Artificial Intelligence: Local Search

Nathan Morgenstern, Seo Bo Shim

September 20, 2017

Contents

Introduction to the Graphical User Interface(GUI)

When the Graphical User Interface starts up the user is able to select the type of puzzle evaluation through a drop down menu. The given options include: Basic Puzzle Evaluation, User Generated Puzzle Evaluation, Basic Hill Climbing, Hill Climbing with Random Restarts, Hill Climbing with Random Walk, Simulated Annealing, and Population Based Approach.

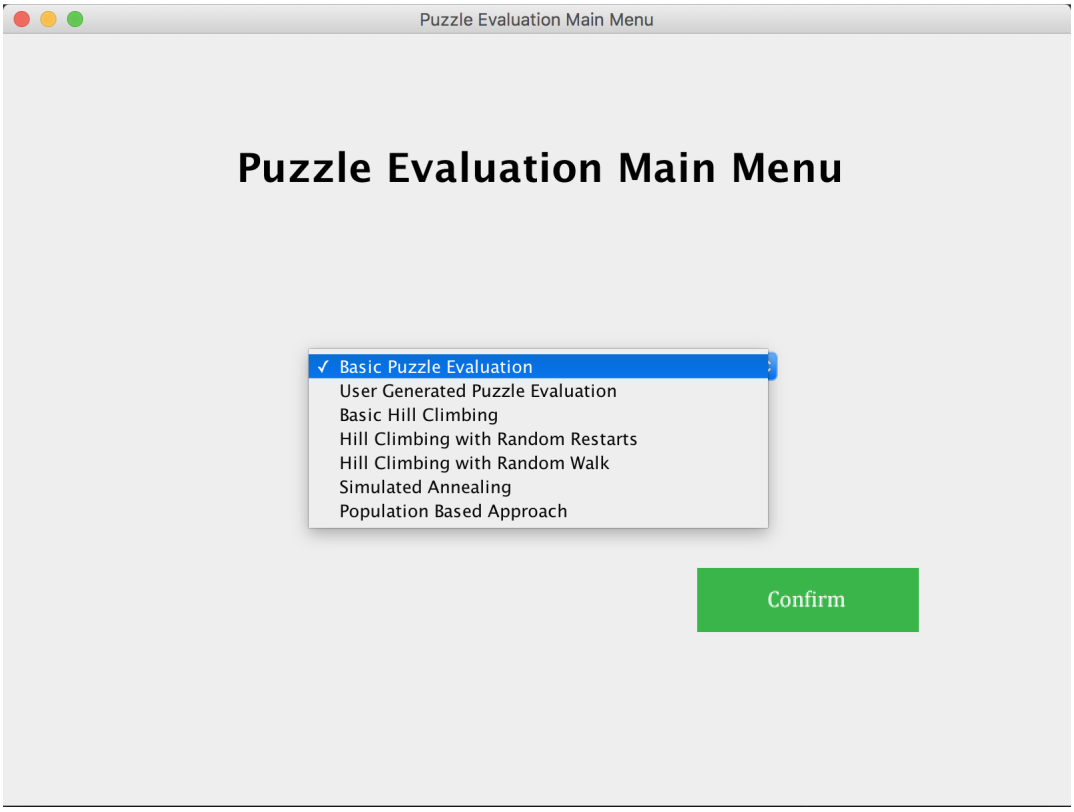

Figure 1: Main Menu of GUI

Each of the options then have their own corresponding window which is comprised of four main tabs: Puzzle Initialization, Puzzle, Puzzle Moves, and Data. The Puzzle Initialization tab is slightly different for each option in regards to the type of input received. The tabs Puzzle and Puzzle moves provide the user with a graphical representation of the generated puzzle as well as a graphical representation of the number of moves that it takes to get to each cell respectively.

Basic Puzzle Evaluation

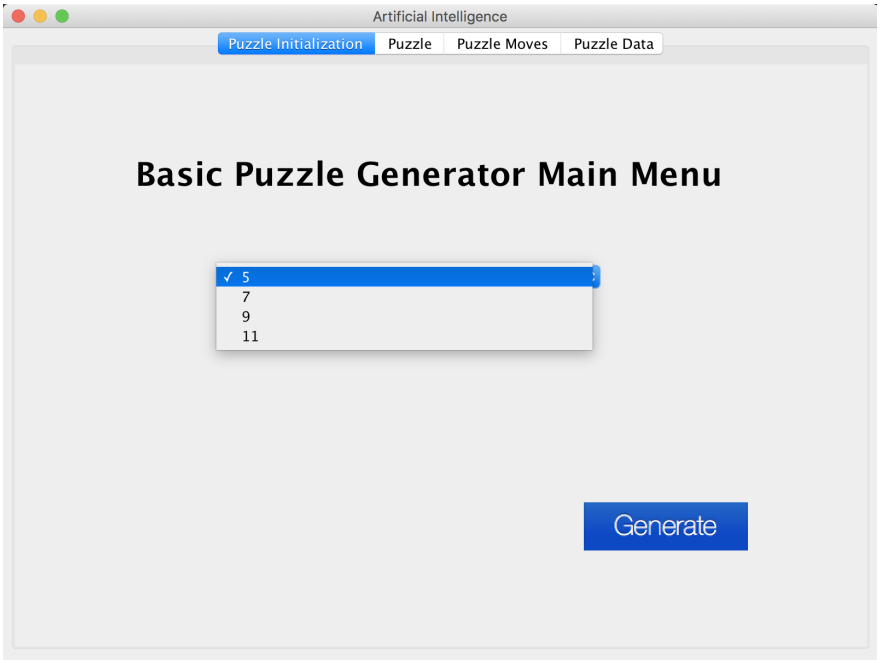

Figure 2: Puzzle Initialization of Basic Evaluation

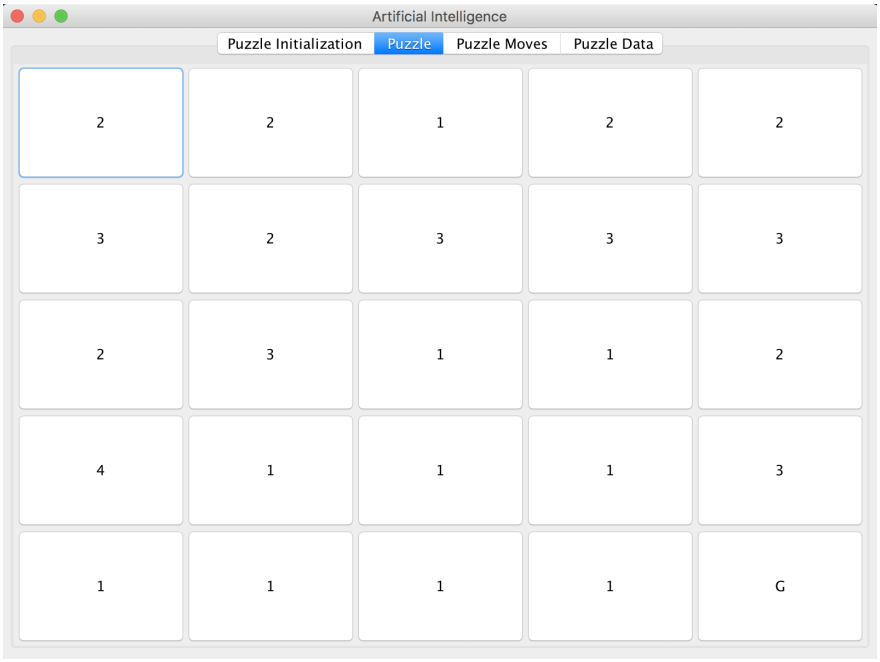

Figure 3: Puzzle Tab of Basic Evaluation

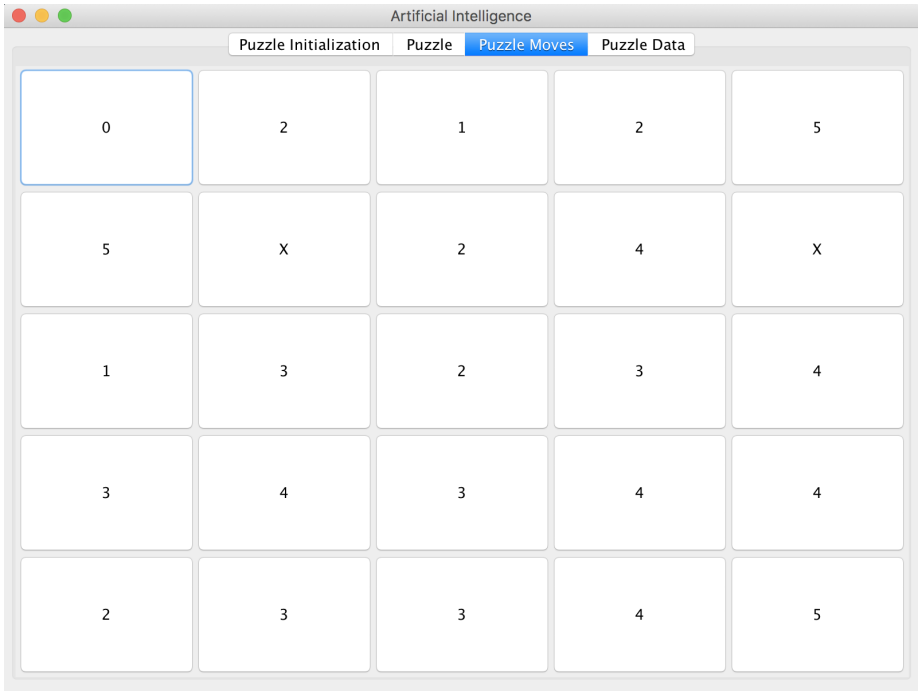

Figure 4: Puzzle Moves Tab of Basic Evaluation

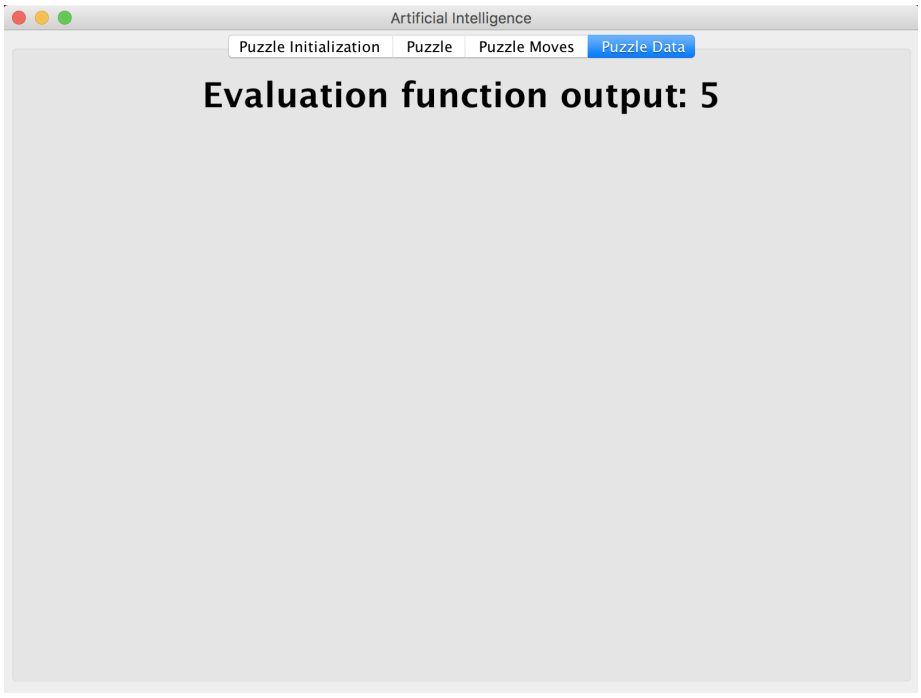

Figure 5: Data Tab of Basic Evaluation

User Generated Puzzle Evaluation

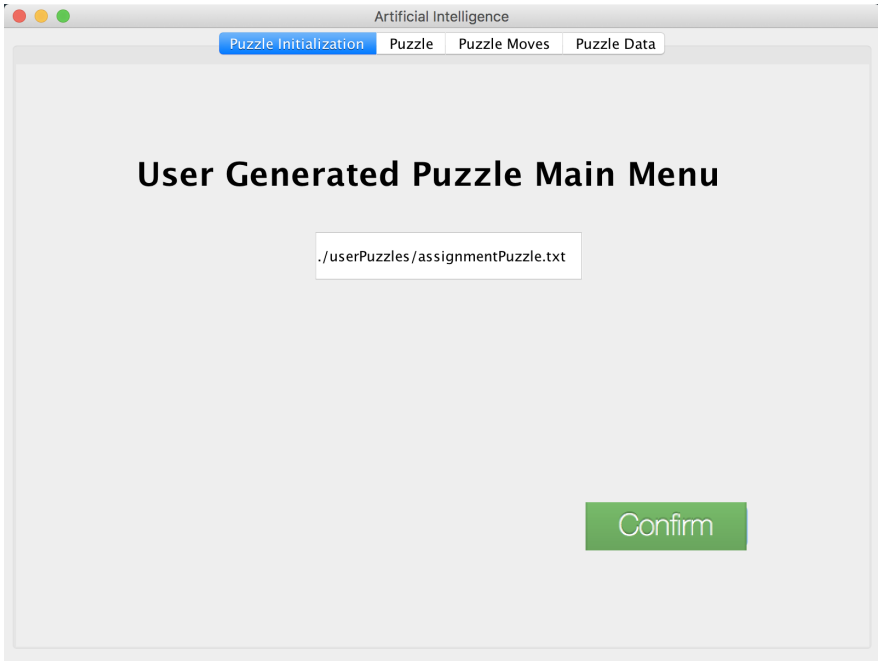

Figure 6: User Generated Puzzle Initialization

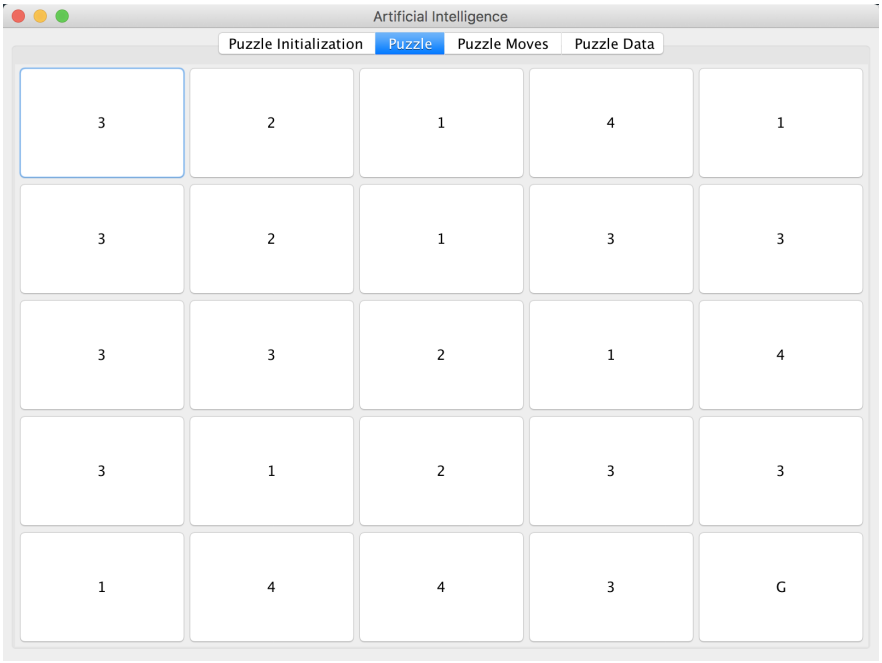

Figure 7: User Generated Puzzle

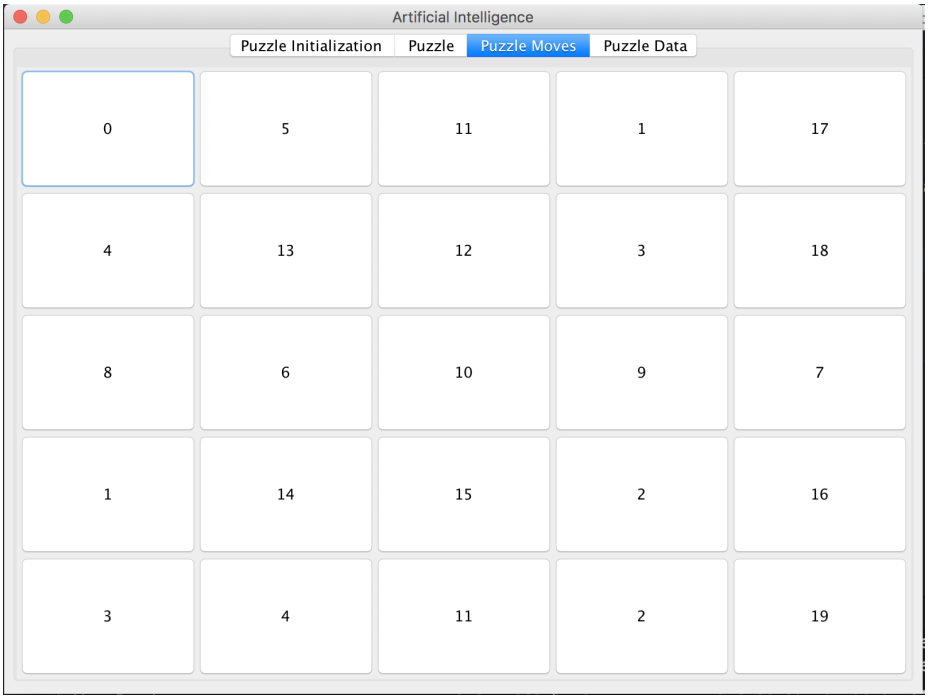

Figure 8: User Generated Puzzle Moves

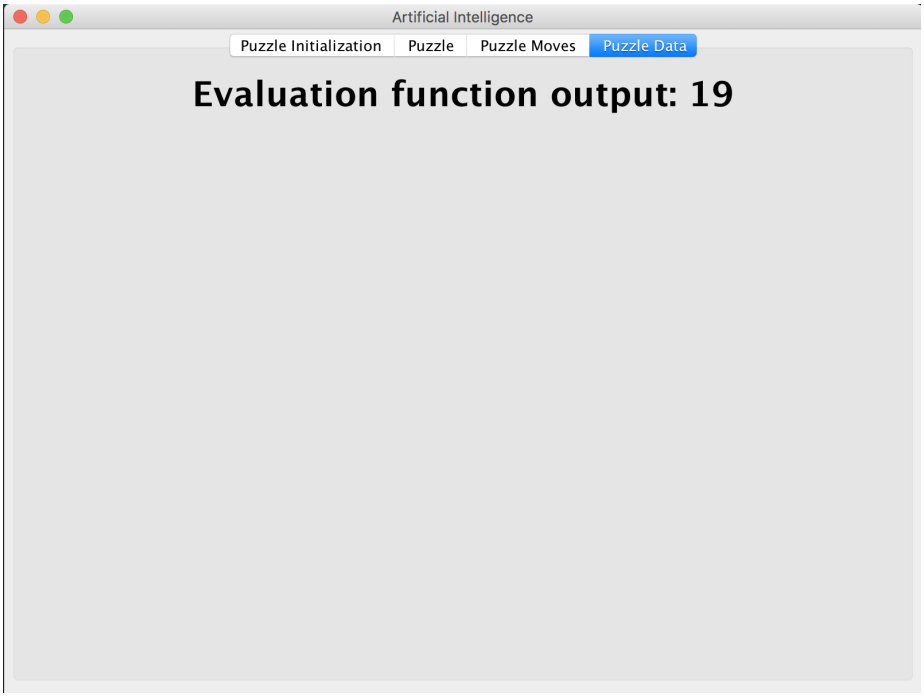

Figure 9: User Generated Puzzle Evaluation

Basic Hill Climbing

Hill Climbing with Random Restarts

Hill Climbing with Random Walk

Simulated Annealing

Population Based Approach

Puzzle Representation

The Graphical User Interface starts up and gives the user

Puzzle Evaluation

In your report please include an example of 2 example puzzles for each size of n, where one of the puzzles is solvable and the other is not solvable.

You will be asked during the demo to execute the evaluation puzzle on example puzzles and present the corresponding visualization. INCLUDE OPTION FOR FILE SELECTION?

Example Puzzle for n = 5

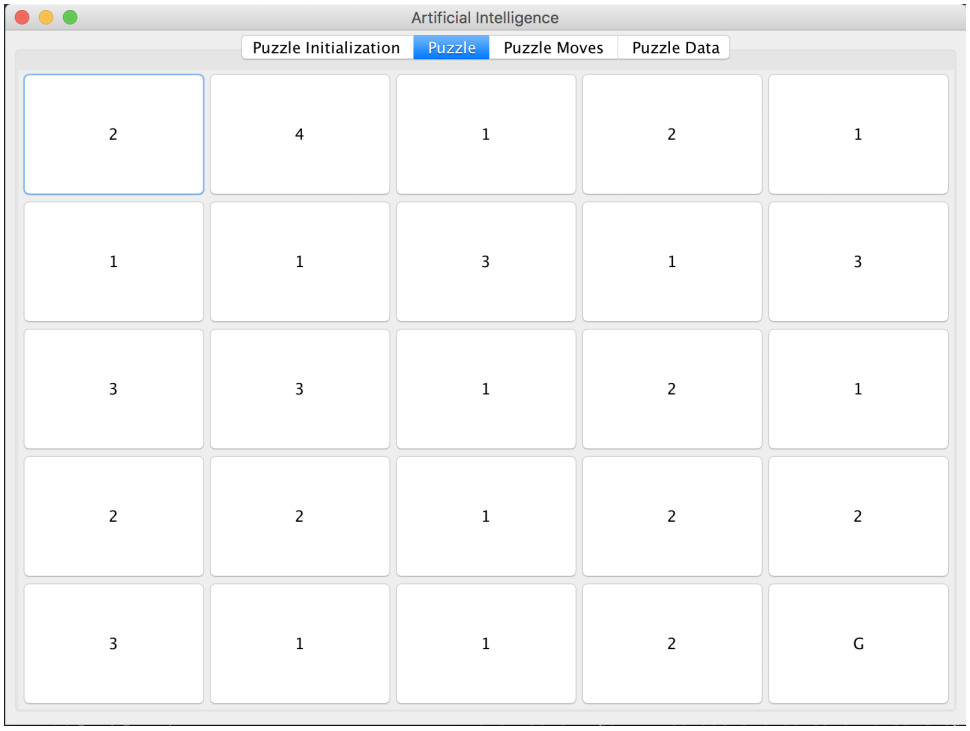

Figure 10: Reachable Goal Puzzle size n = 5

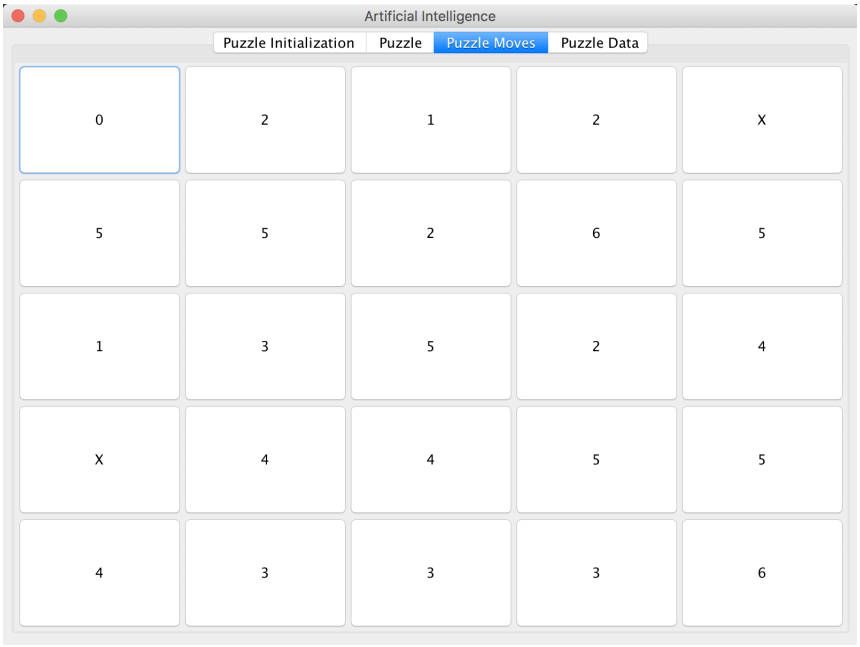

Figure 11: Reachable Goal Puzzle Moves size n = 5

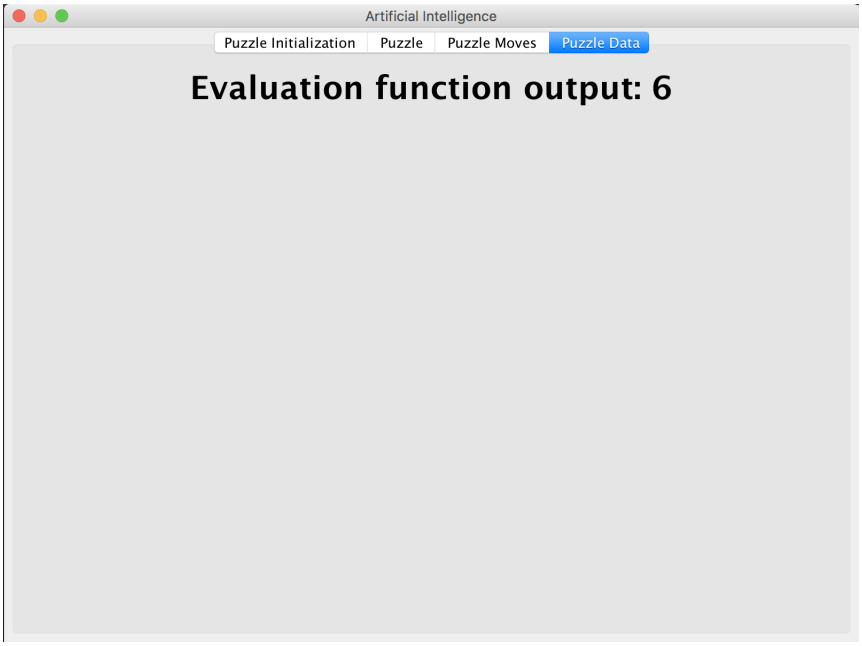

Figure 12: Reachable Goal Puzzle Evaluation size n = 5

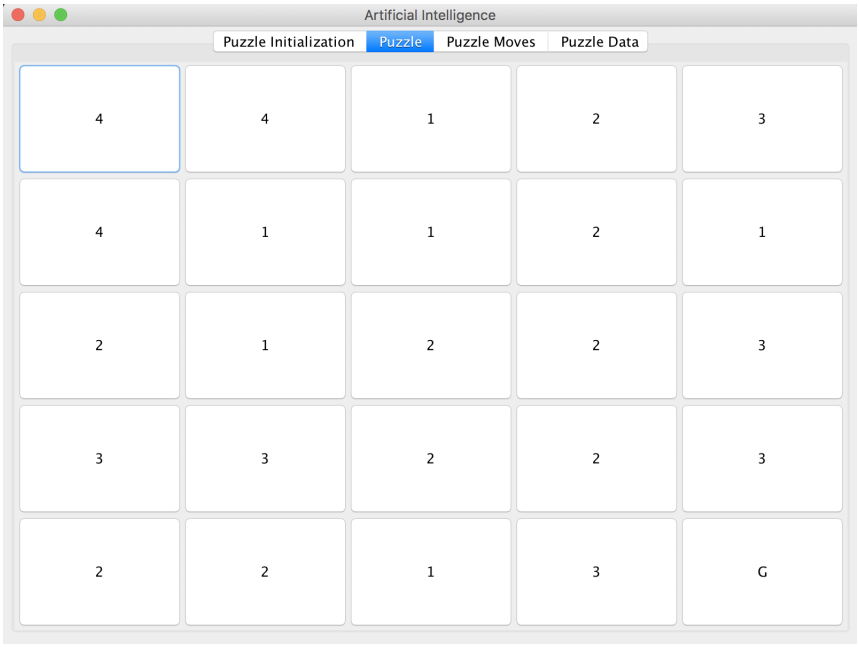

Figure 13: Unreachable Goal Puzzle size n = 5

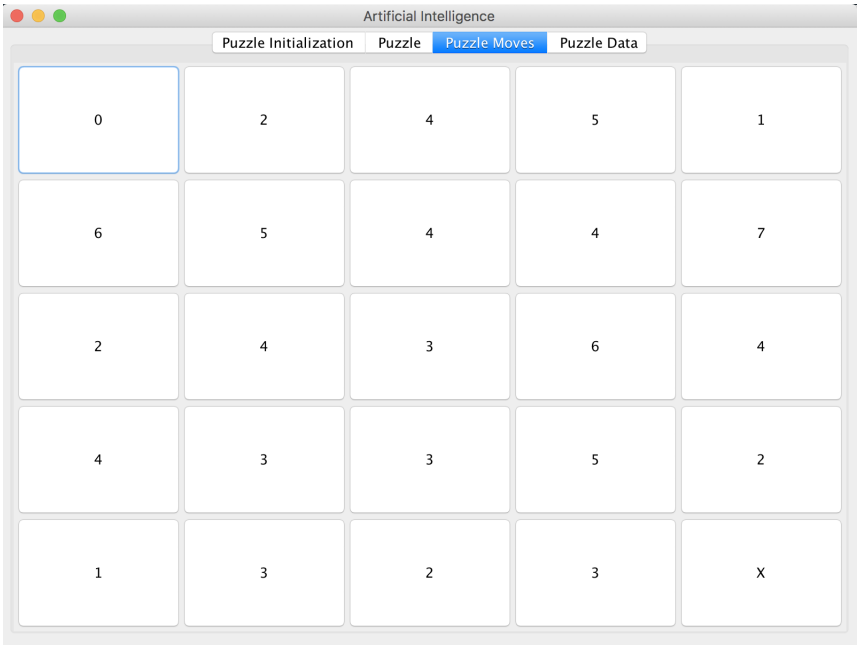

Figure 14: Unreachable Goal Puzzle Moves size n = 5

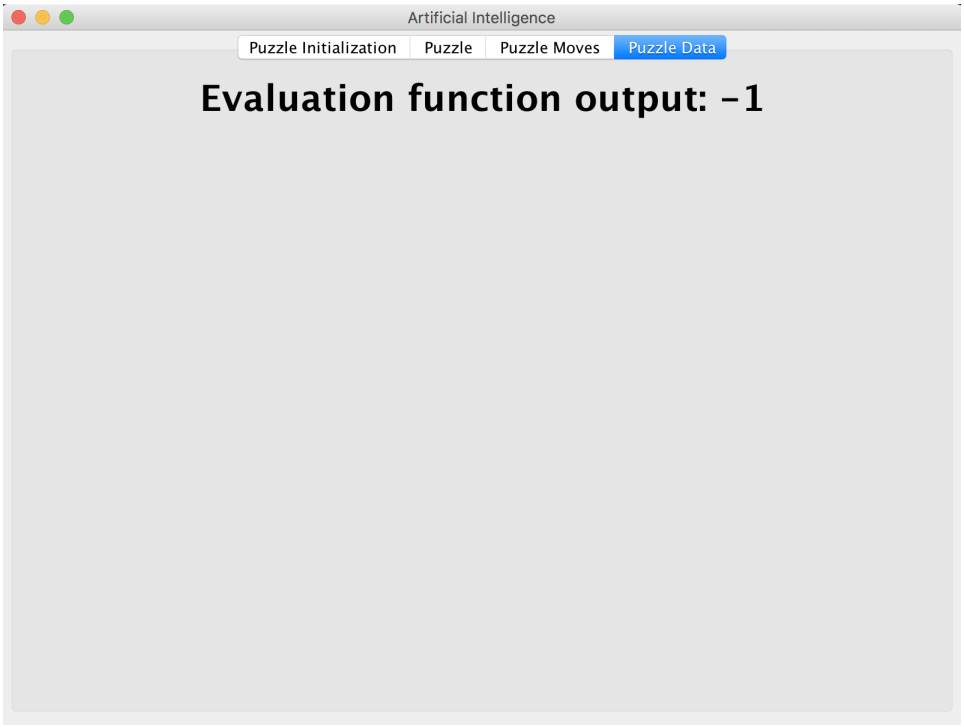

Figure 15: Unreachable Goal Puzzle Evaluation size n = 5

Example Puzzle for n = 7

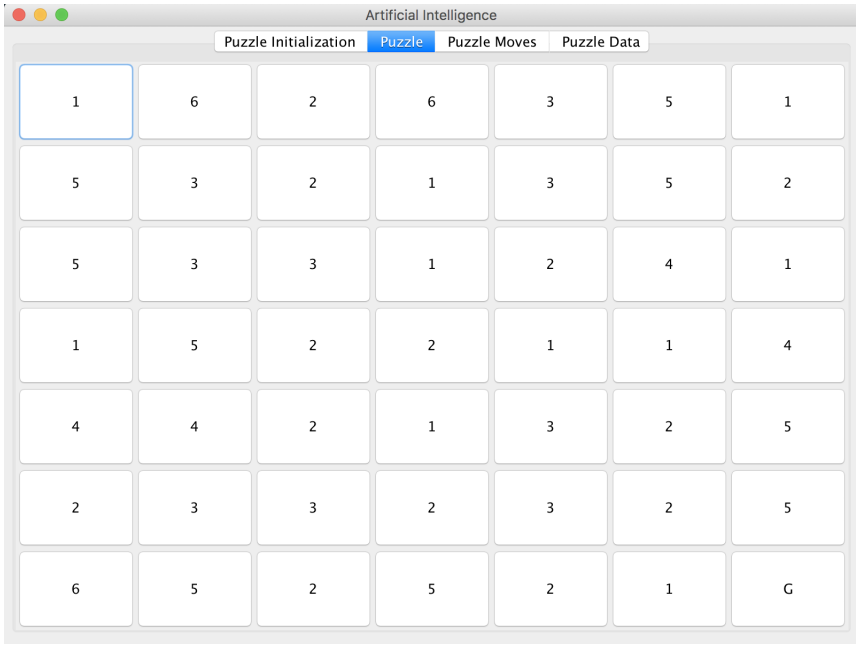

Figure 16: Reachable Goal Puzzle size n = 7

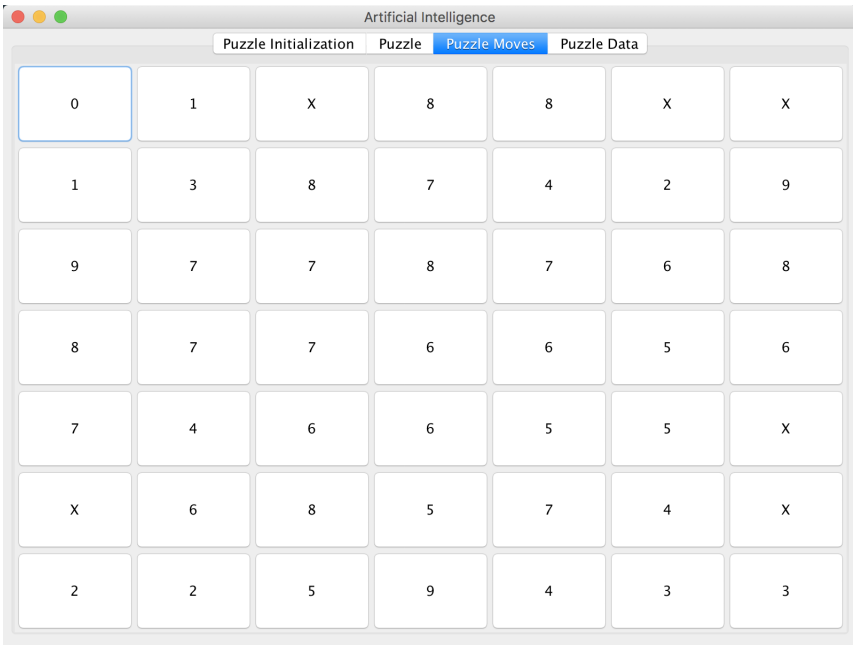

Figure 17: Reachable Goal Puzzle Moves size n = 7

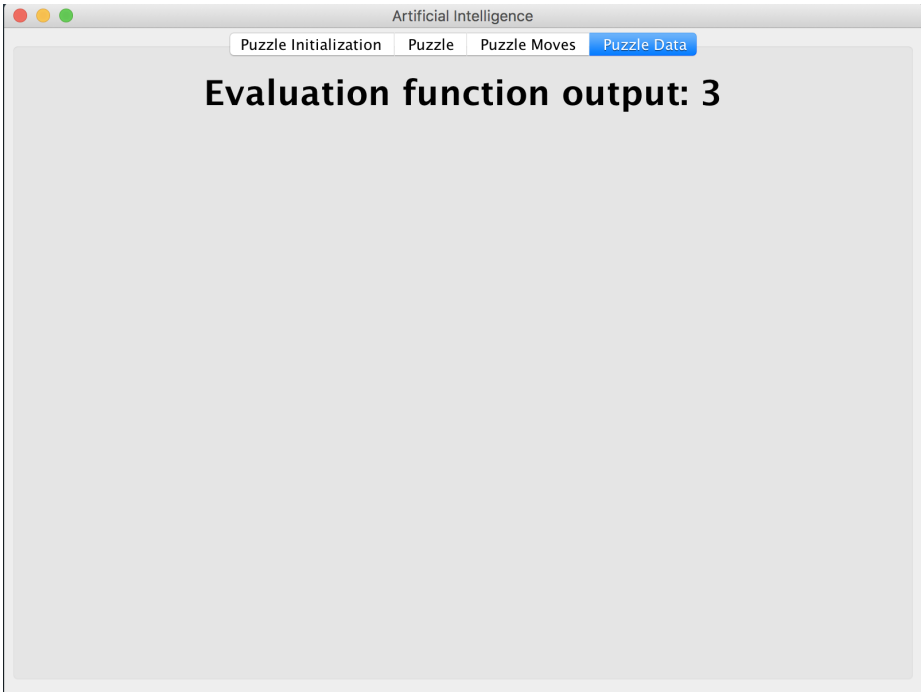

Figure 18: Reachable Goal Puzzle Evaluation size n = 7

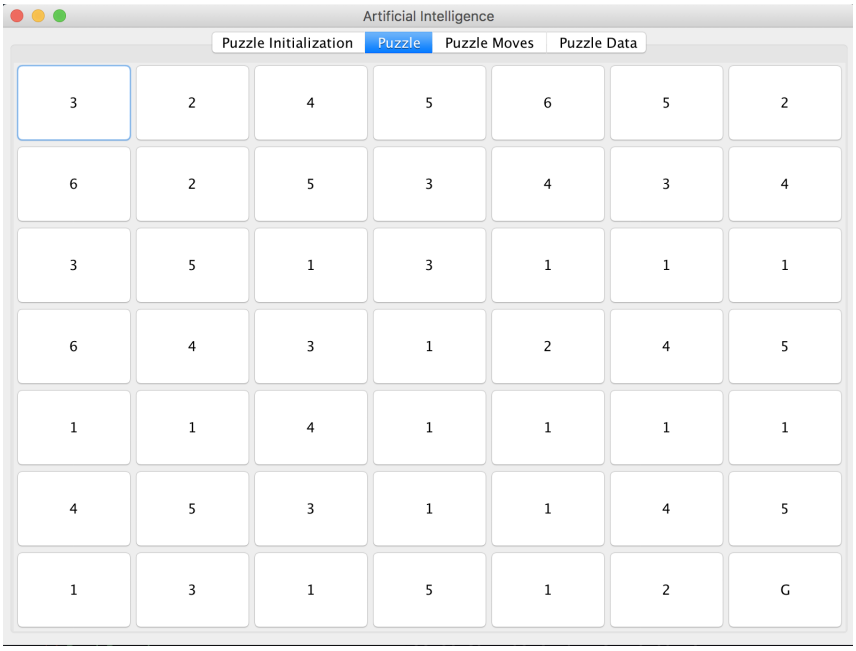

Figure 19: Unreachable Goal Puzzle size n = 7

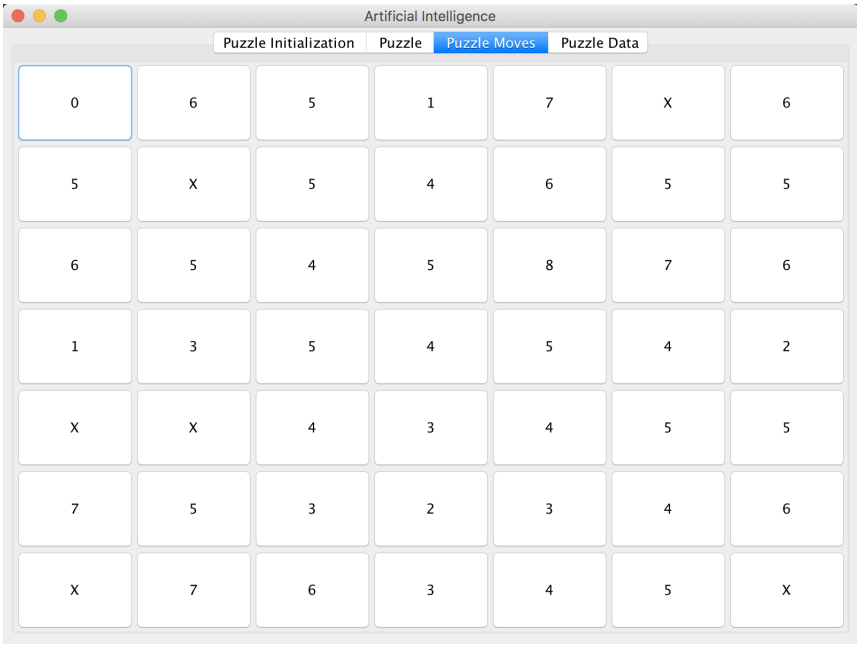

Figure 20: Unreachable Goal Puzzle Moves size n = 7

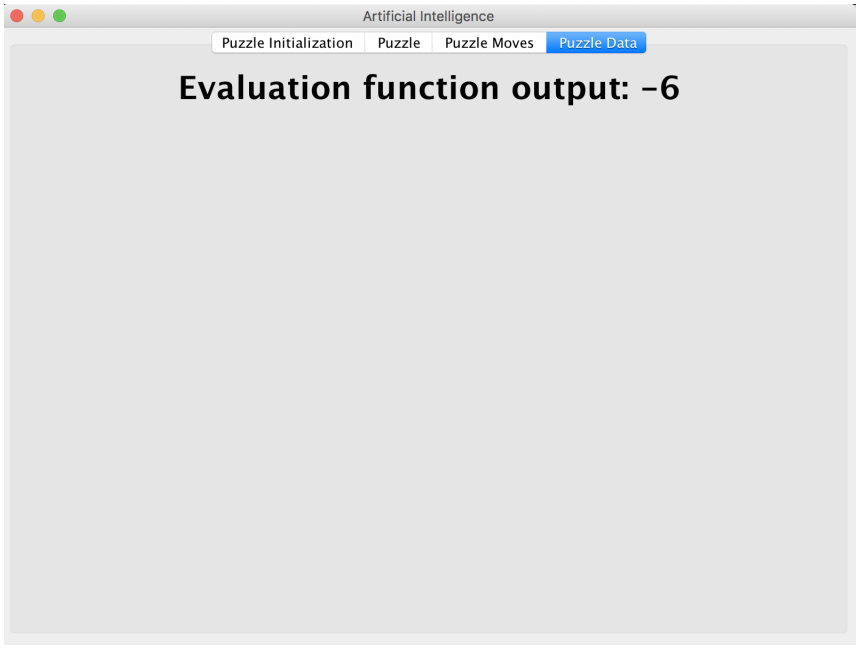

Figure 21: Unreachable Goal Puzzle Evaluation size n = 7

Example Puzzle for n = 9

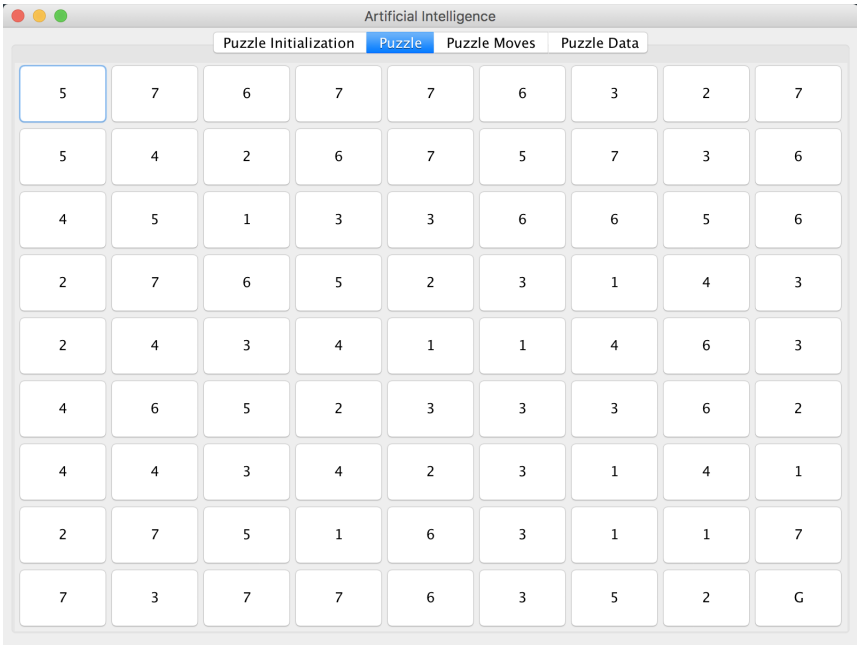

Figure 22: Reachable Goal Puzzle size n = 9

Figure 23: Reachable Goal Puzzle Moves size n = 9

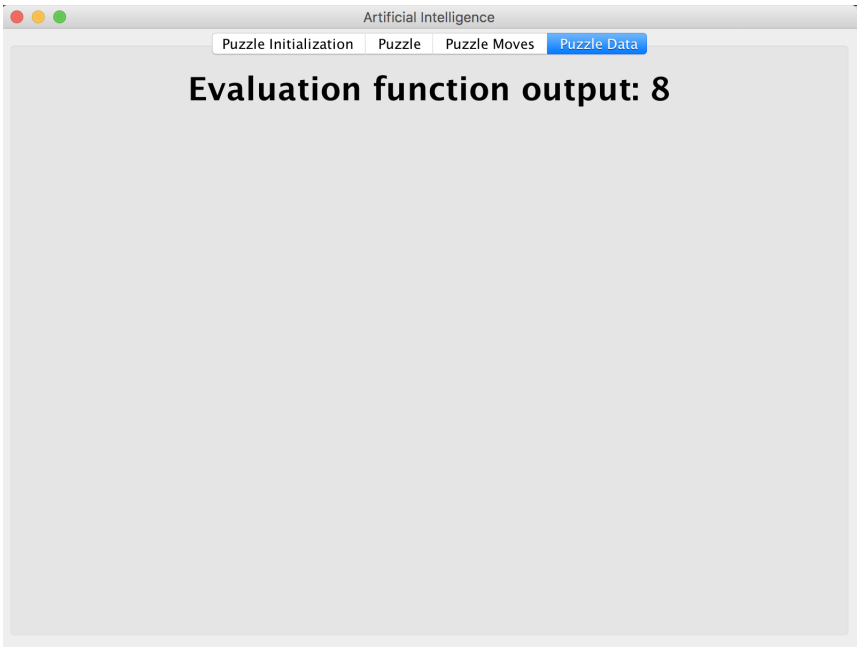

Figure 24: Reachable Goal Puzzle Evaluation size n = 9

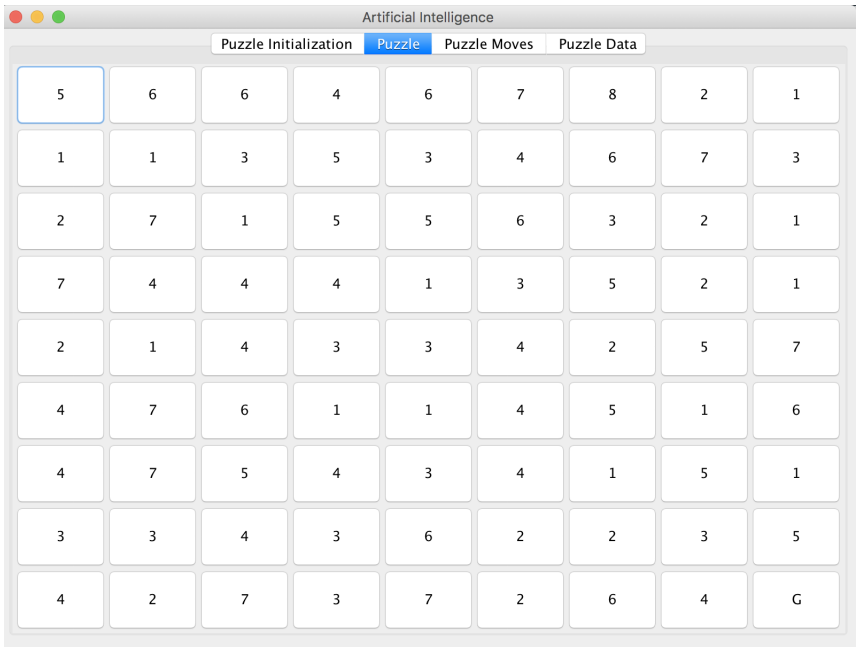

Figure 25: Unreachable Goal Puzzle size n = 9

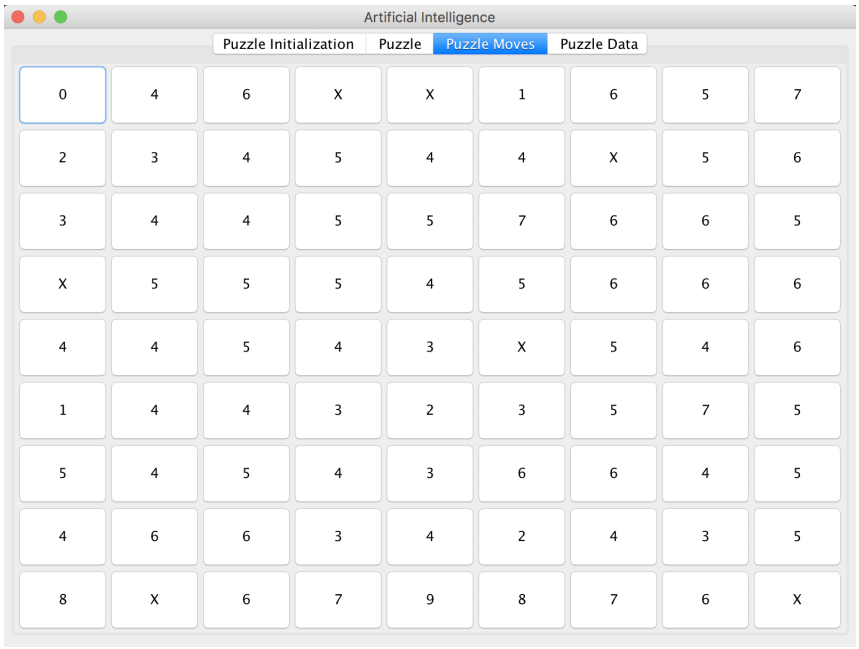

Figure 26: Unreachable Goal Puzzle Moves size n = 9

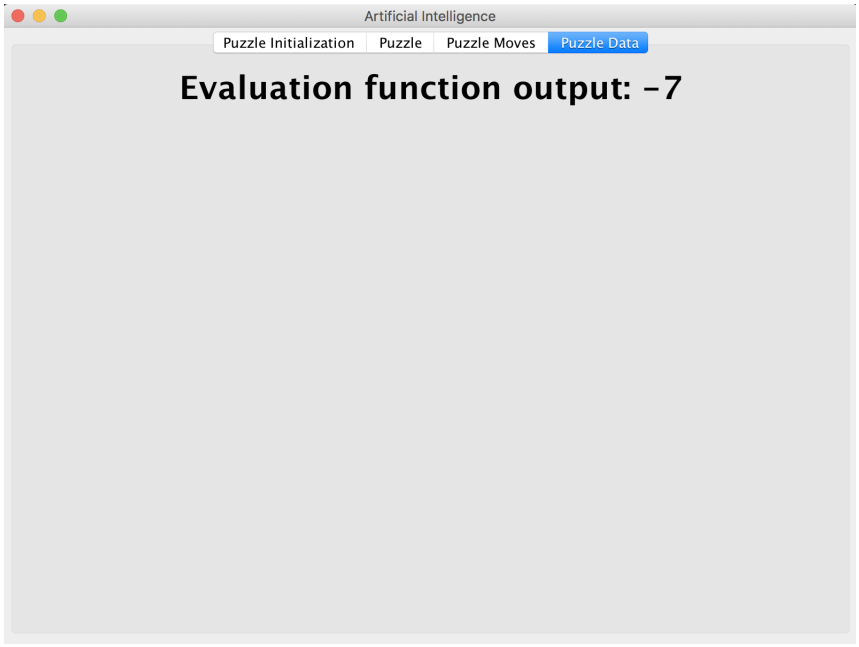

Figure 27: Unreachable Goal Puzzle Evaluation size n = 9

Example Puzzle for n = 11

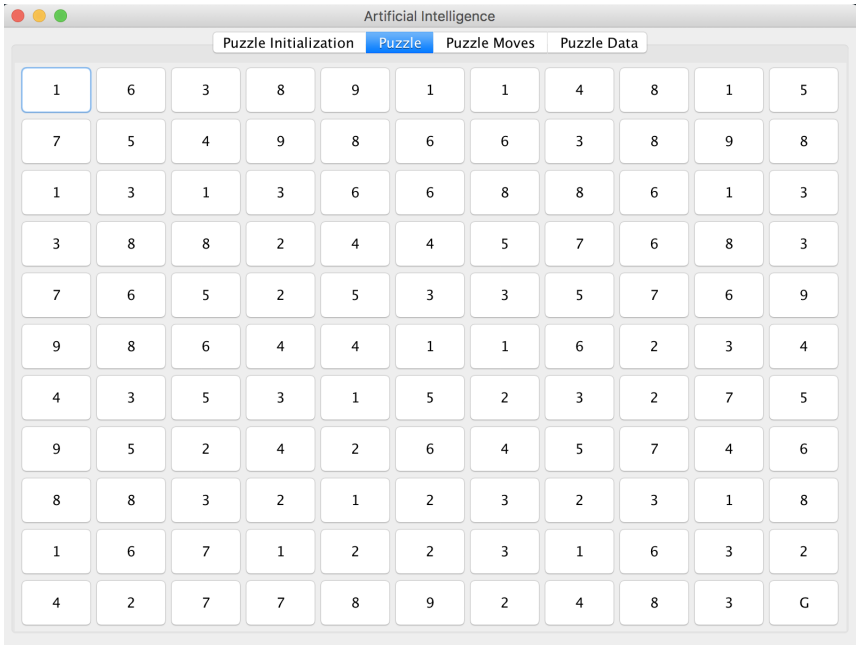

Figure 28: Reachable Goal Puzzle size n = 11

Figure 29: Reachable Goal Puzzle Moves size n = 11

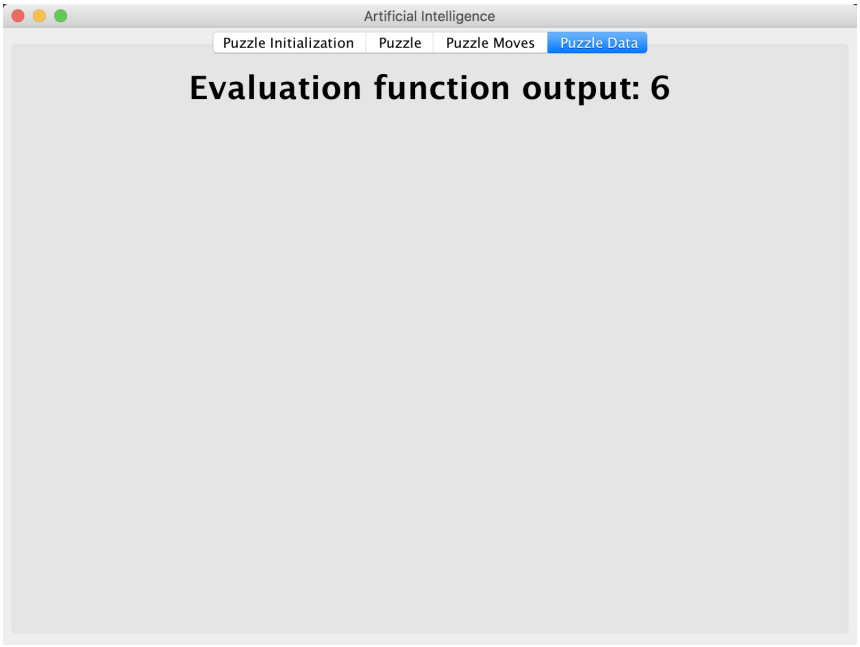

Figure 30: Reachable Goal Puzzle Evaluation size n = 11

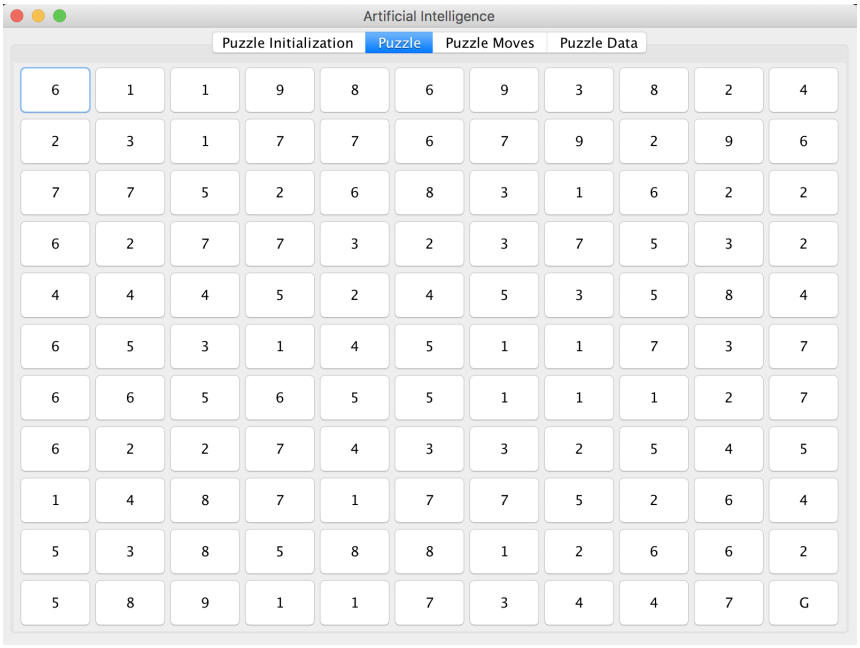

Figure 31: Unreachable Goal Puzzle size n = 11

Figure 32: Unreachable Goal Puzzle Moves size n = 11

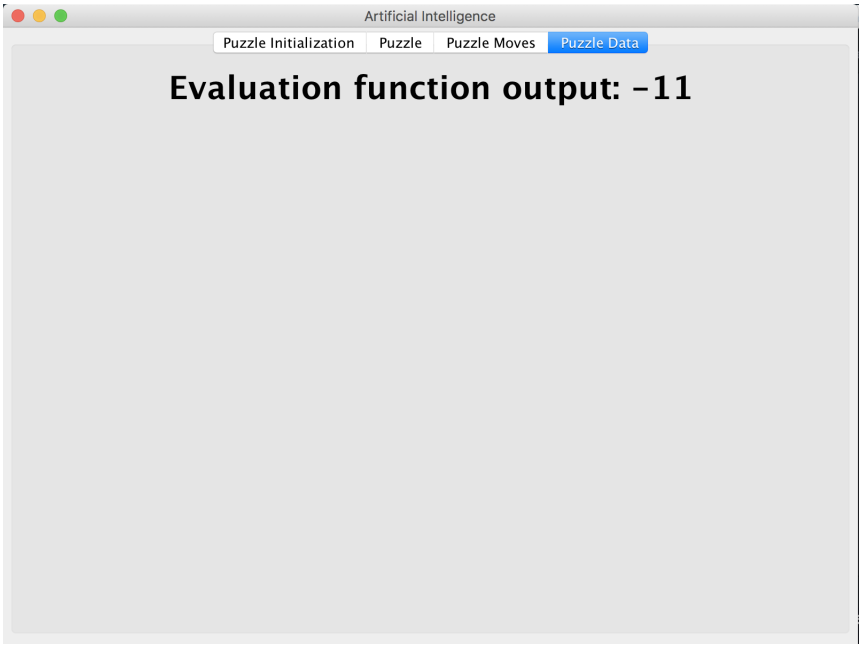

Figure 33: Unreachable Goal Puzzle Evaluation size n = 11

Basic Hill Climbing Approach

Your software should receive the number of iterations for the hill climbing approach as input and visualize the final optimized puzzle configuration, its value and the time it took to compute it.

Provide a plot of how the evaluation function changes as the number of iterations increases averaged over multiple runs of the approach at least 50.

Example Puzzle for n = 5

IMAGES

Example Puzzle for n = 7

IMAGES

Example Puzzle for n = 9

IMAGES

Example Puzzle for n = 11

IIMAGES

Hill Climbing with Random Restarts

Your input in this case should be two numbers a) the number of times you will start a hill climbing process and b) the number of iterations per hill climbing process.

Example Puzzle for n = 5

IMAGES

Example Puzzle for n = 7

IMAGES

Example Puzzle for n = 9

IMAGES

Example Puzzle for n = 11

IIMAGES

Hill Climbing with Random Walks

Compare the output of the above two processes against the one that utilizes random walks for the same number of total iterations. i.e. again again visualize the final optimized puzzle configuration, its value and time it took to compute it.

Your input in this case will be two numbers a) the total number of iterations for hill climbing and b) the probability of the acceptance of a downhill move

Evaluate the effects of different values for probability p and select the one that works best for this problem and preferred number of total iterations

Example Puzzle for n = 5

IMAGES

Example Puzzle for n = 7

IMAGES

Example Puzzle for n = 9

IMAGES

Example Puzzle for n = 11

IIMAGES

Simulated Annealing

Proposal and Implementation of a population based approach