UNIVERSIDADE DA CORUÑA

Grado en Ingeniería Informática
Intelligent Systems

Assignment #1: Search strategies

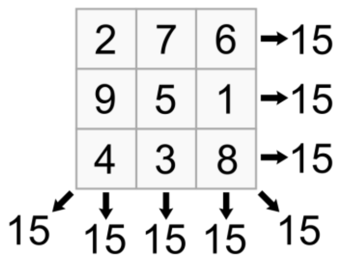
Course 2022/2023

In this assignment, you will implement in Java several search strategies and you will use them to solve a real problem. To facilitate the development of this assignment, you are provided with an IntelliJ IDEA project that has an example code, including an implementation of the Basic Search Strategy #4 as presented in previous sessions.

- **Exercise 1: Perform the following changes on the example code:**
  a) Create a `Node` class following the description given in class (S45). Adapt `Strategy4` so that it records the explored states as `Nodes`.
  b) Change the solve method of the class `SearchStrategy` so that it returns an array of `Nodes` (`Node[]`). Modify the implementation of `solve` in `Strategy4` so that, when a solution is found, it returns the full list of nodes representing the traversed states to get from the initial state to the found solution. To do so, implement in `Strategy4` a method called `reconstruct_sol` as described in class.
  c) `Strategy4` fails when it reaches a state that has no successors. However, there may be states encountered previously that still have unexplored successors. The strategy `Graph Search`, described in class, solves this by keeping track of a frontier that stores the successor states encountered while they are not explored. Implement a class called `GraphSearchStrategy` (that extends `Strategy`) that implements this strategy (you may find that using `Strategy4` as a template is helpful).

- **Exercise 2: We are trying to solve the following problems using search strategies:**

  An NxN magic square is a matrix that contains the numbers between 1 and N^2 arranged so that the sum of the elements of each row (or each column, or each of its main diagonals) is always the same: $\frac{N(N^2+1)}{2}$



Example 3x3 magic square

Our task is to develop an agent capable of, given a partially complete magic square, filling the remaining positions (if possible) to complete a valid NxN magic square (without changing any of the provided values).

Examples:

Initial state:

4	**9**	**2**
3	**5**	
	1	

Goal state:

4	**9**	**2**
3	**5**	**7**
8	**1**	**6**

Initial state:

2		

Goal state:

2	**9**	**4**
7	**5**	**3**
6	**1**	**8**

or any other 3x3 magic square

Initial state:

2			
	1		

Goal state:

2	**8**	**15**	**9**
14	**12**	**5**	**3**
11	**13**	**4**	**6**
7	**1**	**10**	**16**

or any other 4x4 magic square

PART A:

- ❑ Implement the formalization of the problem performed in SGA1 by writing a class named `MagicSquareProblem` that extends `SearchProblem` and defines the subclasses of `State` and `Action` that are needed to solve the problem.
- ❑ Implement the depth-first search strategy and use it to solve the problem (use the first provided example or other simple modifications as the initial state).
- ❑ Adapt your implementation to keep track of:
  - ❑ The number of expanded nodes.
  - ❑ The number of nodes created.

PART B:

- ❑ Report a suitable heuristic for the Magic Square problem. Create an implementation of said heuristic by extending the class Heuristic, which will calculate its value for this problem. Is your heuristic admissible? Is it consistent?
- ❑ Implement the A* search strategy. To do so, create a subclass of `InformedSearchStrategy` and modify the `Node` class so that it stores the cost of the path, the value of the function f and so that it implements the `Comparable` interface. Use this strategy to solve the second example.

PART C:

- ❑ Implement the depth-first search method with backtracking and uses this strategy to solve the third example.
- ❑ Does your program solve the third example in a reasonable time?

- **EVALUATION.**

A test will be held on the last laboratory practice session (Friday, March 10th, 2023). The maximum qualification attainable will be 1.5 points.