**Práctica 2: Búsquedas informadas**

***Autor****: Juan Rodríguez Suárez,* [*alu0101477596@ull.edu.es*](mailto:alu0101477596@ull.edu.es)*.*

***Curso:*** *Inteligencia Artificial, 3º Grado en Ingeniería Informática.*

***Fecha:*** *18 de octubre de 2023.*

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# Descripción del algoritmo A\* implementado

# Tablas resultado

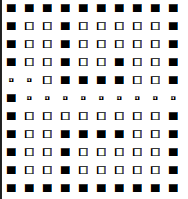
## Distancia de Manhattan

M\_1 ID 1 Filas: 11 Columnas: 10 Entrada: (5, 1) Salida: (6, 10) Camino: [(5, 1), (5, 2), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (6, 9), (6, 10)]

Coste: 30

Generados: [(5, 1), (4, 2), (5, 2), (6, 2), (4, 3), (5, 3), (6, 3), (7, 2), (7, 3), (6, 4), (7, 4), (6, 5), (7, 5), (6, 6), (7, 6), (6, 7), (7, 7), (5, 8), (6, 8), (7, 8), (5, 9), (6, 9), (7, 9), (6, 10)]

Analizados: [(5, 1), (5, 2), (6, 2), (5, 3), (6, 3), (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (6, 9), (6, 10)]

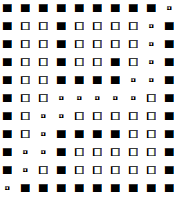


M\_1 ID 2 Filas: 11 Columnas: 10 Entrada: (11, 1) Salida: (1, 10) Camino: [(11, 1), (10, 2), (9, 2), (9, 3), (8, 3), (7, 3), (7, 4), (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (5, 8), (5, 9), (4, 9), (3, 9), (2, 9), (1, 10)]

Coste: 59

Generados: [(11, 1), (10, 2), (9, 2), (9, 3), (10, 3), (8, 2), (8, 3), (7, 2), (7, 3), (7, 4), (6, 2), (6, 3), (6, 4), (6, 5), (7, 5), (5, 2), (5, 3), (6, 6), (7, 6), (4, 2), (4, 3), (6, 7), (7, 7), (3, 2), (3, 3), (5, 8), (6, 8), (7, 8), (8, 8), (2, 2), (2, 3), (5, 9), (6, 9), (7, 9), (4, 8), (4, 9), (8, 9), (3, 7), (3, 8), (3, 9), (2, 7), (2, 8), (2, 9), (1, 10)]

Analizados: [(11, 1), (10, 2), (9, 2), (9, 3), (10, 3), (8, 2), (8, 3), (7, 2), (7, 3), (7, 4), (6, 2), (6, 3), (6, 4), (6, 5), (7, 5), (5, 2), (5, 3), (6, 6), (7, 6), (4, 2), (4, 3), (6, 7), (7, 7), (3, 2), (3, 3), (6, 8), (5, 8), (7, 8), (2, 2), (2, 3), (5, 9), (6, 9), (7, 9), (4, 8), (4, 9), (3, 8), (3, 9), (2, 8), (2, 9), (1, 10)]

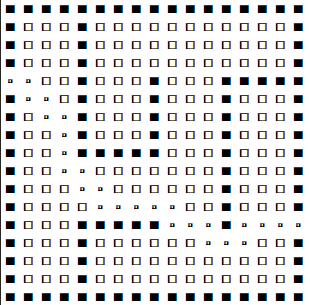


M\_2 ID 1 Filas: 17 Columnas: 17 Entrada: (5, 1) Salida: (13, 17) Camino: [(5, 1), (5, 2), (6, 2), (6, 3), (7, 3), (7, 4), (8, 4), (9, 4), (10, 4), (10, 5), (11, 5), (11, 6), (12, 6), (12, 7), (12, 8), (12, 9), (12, 10), (13, 10), (13, 11), (13, 12), (14, 12), (14, 13), (14, 14), (13, 14), (13, 15), (13, 16), (13, 17)]

Coste: 78

Generados: [(5, 1), (4, 2), (5, 2), (6, 2), (4, 3), (5, 3), (6, 3), (7, 2), (7, 3), (4, 4), (5, 4), (6, 4), (7, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (11, 2), (11, 3), (11, 4), (11, 5), (10, 6), (11, 6), (12, 2), (12, 3), (12, 4), (12, 5), (12, 6), (10, 7), (11, 7), (12, 7), (13, 2), (13, 3), (13, 4), (10, 8), (11, 8), (12, 8), (14, 2), (14, 3), (14, 4), (10, 9), (11, 9), (12, 9), (9, 10), (10, 10), (11, 10), (12, 10), (13, 10), (9, 11), (10, 11), (11, 11), (12, 11), (13, 11), (14, 9), (14, 10), (14, 11), (9, 12), (10, 12), (11, 12), (12, 12), (13, 12), (14, 12), (14, 13), (3, 2), (3, 3), (3, 4), (15, 2), (15, 3), (15, 4), (8, 10), (8, 11), (8, 12), (15, 9), (15, 10), (15, 11), (15, 12), (15, 13), (13, 14), (14, 14), (15, 14), (13, 15), (14, 15), (15, 15), (12, 14), (12, 15), (12, 16), (13, 16), (14, 16), (15, 16), (13, 17)]

Analizados: [(5, 1), (5, 2), (6, 2), (5, 3), (6, 3), (7, 2), (7, 3), (5, 4), (6, 4), (7, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (11, 2), (11, 3), (11, 4), (11, 5), (10, 6), (11, 6), (12, 2), (12, 3), (12, 4), (12, 5), (12, 6), (10, 7), (11, 7), (12, 7), (13, 2), (13, 3), (13, 4), (10, 8), (11, 8), (12, 8), (10, 9), (11, 9), (12, 9), (10, 10), (11, 10), (12, 10), (13, 10), (10, 11), (11, 11), (12, 11), (13, 11), (10, 12), (11, 12), (12, 12), (13, 12), (4, 2), (4, 3), (4, 4), (14, 2), (14, 3), (14, 4), (9, 10), (9, 11), (14, 10), (14, 11), (9, 12), (14, 12), (14, 13), (14, 14), (13, 14), (13, 15), (14, 15), (13, 16), (14, 16), (13, 17)]

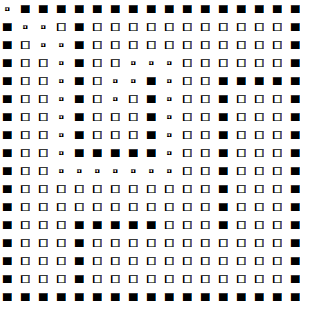


M\_2 ID 2 Filas: 17 Columnas: 17 Entrada: (1, 1) Salida: (6, 7) Camino: [(1, 1), (2, 2), (2, 3), (3, 3), (3, 4), (4, 4), (5, 4), (6, 4), (7, 4), (8, 4), (9, 4), (10, 4), (10, 5), (10, 6), (10, 7), (10, 8), (10, 9), (10, 10), (9, 10), (8, 10), (7, 10), (6, 10), (5, 10), (4, 10), (4, 9), (4, 8), (5, 8), (5, 7), (6, 7)]

Coste: 88

Generados: [(1, 1), (2, 2), (2, 3), (3, 2), (3, 3), (2, 4), (3, 4), (4, 2), (4, 3), (4, 4), (5, 2), (5, 3), (5, 4), (6, 2), (6, 3), (6, 4), (7, 2), (7, 3), (7, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (11, 2), (11, 3), (11, 4), (11, 5), (10, 6), (11, 6), (10, 7), (11, 7), (10, 8), (11, 8), (12, 2), (12, 3), (12, 4), (12, 5), (12, 6), (12, 7), (12, 8), (10, 9), (11, 9), (12, 9), (13, 2), (13, 3), (13, 4), (9, 10), (10, 10), (11, 10), (12, 10), (14, 2), (14, 3), (14, 4), (9, 11), (10, 11), (11, 11), (8, 10), (8, 11), (7, 10), (7, 11), (6, 10), (6, 11), (5, 10), (5, 11), (13, 10), (12, 11), (15, 2), (15, 3), (15, 4), (8, 12), (9, 12), (10, 12), (11, 12), (7, 12), (6, 12), (5, 12), (4, 9), (4, 10), (4, 11), (13, 11), (12, 12), (4, 12), (16, 2), (16, 3), (16, 4), (3, 9), (3, 10), (3, 11), (3, 8), (4, 8), (5, 8), (3, 7), (4, 7), (5, 7), (6, 7), (6, 8), (3, 6), (4, 6), (5, 6), (6, 6)]

Analizados: [(1, 1), (2, 2), (2, 3), (3, 2), (3, 3), (2, 4), (3, 4), (4, 2), (4, 3), (4, 4), (5, 2), (5, 3), (5, 4), (6, 2), (6, 3), (6, 4), (7, 2), (7, 3), (7, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (10, 6), (10, 7), (11, 2), (11, 3), (11, 4), (11, 5), (11, 6), (11, 7), (10, 8), (11, 8), (12, 2), (12, 3), (12, 4), (12, 5), (12, 6), (12, 7), (10, 9), (12, 8), (11, 9), (13, 2), (13, 3), (13, 4), (10, 10), (9, 10), (8, 10), (7, 10), (6, 10), (12, 9), (11, 10), (14, 2), (14, 3), (14, 4), (9, 11), (10, 11), (8, 11), (7, 11), (6, 11), (5, 10), (12, 10), (11, 11), (5, 11), (15, 2), (15, 3), (15, 4), (8, 12), (9, 12), (10, 12), (7, 12), (6, 12), (4, 10), (4, 9), (4, 8), (5, 8), (4, 7), (5, 7), (6, 7)]



M\_3 ID 1 Filas: 5 Columnas: 5 Entrada: (5, 5) Salida: (2, 1) Camino: [(5, 5), (4, 5), (3, 5), (2, 5), (2, 4), (1, 4), (1, 3), (1, 2), (2, 2), (2, 1)]

Coste: 27

Generados: [(5, 5), (4, 4), (4, 5), (5, 4), (3, 5), (4, 3), (2, 4), (2, 5), (1, 4), (1, 5), (1, 3), (1, 2), (2, 2), (2, 1), (3, 1)]

Analizados: [(5, 5), (4, 5), (4, 4), (5, 4), (3, 5), (4, 3), (2, 5), (2, 4), (1, 4), (1, 5), (1, 3), (1, 2), (2, 2), (2, 1)]



M\_3 ID 2 Filas: 5 Columnas: 5 Entrada: (5, 3) Salida: (5, 1) Camino: [(5, 3), (4, 3), (4, 4), (4, 5), (3, 5), (2, 5), (2, 4), (1, 4), (1, 3), (1, 2), (2, 2), (3, 1), (4, 1), (5, 1)]

Coste: 43

Generados: [(5, 3), (4, 3), (4, 4), (5, 4), (4, 5), (3, 5), (2, 4), (2, 5), (1, 4), (1, 5), (1, 3), (1, 2), (2, 2), (3, 1), (4, 1), (5, 1)]

Analizados: [(5, 3), (4, 3), (5, 4), (4, 4), (4, 5), (3, 5), (2, 5), (2, 4), (1, 4), (1, 5), (1, 3), (1, 2), (2, 2), (3, 1), (4, 1), (5, 1)]



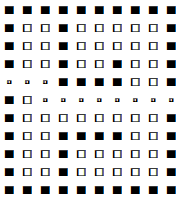
## Distancia euclidiana

M\_1 ID 1 Filas: 11 Columnas: 10 Entrada: (5, 1) Salida: (6, 10) Camino: [(5, 1), (5, 2), (5, 3), (6, 3), (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (6, 9), (6, 10)]

Coste: 30

Generados: [(5, 1), (4, 2), (5, 2), (6, 2), (4, 3), (5, 3), (6, 3), (6, 4), (7, 2), (7, 3), (7, 4), (6, 5), (7, 5), (6, 6), (7, 6), (6, 7), (7, 7), (5, 8), (6, 8), (7, 8), (5, 9), (6, 9), (7, 9), (6, 10)]

Analizados: [(5, 1), (5, 2), (5, 3), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (6, 9), (6, 10)]

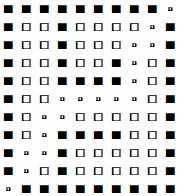


M\_1 ID 2 Filas: 11 Columnas: 10 Entrada: (11, 1) Salida: (1, 10) Camino: [(11, 1), (10, 2), (9, 2), (9, 3), (8, 3), (7, 3), (7, 4), (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (5, 8), (4, 8), (3, 8), (3, 9), (2, 9), (1, 10)]

Coste: 59

Generados: [(11, 1), (10, 2), (9, 2), (9, 3), (10, 3), (8, 2), (8, 3), (7, 2), (7, 3), (7, 4), (6, 2), (6, 3), (6, 4), (5, 2), (5, 3), (6, 5), (7, 5), (6, 6), (7, 6), (4, 2), (4, 3), (6, 7), (7, 7), (3, 2), (3, 3), (6, 8), (7, 8), (8, 8), (5, 8), (2, 2), (2, 3), (6, 9), (7, 9), (8, 9), (5, 9), (4, 8), (4, 9), (3, 7), (3, 8), (3, 9), (2, 7), (2, 8), (2, 9), (1, 10), (9, 7), (9, 8), (9, 9)]

Analizados: [(11, 1), (10, 2), (9, 2), (10, 3), (9, 3), (8, 2), (8, 3), (7, 2), (7, 3), (6, 2), (7, 4), (6, 3), (6, 4), (7, 5), (5, 2), (5, 3), (6, 5), (7, 6), (6, 6), (4, 2), (4, 3), (7, 7), (6, 7), (3, 2), (3, 3), (7, 8), (6, 8), (5, 8), (4, 8), (3, 8), (2, 2), (2, 3), (7, 9), (6, 9), (5, 9), (4, 9), (3, 9), (2, 8), (2, 9), (8, 8), (1, 10)]

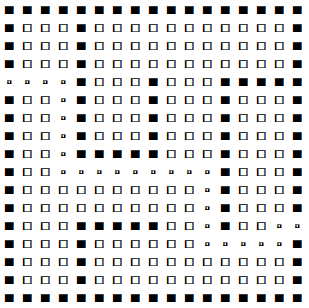


M\_2 ID 1 Filas: 17 Columnas: 17 Entrada: (5, 1) Salida: (13, 17) Camino: [(5, 1), (5, 2), (5, 3), (5, 4), (6, 4), (7, 4), (8, 4), (9, 4), (10, 4), (10, 5), (10, 6), (10, 7), (10, 8), (10, 9), (10, 10), (10, 11), (10, 12), (11, 12), (12, 12), (13, 12), (14, 12), (14, 13), (14, 14), (14, 15), (14, 16), (13, 16), (13, 17)]

Coste: 78

Generados: [(5, 1), (4, 2), (5, 2), (6, 2), (4, 3), (5, 3), (6, 3), (4, 4), (5, 4), (6, 4), (7, 2), (7, 3), (7, 4), (8, 2), (8, 3), (8, 4), (3, 2), (3, 3), (3, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (2, 2), (2, 3), (2, 4), (11, 2), (11, 3), (11, 4), (11, 5), (10, 6), (11, 6), (10, 7), (11, 7), (10, 8), (11, 8), (10, 9), (11, 9), (9, 10), (10, 10), (11, 10), (9, 11), (10, 11), (11, 11), (9, 12), (10, 12), (11, 12), (12, 2), (12, 3), (12, 4), (12, 5), (12, 6), (12, 7), (12, 8), (12, 9), (12, 10), (12, 11), (12, 12), (13, 2), (13, 3), (13, 4), (8, 10), (8, 11), (13, 10), (13, 11), (13, 12), (8, 12), (14, 2), (14, 3), (14, 4), (14, 9), (14, 10), (14, 11), (14, 12), (14, 13), (7, 10), (7, 11), (7, 12), (15, 2), (15, 3), (15, 4), (15, 9), (15, 10), (15, 11), (15, 12), (15, 13), (13, 14), (14, 14), (15, 14), (13, 15), (14, 15), (15, 15), (13, 16), (14, 16), (15, 16), (13, 17), (12, 14), (12, 15), (12, 16)]

Analizados: [(5, 1), (5, 2), (5, 3), (5, 4), (6, 2), (6, 3), (6, 4), (7, 2), (7, 3), (7, 4), (4, 2), (4, 3), (4, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (3, 2), (3, 3), (10, 2), (10, 3), (10, 4), (10, 5), (3, 4), (10, 6), (10, 7), (10, 8), (10, 9), (10, 10), (10, 11), (10, 12), (11, 2), (11, 3), (11, 4), (11, 5), (11, 6), (11, 7), (11, 8), (11, 9), (11, 10), (11, 11), (11, 12), (2, 2), (2, 3), (2, 4), (12, 2), (12, 3), (12, 4), (12, 5), (12, 6), (12, 7), (12, 8), (9, 10), (12, 9), (12, 10), (12, 11), (12, 12), (9, 11), (9, 12), (13, 2), (13, 3), (13, 4), (13, 10), (13, 11), (13, 12), (8, 10), (8, 11), (14, 2), (14, 3), (14, 4), (8, 12), (14, 10), (14, 11), (14, 12), (14, 13), (14, 14), (14, 15), (14, 16), (13, 14), (13, 15), (13, 16), (13, 17)]

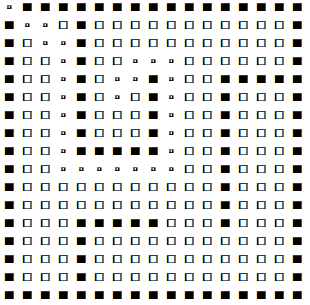


M\_2 ID 2 Filas: 17 Columnas: 17 Entrada: (1, 1) Salida: (6, 7) Camino: [(1, 1), (2, 2), (2, 3), (3, 3), (3, 4), (4, 4), (5, 4), (6, 4), (7, 4), (8, 4), (9, 4), (10, 4), (10, 5), (10, 6), (10, 7), (10, 8), (10, 9), (10, 10), (9, 10), (8, 10), (7, 10), (6, 10), (5, 10), (4, 10), (4, 9), (4, 8), (5, 8), (5, 7), (6, 7)]

Coste: 88

Generados: [(1, 1), (2, 2), (2, 3), (3, 2), (3, 3), (2, 4), (3, 4), (4, 2), (4, 3), (4, 4), (5, 2), (5, 3), (5, 4), (6, 2), (6, 3), (6, 4), (7, 2), (7, 3), (7, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (11, 2), (11, 3), (11, 4), (11, 5), (10, 6), (11, 6), (12, 2), (12, 3), (10, 7), (11, 7), (12, 4), (12, 5), (10, 8), (11, 8), (12, 6), (13, 2), (13, 3), (12, 7), (10, 9), (11, 9), (13, 4), (12, 8), (9, 10), (10, 10), (11, 10), (14, 2), (14, 3), (14, 4), (12, 9), (9, 11), (10, 11), (11, 11), (8, 10), (8, 11), (12, 10), (15, 2), (15, 3), (7, 10), (7, 11), (15, 4), (6, 10), (6, 11), (9, 12), (10, 12), (11, 12), (12, 11), (8, 12), (5, 10), (5, 11), (16, 2), (16, 3), (13, 10), (7, 12), (16, 4), (6, 12), (4, 9), (4, 10), (4, 11), (12, 12), (13, 11), (5, 12), (3, 9), (3, 10), (3, 11), (3, 8), (4, 8), (5, 8), (4, 12), (13, 12), (3, 7), (4, 7), (5, 7), (6, 7), (6, 8), (14, 9), (14, 10), (14, 11), (3, 6), (4, 6), (5, 6), (6, 6)]

Analizados: [(1, 1), (2, 2), (2, 3), (3, 2), (3, 3), (2, 4), (3, 4), (4, 2), (4, 3), (4, 4), (5, 2), (5, 3), (5, 4), (6, 2), (6, 3), (6, 4), (7, 2), (7, 3), (7, 4), (8, 2), (8, 3), (8, 4), (9, 2), (9, 3), (9, 4), (10, 2), (10, 3), (10, 4), (10, 5), (11, 2), (10, 6), (11, 3), (11, 4), (10, 7), (11, 5), (12, 2), (11, 6), (10, 8), (12, 3), (12, 4), (11, 7), (12, 5), (10, 9), (13, 2), (13, 3), (12, 6), (11, 8), (13, 4), (12, 7), (10, 10), (9, 10), (11, 9), (14, 2), (8, 10), (14, 3), (12, 8), (7, 10), (14, 4), (10, 11), (11, 10), (9, 11), (6, 10), (15, 2), (12, 9), (8, 11), (15, 3), (7, 11), (5, 10), (11, 11), (10, 12), (15, 4), (12, 10), (9, 12), (6, 11), (16, 2), (8, 12), (4, 10), (16, 3), (4, 9), (11, 12), (7, 12), (5, 11), (12, 11), (4, 8), (5, 8), (16, 4), (13, 10), (6, 12), (4, 7), (5, 7), (6, 7)]



M\_3 ID 1 Filas: 5 Columnas: 5 Entrada: (5, 5) Salida: (2, 1) Camino: [(5, 5), (4, 5), (3, 5), (2, 5), (2, 4), (1, 4), (1, 3), (1, 2), (2, 2), (2, 1)]

Coste: 27

Generados: [(5, 5), (4, 4), (4, 5), (5, 4), (4, 3), (3, 5), (2, 4), (2, 5), (1, 4), (1, 5), (1, 3), (1, 2), (2, 2), (2, 1), (3, 1)]

Analizados: [(5, 5), (5, 4), (4, 5), (4, 4), (4, 3), (3, 5), (2, 5), (2, 4), (1, 5), (1, 4), (1, 3), (1, 2), (2, 2), (2, 1)]



M\_3 ID 2 Filas: 5 Columnas: 5 Entrada: (5, 3) Salida: (5, 1) Camino: [(5, 3), (4, 3), (4, 4), (4, 5), (3, 5), (2, 5), (2, 4), (1, 4), (1, 3), (1, 2), (2, 2), (3, 1), (4, 1), (5, 1)]

Coste: 43

Generados: [(5, 3), (4, 3), (4, 4), (5, 4), (4, 5), (3, 5), (2, 4), (2, 5), (1, 4), (1, 5), (1, 3), (1, 2), (2, 2), (3, 1), (4, 1), (5, 1)]

Analizados: [(5, 3), (4, 3), (5, 4), (4, 4), (4, 5), (3, 5), (2, 5), (2, 4), (1, 5), (1, 4), (1, 3), (1, 2), (2, 2), (3, 1), (4, 1), (5, 1)]



## Conclusión

En general, la función heurística euclidiana (basada en la recta real desde el punto A hasta el punto B) es menos efectiva que la distancia de Manhattan (genera más nodos) consiguiendo ambas la solución óptima teniendo el coste diagonal igual a 7 y la horizontal/vertical igual a 3.