**Abstract**

The following report analyses the utilization of scientific code to solve the two-dimensional diffusion equation. The analysis consists in the solution of the differential equation using the explicit and Implicit method. The report indicates all the specifications of the parameters used in the analysis, including the boundary conditions, code language used and specific hardware used to run simulations. The results will evaluate the effects of the number of iterations applied, a study of the grid convergence and the effects of diffusive CFL. The report ultimately concludes with a comparison of the expected results using the theoretical behavior. It was found that with \_\_\_\_,\_\_\_\_\_,\_\_\_\_\_ the solution of the two-dimensional diffusion equation is \_\_\_\_\_\_,\_\_\_,\_\_\_\_\_ respectively. When compared to the expected theoretical behavior it was found that the applied numerical methods had an error of \_\_\_\_,\_\_\_\_,\_\_\_ when using \_\_\_\_\_,\_\_\_\_\_,\_\_\_\_\_. It was also found that the explicit method and the implicit method each had an error of \_\_\_\_ and \_\_\_ respectively when compared to the analytical solution. It can therefore be concluded that the \_\_\_\_\_\_method is more effective than the \_\_\_\_method especially when using\_\_\_\_\_.

**Mathematical Statement of Project**

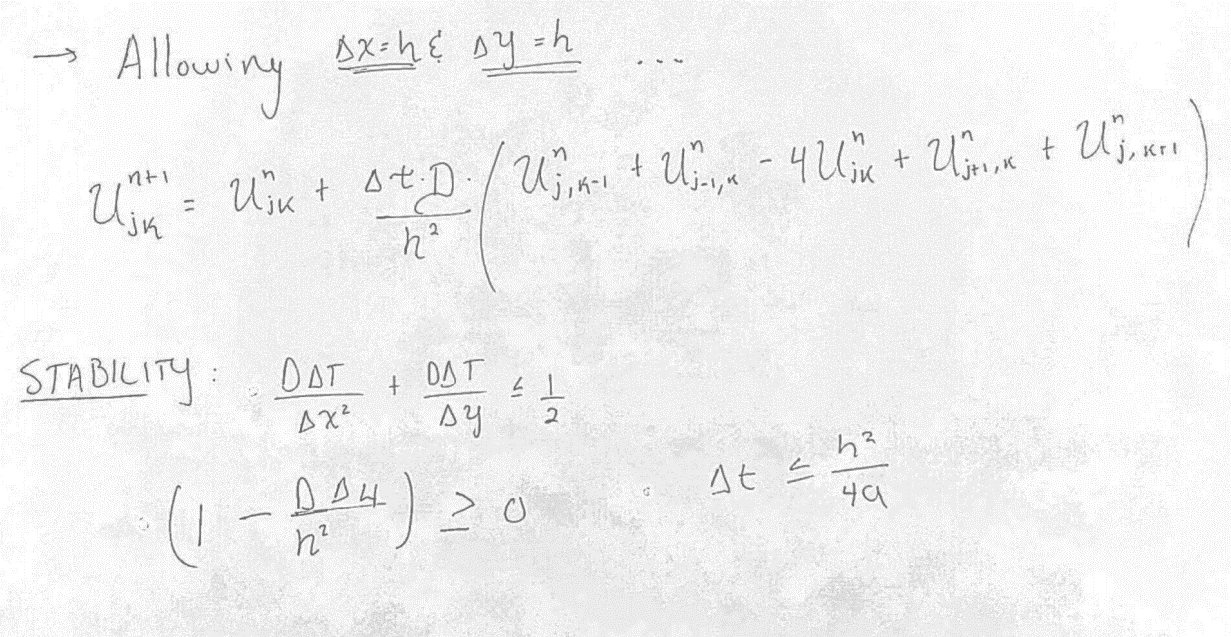
Using computer code and numerical methods, more specifically the explicit and implicit discretization methods, the following two-dimensional diffusion equation is to be solved:

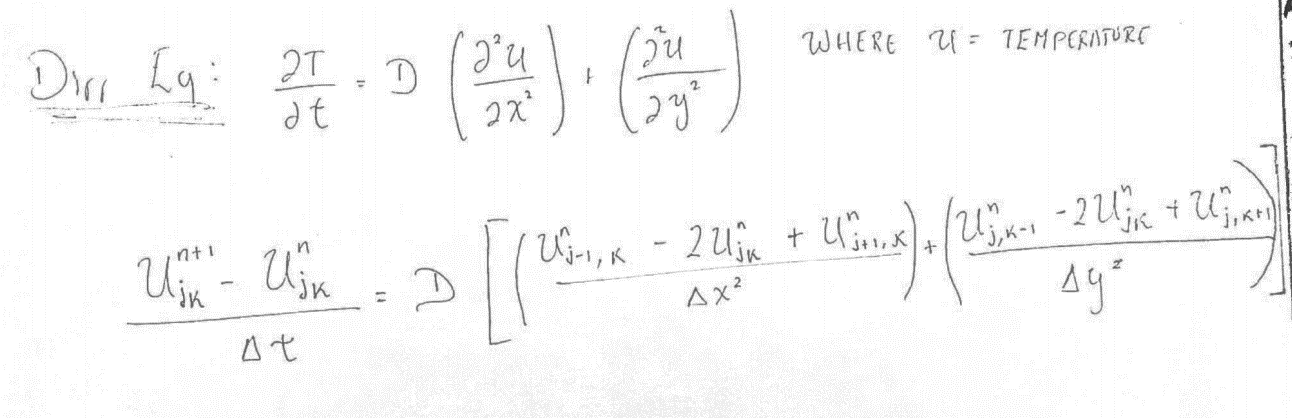
|  |  |
| --- | --- |
|  |  |
|  |  |
| Boundary Conditions: | =0 |
|  |  |

**Discretized version of Equations**

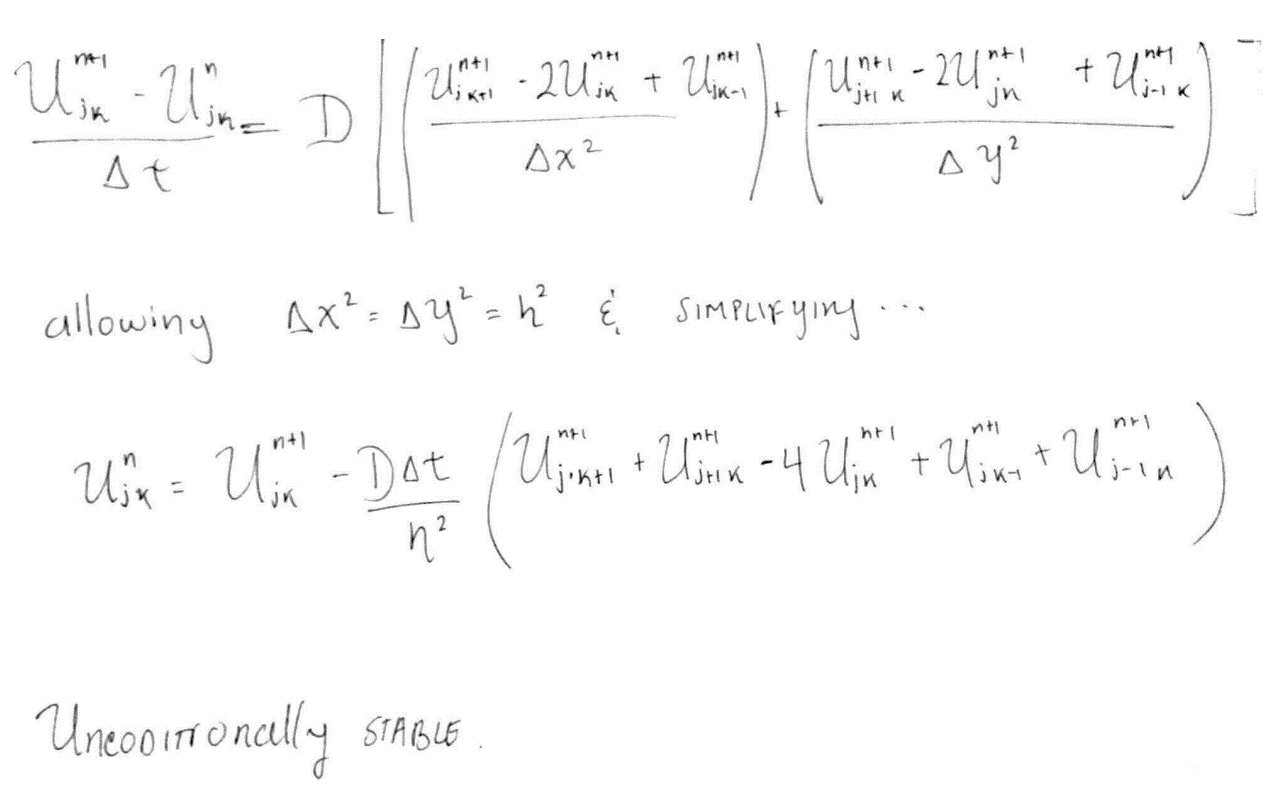
To solve the diffusion equation using computational methods it is necessary to discretize the equations so that they can be translated into a useful code capable of running in MATLAB

**Explicit Method Discretization**





**Implicit Method Discretization**



**Description of Numerical Methods and Pseudo Code**

**Explicit Method**

The explicit method solves the differential equation by going point by point in the grid and solving for temperature (u) using an center difference approximation.

*Peucode*

% Describe all problem parameters

*specify boundaries*

*specify time limit*

*specify initial time conditions*

*specify boundary conditions*

*specify diffusivity*

calculate time step size

calculate space step size

calculate lambda

if *testing if the lambda is appropriate to avoid the calculation to blow up*

for *start time loop with limits*

*initiate graphing based on time step*

for loop going through x

for look going through y

specify boundary conditions

end loop for x

end loop for y

end time loop

**Technical Specifications of Computer Used**

* The Intel Core i5-4200U, Haswell. released in August 2013.:
* Speed: At a clock speed of 1.60 GHz,.
* Cores: It is a dual-core processor,
* Cache: Its 3MB cache
* RAM: 8GB
* Hard Drive:125GB SSD
* OS: Microsoft Windows 10
* System Type: 64-bit

**Results**

Parameters Used in Simulations

Evaluation of the effect of n (number of points used)

Study of Grid Convergence

Effect of Diffusive CFL

Comparison of Expected theoretical behavior

Order of Spatial accuracy of discretization