# Scientific Computing

### Lecturer: Dr. Guy Tel-Zur

## Semester 2011B

## Home assignment number 2 – Parallel Computing of the Game of Life problem

**Goal**:

Practice MPI for a problem similar to the 2D Heat equation that was discussed in class.

By doing this assignment you will learn:

1. How to program a parallel code.
2. How to use the Message Passing Interface library.
3. Domain decomposition issues and ghost points.
4. Conway's Game of Life problem.
5. Basic parallel computing terms: Speed-Up and Efficiency

**The Computing Environment:**

In order to perform the assignment you will need an access to a parallel computer. If you don't have an access to such a computer please install MPI implementation on your desktop/laptop and emulate a parallel machine on your personal computer.

On windows: DenioMPI

On Linux: MPICH or OpenMPI (could also be installed on a guest virtual machine using VirtualBox or VMware Player)

**The assignment:**

Write a parallel "C" program using MPI for the Game of Life problem. The game's rules are described in reference [1] under "Rules":

1. Any live cell with fewer than two live neighbors dies, as if caused by under-population.
2. Any live cell with two or three live neighbors lives on to the next generation.
3. Any live cell with more than three live neighbors dies, as if by overcrowding.
4. Any dead cell with exactly three live neighbors becomes a live cell, as if by reproduction.

Make a partition the 2D domain to 2, 4, 6 and 8 rectangular regions and execute your program using 2, 4, 6 and 8 MPI tasks correspondingly. For each run use the same initial board setup and the same number of iterations. Measure the execution time using MPI\_Wtime() (ignoring the I/O parts in your code).

**Setup:**

Try a board of 2000X2000 cells, if this does not fit in your computer memory then choose the maximal size that can fit.

The number of iteration is 1000.

**Submit:**

1. A documented program
2. Instructions how to execute the program
3. Speedup results: t4/t2, t6/t2 and t8/t2 and the corresponding efficiencies and the number of CPUs (cores) that were used during the different executions
4. Plots of the board before the first iteration and after the last iteration.
5. Conclusions about the performance

**Due:**

Lecture 10, 5/6/2011.

**Reference:**

1. <http://en.wikipedia.org/wiki/Conway's_Game_of_Life>