## Foundations of Artificial Intelligence

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## Presence Exercise 2

## Exercise 2.1

The task in this exercise is to write a software program. We expect you to implement your code on your own, without using existing code (such as examples you find online). If you encounter technical problems or have difficulties understanding the task, please let us know.

Download the file hill-climbing.tar.gz from the website of the course. It contains an incomplete implementation of hill climbing search for the 8 queens problem that was presented in the lecture.

- (a) Implement the heuristic for the 8 queens problem that is presented on Slide 22 of Chapter 20 (print version), where the heuristic value is equal to the number of pairs of queens threatening each other. To do so, implement the function public int h(Configuration \_conf) in the file EightQueensProblem.java.
- (b) Implement hill climbing in the function protected SearchResult search() in the file HillClimbing.java. Since our heuristic is such that smaller values are better, we are considering a minimization variant here, so adapt the function presented on Slide 20 of Chapter 20 (print version) accordingly. Break ties among neighbors with minimal heuristic value uniformly at random. Note that protected SearchResult search() returns a SearchResult object, which contains information if hill climbing found a solution and on the number of steps.
- (c) Test your implementation by verifying the statement on Slide 23 of Chapter 20 (print version), which states that hill climbing with a random initialization finds a solution in around 14% of the cases. You can compile and run your code with javac HillClimbing.java followed by the command java HillClimbing 8queens.
- (d) Copy your hill climbing implementation into a new file HillClimbingWithStagnation.java. Adapt the implementation such that steps without improvement (stagnation) are allowed as described on Slide 8 of Chapter 21 (print version). Verify that approximately 94% of the runs with a bound of 100 steps yield a solution, and that a solution is found after 21 steps on average.