FYS-4096 Computational Physics, exercise 9

Return your solution to project `exercise9` under your GitLab group for this course by Friday 5 AM.

Tag the final version with `final` keyword, and make sure to include a file `problems_solved` in the repository. The `problems_solved`-file should be a comma separated list of problems you have solved.

Problem 0 (0 XP)

Install Fenics on your VM or download an updated VM image from https://www.tut.fi/fys/fys4096.

Problem 1 (2 XP)

I have a frying pan made out of *pure cast iron*, it doesn't even have any coating on it. I use it together with an electrical stove top which I estimate provides 1000 W of power (after losses) to the bottom surface of the pan (radius 20 cm).

Everything but the bottom surface is in contact with airflow for which you can take the heat transfer coefficient '$h = 30\,\mathrm{W}/(\mathrm{m}^2 \cdot \mathrm{K})$'. The ambient temperature in my kitchen is about 20 °C.

Write down the heat equation for the steady state and the boundary conditions for this system. Remember to add the PDF of your solution to the repository.

Problem 2 (2 XP)

Write down the weak formulation of the heat equation in problem 1. Remember to add the PDF of your solution to the repository.

Problem 3 (6 XP)

Let's now solve the temperature distribution of the frying pan numerically. Use the `fenics/dolfin` software suite to solve the weak form equation you got in problem 2. Visualize the surface temperature of the frying pan.

PS. You can find a ready-made mesh for my frying pan in https://www.tut.fi/fys/fys4096/cast_iron_pan.xml and a more finer mesh https://www.tut.fi/fys/fys4096/cast_iron_pan_fine.xml.