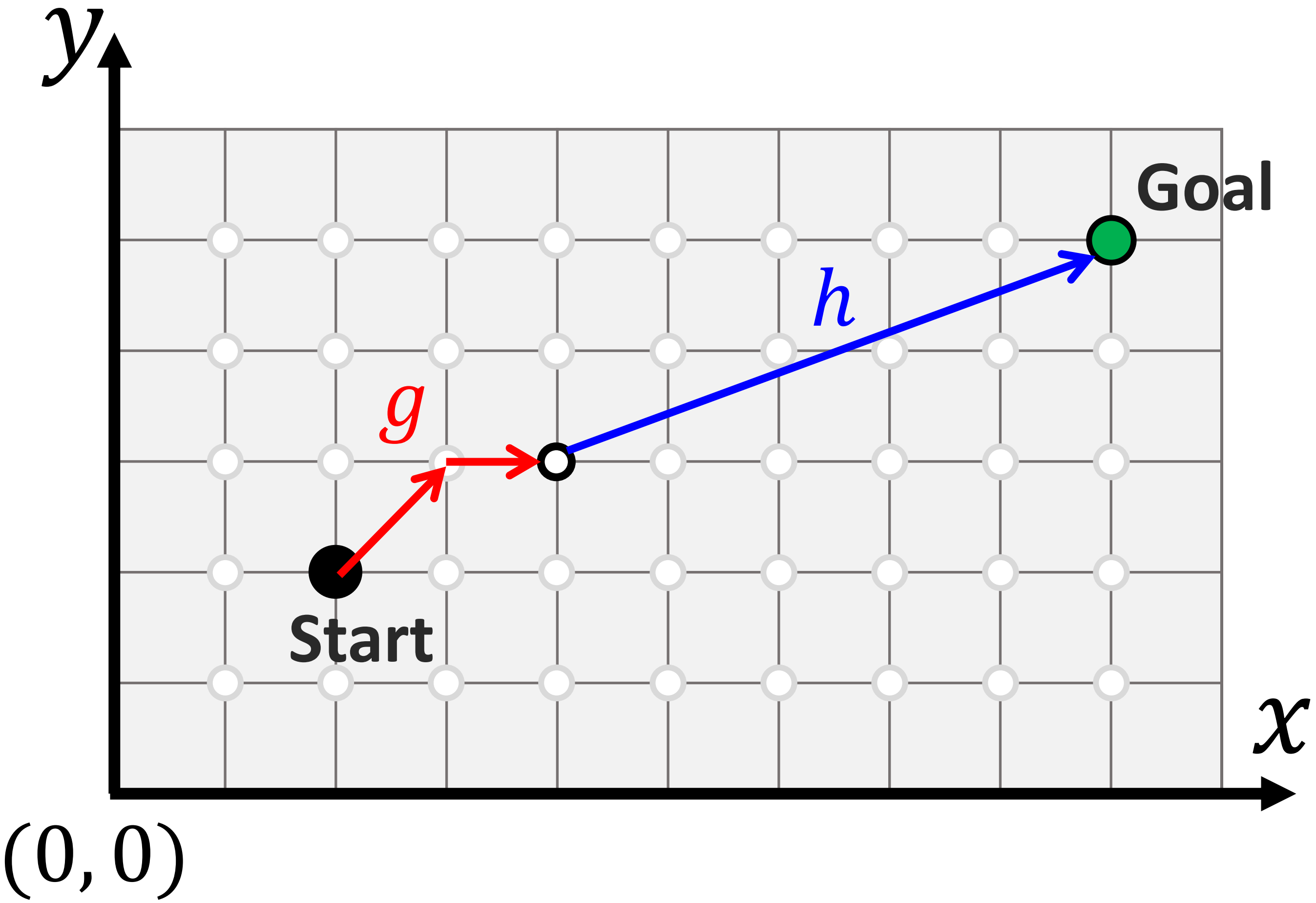
Example on
A* Path Planning Algorithm

A* Algorithm



Definition of cost:

$g(x,y)$ — ***exact cost*** of the path **from** the **Start** node to node (x,y)

$h(x,y)$ — **heuristic** ***estimated cost*** from node (x,y) **to** the **Goal** node

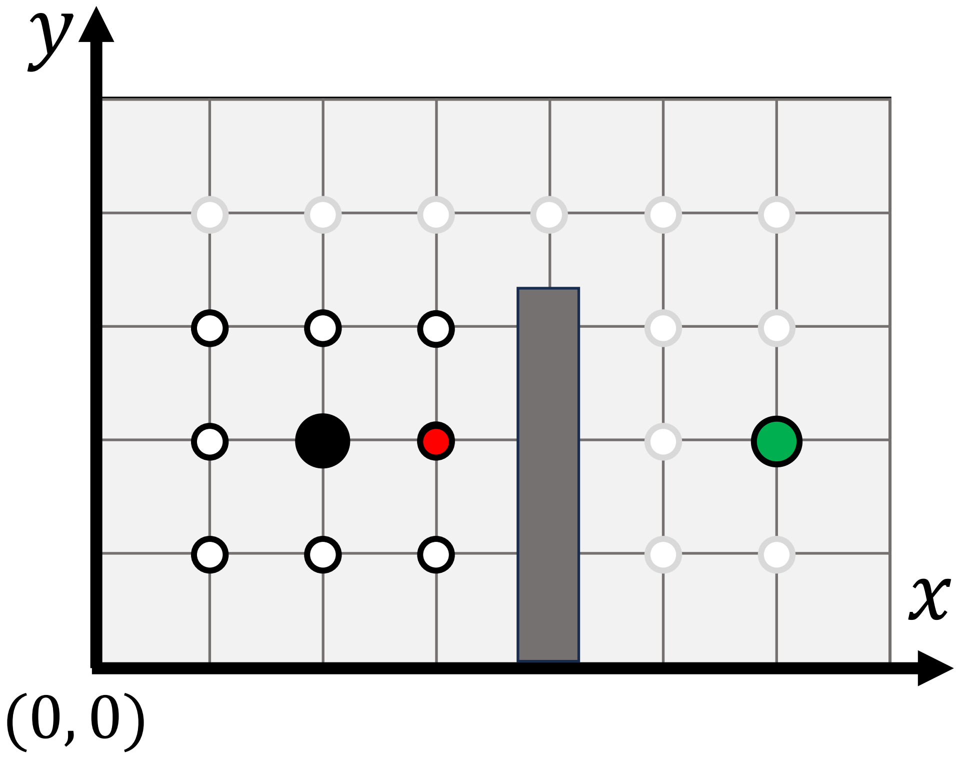
$f(x,y) = g(x,y) + h(x,y)$

total cost of a node (x,y)

Searching procedure:

1) Calculate $f = g + h$ for nodes nearby current node (record costs and source node in open list);
2) Move current node to the node with lowest f (record in close list);
3) Current node is **Goal**, retrieve path from **Goal** to **Start**

A* Algorithm (round 1)



● Start

🟩 Goal

Cost: $f = g + h$

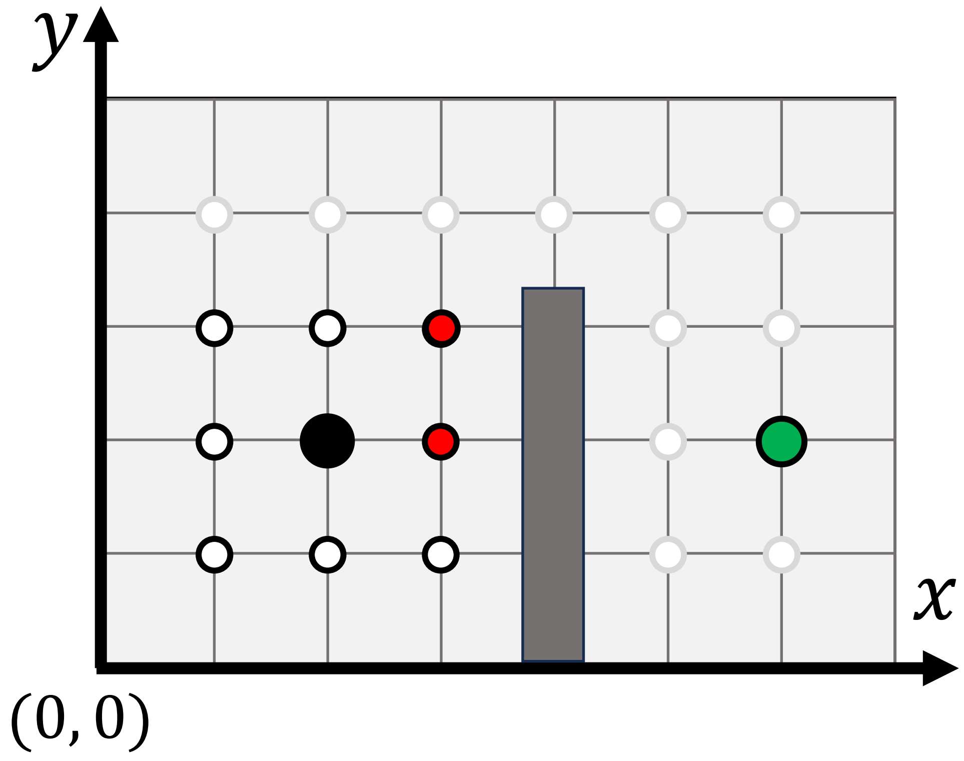
Open List
(searched nodes)

Node	g	h	f	Source
(1,1)	1.4	5.1	6.5	(2,2)
(1,2)	1	5	6	(2,2)
(1,3)	1.4	5.1	6.5	(2,2)
(2,1)	1	4.1	5.1	(2,2)
(2,3)	1	4.1	5.1	(2,2)
(3,1)	1.4	3.1	4.5	(2,2)
(3,2)	1	3	4	(2,2)
(3,3)	1.4	3.1	4.5	(2,2)

Close List
(arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)
(Current node)		

A* Algorithm (round 2)



● Start

🟢 Goal

Cost: $f = g + h$

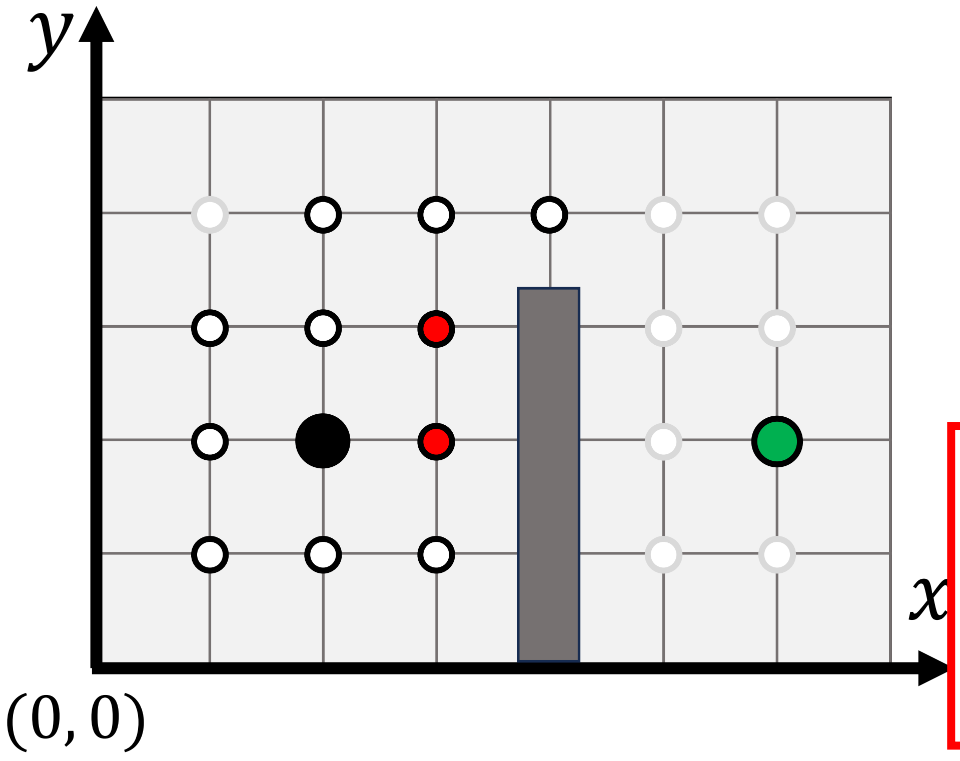
Open List
(searched nodes)

Node	g	h	f	Source
(1,1)	1.4	5.1	6.5	(2,2)
(1,2)	1	5	6	(2,2)
(1,3)	1.4	5.1	6.5	(2,2)
(2,1)	1	4.1	5.1	(2,2)
(2,3)	1	4.1	5.1	(2,2)
(3,1)	1.4	3.1	4.5	(2,2)
~~(3,2)~~	~~1~~	~~3~~	~~4~~	~~(2,2)~~
(3,3)	1.4	3.1	4.5	(2,2)

Close List
(arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)

A* Algorithm (round 3-5)



● **Start**

🟢 **Goal**

Cost: $f = g + h$

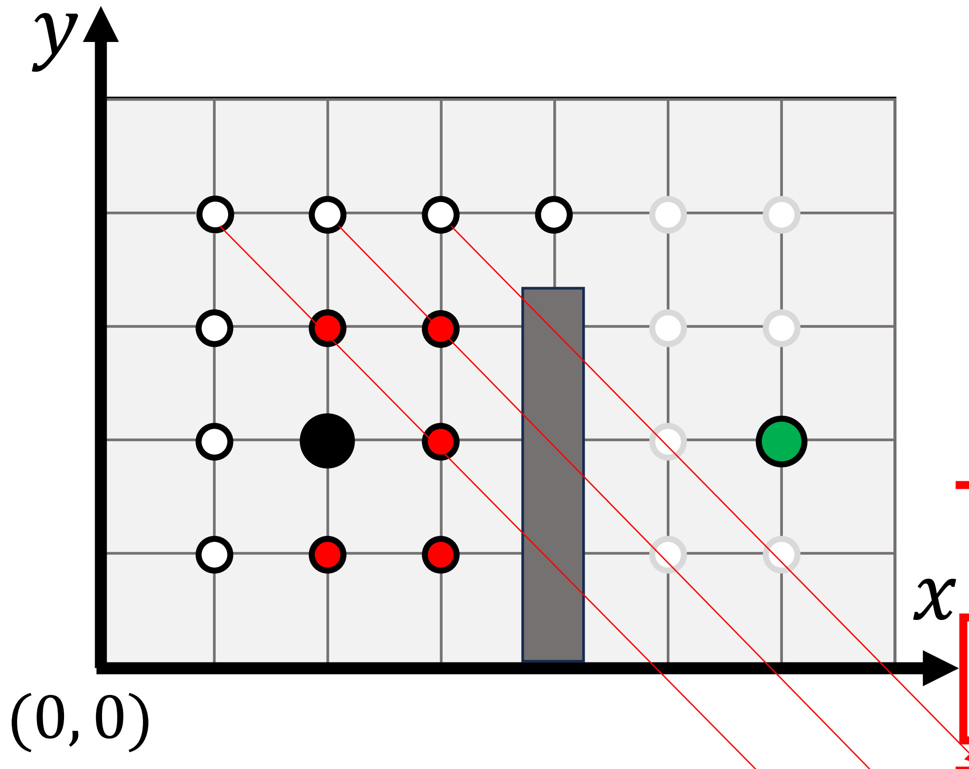
Open List (searched nodes)

Node	g	h	f	Source
(1,1)	1.4	5.1	6.5	(2,2)
(1,2)	1	5	6	(2,2)
(1,3)	1.4	5.1	6.5	(2,2)
(2,1)	1	4.1	5.1	(2,2)
(2,3)	1	4.1	5.1	(2,2)
(3,1)	1.4	3.1	4.5	(2,2)
(2,4)	2.8	4.5	7.3	(3,3)
(3,4)	2.4	3.6	6.0	(3,3)
(4,4)	2.8	2.8	5.6	(3,3)

Close List (arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)
(3,3)	4.5	(2,2)

A* Algorithm (round 6)



Open List
(searched nodes)

Node	g	h	f	Source
(1,1)	1.4	5.1	6.5	(2,2)
(1,2)	1	5	6	(2,2)
(1,3)	1.4	5.1	6.5	(2,2)
~~(2,4)~~	~~2.8~~	~~4.5~~	~~7.3~~	~~(3,3)~~
(3,4)	2.4	3.6	6.0	(3,3)
(4,4)	2.8	2.8	5.6	(3,3)
~~(3,4)~~	~~2.4~~	~~3.6~~	~~6.0~~	~~(2,3)~~
(2,4)	2	4.5	6.5	(2,3)
(1,4)	2.4	5.4	7.8	(2,3)

(update)

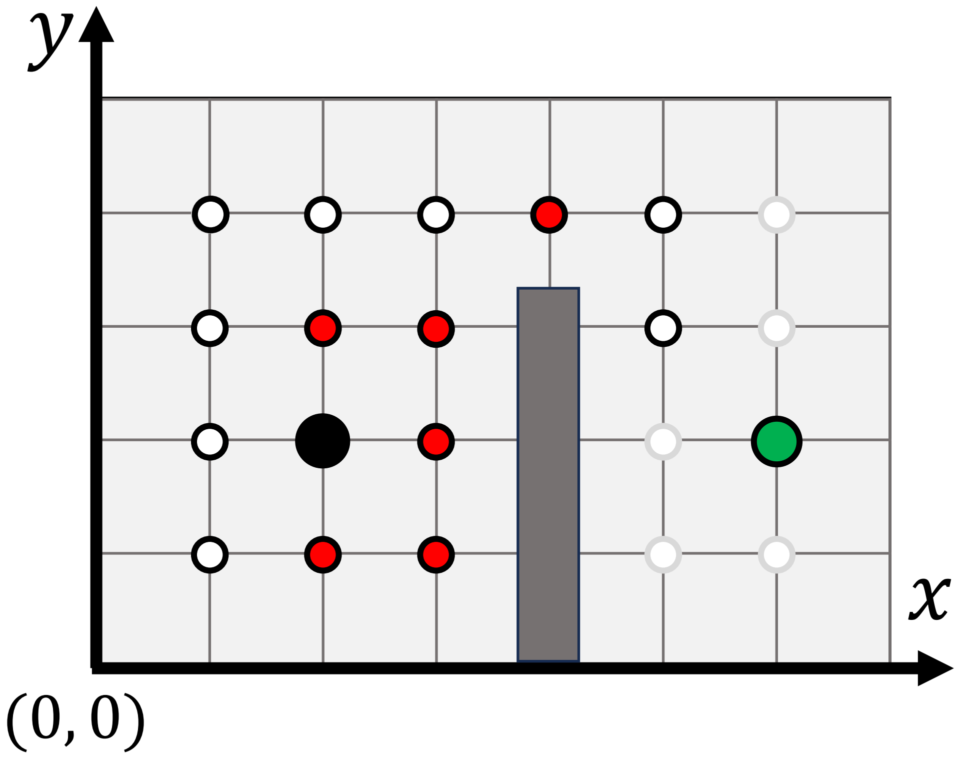
Close List
(arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)
(3,3)	4.5	(2,2)
(2,1)	5.1	(2,2)
(2,3)	5.1	(2,2)
(3,1)	4.5	(2,2)

● **Start**
● **Goal**

Cost: $f = g + h$

A* Algorithm (round 7)



● Start

🟢 Goal

Cost: $f = g + h$

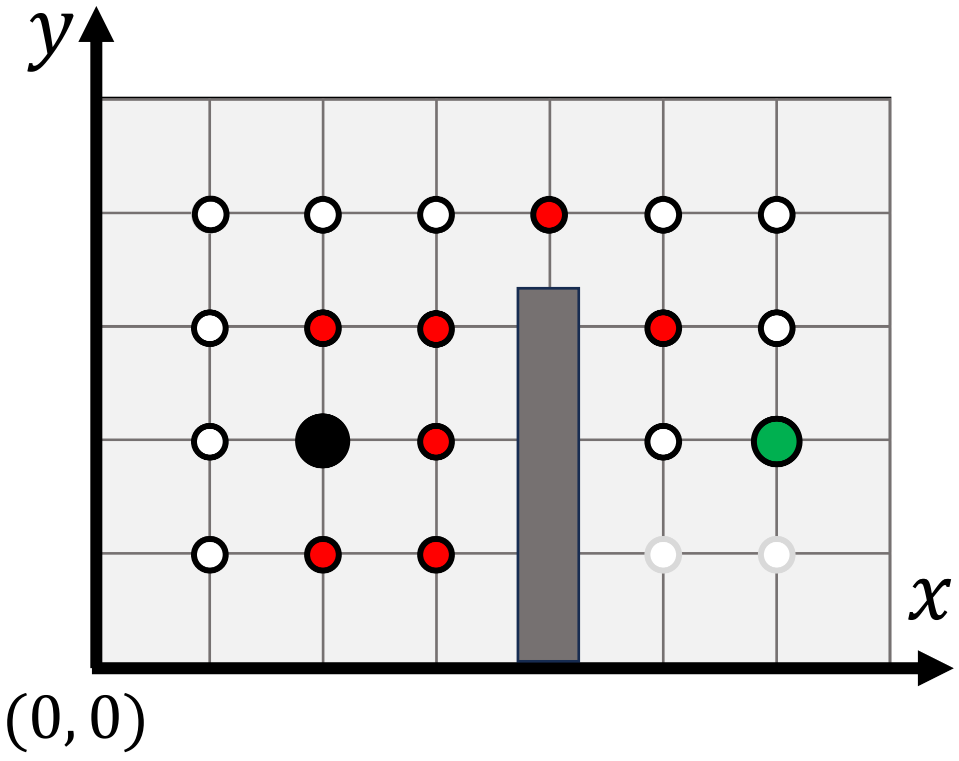
Open List (searched nodes)

Node	g	h	f	Source
(1,1)	1.4	5.1	6.5	(2,2)
(1,2)	1	5	6	(2,2)
(1,3)	1.4	5.1	6.5	(2,2)
(2,4)	2	4.5	6.5	(2,3)
(3,4)	2.4	3.6	6.0	(3,3)
(1,4)	2.4	5.4	7.8	(2,3)
(5,4)	3.8	2.2	6.0	(4,4)
(5,3)	4.2	1.4	5.6	(4,4)

Close List (arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)
(3,3)	4.5	(2,2)
(2,1)	5.1	(2,2)
(2,3)	5.1	(2,2)
(3,1)	4.5	(2,2)
(4,4)	5.6	(3,3)

A* Algorithm (round 8)



● Start

🟢 Goal

Cost: $f = g + h$

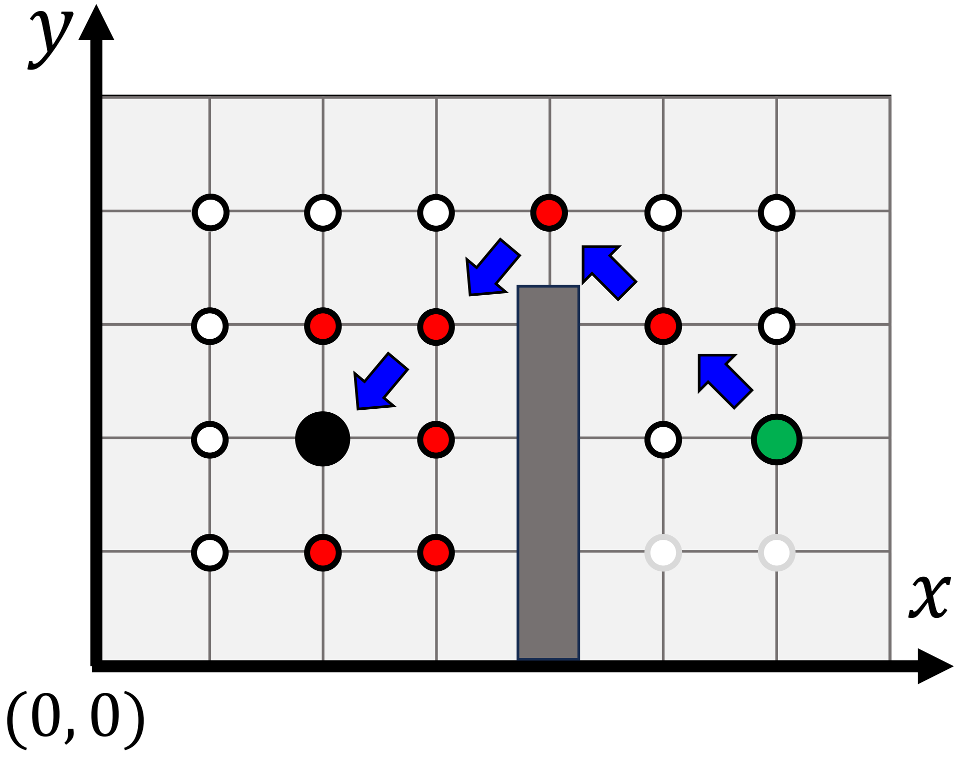
Open List (searched nodes)

Node	g	h	f	Source
(1,1)	1.4	5.1	6.5	(2,2)
(1,2)	1	5	6	(2,2)
(1,3)	1.4	5.1	6.5	(2,2)
(2,4)	2	4.5	6.5	(2,3)
(3,4)	2.4	3.6	6.0	(3,3)
(1,4)	2.4	5.4	7.8	(2,3)
(5,4)	3.8	2.2	6.0	(4,4)
…				
(6,2)	5.6	0	5.6	(5,3)

Close List (arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)
(3,3)	4.5	(2,2)
(2,1)	5.1	(2,2)
(2,3)	5.1	(2,2)
(3,1)	4.5	(2,2)
(4,4)	5.6	(3,3)
(5,3)	5.6	(4,4)

A* Algorithm (round 8)



● Start

● Goal

Cost: $f = g + h$

Close List
(arrived nodes)

Node	f	Source
Start	-	-
(3,2)	4	(2,2)
(3,3)	4.5	(2,2)
(2,1)	5.1	(2,2)
(2,3)	5.1	(2,2)
(3,1)	4.5	(2,2)
(4,4)	5.6	(3,3)
(5,3)	5.6	(4,4)
Goal (6,2)	5.6	(5,3)

Reversely trace back trajectory