CSE 4082 – PROJECT 1

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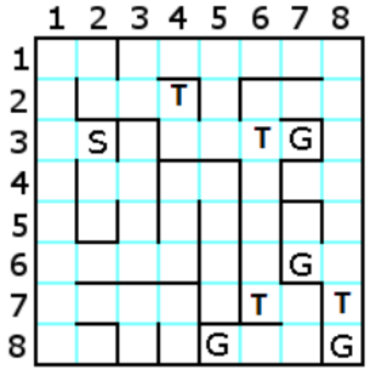
CONTENTS

Section 1: The Output of the Example Maze



a. **Depth First Search**
Cost of the founded solution: 29
The number of expanded nodes: 24
The maximum size of the frontier: 8
The maximum size of the explored set: 24
Solution path: (2,3)-(1,3)-(1,2)-(1,1)-(2,1)-(2,2)-(3,2)-(3,1)-(4,1)-(5,1)-(5,2)-(5,3)-(6,3)-(6,2)-(7,2)-(8,2)-(8,3)-(8,4)-(8,5)-(8,6)-(7,6)

b. **Breadth First Search**
Cost of the founded solution: 29
The number of expanded nodes: 37
The maximum size of the frontier: 7
The maximum size of the explored set: 37
Solution path: (2,3)-(1,3)-(1,2)-(1,1)-(2,1)-(2,2)-(3,2)-(4,2)-(4,3)-(5,3)-(6,3)-(7,3)

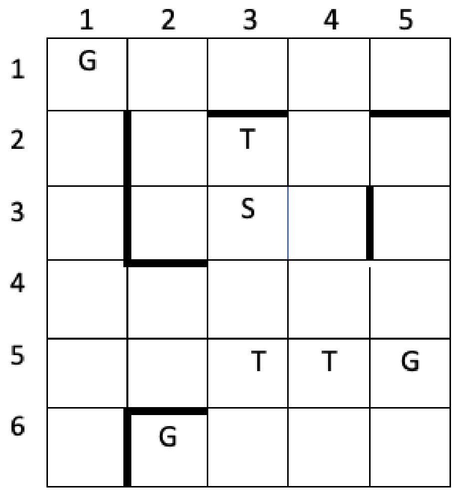
c. **Iterative Deepening**
Cost of the founded solution: 29
The number of expanded nodes: 300
The maximum size of the frontier: 8
The maximum size of the explored set: 24
Solution path: (2,3)-(1,3)-(1,2)-(1,1)-(2,1)-(2,2)-(3,2)-(3,1)-(4,1)-(5,1)-(5,2)-(5,3)-(6,3)-(6,2)-(7,2)-(8,2)-(8,3)-(8,4)-(8,5)-(8,6)-(7,6)

d. **Uniform Cost Search**
Cost of the founded solution: 18
The number of expanded nodes: 46
The maximum size of the frontier: 7
The maximum size of the explored set: 46
Solution path: (2,3)-(1,3)-(1,2)-(1,1)-(2,1)-(2,2)-(3,2)-(3,1)-(4,1)-(5,1)-(6,1)-(7,1)-(8,1)-(8,2)-(8,3)-(8,4)-(8,5)-(8,6)-(7,6)

e. **Greedy Best First Search**
Cost of the founded solution: 29
The number of expanded nodes: 32
The maximum size of the frontier: 6
The maximum size of the explored set: 32
Solution path: (2,3)-(1,3)-(1,2)-(1,1)-(2,1)-(2,2)-(3,2)-(4,2)-(4,3)-(5,3)-(6,3)-(7,3)

f. **A* Heuristic Search**
Cost of the founded solution: 18
The number of expanded nodes: 45
The maximum size of the frontier: 6
The maximum size of the explored set: 45
Solution path: (2,3)-(1,3)-(1,2)-(1,1)-(2,1)-(2,2)-(3,2)-(3,1)-(4,1)-(5,1)-(6,1)-(7,1)-(8,1)-(8,2)-(8,3)-(8,4)-(8,5)-(8,6)-(7,6)

Section 2: The Output of the Maze We Designed



a. Depth First Search
Cost of the founded solution: 13
The number of expanded nodes: 4
The maximum size of the frontier: 6
The maximum size of the explored set: 4
Solution path: (3,3)-(3,2)-(2,2)-(2,1)-(1,1)

b. Breadth First Search
Cost of the founded solution: 4
The number of expanded nodes: 18
The maximum size of the frontier: 9
The maximum size of the explored set: 18
Solution path: (3,3)-(4,3)-(4,4)-(5,4)-(5,5)

c. Iterative Deepening
Cost of the founded solution: 13
The number of expanded nodes: 10
The maximum size of the frontier: 6
The maximum size of the explored set: 4
Solution path: (3,3)-(3,2)-(2,2)-(2,1)-(1,1)

d. Uniform Cost Search
Cost of the founded solution: 4
The number of expanded nodes: 16
The maximum size of the frontier: 11
The maximum size of the explored set: 16
Solution path: (3,3)-(2,3)-(2,2)-(2,1)-(1,1)

e. Greedy Best First Search
Cost of the founded solution: 4
The number of expanded nodes: 4
The maximum size of the frontier: 7
The maximum size of the explored set: 4
Solution path: (3,3)-(4,3)-(4,4)-(5,4)-(5,5)

f. A* Heuristic Search
Cost of the founded solution: 4
The number of expanded nodes: 9
The maximum size of the frontier: 9
The maximum size of the explored set: 9
Solution path: (3,3)-(4,3)-(4,4)-(5,4)-(5,5)

Section 3: Description of the Project

1. **GraphSearch:** The graph search algorithm is implemented in this class.
   a. **Features:**

      strategy: It is an instance of one of the classes of search algoritms defined below.
      grid: Two dimensional array for input maze
      cost: Integer value for final cost of the solution
      exploredSet: Array to stored nodes of the explored set
      lastNode: An instance of Node class to store last visited node
      goalNodes: : Array to store goal nodes
      maxDepth: Integer value to define maximum depth for iterative deepening search
      currentDepth: Integer value to check current depth for iterative deepening search
      IDS_exploredSet: Explored set of iterative deepening search
      maxLenOfExploredSet: Maxmimum lenght of the explored set

   b. **Functions**

      expandNode(node): It returns accessible nodes from the input node.
      checkInNotFrontierOrExploredSet(self, nextNode): It returns true if input node not in explored set or frontier; otherwise returns false.
      search(): Graph search algorithm is implemented on this function.
      printPath(): It prints the solution path.
      printExploredSet(): It prints explored set.
      printIterativeDeepeningExploredSet(): It prints explored set for iterative deepening.

2. **Node:**
   a. **Features:**

      status: It can be N for normal, G for goal, T for trap nodes.
      eastWall, westWall, **northWall**, **southWall:** Boolen values indicates whether there is a wall east, west, north an south of the node or not
      verticalIndex: Vertical index of node
      horizontalIndex: Horizontal index of node
      cost: Cost of the node from initial state
      successor: Last node on the solution path before coming current node
      heuristicCost: Heuristic function value from the node to goal state

3. **DFS:** It is a strategy class for depth-first search.

a. **Features**

frontier: It is LIFO queue for graph search.

maxLenFrontier: It is an integer value to store maximum length of the frontier.

b. **Functions**

operate(): It pops a node from the frontier as regarding the type of the frontier

append(): It push a node to frontier

getLengthOfTheFrontier(): It returns the length of the frontier.

getAllFrontier(): It returns the frontier as a list.

4. **BFS**: It is a strategy class for best-first search.

a. **Features**

frontier: It is FIFO queue for graph search.

maxLenFrontier: It is an integer value to store maximum length of the frontier.

b. **Functions**

operate(): It pops a node from the frontier as regarding the type of the frontier

append(): It push a node to frontier

getLengthOfTheFrontier(): It returns the length of the frontier.

getAllFrontier(): It returns the frontier as a list.

5. **IterativeDeepeningSearch:** It is a strategy class for iterative deepening search.

a. **Features**

frontier: It is LIFO queue for graph search.

maxLenFrontier: It is an integer value to store maximum length of the frontier.

b. **Functions**

operate(): It pops a node from the frontier as regarding the type of the frontier

append(): It push a node to frontier

getLengthOfTheFrontier(): It returns the length of the frontier.

getAllFrontier(): It returns the frontier as a list.

6. **UniformCostSearch:** It is a strategy class for uniform cost search.

a. **Features**

frontier: It is priority queue for graph search.

maxLenFrontier: It is an integer value to store maximum length of the frontier.

b. **Functions**

operate(): It pops a node from the frontier as regarding the type of the frontier

append(): It push a node to frontier

getLengthOfTheFrontier(): It returns the length of the frontier.

getAllFrontier(): It returns the frontier as a list.

7. **GreedyBestFirstSearch**: It is a strategy class for greedy best search.
   a. **Features**

      frontier: It is priority queue for graph search.

      maxLenFrontier: It is an integer value to store maximum length of the frontier.

   b. **Functions**

      calculateHeuristicValues(grid, goalSquares): It uses Manhattan distance as heuristic function and calculates and updates heuristic costs of the nodes.

      operate(): It pops a node from the frontier as regarding the type of the frontier

      append(): It push a node to frontier

      getLengthOfTheFrontier(): It returns the length of the frontier.

      getAllFrontier(): It returns the frontier as a list.

8. **A_StarSearch:** It is a strategy class for A* search.
   a. **Features**

      frontier: It is priority queue for graph search.

      maxLenFrontier: It is an integer value to store maximum length of the frontier.

   b. **Functions**

      calculateHeuristicValues(grid, goalSquares): It uses Manhattan distance as heuristic function and calculates and updates heuristic costs of the nodes.

      operate(): It pops a node from the frontier as regarding the type of the frontier

      append(): It push a node to frontier

      getLengthOfTheFrontier(): It returns the length of the frontier.

      getAllFrontier(): It returns the frontier as a list.