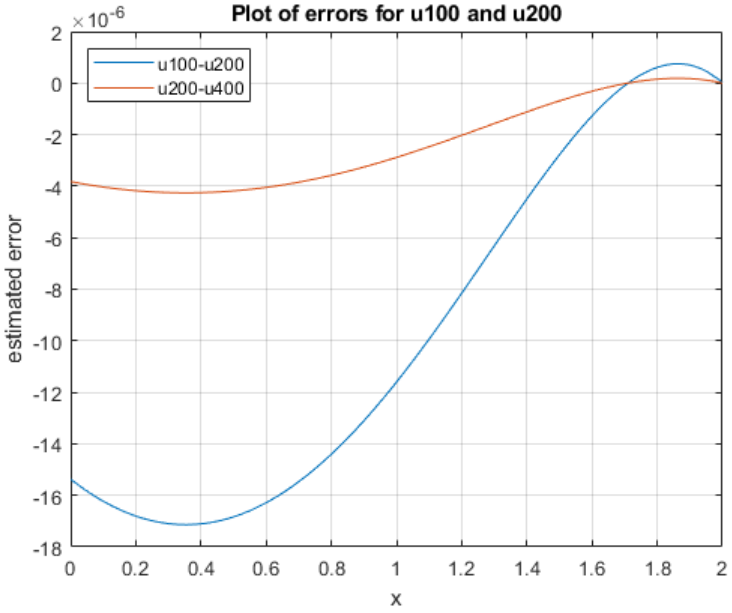
Problem 3

Problem 3 we were given the simple task of approximating $\frac{d}{dx}\sin(x)$ when $x = 1.45$. From there we found the exact error of each method for different values of h. From the graph below we see that the second order method is more accurate at a larger h value.



Problem 4

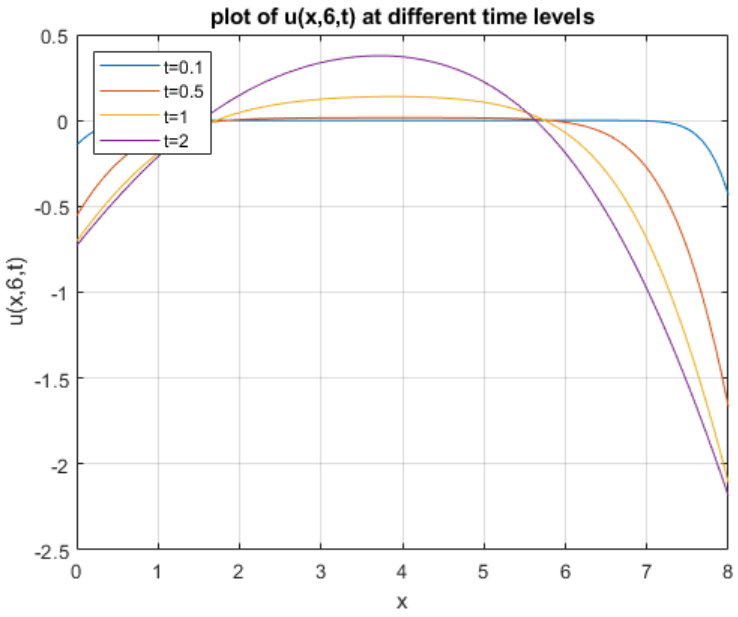
In problem 4 we continue with problem 6 homework 5. We program FTCS to solve the problem to T=3 and N=100,200,400. Then using the spline function in matlab we plotted $u_{(N=100)} - u_{(N=200)}$ and $u_{(N=200)} - u_{(N=400)}$ vs x. At $T = 3$.



Problem 5

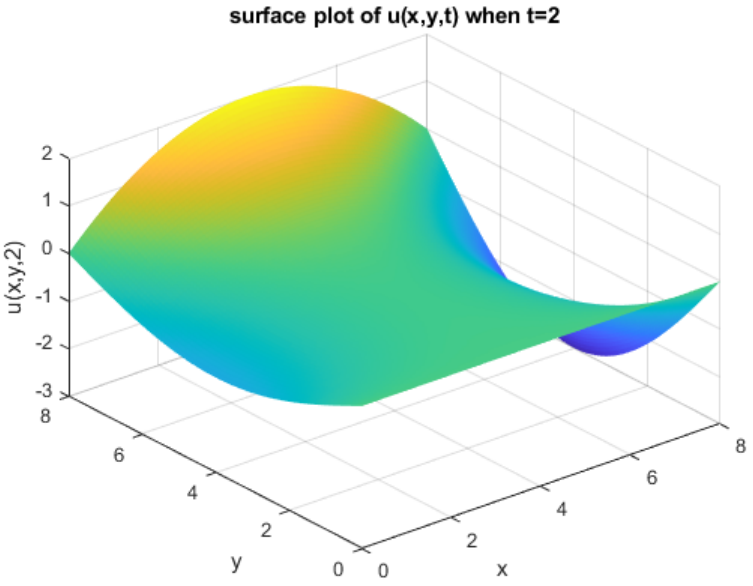
Part 1

Problem 5 was a 2D IBVP of the heat equation we needed to solve the equation to T=2 using FTCS. Then plot $u(x, 6)$ vs. x at $t = 0.1, 0.5, 1, 2$. Pictured below



Part 2

In part 2 we did a surface plot u vs (x, y) at $T = 2$. shown below.

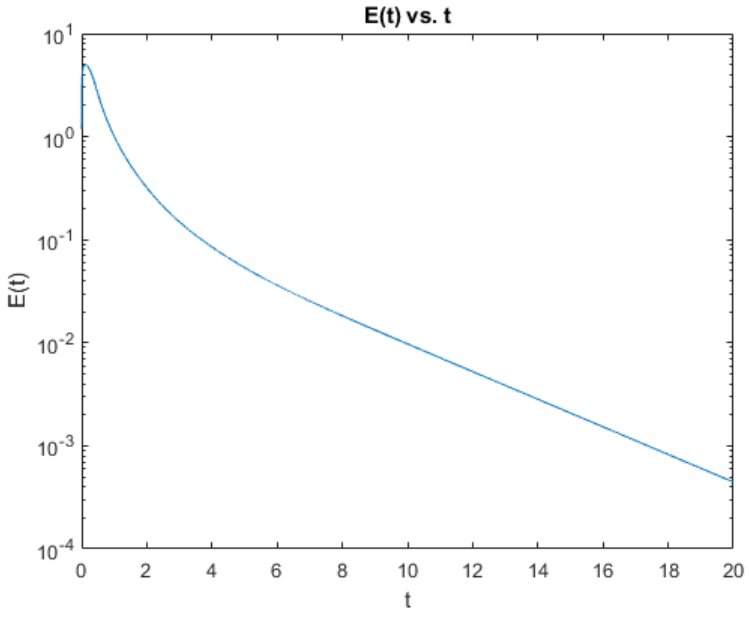


Problem 6

Using the same IBVP from Problem 5 problem 6 asks us to solve the IBVP to $T = 20$.

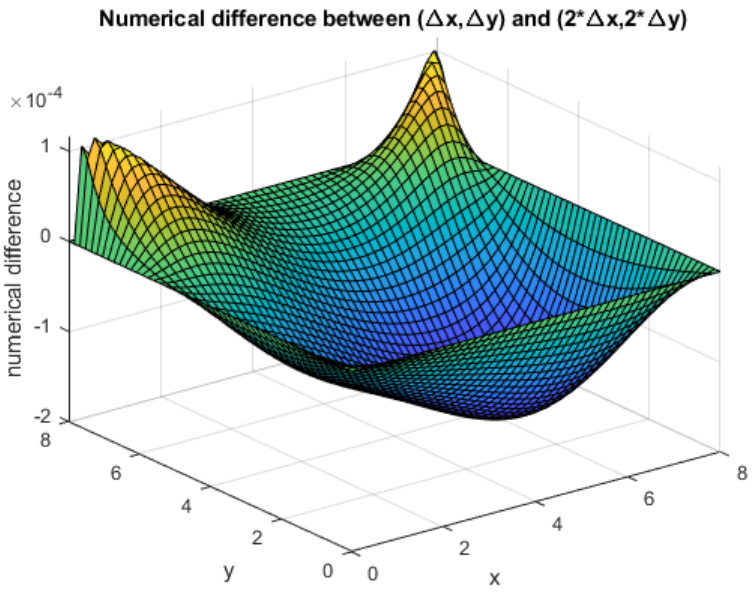
Part 1

Part 1 asks us to plot the max difference between the current time and the next time step of the internal points the plot is shown below.



Part 2

Part 2 has us rerun the simulation using twice the step size for x and y then we calculate the difference at T=20 between the two grids on their common grid points. The surface it creates is shown below.


Numerical difference between (Δx, Δy) and (2*Δx,2*Δy)
×10^-4
1
0
-1
-2
numerical difference
8
6
4
2
0
y
0
2
4
6
8
x