

Q 1: (5 points) Deadline - 11:59 pm on October 15, 2017

Let us assume that a robot is moving in a 2D workspace. The workspace is divided into small rectangular blocks using a grid. The size of the workspace is 5×5 . The lower left grid block has the ID (0, 0), and the upper right grid block has the ID (4, 4). The blocks (2, 3), (0, 2) and (4, 1) are covered with obstacles. We have two robots whose initial locations are (0, 0) and (4, 4), respectively. The robots have to move to the blocks (4, 4) and (0, 0), respectively. The robots have four motion primitives: L, R, U, D that can take the robot from its current block location to the left, right, upper and lower block respectively.

Write a SAT query whose solution will give the trajectories of the robots as the sequences of their motion primitives. Generate the trajectories using MiniSAT solver.

MiniSAT webpage: <http://minisat.se>

Q 2: (5 points) Deadline - 11:59 pm on October 22, 2017

Consider the following two functions:

```
int func1(int a, int b)
{
    int c1, c2, c3, c4;
    c1 = a + 1;
    c2 = b * 4;
    c3 = c1 + c2;
    c4 = f(c3);
    return c4;
}

int func2 (int x, int y)
{
    int z1, z2, z3, z4;
    z1 = y << 2;
    z2 = z1 + 1;
    z3 = x + z2;
    z4 = g(z3);
    return z4;
}
```

Assume that for any two integers p and q , if $p = q$ then $f(p) = g(q)$. Now, using the SMT solver Z3, determine if the two functions `func1` and `func2` are equivalent. If the functions are not equivalent then from the model generated by Z3, provide the values for the inputs of the functions that demonstrate the functions are not equivalent.

Z3 Wbdpage: <https://rise4fun.com/Z3/tutorial/guide>