Evolutionary Algorithms (89-521)
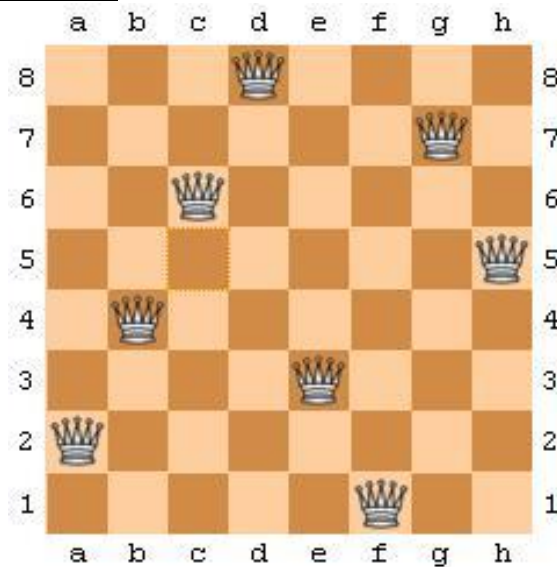
Exercise #1

This project contains two problems, which you will solve using Genetic Algorithms (GA).

You have to write <u>your own</u> GA code (do not use external libraries), in any sensible programming language.

<u>You have to upload a report with all the details as *explained at the end of the exercise*.</u>

Problem 1: Eight Queen Puzzle

Take a look at the above chessboard. You see that the eight queens are placed on the board, and none of them can capture each other (no two queens are on the same row, column, or diagonal).

The puzzle was originally proposed in 1848 by the chess player Max Bezzel, and over the years, many mathematicians, including Gauss, have worked on this puzzle. The problem can be quite computationally expensive as there are 4,426,165,368 possible arrangements of eight queens on a chessboard (8 x 8 squares), but only 92 correct solutions.

The goal of your GA is to evolve a solution to the puzzle (arrangement of 8 queens such that they don't capture each other). Each chromosome should represent the positions of all 8 queens. Explain how you encode the chromosome. The fitness function should be quite simple.

For comparison, implement a random solution for the problem (brute-force). Compare the performance of GA to that of random search.

Problem 2: Text Generation

Your GA chromosome represents a piece of text of size 300 characters, where each character can be any letter from English alphabet, and the characters period and space (for a total of 28 characters).

We would like the result to be the following text from Shakespeare's Hamlet:

```
to be or not to be that is the question. whether tis
nobler in the mind to suffer. the slings and arrows of
outrageous fortune. or to take arms against a sea of
troubles and by opposing end them. to die to sleep. no
more. and by a sleep to say we end. the heartache and
the thousand natural shocks.
```

The fitness function receives each chromosome, compares it to the above text, and returns a score between 0 to 300 for the number of characters that match correctly. No other information could be provided (e.g., no information regarding which characters are in the correct place, etc.).

What to Submit
- A document (pdf or doc) describing in detail your experiments, how the parameters were selected, etc., including:
    - Time to obtain correct output
    - Graph showing best and average scores per epoch
- All source code needed for running your program.

The above should be put in a single ZIP file, named 012345678_012345678.zip, where 012345678 stands for your ID numbers (one or two ID numbers if doing the exercise as a couple).