**Rat in Maze Solver with Java - Documentation**

**Project Overview**

The "Rat in Maze" solver is a Java-based program designed to navigate through a matrix representing a maze. The rat starts at the upper left cell and aims to reach the lower right cell, moving only forward or down. This project implements multithreading to explore multiple paths simultaneously, limiting the number of threads to a maximum of four for efficient processing.

**- Problem Modeling**

* Maze Representation: The maze is represented as a matrix where the upper left cell is the starting point, and the lower right cell is the destination.
* Movement Constraints: The rat can only move forward or down within the maze.
* Multithreading Approach: Threads are used to explore possible directions concurrently. The total number of threads is limited to a maximum of four, ensuring efficient exploration.

**- Features**

Real-time Maze Visualization

* The program displays the maze with the rat's path in real time as it navigates through the matrix.
* Updates to the maze are reflected instantly during traversal.

Limited Thread Creation

* Threads are generated to explore available paths in the maze.
* The maximum number of threads created is restricted to four to optimize processing.

Efficient Pathfinding

* The program ensures efficient traversal by exploring multiple paths concurrently.

**-Output**

* Real-time Maze Representation
* The maze matrix displays the rat's path in real time as it traverses the maze.
* Updates to the maze due to rat movement are shown instantly.

**-Multithreading Strategy**

* Thread Management: The program creates threads to explore available directions while limiting the total active threads to a maximum of four.

**Example Scenario:**

Start:

first we enter the size of the maze which is 8X8 in our example

A screenshot of a computer

Description automatically generated

Maze Initialization

* The program initializes a maze matrix with the starting point (upper left) and the destination (lower right).
* Threads are spawned to explore available directions from the starting point. A screenshot of a crossword puzzle

  Description automatically generated

Real-time Visualization

* As the rat navigates through the maze, the program visually updates the maze grid to reflect the rat's path in real time.

A screenshot of a game

Description automatically generated

**-Thread Limitation**

* The number of threads created is limited to a maximum of four to ensure efficient processing.

**-Pathfinding and Solution**

* The rat explores the maze using multiple threads, aiming to find a path to the destination while visualizing its progress in the maze.

A screenshot of a game

Description automatically generated

**Notes:**

The program utilizes multithreading to efficiently explore multiple paths in the maze, providing real-time updates of the rat's progress.

The maximum limit of four threads ensures optimized processing, offering an interactive experience during maze traversal.