LAB 4

Branch and bound with OpenMP: N-queens puzzle

2018-2019 Q1

Par2013

Daniel Palomo Cabrera i David Soldevila Puigbi

Introduction

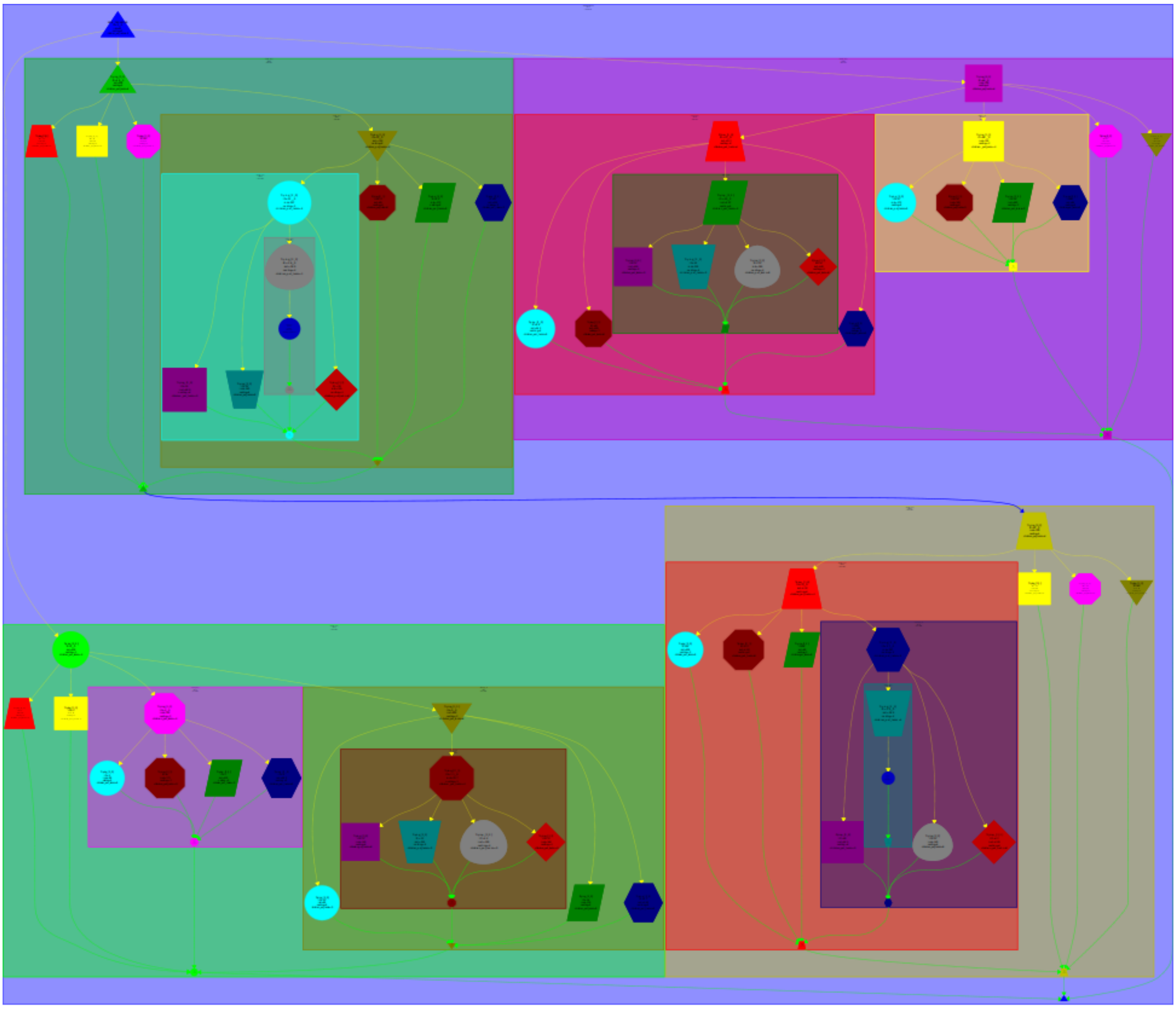
First of all, we are going to understand the nqueens algorithm. It consist of a recursive algorithm that tries to put N chess queens into a N x N chess table in order that every queen doesn’t attack any other queen (no column, row or diagonal is shared).

Understanding the potential parallelism in Nqueens

Executing the sequential version of the program with 12 queens in a table of 12 x 12 the program gives us the following output:

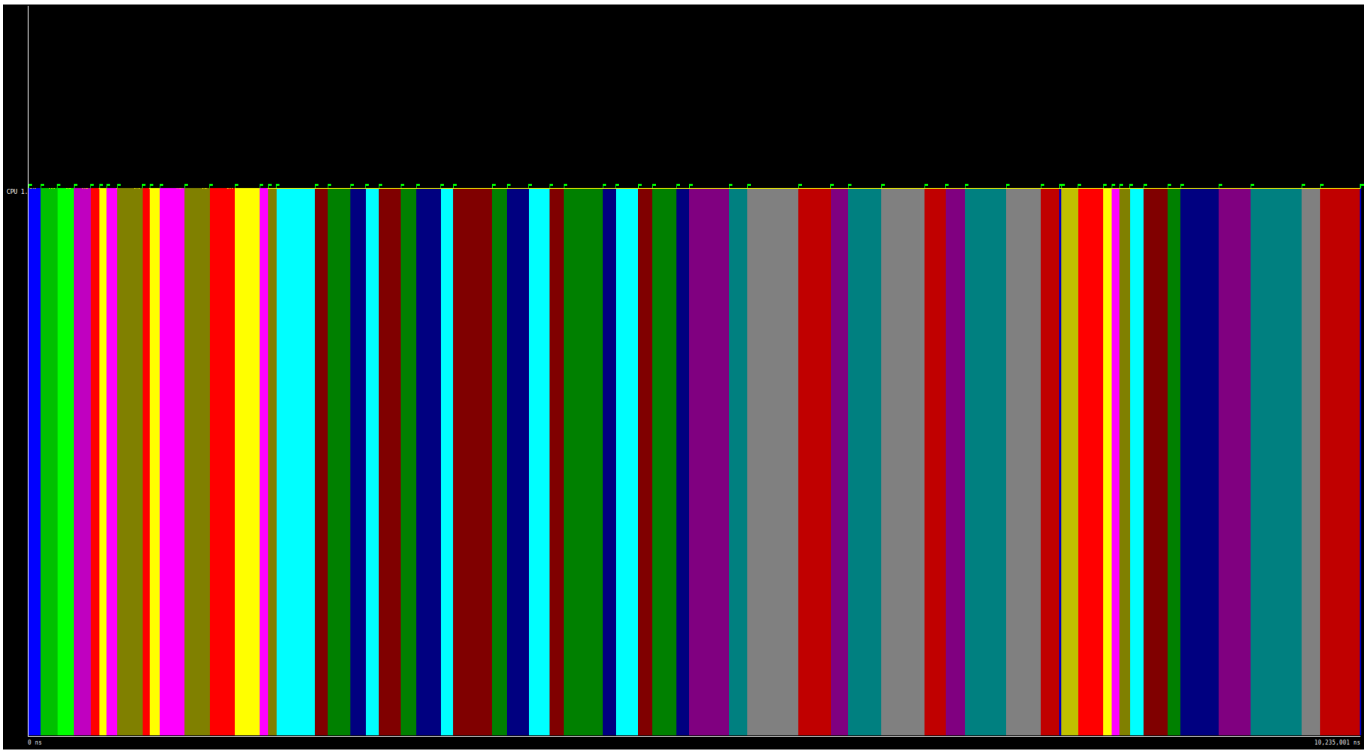
```
  board size:              12
  recursion cutoff level:  8

one solution:  0  2  4  7  9 11  5 10  1  6  8  3

number of solutions: 14200
```

Lets discuss about the parallelization of the algorithm using Tareador. First take a look at the dependence graph for the execution of the algorithm with n equals 4.

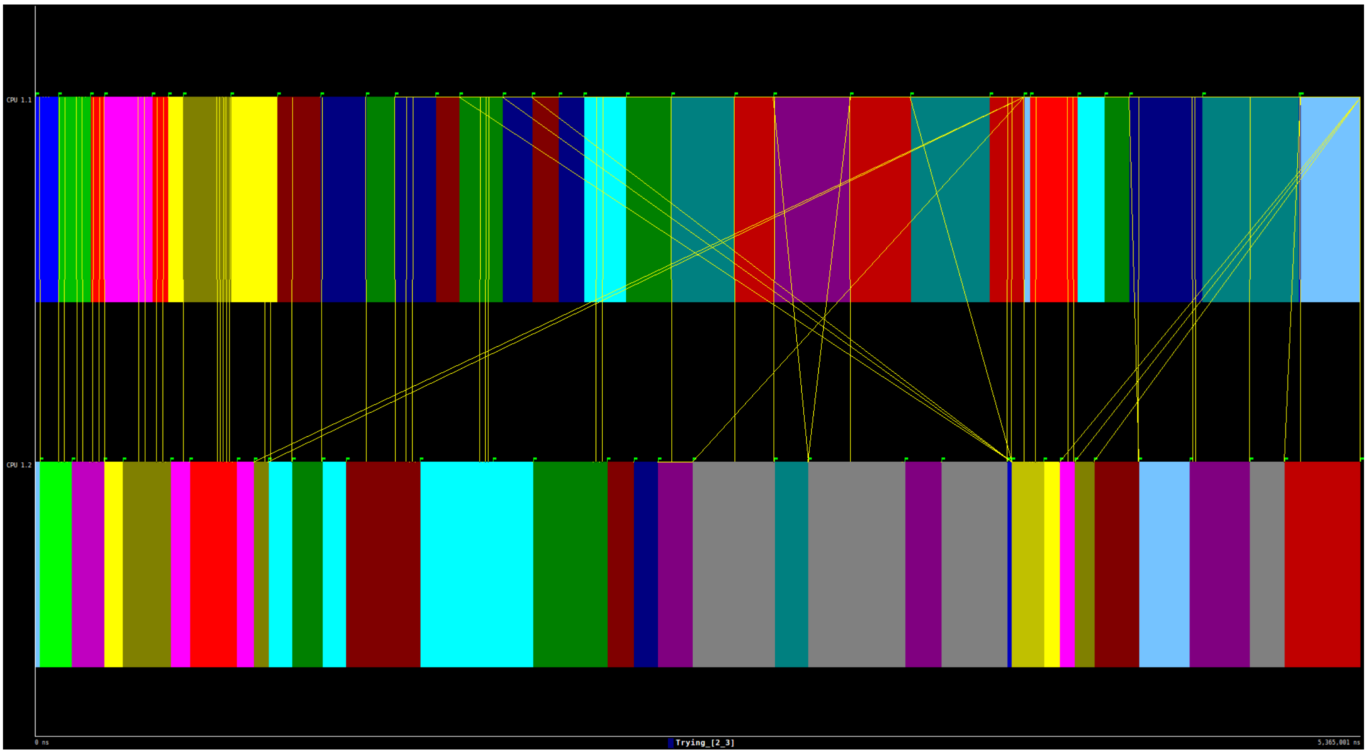


Dependence grpah generated by Tareador

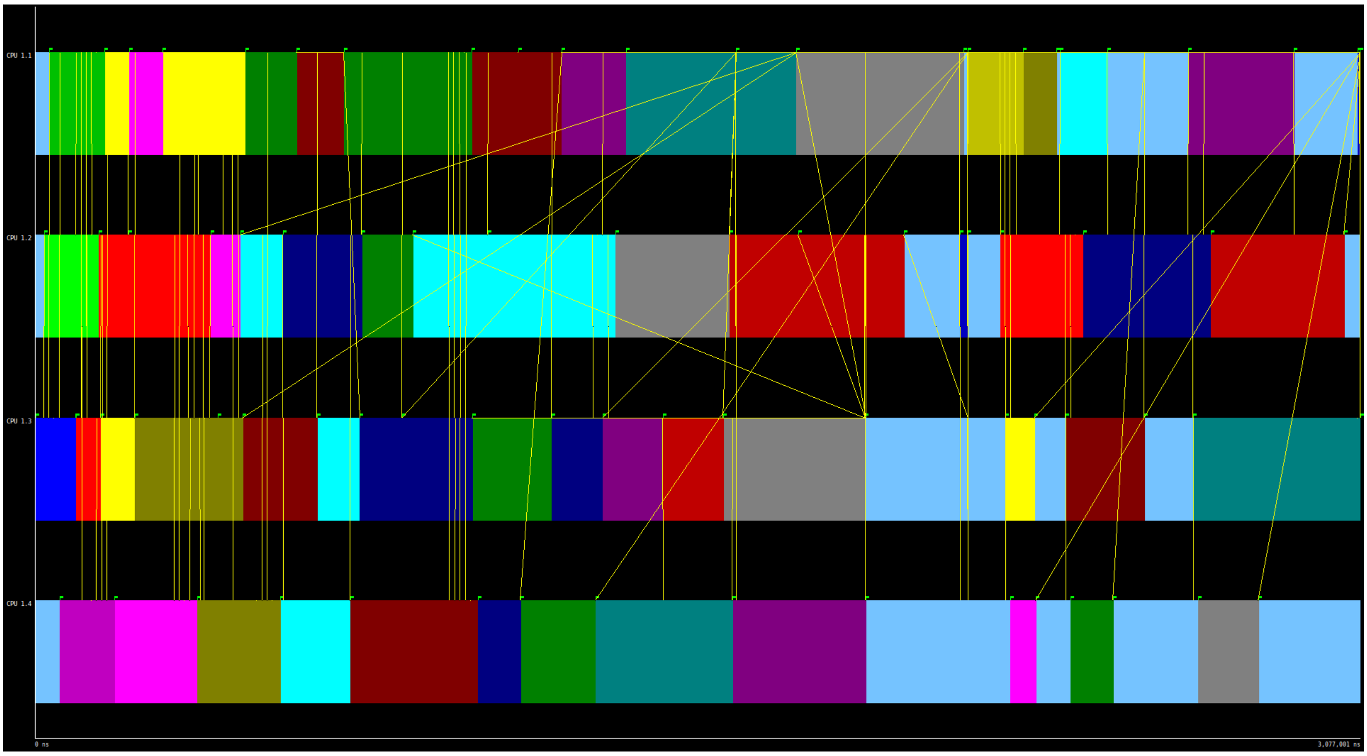
Even thought Tareador shows that block with id 1 (bottom left) at the second row it can be executed at the same time of the blocks in the first row. Note this at the simulation with different number of cores.



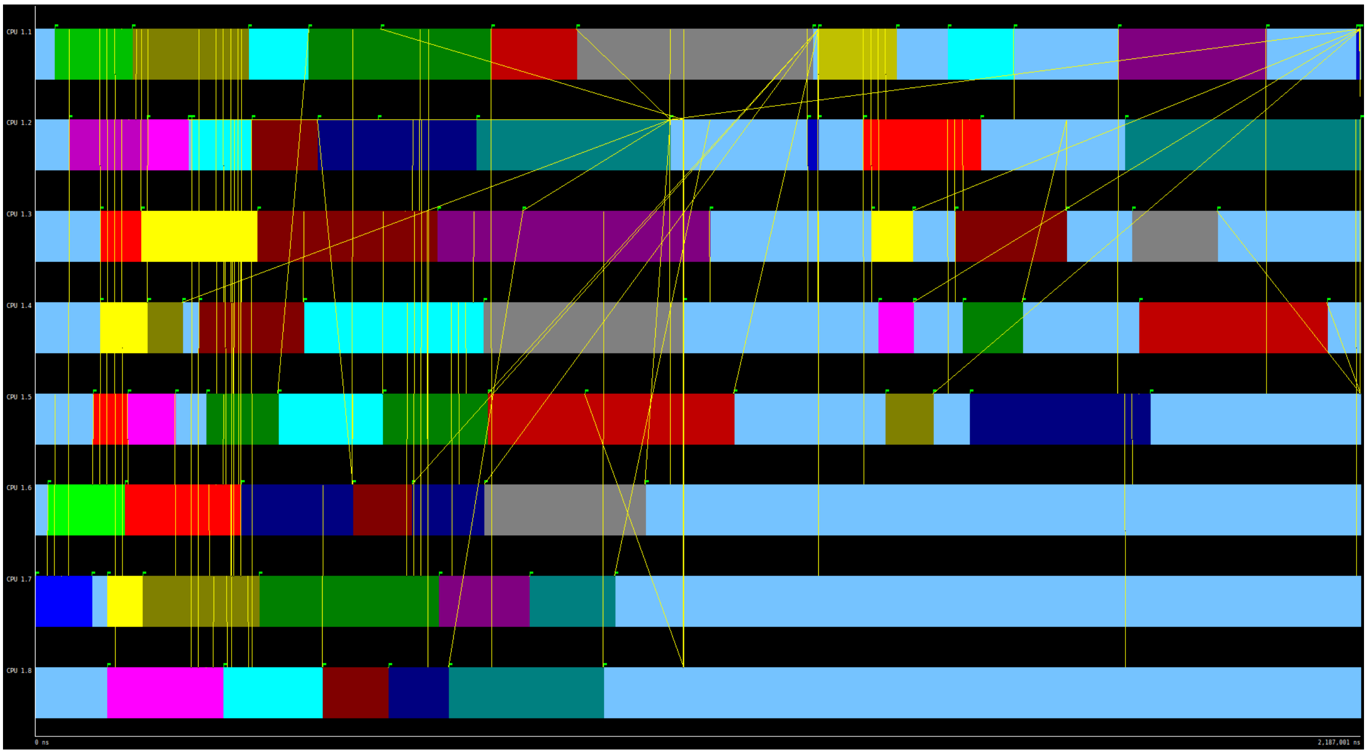
Simulation of execution of nqeens using 1 core



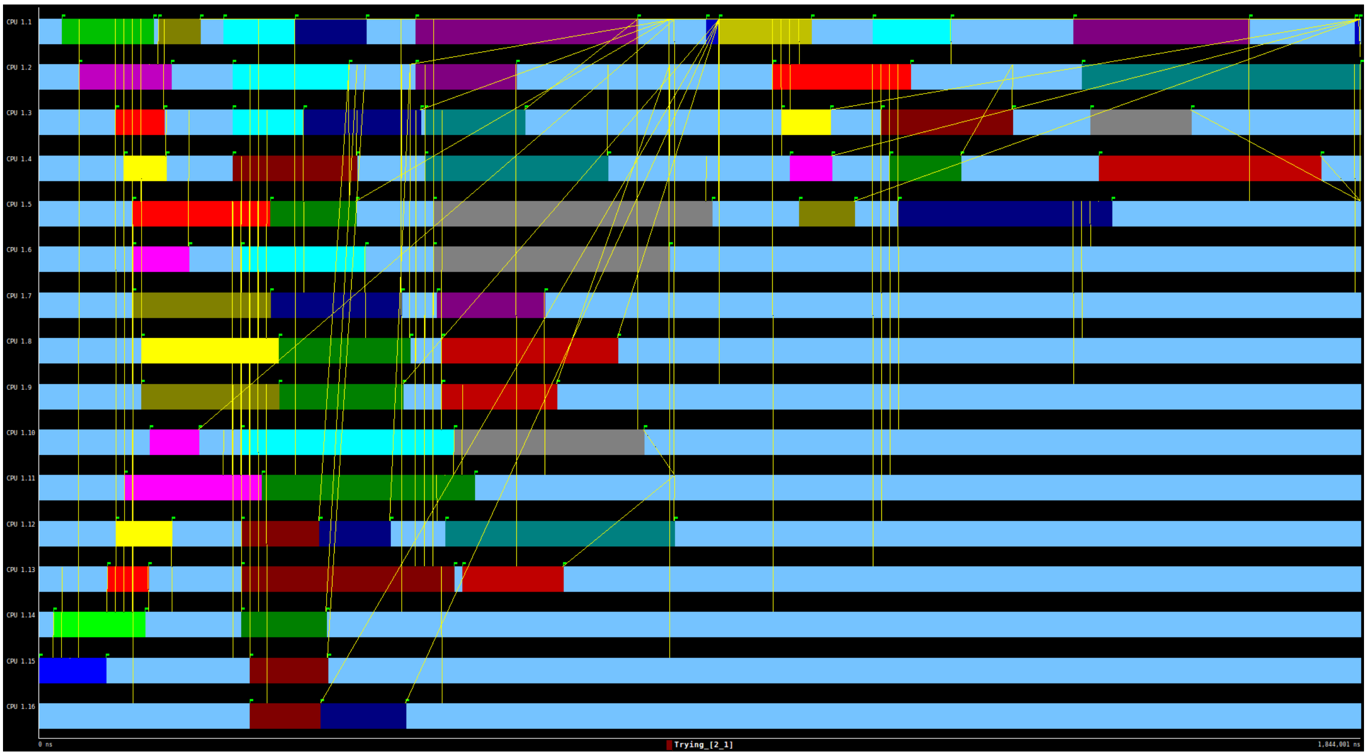
Simulation of execution of nqeens using 2 core



Simulation of execution of nqeens using 4 core



Simulation of execution of nqeens using 8 core



Simulation of execution of nqeens using 16 core

With 32 cores the time is exactly the same as the 16 cores simulation.

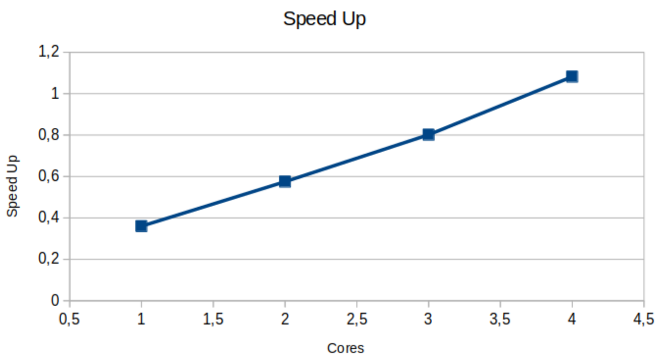
Shared-memory parallelization

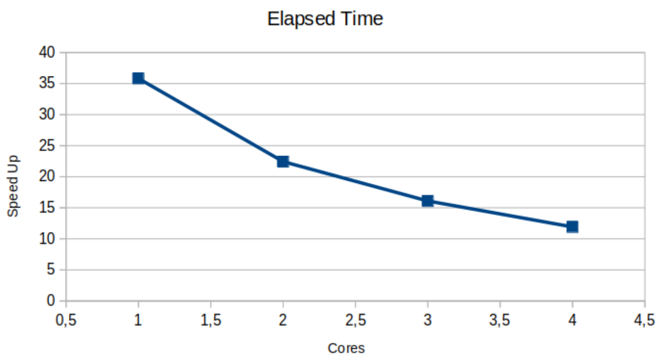
At last we will parallelice the nqueen algorithm using OpenMP.

In order to reach a good level of parallelization for each task the program creates a copy of the chess board. That strategy eliminate the dependence of reading and writing the chess board.

Last, we introduced a critical zone at the main case, only one thread should be the one who edit the number of solutions.

With that changes we got the following elapset tiem and speed up polts.





Note that the scalability is not stronger than we have seen at previous seasons.