Safety and Dependability

Frozen Lake. You v[illegible]ake, but beware, it is treacherous!

The lake is a rathe[illegible] as a rectangle with 6x4 squares. You start at square (1,1)—the start, and you want to [illegible]-the goal. In order to do so, you can go up, down, left, or right by de- or incrementing [illegible]rdinate, under the condition that the first coordinate has to stay in the value range $\{1, \ldots$ coordinate has to stay in the value range $\{1, \ldots, 4\}$.

Before you start, 5 [illegible] randomly inserted in the lake, taking out five squares uniformly at random, excluding the start, the goal, and all positions where there is already a hole.

Claim of Your Friend. Your friend claims that a random walk that merely does not allow moves that would lead into (a hole in) the lake has the same chance of reaching the goal as a well planned path.

1. Model your attempt to cross the lake as a Markov decision processes in IscasMC, ePMC, or PRISM. For this, create a strategic player, who navigates the lake with full knowledge of where the holes are. (**33 marks**)

2. Model a random walk as a Markov chain in IscasMC, ePMC, or PRISM. For this replace the strategic player by a random one, who cannot move to any place where a hole has been inserted, but does not plan her walk. (**22 marks**)

3. Assume you want to maximise your chance of reaching the goal. Write a Probmela (PRISM) property (10 marks) and determine your chance to reach the goal for both models (10 marks). (**20 marks**)

4. Answer the question raised. (Does a strategically planned walk provide a higher chance to reach the goal than a random walk?) (**15 marks**)

5. Briefly ($\leq$ 123 words) describe a contemporary research problem associated with Markov chains, Markov games, or Markov decision processes. Cite two recent (from 2017 or younger) articles or conference papers related to the problem you described. (**10 marks**)

Your model shall be sufficiently detailed such that, in a simulation, you can follow the game.

Please hand in:

- a sufficiently commented / explained IscasMC, ePMC, or PRISM model (executable .pm files) for task (1),
- a sufficiently commented / explained IscasMC, ePMC, or PRISM model (executable .pm files) for task (2),
- property files and the results for task (3),
- an answer with an explanation (using whatever it takes) for task (4), and
- a brief description of a research problem, supported by two citations, for task (5).

good luck!