Exercises for the Math course, 17.October 2007

Exercise 1:

- Given are the vector fields
  - v(x,y) = (0,x) (1^{st})
  - V(x,y) = (2x+y,x-y^2) (2^{nd} in case there is still time left)

- Calculate analytically the curl and divergence of this field

- Model the field by modifying exercise1.R
  1. Change the initialization of the field to get the required vector field
  2. Plot the vector field and compare with what you expected
  3. Calculate and plot the curl using the diff.x and diff.y functions
  4. Calculate and plot the divergence using the diff.x and diff.y functions

Exercise 2:

Temperature distribution,

This exercise is based on exercise2.R

- You observe a temperature distribution T(x,y) on a heat conductive surface (you assume that there is no heat loss away from the surface)
  T(x,y) = 1/sqrt(x^2+y^2)
  (This part is already programmed)

- What is the heat flux density ? (assume k = 1)

- Are there any heat sources in the region ?

- Calculate this locally, and by calculating the flux around a closed boundary

Exercise 3:

This exercise is again based on exercise1.R

- Adapt exercise1, to model the flow in a tube which was presented in the lecture
  Compare the numerical and analytic result of the curl

Exercise 4: (if there is time left)

Rotating disc:

This exercise is based on exercise4.R

Given is a velocity field of a disc rotating around (0,0) with the angular speed omega

- Calculate the rotation of this field analytically and numerically, plot the rotation
- Check Stoke's law using a rectangular box with the corners (-8,-8) (8,8) which corresponds to the indices (3,3) (19,19)