Computational Electromagnetics and Applications
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Indian Institute of Technology, Bombay
Summary of Week 2

First we looked at the concept of numerical accuracy from different prospectives

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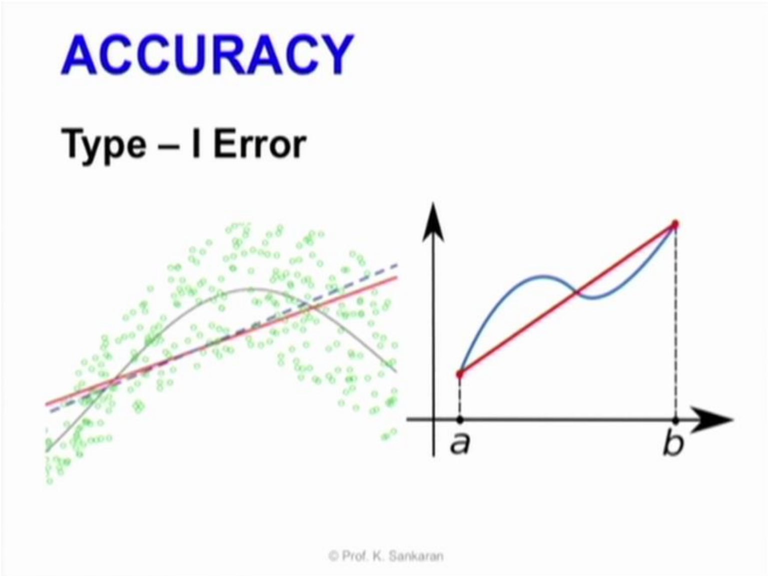

The first type of error we addressed emerges from linearization of any nonlinear phenomena

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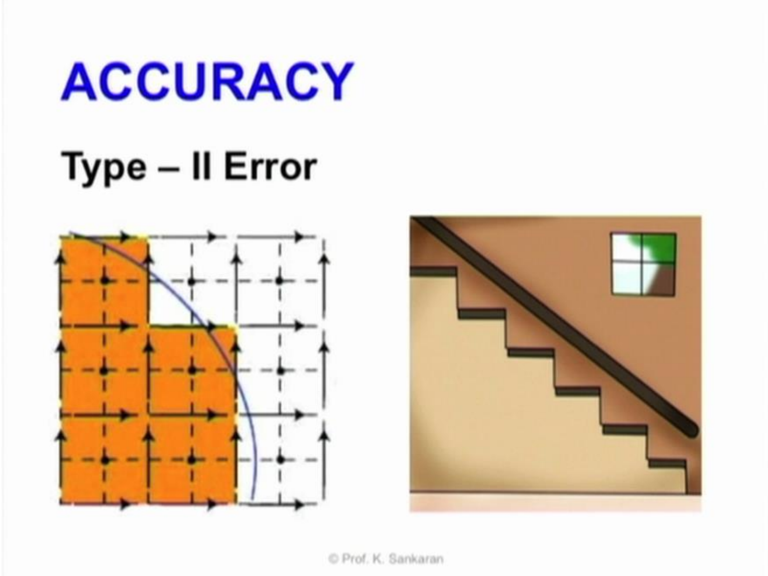

The second type of error is due to spatial discretization. We also called this type of error as the staircasing error in the case of Finite difference method

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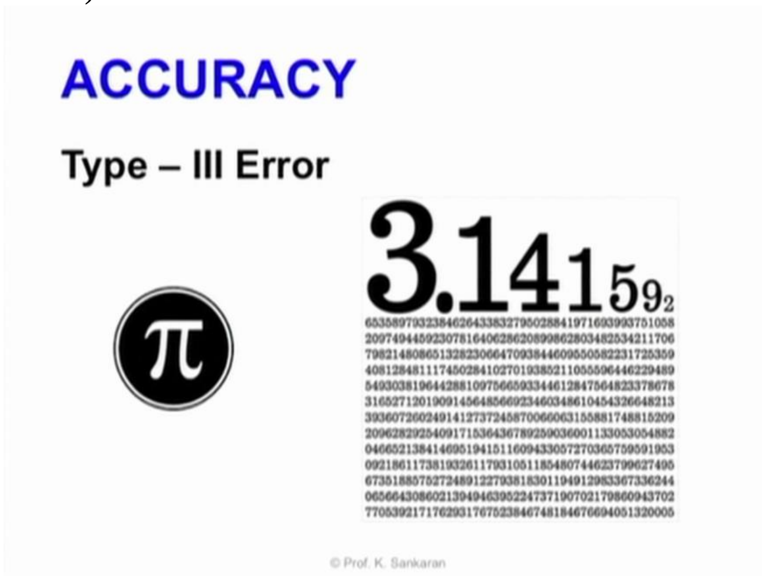

The third type of error comes from floating point truncation or the round up error in our calculation.

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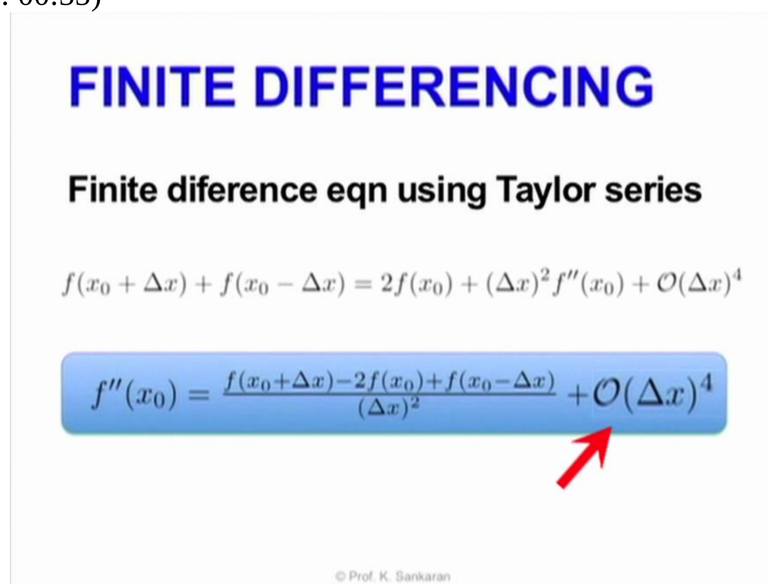

We have a similar type of error that we addressed while studying Taylor series approximation. If you remember we talked about the order of truncation error while introducing Taylor series approximation for different Finite difference schemes.

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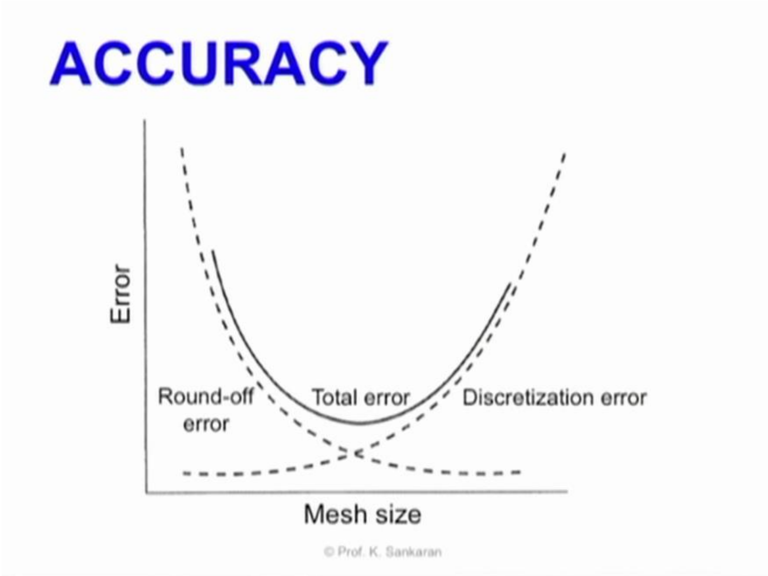

In any modelling exercise the total error is a summation of all these errors we have looked at the graph which illustrates this as the function of spatial discretization.

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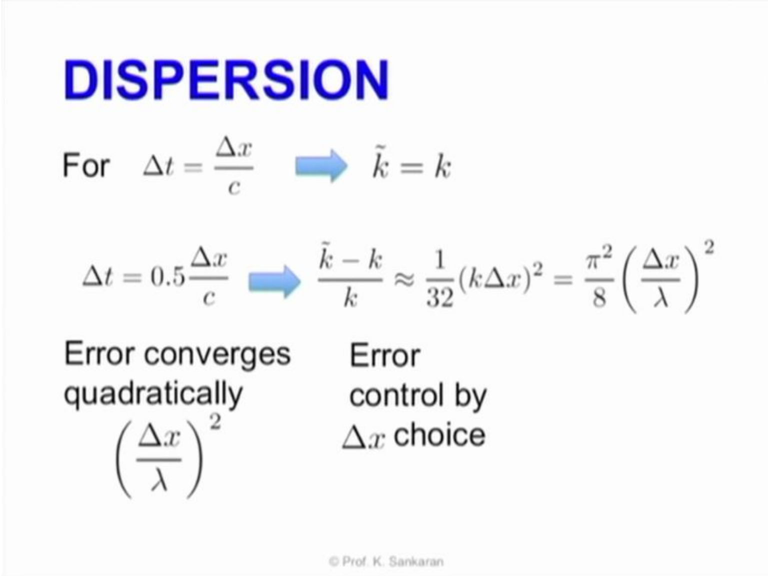

We also addressed another type of numerical error related to the face of the numerical solution which is termed as dispersion error.

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Later we looked at the concept of stability of a numerical scheme.

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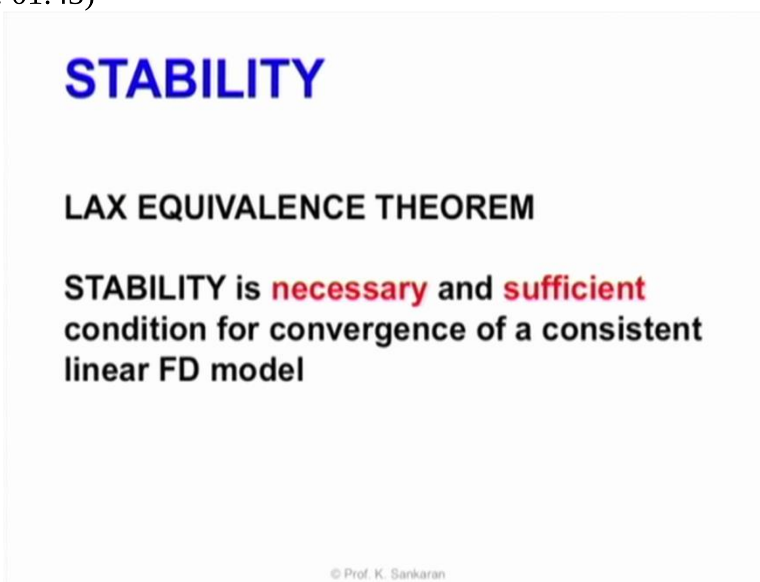

We briefly introduced the Lax theorem for stability.

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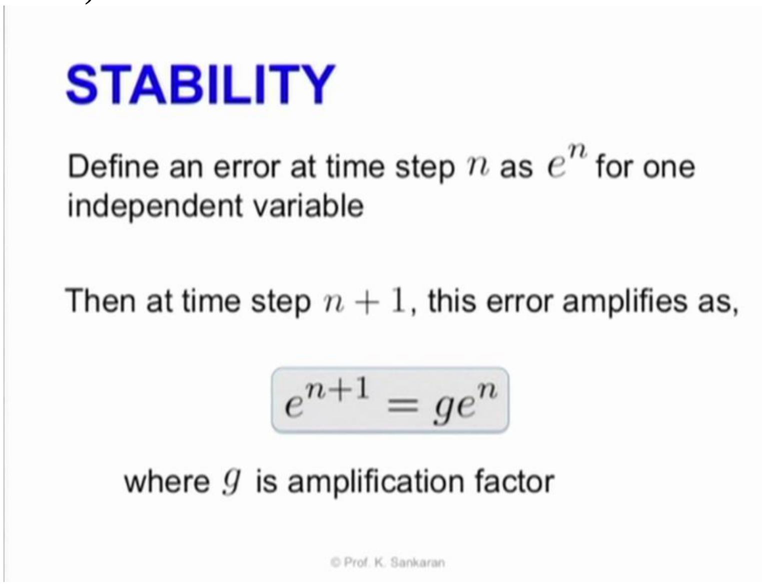

And also investigated the role of error amplification factor.

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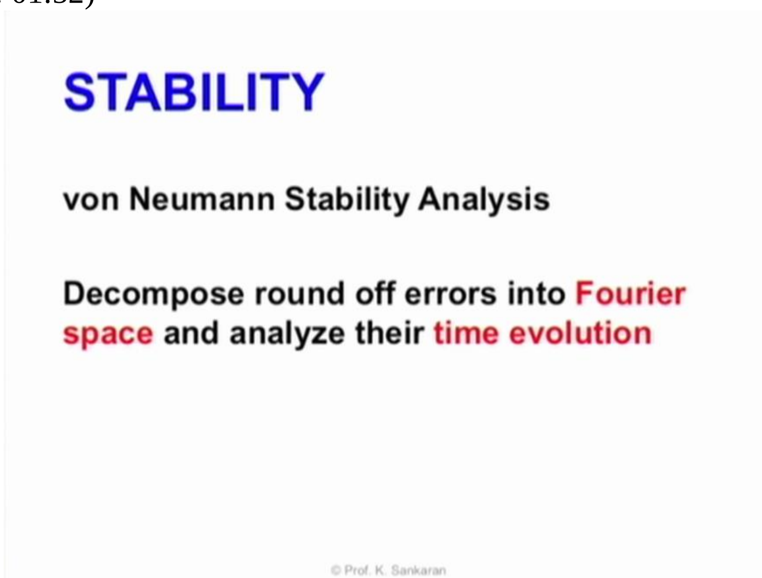

We shortly mentioned about Von Neumann analysis for stability to study the stability of any numerical scheme

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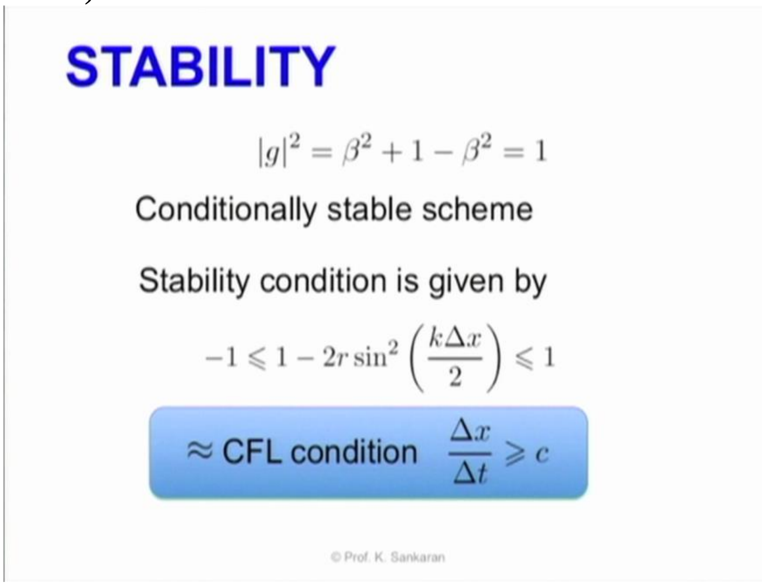

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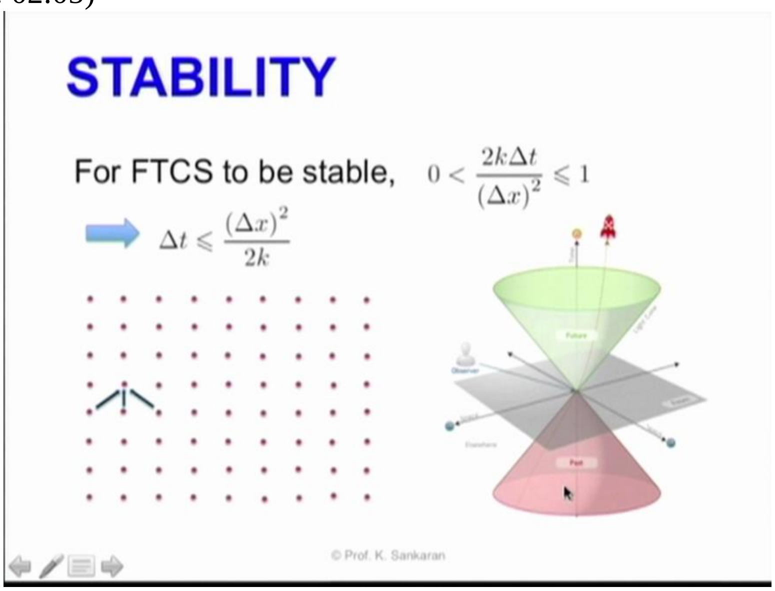

We derived CFL light condition for forward in time centered in space scheme giving the analogy of the light core.

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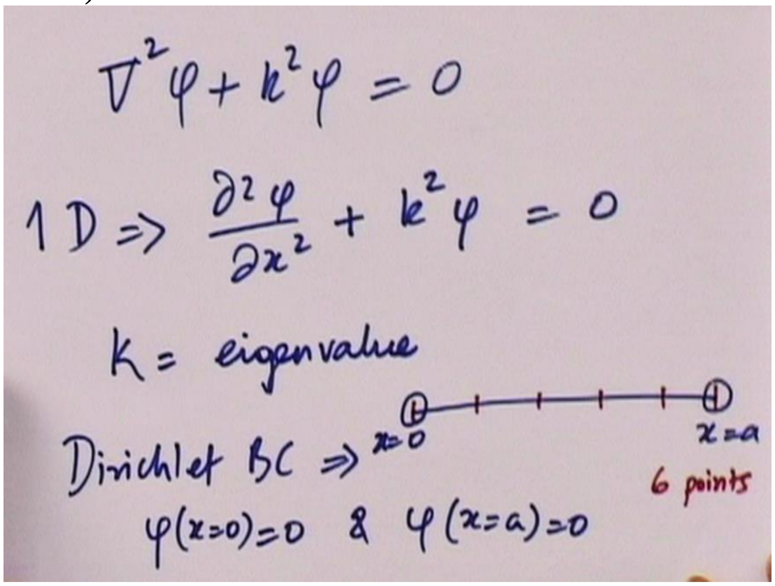

As a first exercise we studied one dimensional Helmholtz equation.

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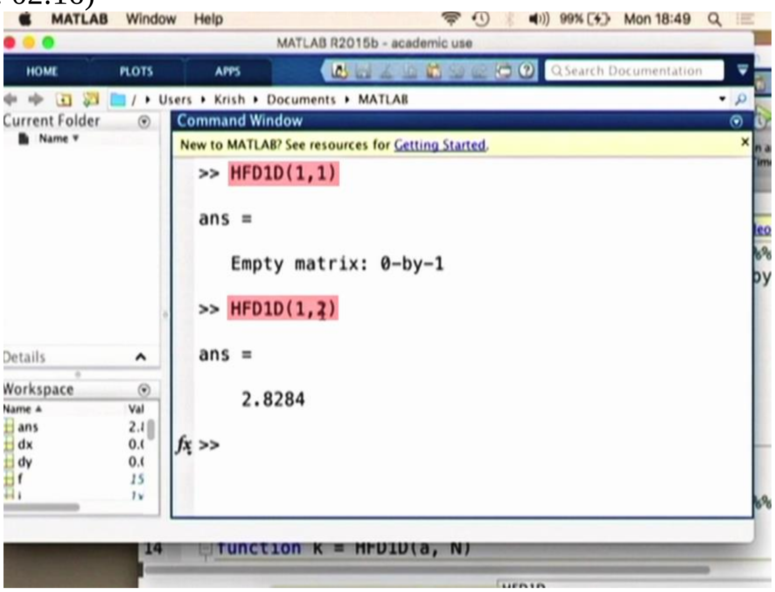

And calculated the Eigen values by changing various parameters of the simulation.

We also noticed the accuracy of the simulation improved as we refine the spatial discretization which confirms that the solution is converging and the method is stable.

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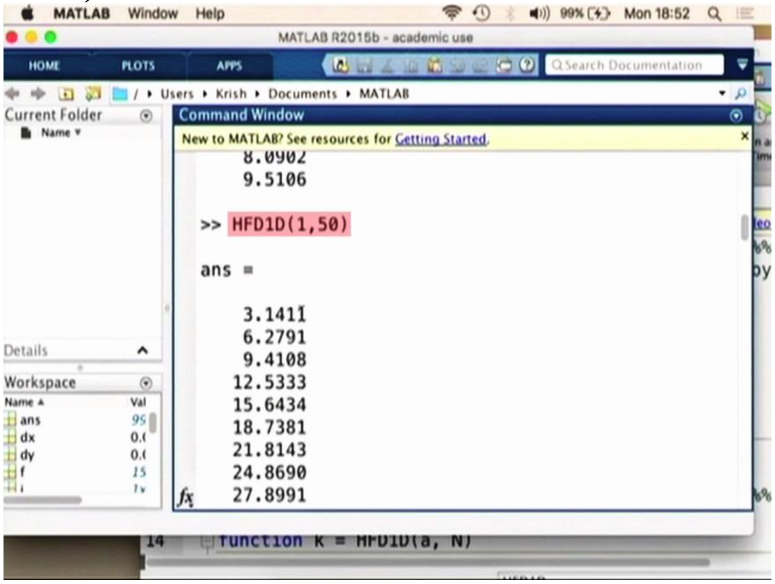

The next exercise is that of a Coaxial Rectangular capacitor

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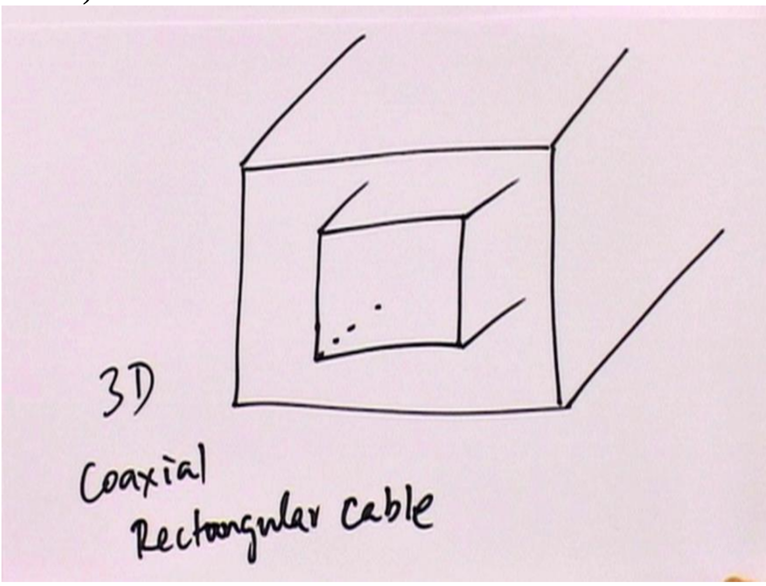

Where we calculated the capacitance per unit length by solving Laplace equation.

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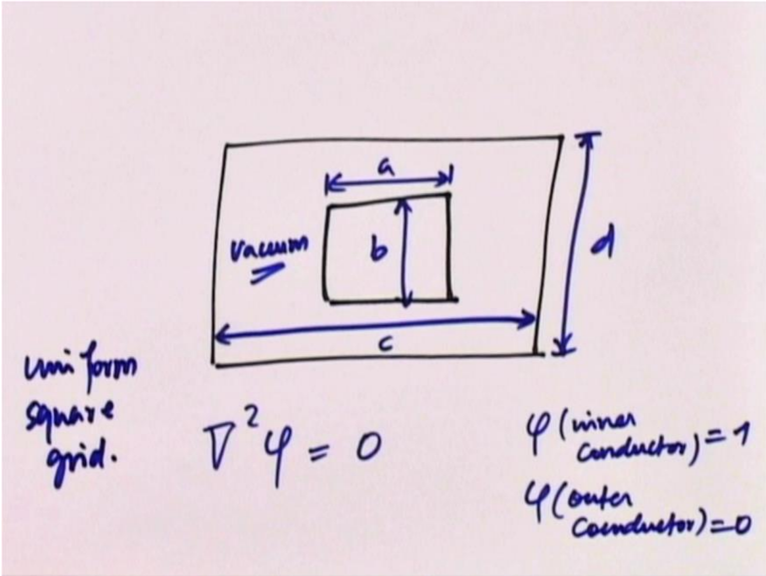

We used Gauss Seidel iteration method in order to compute the solution of the algebraic finite difference equation. We remarked that the solution converges and the speed of convergent itself greatly varies by the choice of proper iterative method.

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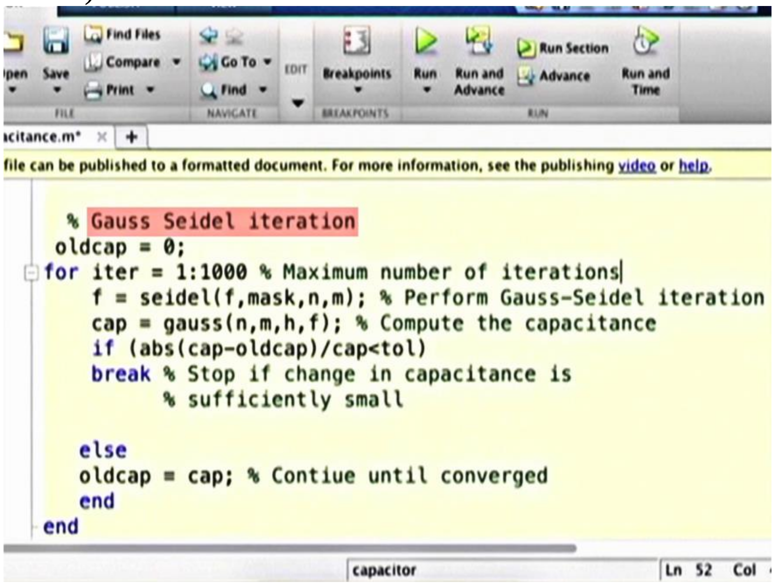

We also noticed the accuracy of computed capacitance improved with respect to mesh refinement confirming the convergence of the method.

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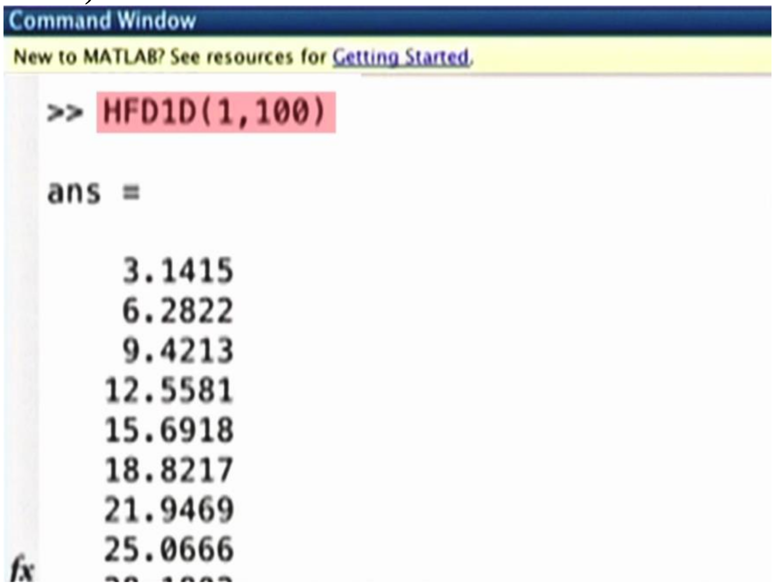

We noticed that the forward in time centered in space scheme is inherently unstable.

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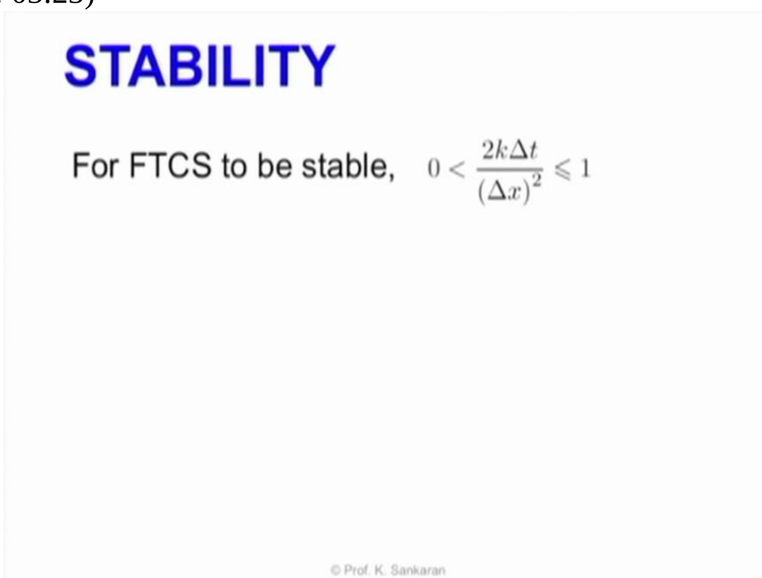

And one has to keep the time stepping prohibitively small to simulate any practical problem.

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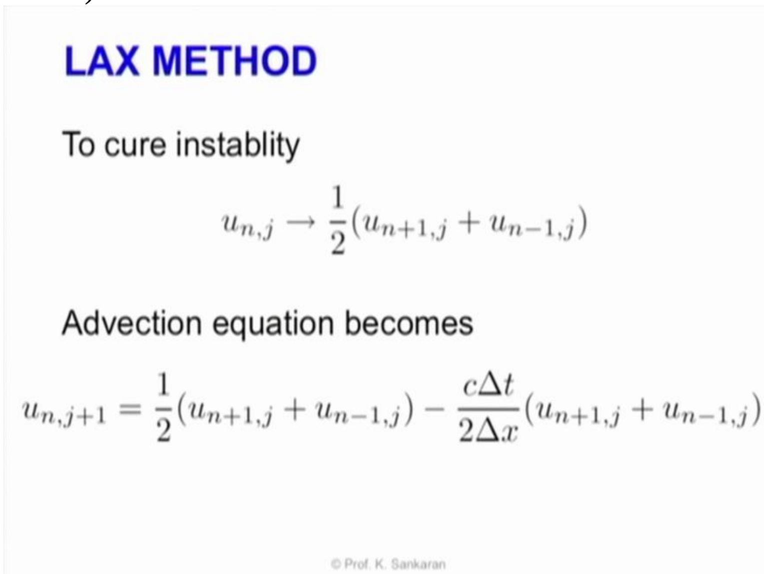

In order to cure this instability we introduced Lax method. We illustrated the Lax method using an example of advection equation.

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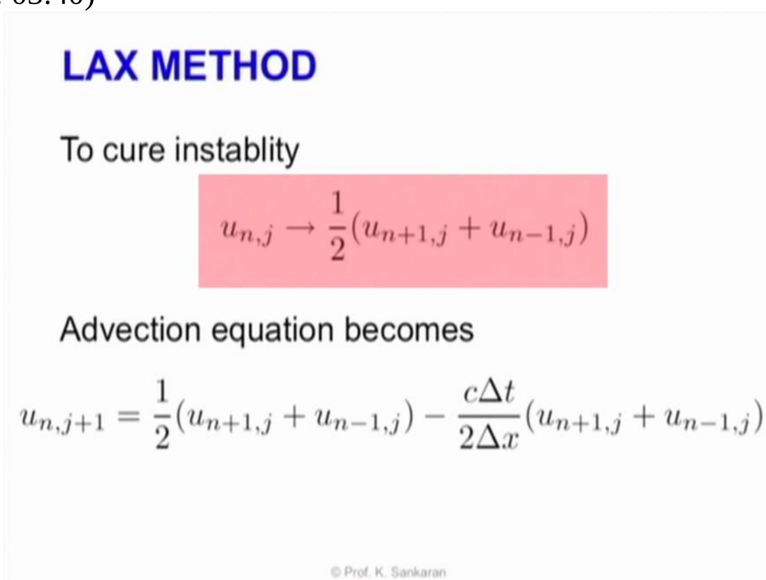

The (())(03:41) of this method lies in taking the average of two neighboring special terms in the forward in time centered in space scheme.

I encourage you to practice the exercises and examples that we have studied in this week and get ready for the next week. So until then Good Bye!