Trabalho prático individual nº 1

Inteligência Artificial / Introdução à Inteligência Artificial
Ano Lectivo de 2020/2021

13-14 de Novembro de 2020

I Observações importantes

1. This assignment should be submitted via *Moodle* within 32 hours after the publication of this description. The assignment can be submitted after 32 hours, but will be penalized at 5% for each additional hour.

2. Complete the requested functions in module `"tpi1.py"`, provided together with this description. Keep in mind that the language adopted in this course is Python3.

3. Include your name and number and comment or delete non-relevant code (e.g. test cases, print statements); submit only the mentioned module `"tpi1.py"`.

4. You can discuss this assignment with colleagues, but you cannot copy their programs neither in whole nor in part. Limit these discussions to the general understanding of the problem and avoid detailed discussions about implementation.

5. Include a comment with the names and numbers of the colleagues with whom you discussed this assigment. If you turn to other sources, identify those sources as well.

6. All submitted code must be original; although trusting that most students will do this, a plagiarism detection tool will be used. Students involved in plagiarism will have their submissions canceled.

7. The submitted programs will be evaluated taking into account: performance; style; and originality / evidence of independent work. Performance is mainly evaluated concerning correctness and completeness, although efficiency may also be taken into acount. Performance is evaluated through automatic testing. If necessary, the submitted modules will be analyzed by the teacher in order to appropriately credit the student's work.

II Exercices

Together with this description, you can find the module `tree_search`, similar to the one initially provided for the practical classes, but with small changes and additions, namely:

- A new abstract method `middle` in the class `SearchDomain`.
- A new attribute `children` (list of child nodes) in the class `SearchNode`.
- New attributes `terminal`, `non_terminal` and `root` in the class `SearchTree`.
- New method `show()`, in the class `SearchTree` which displays the full structure and content of a generated search tree.

You can also find in this assignment the modules `cidades` and `strips`, containing similar classes to those used in the practical classes. Don't change the `tree_search`, `cidades` and `strips` modules.

The module `tpi1_tests` contains several test cases. If needed, you can add other test code in this module.

Module `tpi1` contains the classes `MyTree(SearchTree)`, `MySTRIPS(STRIPS)`, `MinhasCidades(Cidades)`. In the following exercices, you are asked to complete certain methods in these classes. All code that you need to develop should be integrated in the module `tpi1`.

1. In class `MySTRIPS`:
   (a) Implement the method `result(state,action)`, which is supposed to return a list of predicates describing the new state produced by `action` in `state`.
   (b) Suppose that Python didn't have the data type `set`, that we can use in the `strips` module to represent states. Suppose also that we use lists to represent STRIPS plannig states, as in the previous exercice. In this case, how could we easily find out if two states are equivalent? One possibility is to sort the lists representing the two states and then see if they are equal. This is done by method `equivalent(state1,state2)` in class `STRIPS`. However, you need to implement the method `sort(state)` in class `MySTRIPS`.
2. In class `MinhasCidades`, implement the method `middle(state1,state2` which determines the state `m` which maximizes the sum of the heuristic values `heuristic(state1,m)` and `heuristic(m,state2)`.
3. Two uninformed search strategies are well known: *breadth-first search* and *depth-first search*. They have well known advantages and disadvantages. In the following exercices you will implement two new strategies that you can see as fusions of those basic strategies in an attempt to retain the advantages of both and avoid as much as possible their disadvantages. All required methods are to be implemented in the class `MyTree`.
   (a) Implement the method `hybrid1_add_to_open(lnewnodes)` which adds those nodes in even position of `lnewnodes` to the front of the `open_nodes` queue and the remaining nodes to the end of the queue.
   (b) Implement the method `hybrid2_add_to_open(lnewnodes)` which adds the nodes in `lnewnodes` to the `open_nodes` queue in such a way that the nodes in the queue are always sorted by `depth-offset`. In this context, the `offset` of a node is its position among the nodes at the same `depth`, considering that the leftmost node (i.e. the node first created at that depth) is at position `0` (zero).
   (c) Implement method `search2()` by copying the standard `search()` method from the `tree_search` module and adding code to include in each node its `depth` and `offset`.

4. When search spaces are large, one possibility is to use some sort of divide and conquer strategy. Implement in the class `MyTree` the method search_from_middle() which determines the middle state (by calling a previously implemented method, see above) and diving the given search problem in two search problems (one from the initial to the middle state, and the other from the middle state to the goal state), solving them separately and concatenating the respective solutions. The method should store the two auxiliary search trees in attributes `from_init` and `to_goal` of the main search tree where the method is called.

III Clarification of doubts

This work will be followed through `http://detiuaveiro.slack.com`. The clarification of the main doubts will be placed here.