About the course.

name: **Scientific Computing III, 5hp**

webpage: studentportalen (I sent out an e-mail with link)

All sessions will be held online. See studentportalen for Zoom links.

**Teachers:**
- Igor Tominec <igor.tominec@it.uu.se>, F3.A
- Pei Fu <pei.fu@it.uu.se>, F3.B
- Tuan Anh Dao <tuananh.dao@it.uu.se>, F3.C, MasFinMa1
The organization of the course

**Duration.** 8 weeks. 11 Lectures. 3 Labs. 3 Workouts. 3 Projects.

**Content.** Three blocks.
- Block 1: Iterative methods for solving linear systems of equations. (IM)
- Block 2: Finite difference method (FDM) for solving partial differential equations.
- Block 3: Finite element method (FEM) for solving partial differential equations.

**Literature.**


SC III: Four different sessions.

- Labs
- Lectures
- Workouts
- Problem solving
**Labs**

Typically you try out some codes that are already written.

In this way you prepare yourself for a set of upcoming lectures.

3 labs all together.

Lab instructions available on Studentportalen.

The lab organization:

- Download the instructions, start running the Matlab codes on your own.
- If you have a question, make a Zoom room, paste the link into the queue‐spreadsheet (see studentportalen for the link).
- Pei, Tuan or me will join your room and help you out.
- Nothing to hand in.
Workouts

Mandatory to attend.

You solve pen and paper exercises.

3 workout sessions all together.

The workout organization

- Before the session: read through the workout, try to solve as many obligatory exercises as you can.
- Join the Zoom session of your corresponding group (links in studentportalen).
- You will be subdivided into breakout rooms.
- Pei, Tuan or me will go through the breakout rooms and help you out if you have questions.
- After the session: upload handwritten attempts to solutions to studentportalen.
Problem solving sessions

**First part:** a teacher solves some workout/exam exercises for you.

**Second part:** instructions + kick-off of a project.

**Project:** write code+report, hand in, revise when you get feedback.

3 mini projects.

**The problem solving organization:**
- Before the session: read the project instructions.
- Join the Zoom session of your corresponding group.
- Try to ask questions while Pei, Tuan or me are solving the exercises.
- Ask questions about the project.
- After the session: continue/start working on the project in groups of max 2.
- Hand in the project report (English) in time.
The goals of the course.

- explain **the idea behind the algorithms** that we consider in the course
- account for the **fundamental difference** between methods based on **finite differences and finite elements** and their advantages and disadvantages given different application problem.
- interpret and relate computational results to the **concepts consistency, stability, convergence**.
- **solve problems in science and engineering given a mathematical model**, by structuring the problem, choose appropriate numerical method and use advanced software and self-written code to generate solution.
- present, explain, summarize, evaluate and discuss methods and results and formulation conclusions in a **written report**.
Examination

In order to pass the course, the student must have:

- participated and passed the mandatory workouts,
- worked actively in the project and submitted a report,
- passed the written exam.
What is Scientific Computing?

Reality

Model

Physics

Mathematics

Programming

Solutions

Numerical Methods

- What can you say about Dorian?
- Where will it go?

\[ h_t + h \cdot u = a, \text{ on } \Gamma_a, \]
\[ h(x, 0) = h_0(x), x \in \omega, \quad h(x, t) = h_{\gamma}(x, t), x \in \gamma_{\omega}, \]
\[ -\nabla \cdot \sigma(u, p) = -\nabla \cdot (2\eta)(u)D(u) + \nabla p = pg, \quad -\nabla \cdot u = 0, \]
\[ \sigma n = 0, \text{ on } \Gamma_{\omega}, \]
\[ T n = -C f(T u) T u, \quad n \cdot u = 0, \text{ on } \Gamma_b, \]

- How can we forecast the path of Dorian?
- What do the colors mean?
What is Scientific Computing?

Switch to the lecture notes.