Last Lecture: Class Review & Feedback

Logistics: 1) Homeworks:

- HW10 due today
- last chance to complete HW7
- last chance to submit HW 8-10 Fri 5/1
  ⇒ do as practice for final

2) Grad project
   - due Fri 5/1 midnight
   - submit single zip file on Canvas
   - 3-5 write up pdf
     → Problem statement: PDE, BC, IC
   - Matlab code

3) Final Exam
   - in class 9am - 11:30 am
   - Matlab grader
   - Bring LAPTOP!
   - Letter sized cheat sheet
   - main function calls on the board

Class Review

Aim: 1) Understand how we construct numerical models in Geoscience
- given PDE, BC, IC → code

2) Learn good coding practices
- vectorization (no for loops)
- sparsity (spalloc, spdiags)
- compartmentalization (functions
  ⇒ build complex models
- code like you mean it
  ⇒ functioning, efficient, useful

3) Discrete operator approach

- recoguize all PDE's are built from div, grad & curl
  discrete equivalents: $\underline{\underline{D}}$, $\underline{\underline{G}}$, $\underline{\underline{C}}$
  - hides details (dimension, geometry)
  - Tensor products: 1D – 3D
  - Readable code

⇒ solve 'any' PDE problem

Can be extended to:

1) Gradients of vectors
2) Divergence of tensors

$$\nabla \cdot \underline{\underline{\sigma}} = \rho g$$

$$\underline{\underline{\sigma}} = \lambda (\nabla \cdot \underline{v}) \underline{\underline{I}} + \mu (\nabla \underline{u} + \nabla \underline{v}^T)$$

⇒ elasticity, viscous flow, Maxwell

3) Non-linear problems

⇒ Newton's method ⇒ Jacobian operators hide complexity

- Think in linear algebra

Pre requisites:

Computational:

GEO 325 G Computational Applications in Geo

GEO 352 P Python for Geoscience Research

Mathematics:

M 427J Differential Eqns & Linear Algebra

M 427L Advanced Calculus for Applications

→ multivariable calculus.