② Building Block Hypothesis: Describe a problem where the BBH does not hold

Δ: Generally speaking, BBH breaks down in environments with very sparse reward (fitness) settings. This is due to the fact that then (almost) every sub-optimal solution has a fitness of 0. Thus, we don't know which are 'better' and the GA turns into random search.

Specific examples

- Needle-in-Haystack:

$$f(x_1, \dots, x_n) = \begin{cases} 1 & \text{if } (x_1, \dots, x_n) = (0, \dots, 0) \\ 0 & \text{otherwise} \end{cases}$$

- Guess-42:

$$f(x) = \begin{cases} 1 & \text{if } x = 42 \\ 0 & \text{otherwise} \end{cases}, \quad x \in \mathbb{N}$$

- Pseudo-Boolean AND:

$$f(x_1, \dots, x_n) = \prod_{i=1}^{n} x_i \qquad x \in \{0, 1\}$$

⇒ In all 3 cases, the fitness of every sub-optimal solution is 0. Hence, the GA mechanisms break down and we end up with random search