



# CS441 – Artificial Intelligence

Project Topic:

Implementation of  
*A\* search Algorithm and Dijkstra's Algorithm*

# Content

---

## I. Introduction

A\* Search Algorithm

Dijkstra's Algorithm

## II. Calculations

Euclidean Distance

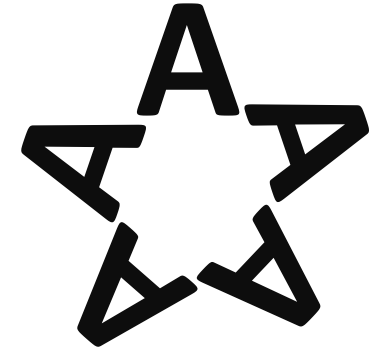
## III. Illustration of Algorithms

## IV. Demonstration

# 1. Introduction

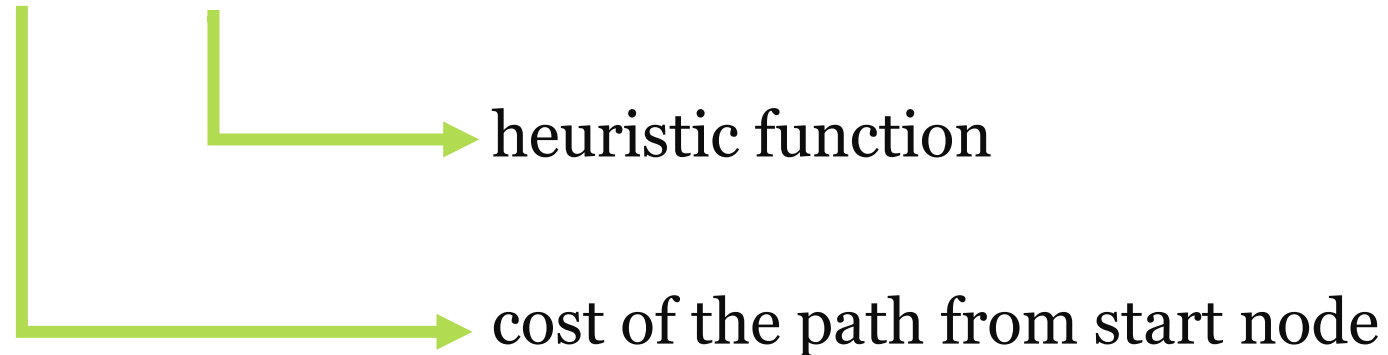
- *A\* Search Algorithm*
- *Dijkstra's Algorithm*

# 1. Introduction ( $A^*$ Search)

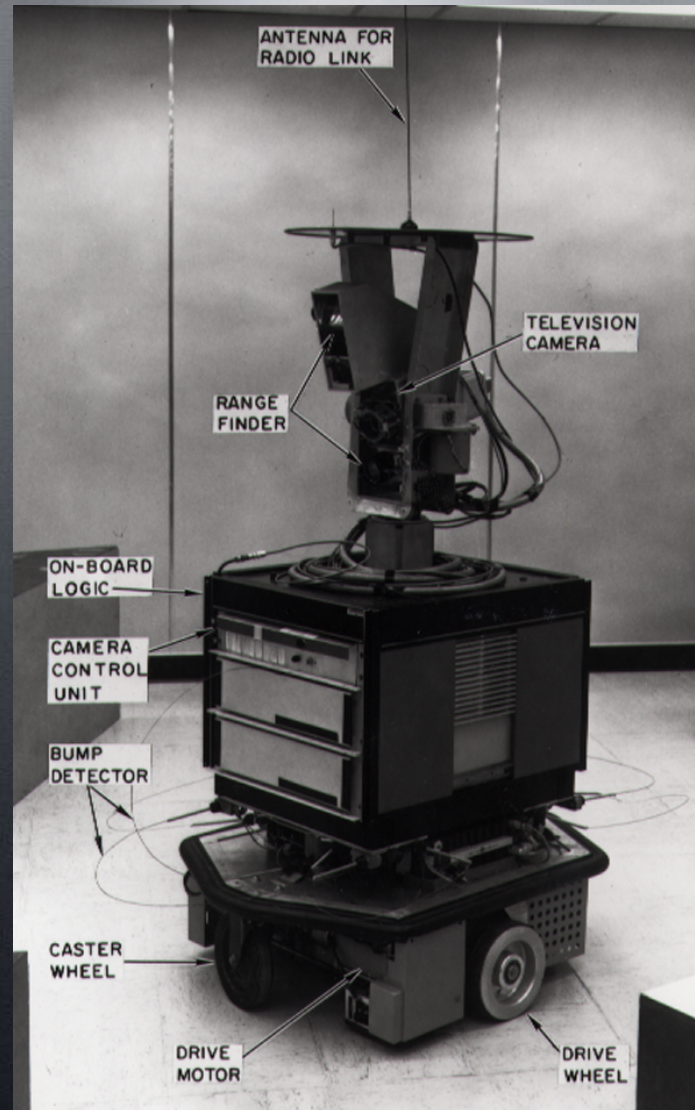


- Best-first search
- Admissibility
- Minimizes

$$f(n) = g(n) + h(n)$$



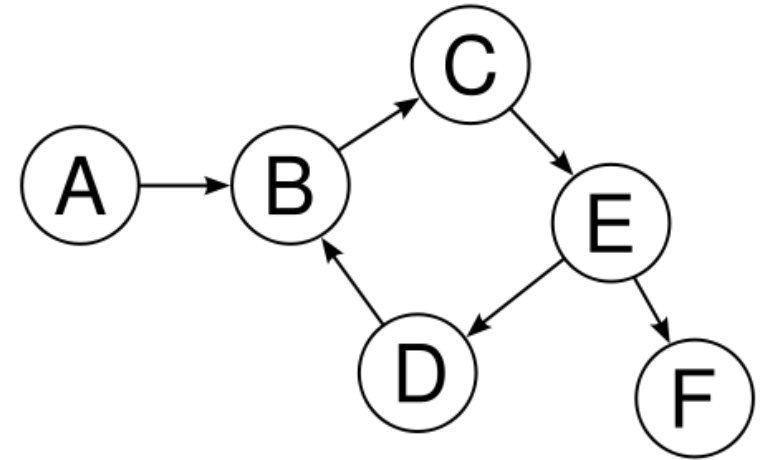
$$h(n) \leq h^*(n) \longrightarrow \text{is the optimal cost}$$



Shakey project - 1972

# 1. Introduction (*Dijkstra's Algorithm*)

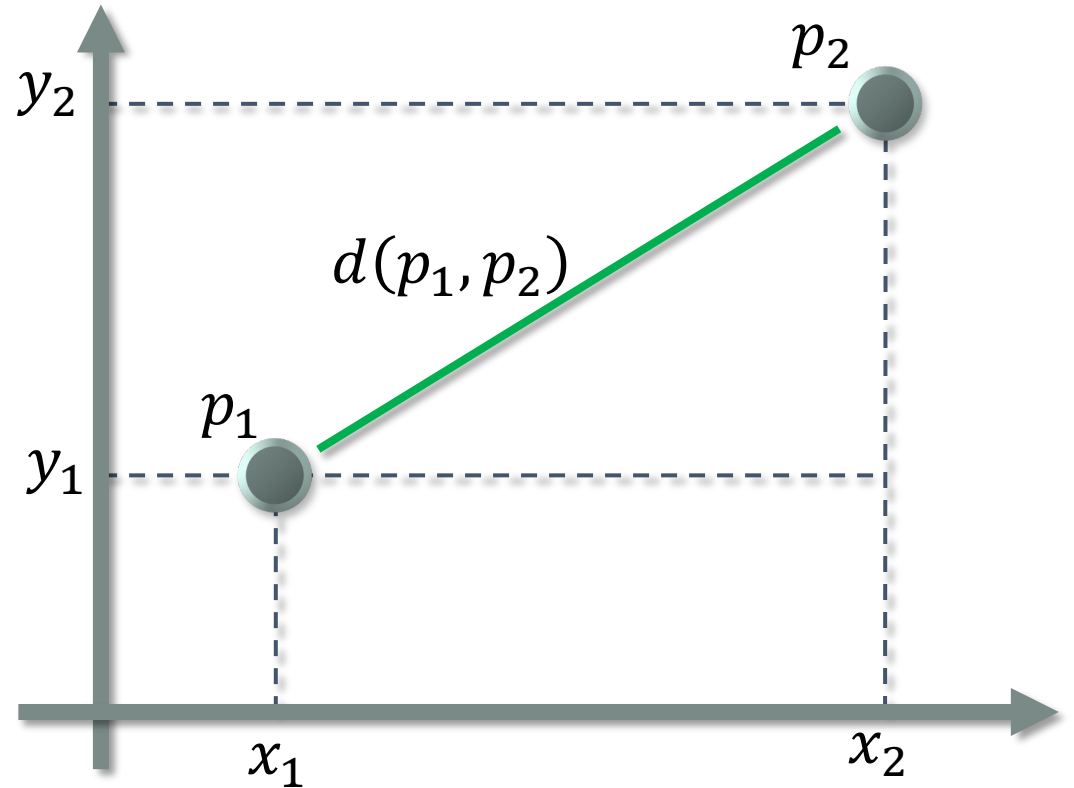
- Step-by-step process



## 3.1 Euclidean Distance

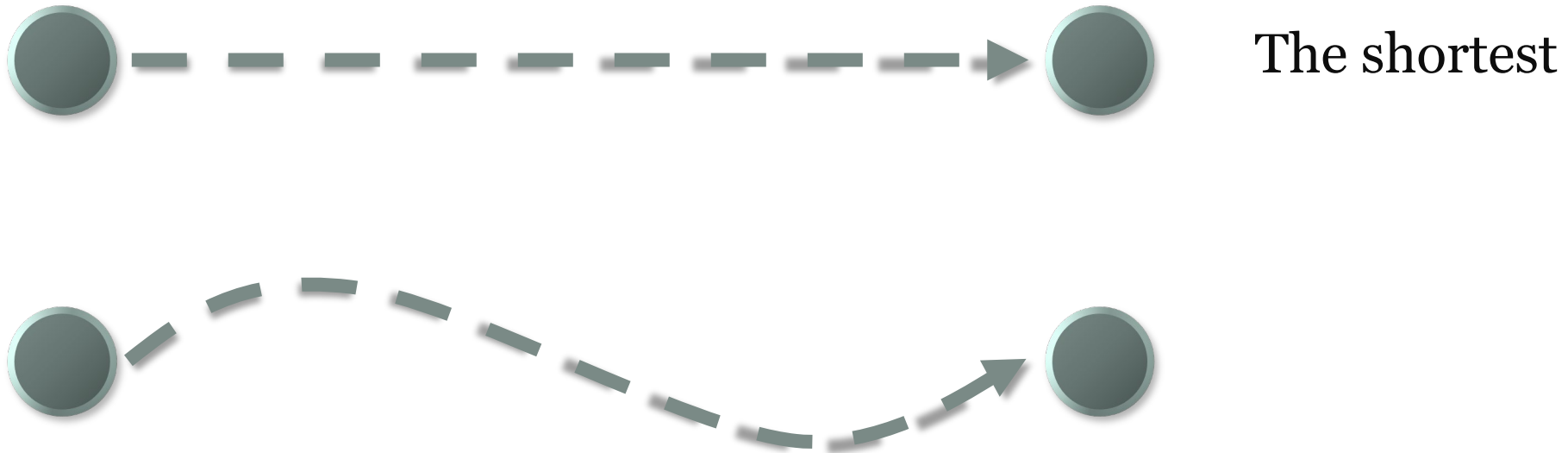
$$d(p_1, p_2) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Formula: Euclidean Distance



# 3.1 Euclidean Distance in Heuristic

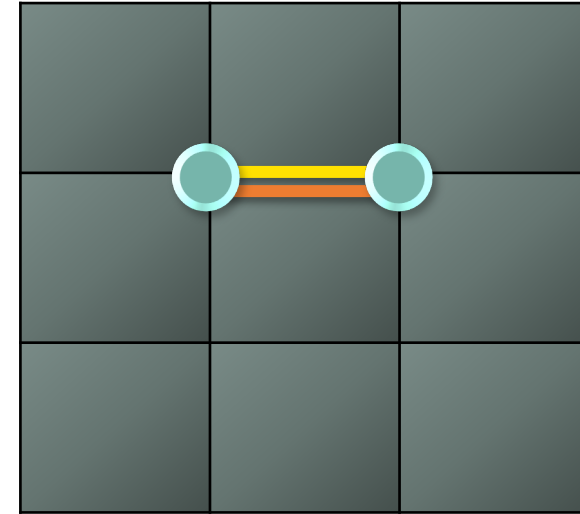
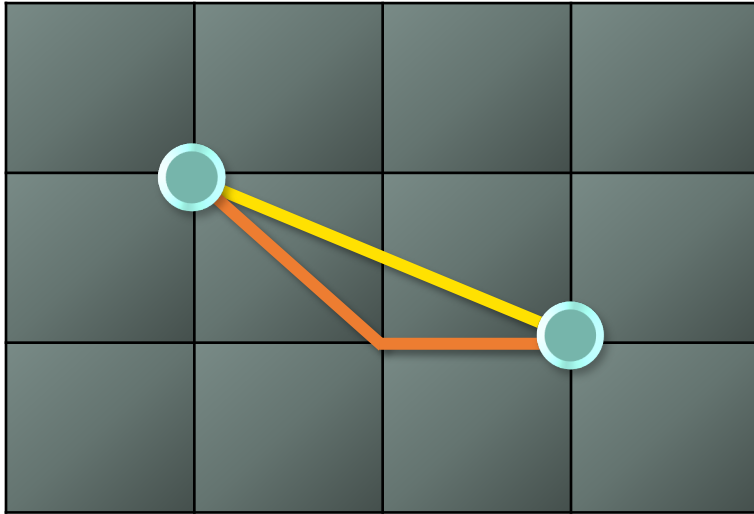
A\* Search Algorithm





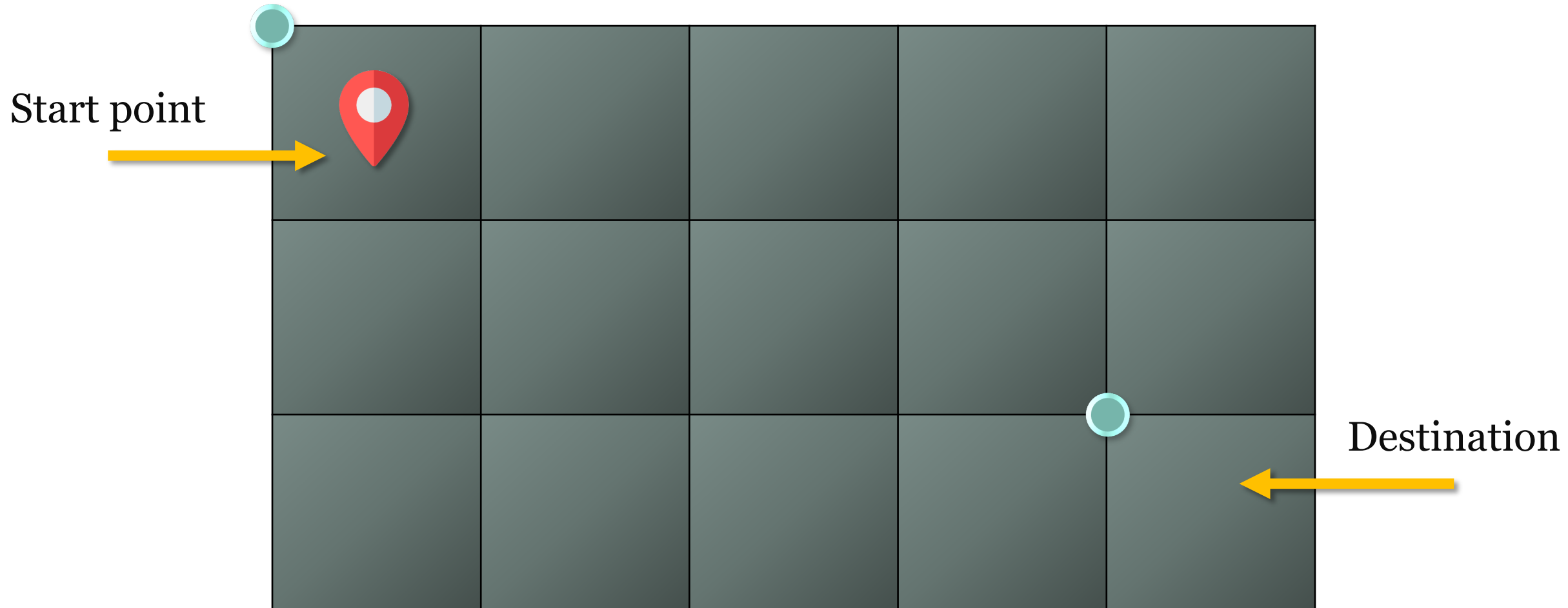
# 3.1 Euclidean Distance in Heuristic

A\* Search Algorithm



No over estimation

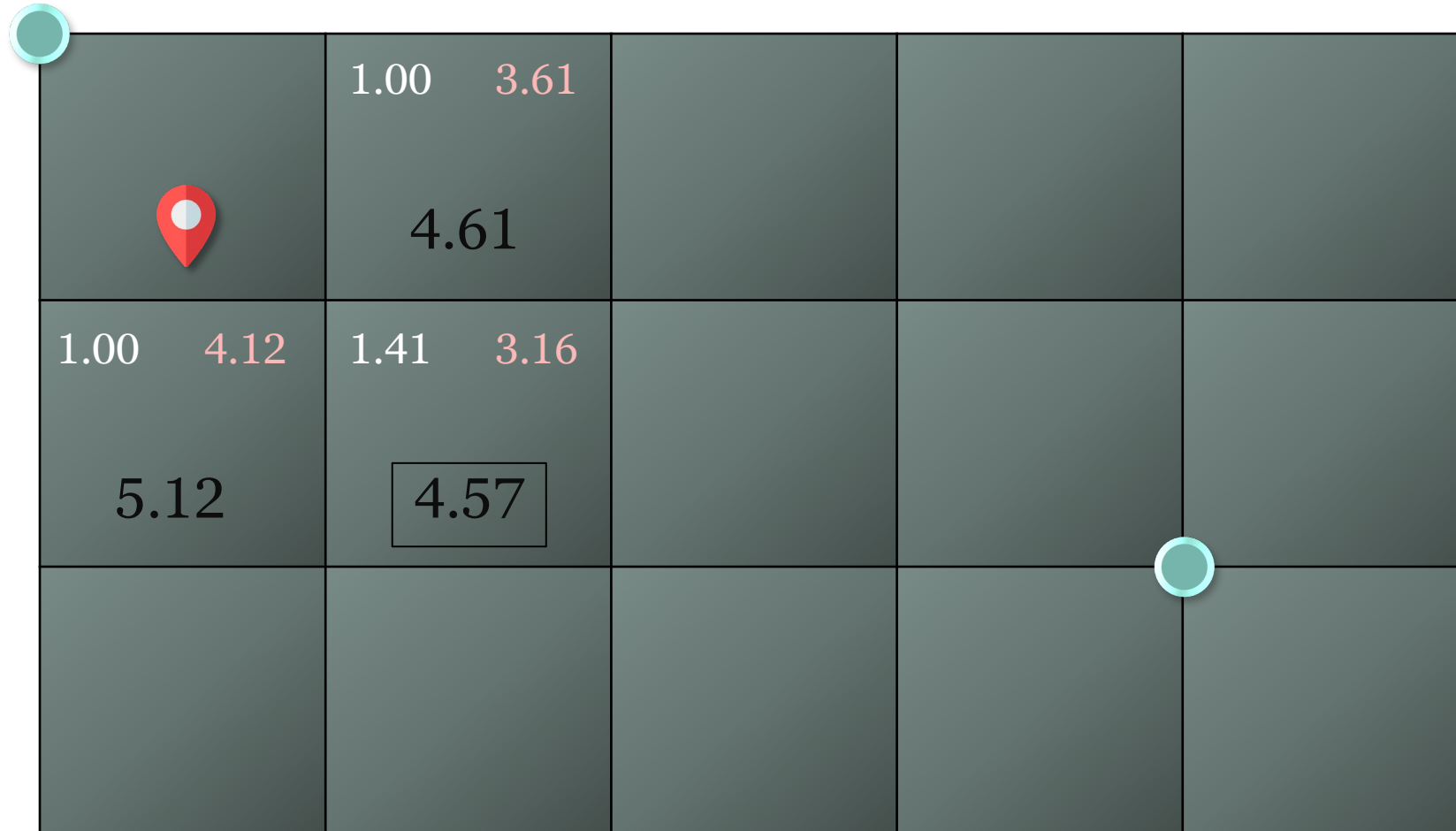
# A\* Search Algorithm



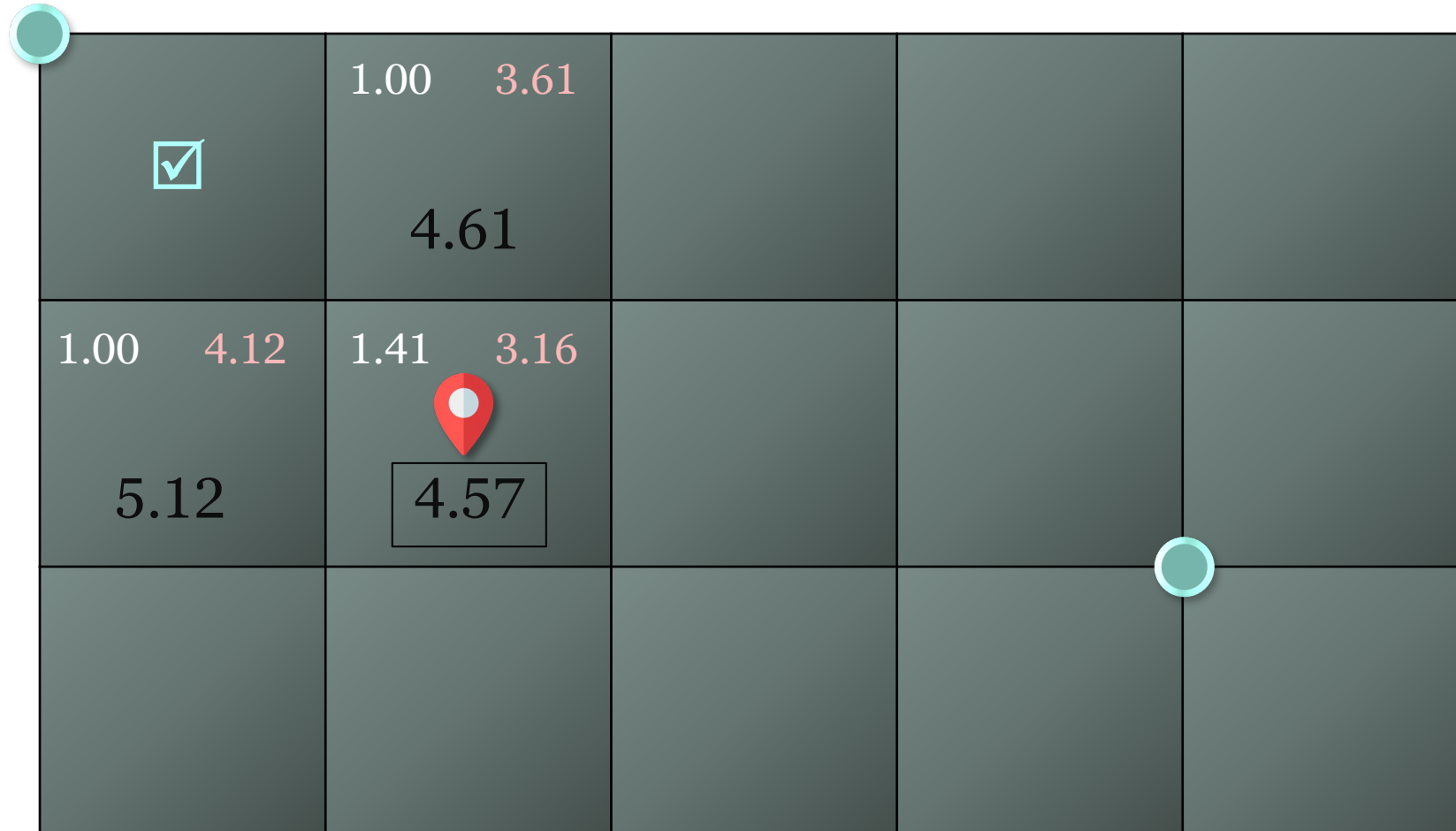
# A\* Search Algorithm



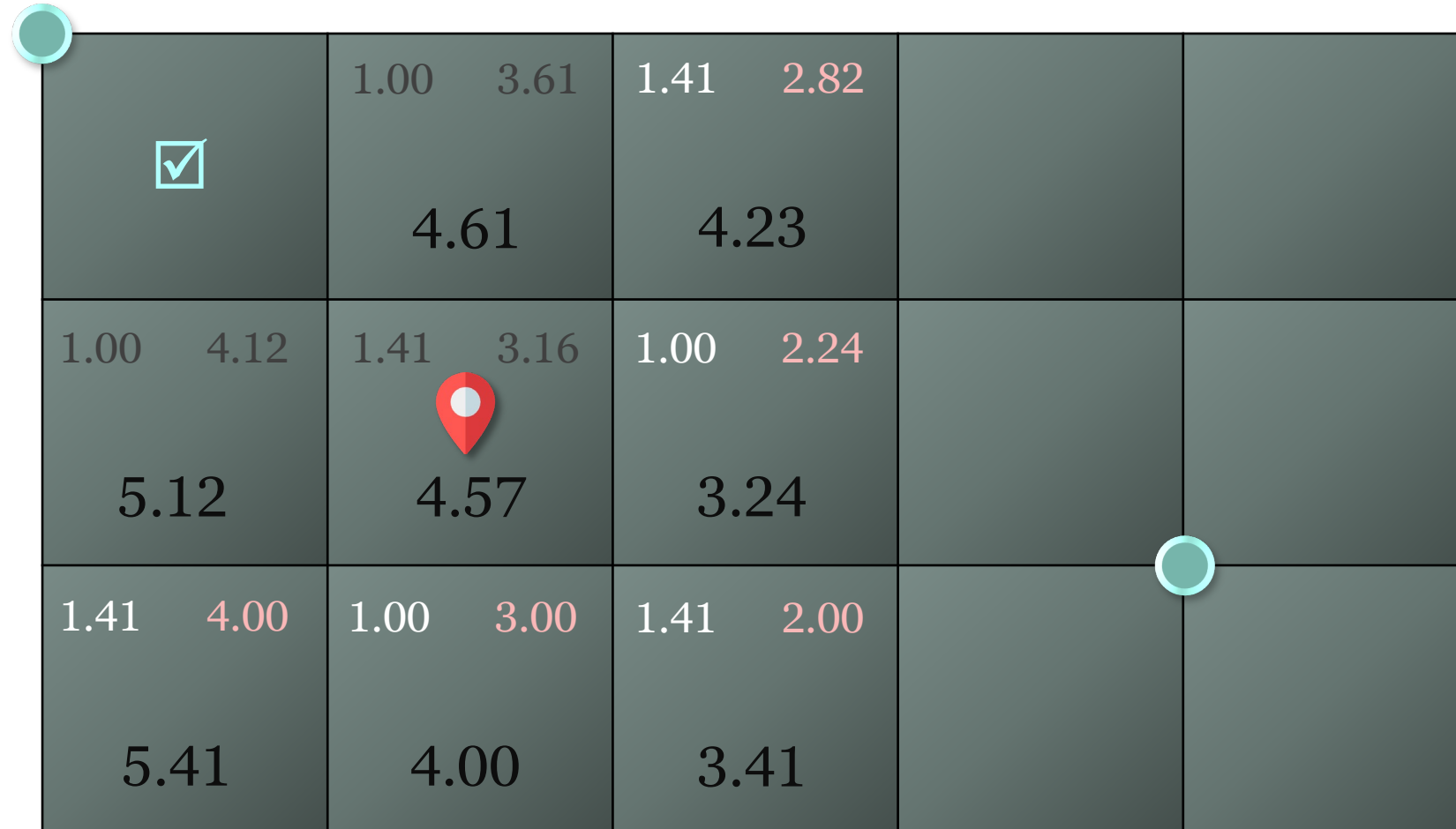
# A\* Search Algorithm



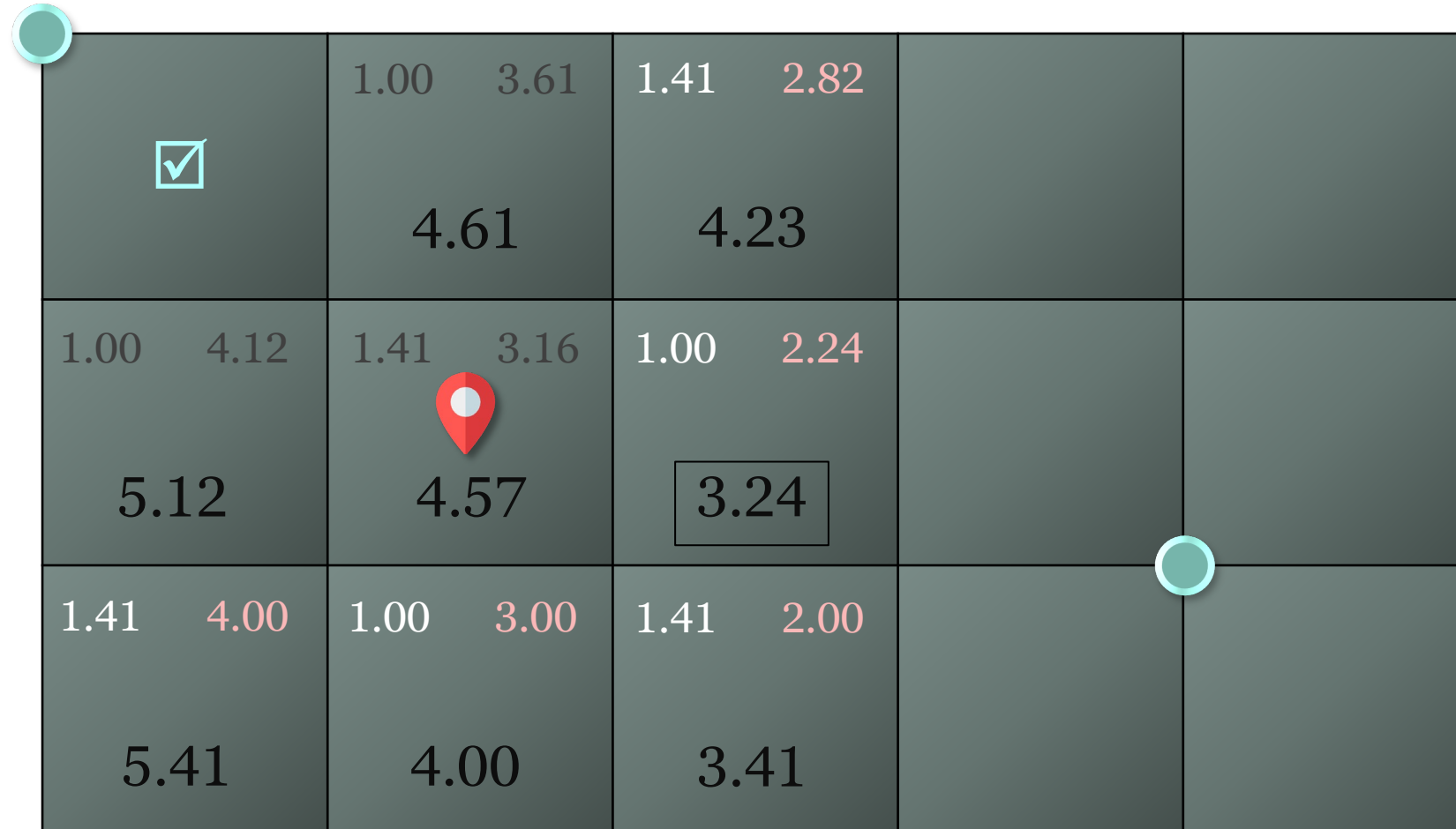
# A\* Search Algorithm



# A\* Search Algorithm



# A\* Search Algorithm



# A\* Search Algorithm





# A\* Search Algorithm



A 3x4 grid representing a search space. The grid contains numerical values and icons. A red location pin icon is placed on the cell containing 3.24. Two teal circles are placed on the grid: one at the top-left corner and one on the right edge of the bottom row.

 1.00 3.61 4.61	1.41 2.82 4.23	1.41 2.24 3.65	
1.00 4.12 5.12	1.41 3.16  4.57	1.00 2.24  3.24	1.00 1.41 2.41
1.41 4.00 5.41	1.00 3.00 4.00	1.41 2.00 3.41	1.41 1.00 2.41

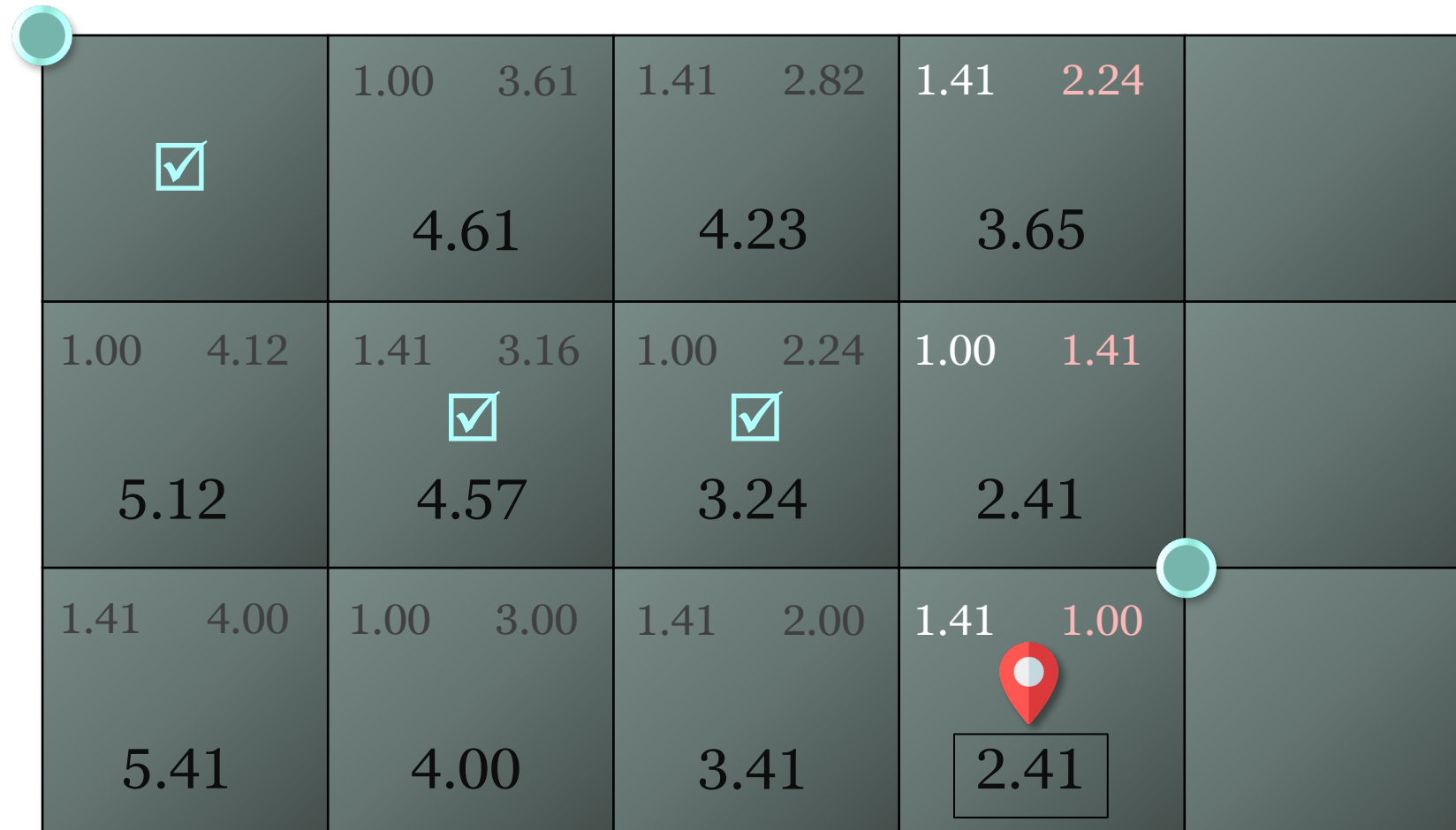
# A\* Search Algorithm





A 3x4 grid illustrating the A\* Search Algorithm. Each cell contains a G-cost (top-left), H-cost (top-right), and F-cost (bottom-center). The start node is marked with a teal circle at the top-left. The goal node is marked with a red location pin in the middle row, third column. The current node is marked with a teal circle at the bottom-right. The path from start to goal is highlighted with a teal checkmark in the top-left, middle-left, and middle-middle cells. The current node's F-cost (2.41) is highlighted with a black border.

 ✓ 1.00 3.61 4.61	1.41 2.82 4.23	1.41 2.24 3.65	
1.00 4.12 5.12	1.41 3.16 ✓ 4.57	1.00 2.24  3.24	1.00 1.41 2.41
1.41 4.00 5.41	1.00 3.00 4.00	1.41 2.00 3.41	1.41 1.00 2.41 

# A\* Search Algorithm



A 3x4 grid illustrating the A\* Search Algorithm. Each cell contains a G-cost (top left), H-cost (top right), and F-cost (center). The start node is marked with a teal circle at the top-left. The goal node is marked with a red location pin at the bottom-right. Cells with a teal checkmark are expanded nodes. The current node being evaluated is the bottom-right cell, which is highlighted with a teal circle and a red location pin.

 ✓ 1.00 3.61 4.61	1.41 2.82 4.23	1.41 2.24 3.65	
1.00 4.12 5.12	1.41 3.16 ✓ 4.57	1.00 2.24 ✓ 3.24	1.00 1.41 2.41
1.41 4.00 5.41	1.00 3.00 4.00	1.41 2.00 3.41	1.41 1.00  2.41

# A\* Search Algorithm



A 3x5 grid representing a search space. The grid contains numerical values and icons. A teal circle is at the top-left corner. A red location pin is at the bottom-right cell. Three cells contain a teal checkmark icon. The values are as follows:

  4.61	1.00 3.61 4.61	1.41 2.82 4.23	1.41 2.24 3.65	
1.00 4.12 5.12	1.41 3.16  4.57	1.00 2.24  3.24	1.00 1.41 2.41	1.41 1.00 2.41
1.41 4.00 5.41	1.00 3.00 4.00	1.41 2.00 3.41	1.41 1.00  2.41	1.00 0.00 1.00

# A\* Search Algorithm






A 3x5 grid illustrating the A\* Search Algorithm. Each cell contains a G-cost (bottom) and H-cost (top) pair. The start node is at (0,0) and the goal node is at (2,4). Cells with a checkmark are on the path. The goal cell is highlighted with a red pin and a box.

 ✓ 4.61	1.00 3.61 4.61	1.41 2.82 4.23	1.41 2.24 3.65	
1.00 4.12 5.12	1.41 3.16 ✓ 4.57	1.00 2.24 ✓ 3.24	1.00 1.41 2.41	1.41 1.00 2.41
1.41 4.00 5.41	1.00 3.00 4.00	1.41 2.00 3.41	1.41 1.00 2.41 	1.00 0.00 1.00

# A\* Search Algorithm

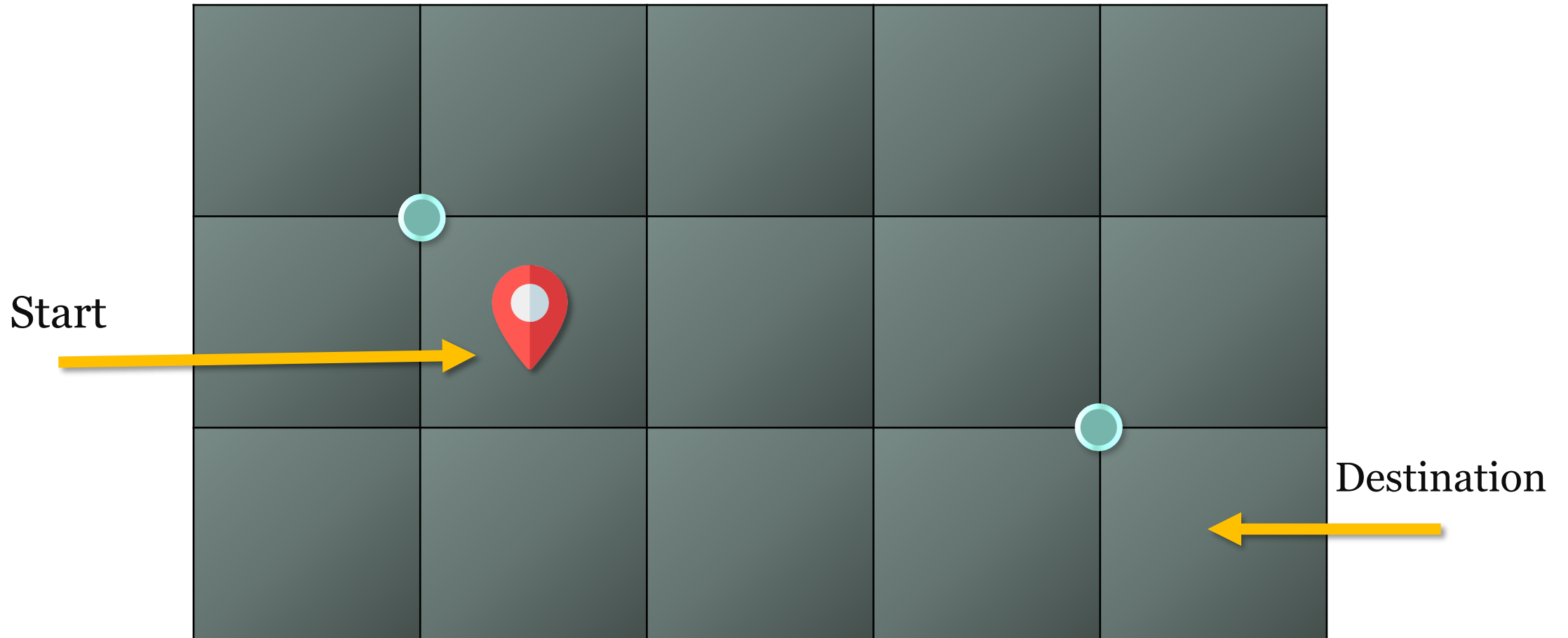


A 3x5 grid representing a search space. The start node is at the top-left (row 1, col 1), marked with a teal circle and a checkmark. The goal node is at the bottom-right (row 3, col 5), marked with a red location pin and a checkmark. Each cell contains a G-value (top-left), a H-value (top-right), and a total F-value (bottom-center). Cells with checkmarks have their F-values highlighted in teal. The goal cell has its F-value highlighted in a box.

 ✓ 4.61	1.00 3.61 4.61	1.41 2.82 4.23	1.41 2.24 3.65	
1.00 4.12 5.12	1.41 3.16 ✓ 4.57	1.00 2.24 ✓ 3.24	1.00 1.41 2.41	1.41 1.00 2.41
1.41 4.00 5.41	1.00 3.00 4.00	1.41 2.00 3.41	1.41 1.00 ✓ 2.41	 1.00 0.00  <div>1.00</div>

*The end...*

# Dijkstra's algorithm



# Dijkstra's algorithm

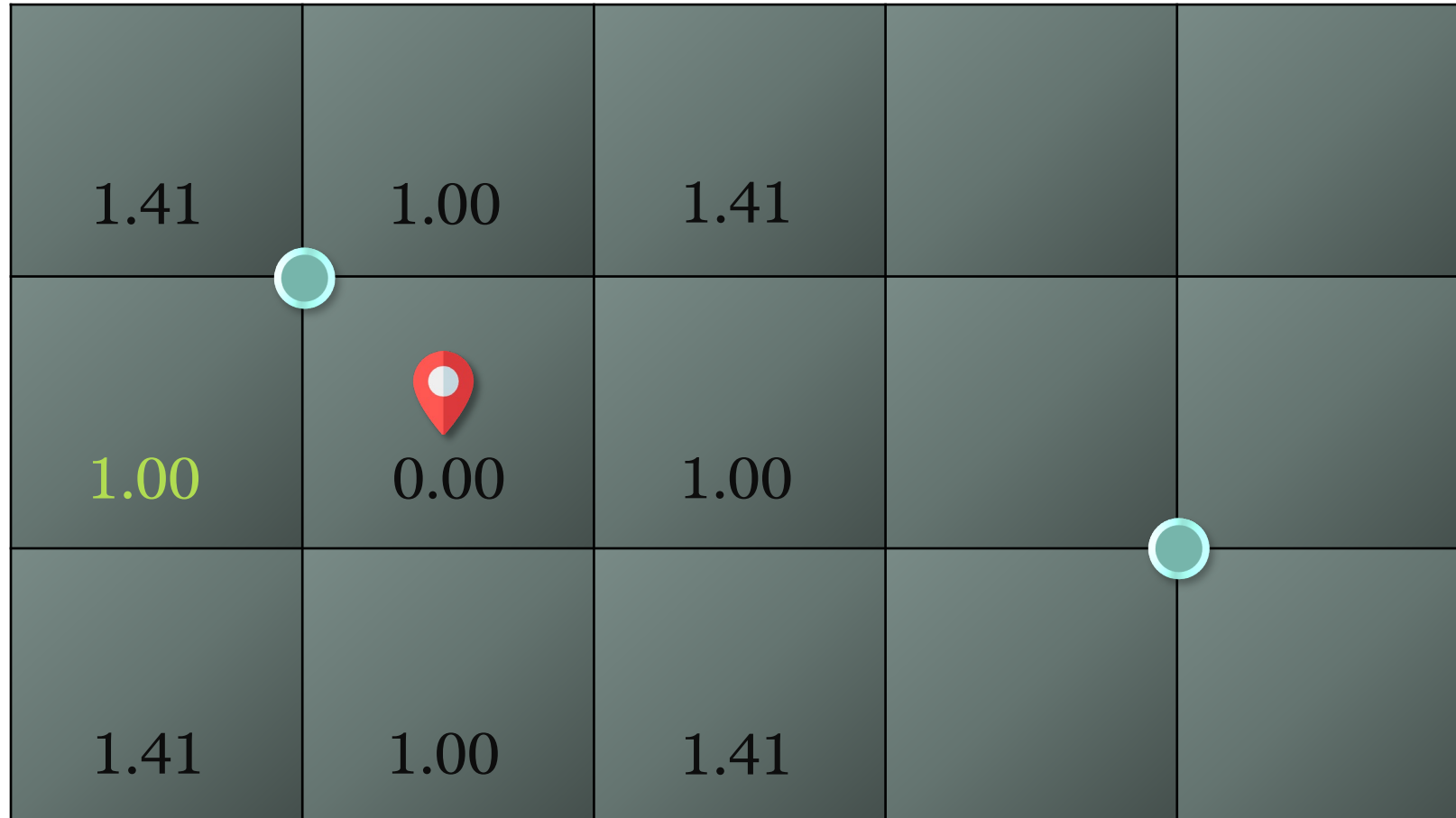




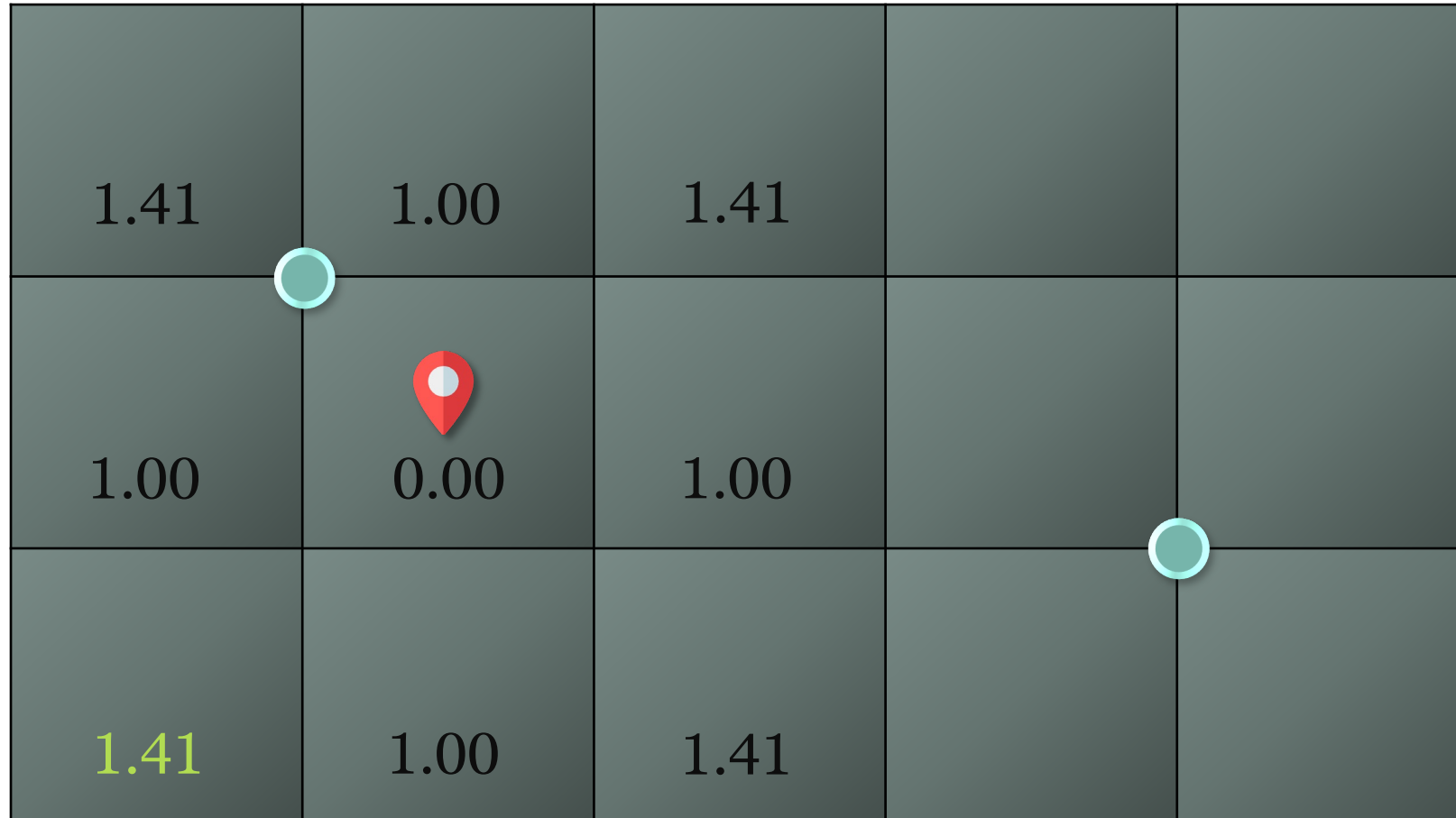
# Dijkstra's algorithm



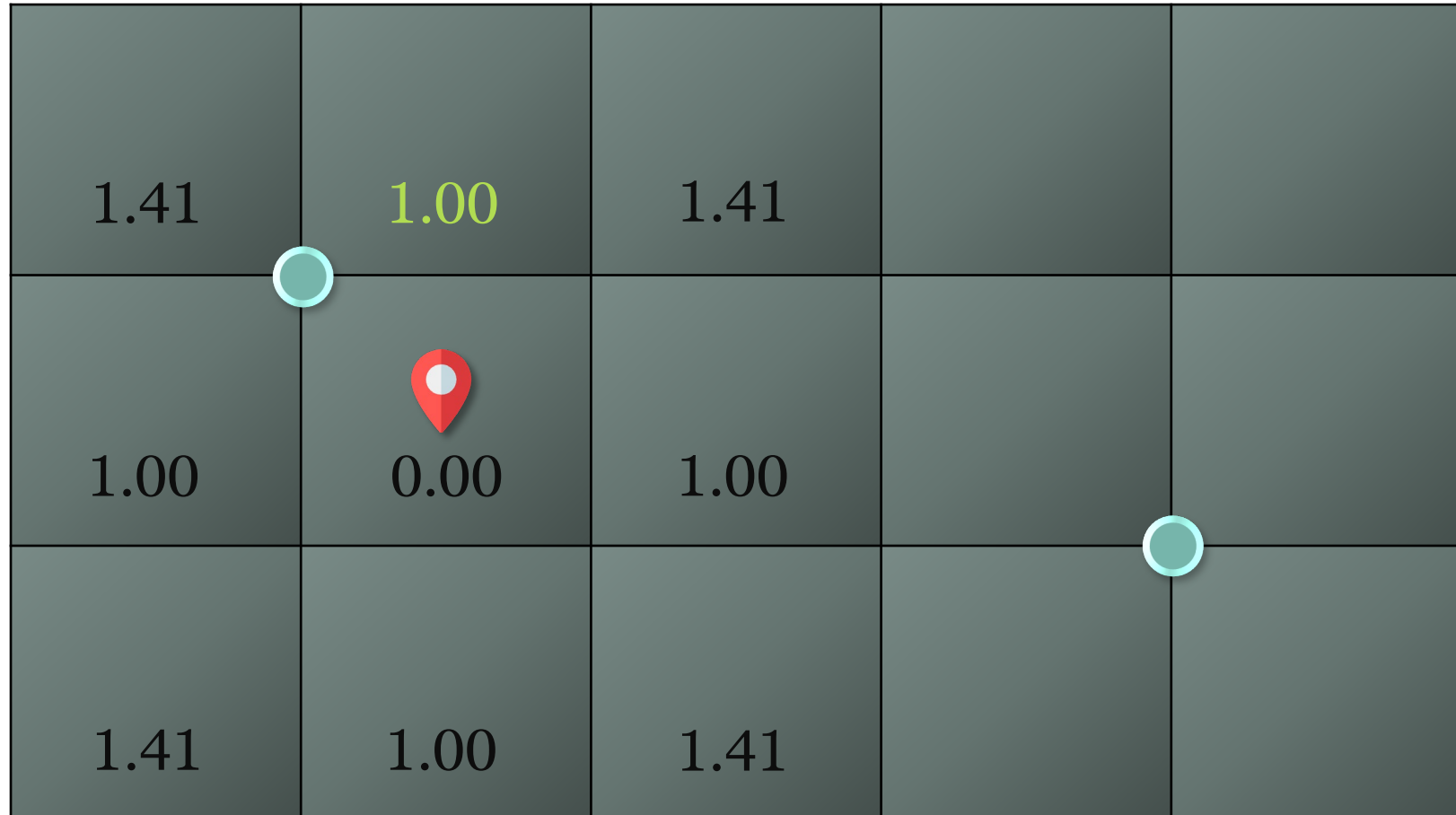
# Dijkstra's algorithm



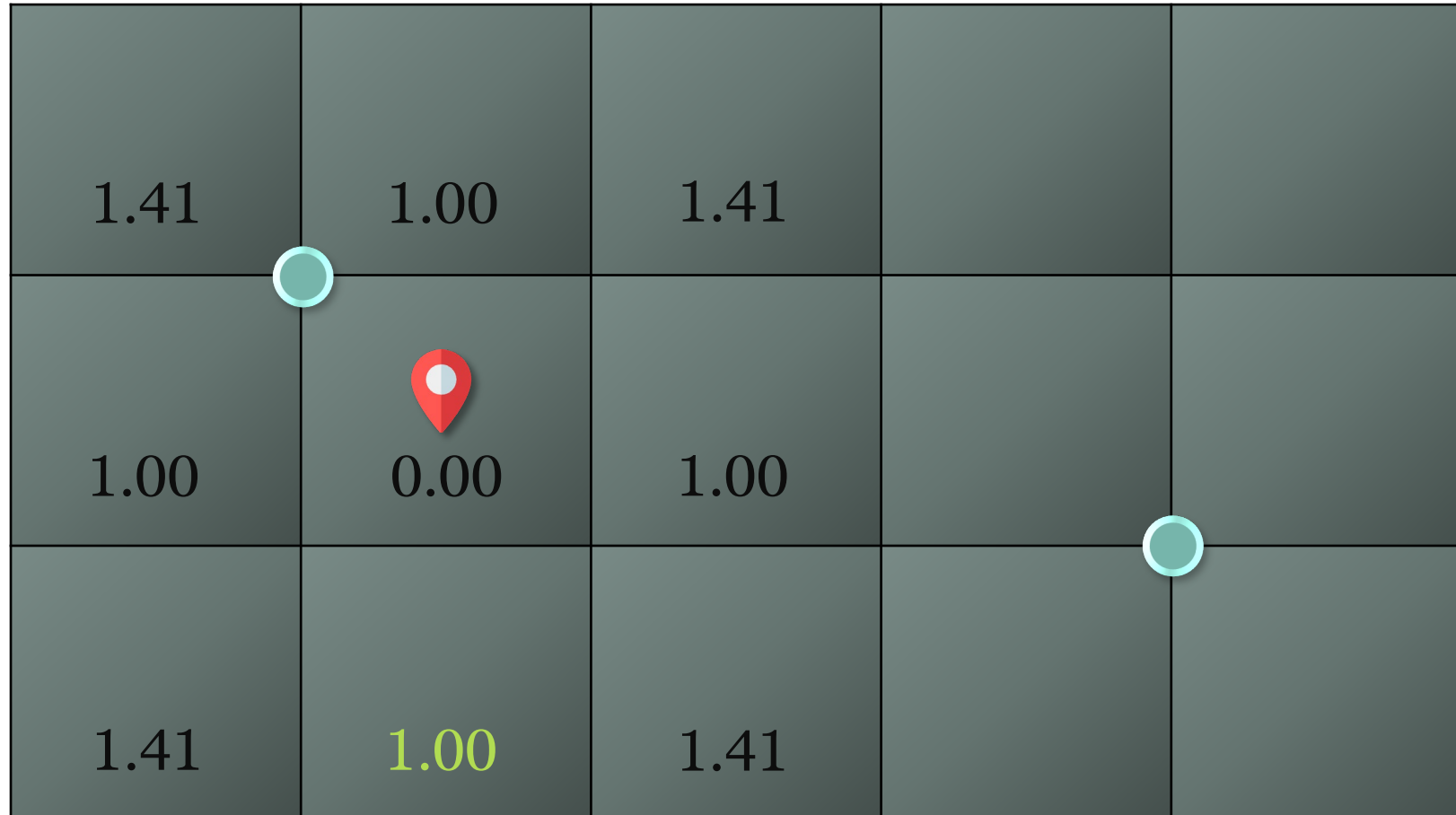
# Dijkstra's algorithm



# Dijkstra's algorithm



# Dijkstra's algorithm



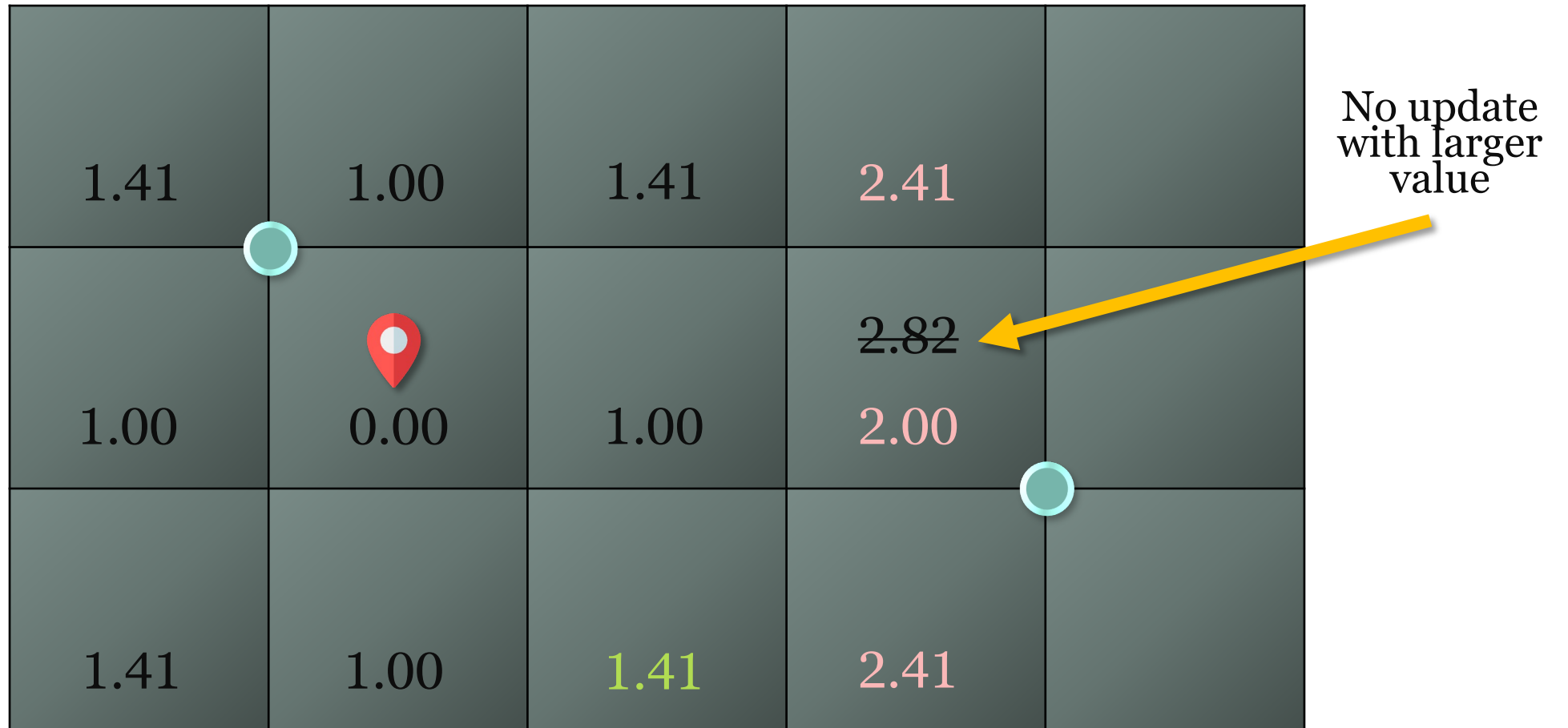
# Dijkstra's algorithm



# Dijkstra's algorithm



# Dijkstra's algorithm

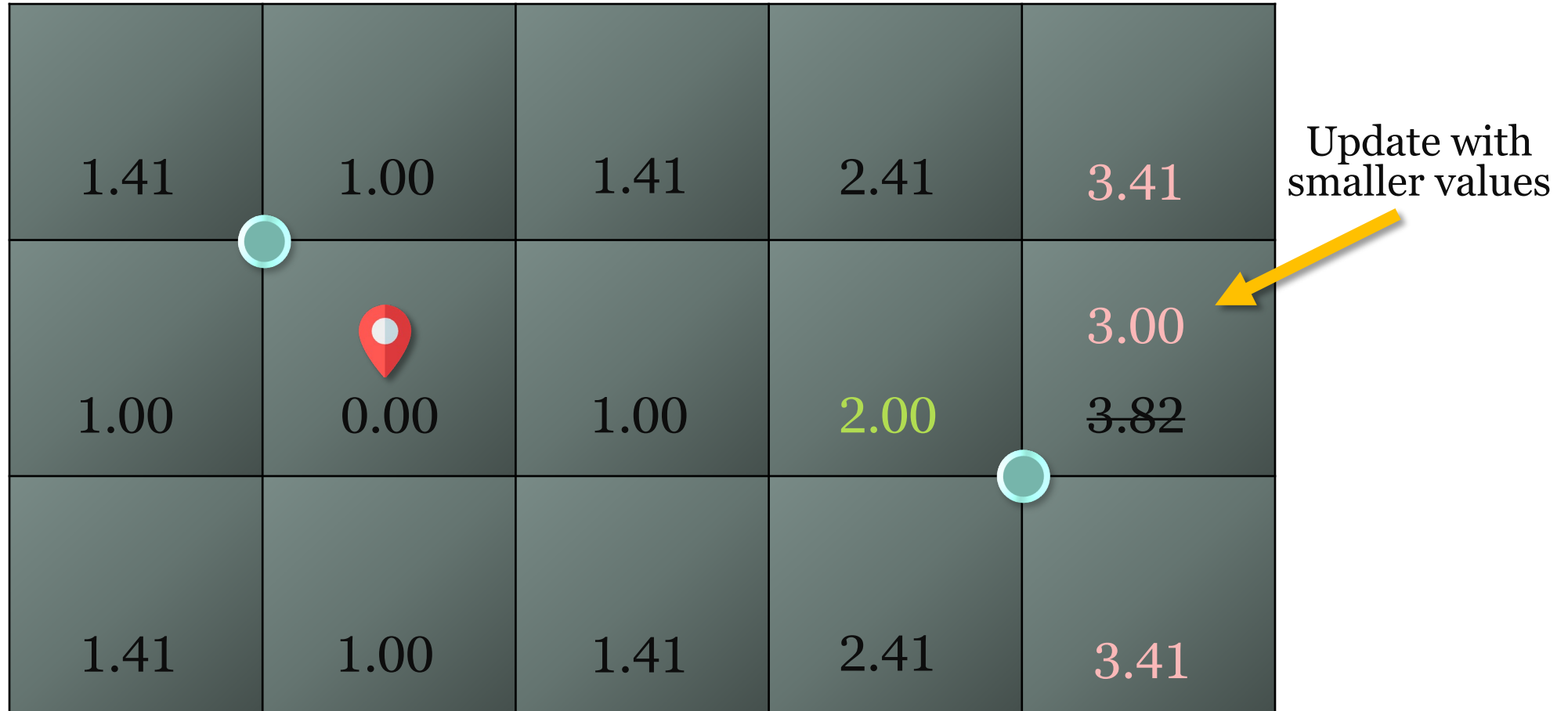




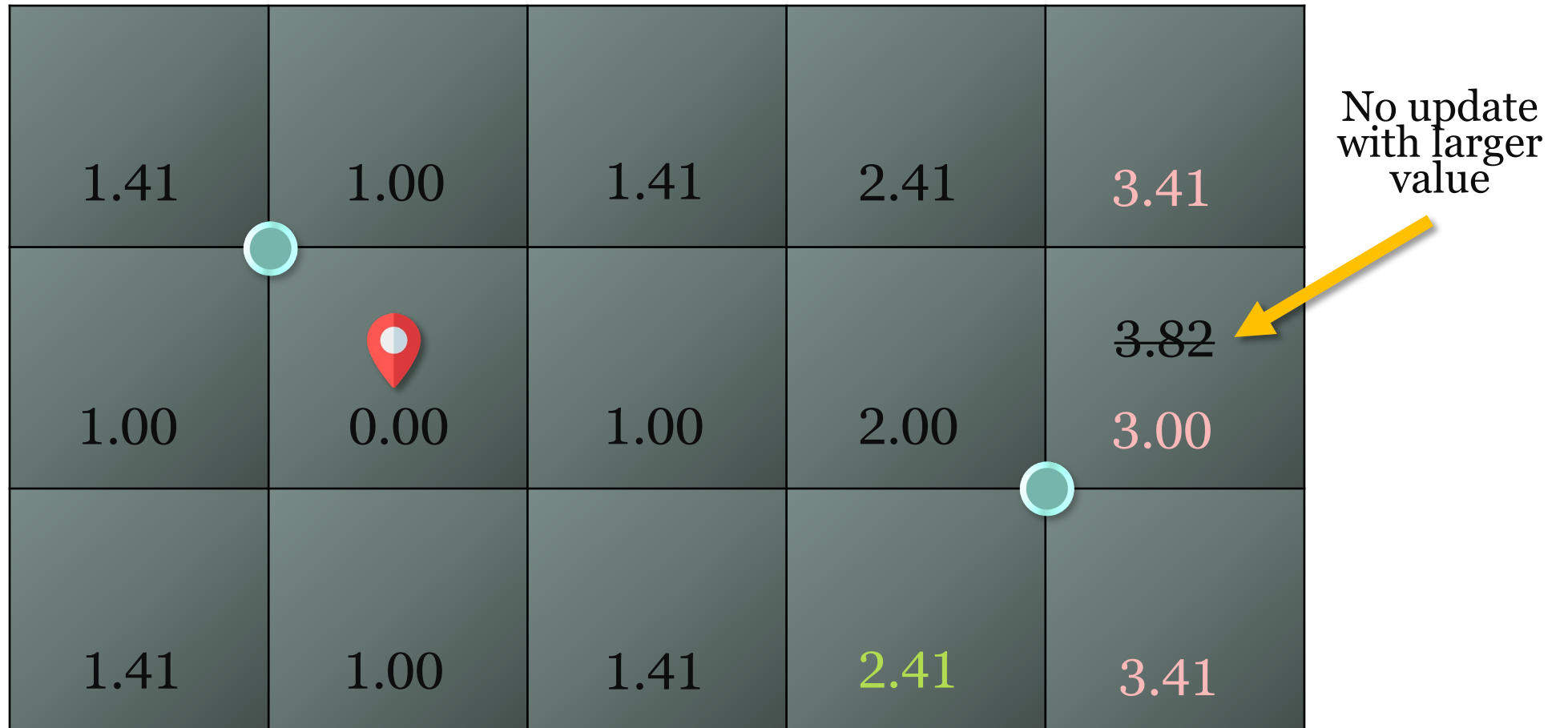
# Dijkstra's algorithm



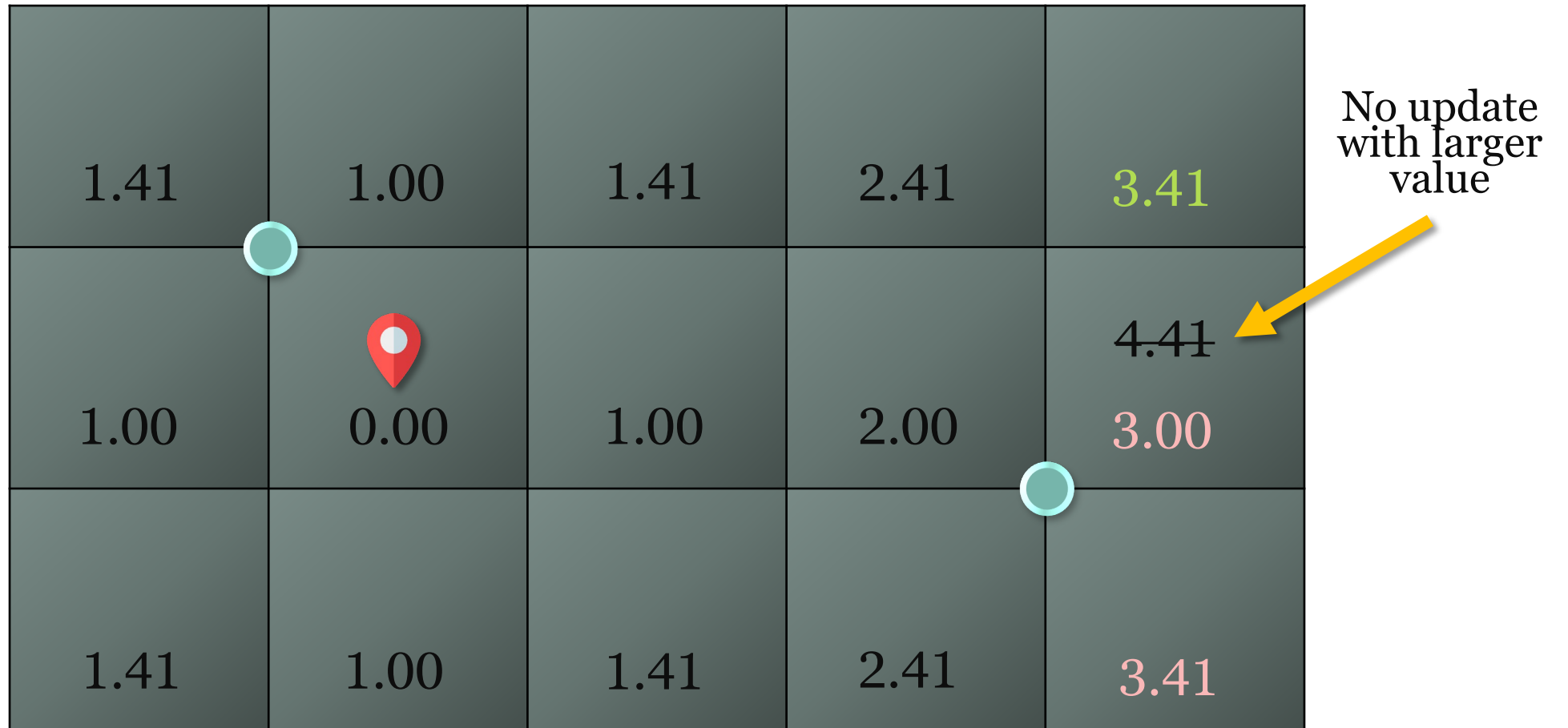
# Dijkstra's algorithm



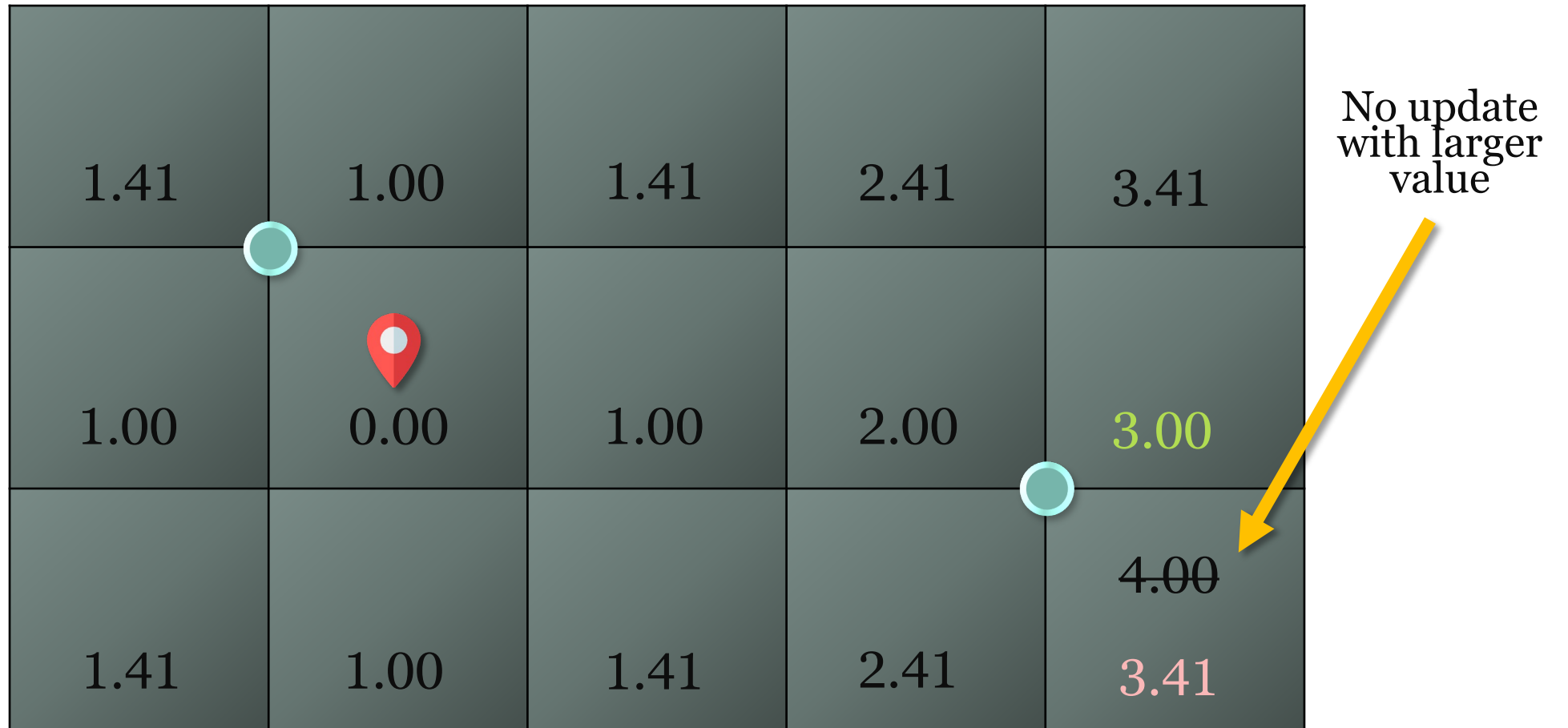
# Dijkstra's algorithm



# Dijkstra's algorithm



# Dijkstra's algorithm



# Dijkstra's algorithm

1.41	1.00	1.41	2.41	3.41
1.00	<input checked="" type="checkbox"/> 0.00	<input checked="" type="checkbox"/> 1.00	<input checked="" type="checkbox"/> 2.00	3.00
1.41	1.00	1.41	2.41	 3.41

*The end...*

# Time for demonstration

---