Bachelor in Computer Science and Engineering

Artificial Intelligence 2024-2025
Grupo 89

Final practice

“Heuristic Search in Radars”

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Introduction

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Parte II

Explanation of the system

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1. Modeling of the search problem

The modeling consist of multiple parts which help us to mathematically understand the problem we are facing, it is composed by:

- Space state: Set of all the states composing the problem

$$S = \{(i,j) | i \in [0, W-1], j \in [0, H-1], \Psi^* <= \text{Tolerance}\}$$

- Initial state: It is a definition of the starting point of our situation

$$S_0 = \{(i_0, j_0) | \Psi^*(i,j) <= \text{Tolerance}\}$$

- Operator/Action function: Inside a search problem, these are functions describing how the subject can move from one state to another inside the space state

$$A(s) = \{s' \in S | (s'(i) = s(i \pm 1)) \vee (s'(j) = s(j \pm 1)), \Psi^*(s') <= \text{Tolerance}\}$$

- Goal state: Particular state representing the objective of the problem, it is the state we want to reach

$$G = \{\{p_1, p_2, p_3, ..., p_n\} | n \in \mathbb{N}, s_{\text{goal}} = p_{i+1} = (i_{\text{goal}}, j_{\text{goal}}) \in S\}$$

- Path cost: Each action requires a cost to pay, the objective of the search problem is to reach the goal state from the initial state having the smallest possible cost

$$C(s, s') = \Psi^*(s')$$

1.1. Heuristics designed

- Euclidean distance (h_1):

  Given a grid of size $W \times H$ with states composed by tuples of the form $(i,j) \in \mathbb{Z}^2$

$$h_1 = \sqrt{(i - i_{\text{goal}})^2 + (j - j_{\text{goal}})^2}$$

  And whose properties are:

- $h_1(s) \geq 0, \forall s \in S$
- $h_1(s) = 0$ iff $s = s_{\text{goal}}$
- $h_1(s) \leq h_1^*(s)$ where $h_1^*(s)$ is the real optimum cost from s to s_{goal}

- Manhattan distance (h_2):

  Given a grid of size $W \times H$ with states composed by tuples of the form $(i, j) \in \mathbb{Z}^2$

$$h(s) = |i - i_{\text{goal}}| + |j - j_{\text{goal}}|$$

Parte III

Experiments

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Parte IV

Use of AI

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Parte V

Conclusion

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