School of Computer Science
University of St Andrews
2013-14
CS4402
Constraint Programming
Practical 1: Modelling

This Practical comprises 50% of the practical component of CS4402. It is due on Tuesday 11th March 2014 at 23:59.

The deliverable of this practical is a report plus the Essence' constraint models that you will write. Your report should document both your final models and your modelling decisions in detail. Similarly, it should justify your experimental design, describe it in sufficient detail that a competent reader could repeat your experiments, and contain a detailed analysis of your experimental results.

This practical will be marked following the standard mark descriptors as given in the Student Handbook. Part 4 is an extension to the practical. It will be possible to obtain a mark of 17 without doing part 4 if parts 1-3 and the report are completed to a very high standard.

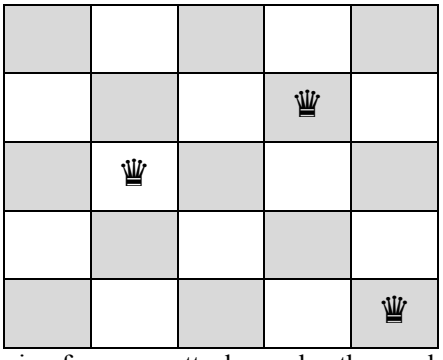
The M-Queens Puzzle

The M-Queens Puzzle is described as follows:

- Given a positive integer m,
- Minimise the number of queens placed on an m x m chess board such that,
    - No pair of queens attack each other, and
    - Every empty square on the chess board is attacked by some queen.

Recall that in chess a queen can move any number of squares along a row, column, or diagonal.

For the instance m = 5, an optimal solution is:



You can see that no pair of queens attacks each other and that every unoccupied square is attacked.

Part 1: A 0/1 Model of the M-Queens Puzzle

The first part of this practical is to write a constraint model (in Essence') of the M-Queens puzzle. For this part you must use a viewpoint in which each square of the chess board is represented by a variable with domain {0,1}, where an assignment of

the value 1 means that a queen is placed in the associated square, and an assignment of 0 means that the square is unoccupied.

Part 2: A Different Viewpoint

This part of the practical is to write a second model of the M-Queens puzzle, but using a viewpoint different from that in Part 1. The choice of this viewpoint is for you to decide, but you might draw some inspiration from existing models of the N-Queens problem seen in lectures and your own reading.

Part 3: Empirical Evaluation

Design and run a set of experiments to compare the merits of your two models. You should use a variety of instances (by varying m) and explore different heuristics.

Part 4: Extension

What symmetry is present in the 0/1 model? Modify your model to break this symmetry and design and run a set of experiments to compare it with the original model.