

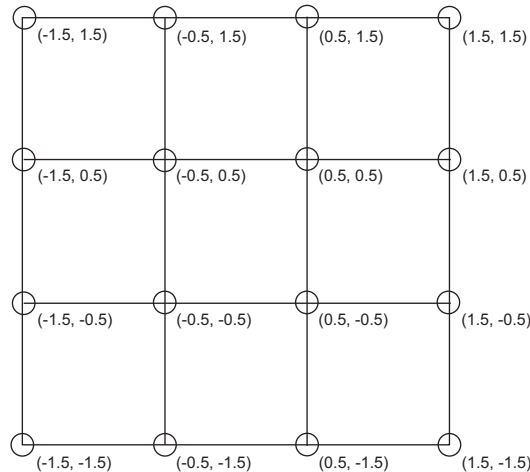
Visualization (Assignment 6)

Exercise 6.1 [4 Points] Marching Squares / Isolines

A two-dimensional scalar field is given by

$$f(x, y) = \left(x - \frac{1}{2}\right)^2 - y^2.$$

1. Evaluate the function at the discrete sample points specified by the grid shown in the figure below. The coordinates of the equidistant grid points are given in parentheses. Round the function values to the first digit after the decimal point.



2. Calculate and draw the approximated isolines for $f(x, y) = 0$ according to the *Marching Squares* algorithm.
3. Calculate the analytical solution for $f(x, y) = 0$ and sketch the exact isolines in the diagram. Explain the differences between the analytical solution and the solution of the isoline algorithm.

Exercise 6.2 [2 Points] Node Order

So far we have applied different techniques to grids consisting of quads and triangles. An often neglected aspect thereby is the so-called node order, i.e., the local ordering of a cell's vertices. While some algorithms and concepts are mostly invariant to changes or inconsistencies of node order, others produce incorrect results. Discuss the implications of rotation, mirroring, and generic permutations of node order for the marching squares algorithm and for bilinear interpolation.

Exercise 6.3 [6 Points] Newton Iteration

Newton iteration is used for estimating local coordinates within a quad. Local coordinates are required, e.g., for the interpolation of values within the quad.

Insert your Newton interpolation code into the function *newtonIteration()* in the file *newton.cpp*. You can download the file *newton.cpp* from the lecture homepage.

The vertex order is shown in Figure 1. Assure that the local coordinates do not exceed the interval of their definition. If this is the case, stop the iteration. If the iteration completes successfully, interpolate the value using the calculated local coordinates.

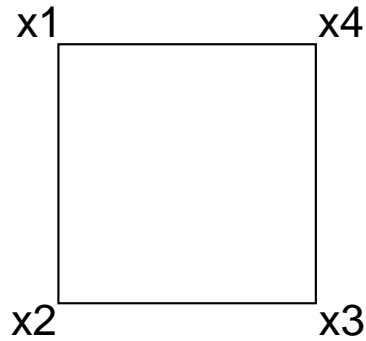


Figure 1: Order of vertices

Also hand in the ϕ function that you have used to map the α -values of the local coordinates to a point inside the quad.

Submission: 07.06.2013, 10:00

please hand in your submission in the eClaus system.