

NUMB3RS Activity: The Labyrinth Episode: "One Hour"

Topic: Logic Mazes

Grade Level: 9 - 12

Objective: Students will be able to analyze a basic logic maze through simulation and determine a winning strategy.

Time: 20 minutes

Introduction

In "One Hour," kidnappers take a small boy hostage and evade the FBI in a chase through Los Angeles. When Don asks Charlie and Amita to help stay one step ahead of the kidnappers, Charlie realizes that the kidnappers are leading them on a chase through the city as if the streets were a maze—a logic maze.

A logic maze is a maze with rules. That is to say, the way out might be obvious to see, but the constraints on movement through the maze make it difficult. Imagine a chess board where you must move from the lower-left corner to the upper right. It is not too hard with a queen, but a little more difficult with a knight.

This activity analyzes a logic maze based on the Greek myth about Theseus and the Minotaur. The rules for the game were invented by Robert Abbott, a computer programmer who, since 1962, has focused his attention on inventing games.

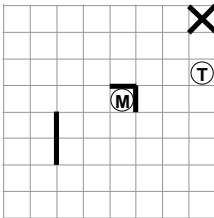
Discuss with Students

To have the game proceed smoothly, it might be beneficial to make an overhead of the first game board and describe the game, emphasizing the rules outlined in the activity.

At the conclusion of the activity, have the students design their own mazes for each other to try to escape.

Student Page Answers:

1. *The Minotaur would get him in two moves before Theseus reached the wall.*
- 2.



Puzzle #1: *The key is to have Theseus move once to the left and then move up until the Minotaur is even with the cup or "trap." When this happens, Theseus should move left. This will trap the Minotaur allowing Theseus to exit safely.*

Puzzle #2: *Theseus needs to move directly below the bottom trap and wait for the Minotaur. Once the Minotaur is trapped, Theseus is to move directly behind the trap on the right and wait for the Minotaur to be trapped again. Theseus should then proceed directly behind the top trap and exit the labyrinth.*

Puzzle #3: *This maze was created by Toby Nelson. It is quite diabolical. The technique is to first trap the Minotaur in the trap directly above him, then into the trap where Theseus starts the game at, then to get the Minotaur into the trap directly below where the Minotaur started.*

Name: _____ Date: _____

NUMB3RS Activity: The Labyrinth

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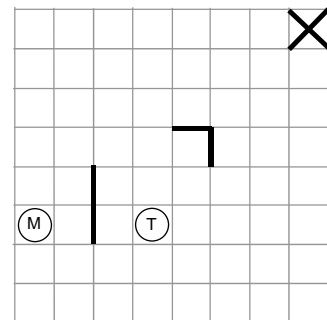
Logic mazes are mazes that the way a piece moves is dictated by certain rules. For instance, the piece can only move forward two squares or backward one square. For this activity, we will explore the logic maze based on the Greek myth about Theseus and the Minotaur.

In the myth, Theseus was placed in a labyrinth where the Minotaur resides. Theseus' goal was to escape the maze before being eaten by the Minotaur. The rules for this logic puzzle are:

- The Minotaur always moves two spaces per turn when possible. These spaces do not need to be in a straight line. Theseus, on the other hand, can move only one space per turn.
- Given the option, the Minotaur will always move to minimize his horizontal distance from Theseus, before moving in a vertical direction.
- Theseus can decide to wait and let the Minotaur take another turn.
- The Minotaur will never move in a direction away from Theseus—he will either move closer to Theseus, or, if that is not possible (e.g., a wall blocks the path), he will stay where he is.

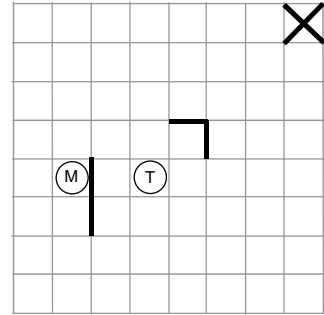
To illustrate this, suppose the Minotaur is the counter with an M, and Theseus is the counter with a T. For Theseus to reach the X and leave the maze, he must move based on what he knows about Minotaur.

This is the initial setting. If Theseus moves up one space, the Minotaur will first move toward Theseus and encounter a wall, but then he will move up one space.

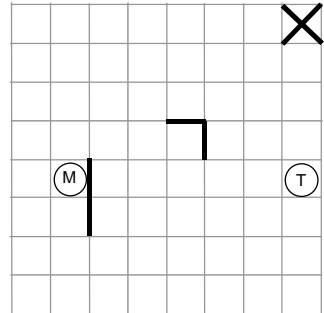


It might appear that the next move would be to move up again.

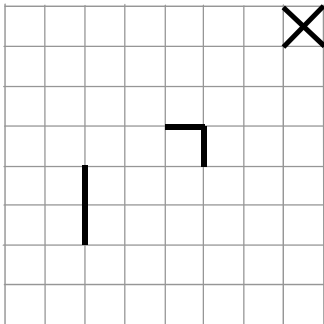
1. Why would this not be a good idea?



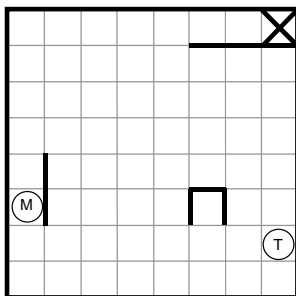
Because moving up is unwise, Theseus will move right, forcing the Minotaur to not move. (Remember, the Minotaur must move closer to Theseus, but because there is a wall in the way, the Minotaur will remain in the same place.) In fact, Theseus will move right all the way to the edge of the board.



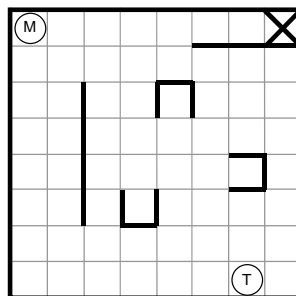
2. Draw what the board will look like after Theseus moves up twice from his current position.



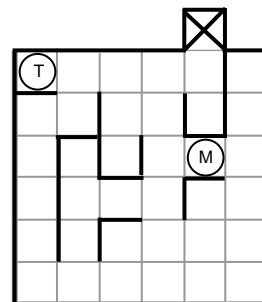
Now that the rules of the game are known, see if you and your neighbor can help Theseus escape the Minotaur in puzzles 1, 2, and 3.



Puzzle #1



Puzzle #2



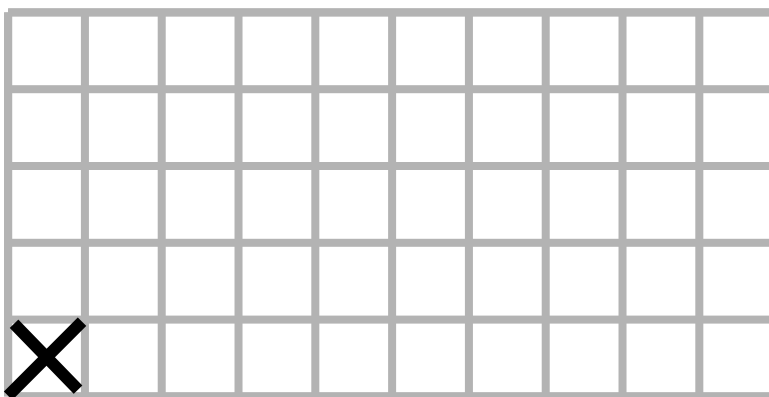
Puzzle #3

The goal of this activity is to give your students a short and simple snapshot into a very extensive mathematical topic. TI and NCTM encourage you and your students to learn more about this topic using the extensions provided below and through your own independent research.

Extensions

Introduction

A different type of logic game is called "Chomp." This game is played on an $m \times n$ grid, where the bottom left square is "poison." The players alternate moves, choosing any of the other squares except the poison one. For any chosen square, that square along with all other squares above it and to the right of it, become "eaten" (chomped). Once a square is "eaten," it can no longer be chosen. The player forced to chomp the poison square loses. Play "Chomp" on the board below and see how you do.



Additional Resources

- Try your hand at a computer version of Theses and the Minotaur with other mazes at the Web site: <http://www.tnelson.demon.co.uk/mazes>
- The Logic maze, Theseus and the Minotaur, was invented by Robert Abbott. To view many of his mazes and try them out, visit his Web site at: <http://www.logicmazes.com>
- An interactive version of Chomp can be found at the Web site: <http://www.math.ucla.edu/~tom/Games/chomp.html>
- There are other types of logic mazes called Multi-State Mazes. They can be found at: http://www.maa.org/editorial/mathgames/mathgames_11_24_03.html