

COMP 4106 - ARTIFICIAL INTELLIGENCE  
WINTER 2020

ASSIGNMENT #1

DUE DATE: FEBRUARY 20, 2020

# A Game of Cat and Mouse

## Introduction

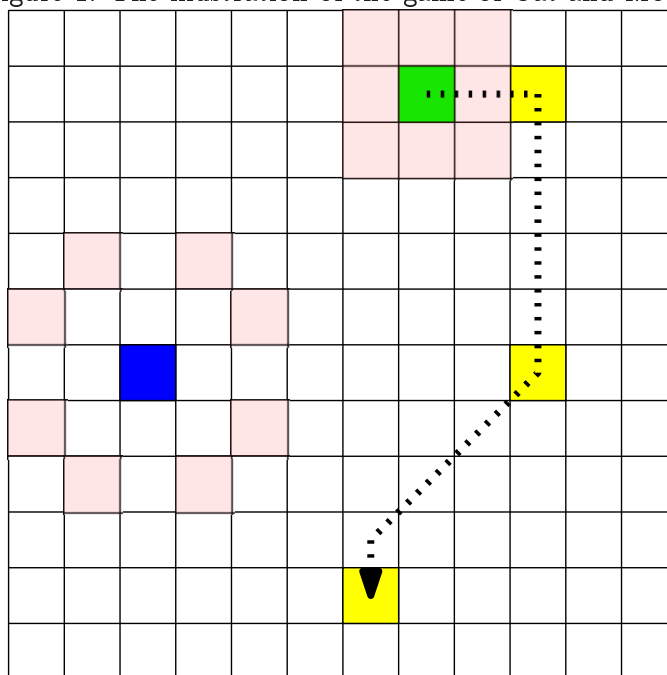
In this assignment you will be implementing a game of Cat and Mouse. This game is inspired by many earlier games, such as the *snake game* available for mobile phones and many other platforms (video available at <https://www.youtube.com/watch?v=XINAniQCh8Y>).

The game can be played on a varying size grid board. It starts with with a board randomly scattered with cheese, a Mouse, and a Cat. The Mouse, being greedy, always picks the closest cheese, where “closest” is measured in terms of the Euclidean distance. If there is a tie in distance, the Mouse always prefers cheese in the South-East (Bottom-Right) direction. The Mouse emulates the move-set of a king from the game of Chess, only being able to move a distance one in any direction. The goal of the Cat is to trap the Mouse, and prevent the Mouse from eating all the cheese. If the Mouse eats all the cheese, then the Cat loses. The move-set of the Cat emulates the moves of a knight from the game of Chess.

The objective of the game is determine a move-set for the Cat, in such a way that the Mouse does not eat all the cheese on the board. The less cheese eaten, the better.

## Game Definition

Figure 1: The illustration of the game of Cat and Mouse



The above figure illustrates the game. The blue box shows the location of the Cat. The green box is the current location of the Mouse. The red boxes are the possible moves the Cat can make, and the moves that the Mouse can make. The yellow boxes are the locations of cheese that the Mouse wants to eat. Lastly the arrow, is the path that the Mouse has chosen to take.

To simplify the game, assume that the Mouse only takes a single step forward each time the Cat moves. All your search algorithms should predict the motion of the Mouse along with the

Cat, because the position to which it will move next is deterministic. If a Mouse eats all the cheese, then a new game is started, and the Mouse, Cat, and cheese are randomly placed back onto the board.

### Assignment Objectives

- Implement the *game of Cat and Mouse*.
- Implement a *Breadth\_First Search* for the Cat to play the game.
- Implement *Depth\_First Search* for the Cat to play the game.
- Implement *A\* search*.
  - Implement two (2) different heuristics for the Cat to play the game.
  - Implement a third heuristic which takes the average of the first two heuristics.
- Write a short report (no more than two (2) pages) about the state space of the game, and about the choice of your heuristics.

### Questions

During the demo you should be prepared to discuss the following questions:

- Which search worked best?
- Which heuristics did you use?
- Why did you choose these heuristics?
- Does the combination of the two heuristics work better or worse than they do individually?
- How well do the searches work if you increase the size of the board to 30x30 or 50x50.
- How many nodes are searched for each of the searches on average with respective deviation. (*BFS*, *DFS*, and *A\**)
- What is the average number of moves required for each type of search with respective deviation. (*BFS*, *DFS*, and *A\**)
- Which search works best if you increase the speed of the Mouse to two steps per turn? Three steps?

### Bonus

The following items are considered as bonus. You should work on these if you have completed the required objectives.

- Consider the game when there is only one Cat, and multiple mice.
- Consider the game when there are multiple Cats cooperate on trapping multiple mice.
- Implement a DFS that is optimal. How can this be achieved?

## Tips

Don't spend too much time on the graphics. The search maybe slow. In this case, think about how you can optimize it. Command-line graphics are perfectly fine.

Your first priority should be to make sure that the search works.