Assignment 5 - Synthesis II

Submission details: Please submit a .py file. Submit via GradeScope. If you have questions on this process, get in touch via the Slack or via email.
Due: 10/5/20

For this assignment, you’ll develop a synthesizer in Z3.

In class on Thursday 10/1, we played around with a Z3 program for synthesizing sequences of simple robot motion planning primitives in a 1D environment. Example:

```
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
```

↑ start

↑ goal

Our in-class robot could move left or right.

Task 1

For this assignment, extend the in-class synthesizer so that the robot has a 2D environment and can move left, right, up, or down. How will you represent the environment?

Examples:

```
0 1 2 3
4 5 6 7
8 9 10 11
12 13 14 15
```

```
3,0 3,1 3,2 3,3
2,0 2,1 2,2 2,3
1,0 1,1 1,2 1,3
0,0 1,0 2,0 3,0
```

Task 2

Implement iterative deepening. Your program should first try searching for instruction sequences of length 1, then length 2, and so on.
Add obstacles to your environment. When the robot runs an instruction that would move it into a square with an obstacle, it should stay in its original position instead. How will you represent obstacles?

Hint: Remember to build up the constraints on the robot’s movements using Z3 constraints instead of normal Python. E.g., You’ll want to use $\text{And}(x, y)$ instead of $x \text{ and } y$. You’ll want to use a bunch of $\text{Ands}$ instead of $\text{if } 	ext{val in list}$.

Some Useful Resources
https://ericpony.github.io/z3py-tutorial/guide-examples.htm
https://z3prover.github.io/api/html/namespacez3py.html
Some Fun Resources
https://www.cs.cornell.edu/~asampson/blog/minisynth.html
https://www.mattkeeter.com/projects/synthesis/