Overview of project task

TANA21/22: Beräkningsmatematik *Andrew R. Winters* *Autumn 2019*

There is a project component to this introductory course in scientific computing. The learning goals of this project are to develop the abilities to:

1. Translate a mathematical formula or algorithm into a computer program.
2. Debug a computer program.
3. Verify that the implementation of a formula or algorithm is correct by comparing computed results with theoretical estimates.
4. Write a scientific report that collects and discusses your results from the computer project.

Overall, the project task serves to unify scientific computing concepts from the lecture, the written exercises, and the computer exercises.

The problem to be solved in the project will be the numerical solution of a two-point boundary value problem governed by a second-order, linear ordinary differential equation (ODE)

$$\begin{aligned} y''(x) &= p(x)y'(x) + q(x)y(x) + r(x) \quad \text{where} \quad x \in (a,b), \\ y(a) &= \alpha, \\ y(b) &= \beta. \end{aligned}$$

Physical applications of such a two-point boundary value problem are numerous such as the load and deformation of a length of a beam or the heating of a wire as electricity is run through it. This problem uses an ODE model for a function in the interior of the interval where the function is fixed with *boundary conditions* by two constant values at either side of the interval.

Organization and presenting results

The project component is divided into mini-projects such that tasks pertinent to the current Lecture subject(s) can be worked on in tandem. The number of mini-projects a student must complete depends on their course registration:

- Students registered in TANA21 will have two mini-projects.
- Students registered in TANA22 and 9AMA73 will have three mini-projects. The same two mini-projects as the TANA21 students plus an additional mini-project concerning another topic from the Lecture.

The mini-projects are to be solved and the final project report will be written in same groups in which students complete the computer lab exercises.

Some of the mini-projects will come in two variants called "Version Eins" or "Version Zwei". Each pair of students solve one of the versions that will be assigned through the course homepage. This assignment also determines how pairs of students will oppose one another during presentation in the seminar portion. There will be a Handledning session on Monday or Tuesday of Week 42 (depending on your Grupp) for assistance with the mini-projects. The Seminar is then held at the end of Week 42 on Friday, October 15.

To describe the numerical problem and results obtained, the pairs of students must prepare a written project report. This project report can be subdivided to discuss each mini-project separately if it helps with organization. Details on the style and content for the project report is provided on the course homepage in the document `project_writeup_format.pdf`.

Preparation and submission of project task

Each of the mini-projects (whichever version your group has been assigned) are solved in following way:

1. Read the mini-project description with particular focus on any formula, algorithms, or theoretical results that are of importance.
2. Solve the problem in MATLAB
3. Perform the numerical tasks that answer the questions posed by the particular mini-project.
4. Compile necessary numerical results and write the report in the required format.
5. Submit the written report to the opposing group at least one day before the seminar session.
6. Prepare for the opposition (described below).
7. Print a paper copy of your own report and bring it to the seminar, although having your computer available is also useful.
8. Discuss the mini-projects during the seminar where a "Version Eins" group and a 'Version Zwei" group form a discussion pair.
9. Make any changes to your report based on this discussion and submit them to the seminar leader within a week of the seminar date.

Use the checklists below to prepare your own report as well as the opposition to another group's report.

Verify that:

☐ The report is written according to the required format.

☐ All portions of the task are complete.

☐ The numerical results and their discussion answer the questions posed in the mini-project description.

Consider if:

☐ You know that the report clearly explains what you did, how you did it, and if you resolved the stated problems.

☐ You know that the report convinces yourself and others that the solutions and your MATLAB codes are correct.

☐ You think it would be straightforward to replicate the solution procedure and obtain similar results to those presented in the report.