

Heuristic Calculation Example for A*

We want to compute a heuristic $h(n)$, which estimates the cost from the current hold to the goal hold.

This heuristic should reflect the difficulty of making the transition between two holds based on the following factors:

Factors in the Heuristic:

1. Distance Between Holds (d)
2. Hold Type (h_t)
3. Wall Angle (w_a)
4. Movement Complexity (m_c)

1. Distance Between Holds (d)

The distance between two holds is a fundamental factor in climbing difficulty.

- The Euclidean distance between two holds can be calculated using the formula:

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

- A greater distance typically makes the move harder, so the heuristic should scale accordingly.

2. Hold Type (h_t)

Different holds require different amounts of strength and skill to use.

- Assign a difficulty value to each hold type. For example:

- Jug: 1 (easiest)
 - Crimp: 3 (harder)
 - Sloper: 4 (hardest)
- The heuristic should add a penalty based on the difficulty of the destination hold:

$$h_t_penalty = difficulty_factor * hold_type_penalty$$

3. Wall Angle (w_a)

The angle of the wall impacts how difficult it is to move between holds.

- Overhanging walls make moves harder, while slab walls may make them easier.
- Assign a penalty or multiplier based on the angle:

$$w_a_penalty = wall_angle_factor * distance$$

4. Movement Complexity (m_c)

Some moves are more complex than others, requiring more advanced techniques or greater body control.

- For example, crossing hands or lunging dynamically adds difficulty.
- Penalize moves with greater complexity:

$$m_c_penalty = complexity_factor * movement_difficulty$$

Final Heuristic Formula:

The total heuristic cost could be a weighted sum of the factors:

$$h(n) = d + h_t_penalty + w_a_penalty + m_c_penalty$$

This heuristic helps A* prioritize paths that minimize climber effort by considering hold distance, hold type, wall angle, and the complexity of the movement between holds.