CECS 451
Assignment 3
Total: 60 Points

General Instruction

- Submit uncompressed file(s) in the Dropbox folder via BeachBoard (Not email).
- Use `Python 3`, any other programming language is not acceptable.
- You can import modules in the Python Standard Library (please check the full list *here*). If you want to use any other library, please consult with the instructor.
- Your submission may be evaluated automatically using a script file, so if you would not follow the output format, you may receive zero point even though your program outputs correct answers.

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1. Implement 5-queens problem solvers using the **hill-climbing algorithm** and the **genetic algorithm**.
   (a) (30 points) Implement a program that performs the **hill-Climbing algorithm** to find a solution.
   (b) (30 points) Implement a program that performs the **genetic algorithm** with 8 states including the three operations, i.e., **selection, crossover, mutation** to find a solution.

   Program specification.

   i. You can use `numpy` library.
   ii. Find the `board.py`, and please do not modify it.
   iii. An initial state locates a queen per each row. Please use an appropriate and simple local search strategy.
   iv. The function `get_fitness` in the `board.py` returns **the number of attacking pairs**. It assumes a queen per each row, which means it checks only columns and diagonals.
   v. The hill-climbing algorithms can stuck in local minima. Please implement the random restart procedure when they stuck.
   vi. Please report running time and a solution.

```
Running time: 200ms
[[1 0 0 0 0]
 [0 0 0 1 0]
 [0 1 0 0 0]
 [0 0 0 0 1]
 [0 0 1 0 0]]
```

   vii. Submit `hill.py` and `genetic.py`.