VPS 5 **Parallel and Distributed Software Systems** **ST 16, Exercise 1**

Deadline: 1st of April 2016 17:00

Name____

Points ________ **Effort in hours** ________

1. Wator – Eat or be eaten … (8 Points)

Wator is the Name of a small circular planet, far far away from our galaxy, were no man has ever gone before. On Wator there live two different kinds of species: *sharks* and *fish*. Both species live according to a very old set of rules which hasn't been changed for the last thousands of years.

For **fish** the rules are:

- at the beginning of all time there were f fish
- each fish has a constant energy E_f
- in each time step a fish moves randomly to one of its four adjacent cells (up, down, left or right), if and only if there is a free cell available
- if all adjacent cells are occupied, the fish doesn't move
- in each time step fish age by one time unit
- if a fish gets older than a specified limit B_f, the fish breeds (i.e., a new fish is born on a free adjacent cell, if such a cell is available)
- after the birth of a new fish the age of the parent fish is reduced by B_f

For **sharks** the rules are:

- at the beginning of all time there were s sharks, each with an initial energy of E_s
- in each time step a sharks consumes one energy unit
- in each time step a shark eats a fish, if a fish is on one of its adjacent cells
- if a shark eats a fish, the energy of the shark increases by the energy value of the eaten fish
- if there is no fish adjacent to the shark, the shark moves like a fish to one of its neighbor cells
- if the energy of a shark gets 0, the shark dies
- if the energy of a shark gets larger than a specified limit B_s, the shark breeds and the energy of the parent shark is equally distributed among the parent and the child shark (i.e., a new shark is born on a free adjacent cell, if such a cell is available)

In the Moodle course you find a ready to use implementation of Wator. Make a critical review of the code and analyze its design, performance, readability, etc. **Write a short report** which outlines the results of your review.

To get a fair comparison of the application's performance, **analyze** a Wator world of 500 x 500 cells. How long takes a run of 100 iterations on average with deactivated graphical output? Execute several independent test runs and **document the results in a table** (also calculate the mean value and the standard deviation). Then **answer the following questions**: Where and what for is most of the runtime consumed? What can be done to improve performance? What are the most performance-critical aspects?

2. Wator – Optimization (16 Points)

Based on your analysis, change the application step by step to improve performance. Think of at least **three concrete improvements** and implement them. Document for each improvement how the runtime changes (in comparison to the prior and to the initial version) and calculate the speedup. Each single optimization should yield a speedup of at least 1.05 compared to the prior version. Test your improvements with the settings given in the previous task.