CS440

Assignment 2 (due Tue 9/23 at 5pm)

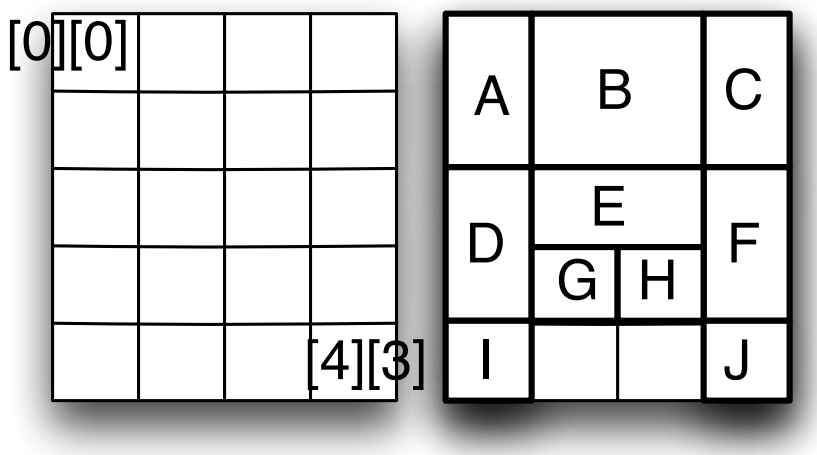
The Huarong Pass Puzzle

Your task is to write a program that uses uninformed search to solve the Huarong Pass Puzzle. It is a sliding block puzzle where the tiles are initially arranged as shown in the picture below. The objective is to move the top center piece, representing the Chinese general Cao Cao to the opening at the bottom. Details about the history of the puzzle and other information is available at: `http://chinesepuzzles.org/huarong-pass-sliding-block-puzzle/`.

In writing your program use the `search.py` module which is provided with our text book (see `http://code.google.com/p/aima-python/`. Your module, named `p2.py` will contain a class `HauaongPass` which is a subclass of `search.Problem`. First we need to discuss how a state of the board will be represented. The board is a 5×4 grid, so will be represented as a 5×4 python tuple-of-tuples, such that element `[i][j]` represents the corresponding location on the board (see figure below). Tuples are like lists, with the exception that they are immutable, i.e. cannot be modified once created. As such, they are hashable, which is required by the search code we will be using (a hashtable will be used to keep track of visited states). Each tile is assigned a letter as shown in the figure, and the initial state shown below is represented by the value:

```
"(('A', 'B', 'B', 'C'),
  ('A', 'B', 'B', 'C'),
  ('D', 'E', 'E', 'F'),
  ('D', 'G', 'H', 'F'),
  ('I', 'X', 'X', 'J'))"
```

where `'X'` represents empty grid points, and `'B'` is the tile that represents Cao-Cao (note that cutting and pasting the above to your source will require you to replace the string quote marks). Next, we need to define how actions will be represented. An action is defined by a tuple `(tile, direction)`, which indicates the direction in which to move the given tile. The tile is one of the tiles {`'A',...,'J'`}, and direction is one of {`'UP', 'DOWN', 'LEFT', 'RIGHT'`}. For example, a possible action from the initial state is: `('G', 'DOWN')`. Note that in some cases a tile can be moved two squares in a given direction - e.g., `'I'`. But the action `('I', 'RIGHT')` moves tile `'I'` one square to the right. And note that if a tile spans multiple grid points, all of them are potentially affected.



In order to work with the search methods provided in `search.py`, your class needs to provide several methods (these appear as "abstract" stubs in `search.Problem`):

- A constructor `__init__()` with no arguments that sets the attribute `initial` to the initial state of the search. Note that in Python, the constructor of a parent class does not get called automatically.
- `actions(self, state)` returns a Python list that contains the possible actions from the given state.
- `result(self, state, action)` returns the state that results from applying the given action to the given state.

- `goal_test(self, state)` tests whether the given state is a goal state, i.e. that Cao Cao is in the middle of the bottom row.

For testing purposes, include in your module a function called `huarong_pass_search` that receives as input a parameter which is one of the following strings: 'BFS', 'DFS', 'IDS', 'BID' which represent the desired search strategy ('BID' stands for bidirectional search). The function returns a list of actions that when applied to the initial state lead to the goal state. Note that this is not a method of the HuarongPass class.

Submission Prepare a module called `p2.py` and submit it via checkin as P2. At the top of the module have a comment in triple quotes that identifies you and the assignment:

```
"""
CS440 assignment X
Submitted by ... (include name and eid)
And some comment about your code and how to use it
"""
```