HY342 - Parallel Programming

In this exercise you will develop a parallel program for the “Game of Life”.

The game “Game of Life” was invented in 1970 by John Conway and is a game of

0 players (world simulation), also known as cellular automaton. The

game consists of a two-dimensional world that is divided into cells. Each such cell

it is either "alive" or "dead" in a given generation. The game consists of a

set of rules that describe how cells evolve from one generation to the next.

These rules calculate the state of a cell in the next generation as a function of the states of neighboring cells in the current generation. In the two-dimensional world

of the game, neighboring cells are the 8 cells located horizontally, vertically, or

diagonally next to the given cell.

Conway's rules for the game are summarized as follows:

1. A living cell with less than two living neighbors dies of loneliness:

in the next generation it will be dead.

2. A live cell with more than three live neighbors dies of overpopulation: in the next generation it will be dead.

3. A live cell with exactly two or three live neighbors survives: to the next

generation remains alive.

4. A dead cell with exactly three living neighbors becomes alive: in the next generation

it will be live.

You can read more about the Game of Life on Wikipedia: http://en.wikipedia.

org/wiki/Conway’s_Game_of_Life.

In this exercise you will implement Conway's Game of Life in C with parallelism

OpenMP, with the constraint that the 2D world is finite dimensional. For

each cell at the edge of the world, assume that the neighbors would be located beyond

limit of the world are dead. Your program should take the initial state

of the world from a text file (argv[1]), calculate the state of the world afterwards

from some generations (argv[2]) and save the result to a text file

(argv[3]).

The format of the file describing the 2D world is as in the example:

1

8 7

| | | | | | |*|

| | | | | |*|*|

| |*| | | |*|*|

| | | | | | | |

| | | | | | |*|

| | |*|*| | |*|

| | |*|*| | | |

| | | | | | | |

where the first line of the file contains the dimensions of the table (here 8 lines by 7

columns per line) and the following lines of the file the contents of the 2D

world, where the * character represents a live cell and the ' ' character represents a dead one. The characters | set cell and table boundaries.

With your program, please also submit a report with metrics on your program's performance. For measurements use input file glid1.txt and glid2.txt,

and measure the execution time with the time (shell) command for 100 and for 1000 generations.

Repeat each measurement 5 times.

1. What is the average speedup for parallelism 1, 2 and 4?

2. Calculate the run time variance for each experimental configuration

(parallelism × input-size), and the variance of execution times for serial

program.

3. Where is the overhead of the OpenMP program with parallelism 1 due, in relation

with the serial program (ie compiled without -fopenmp)?

4. Briefly describe how the speedup you observe changes with iterations (100-1000), and how with input size (glid1.txt, glid2.txt),

and why;