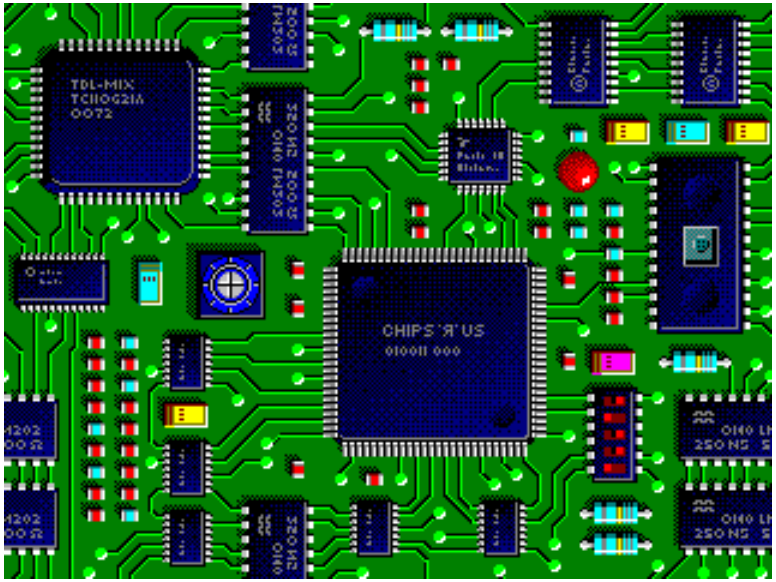
Lee's Wire Routing Algorithm

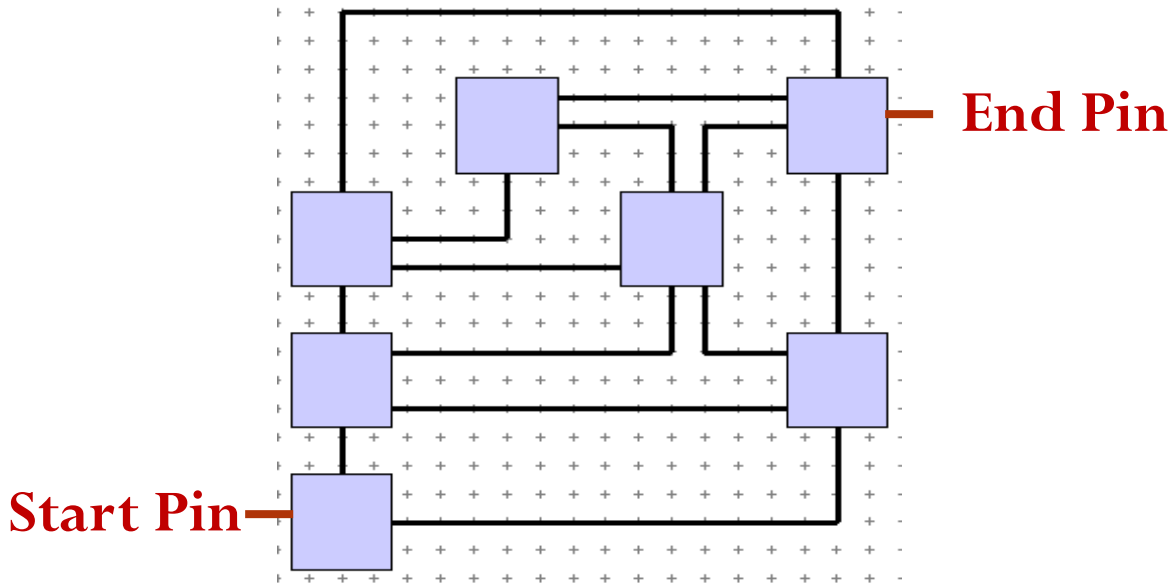
Application of Queue: Wire Routing

- Select paths to connect all pairs of pins that need to be connected together.
- An important problem in **electronic design automation**.



A Simplified Problem

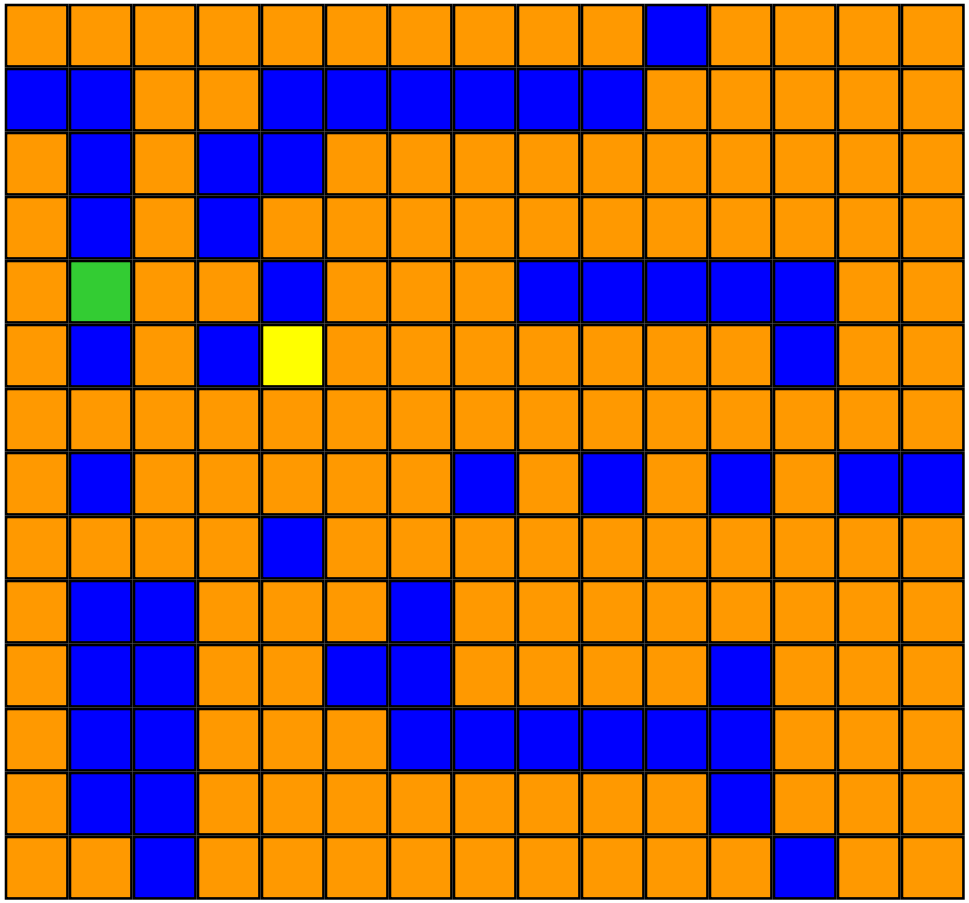
- Condition: We have all blocks laid on the chip. We also have some of the wires routed.
- Problem: We want to connect the next pair of pins.
- Constraint: we can only draw wires horizontally or vertically.



Modeling as a Grid

Start Pin

End Pin



- Blue squares are **blocked** squares.
- Orange squares are **available** to route a wire.

How to find a path from the start pin to the end pin?

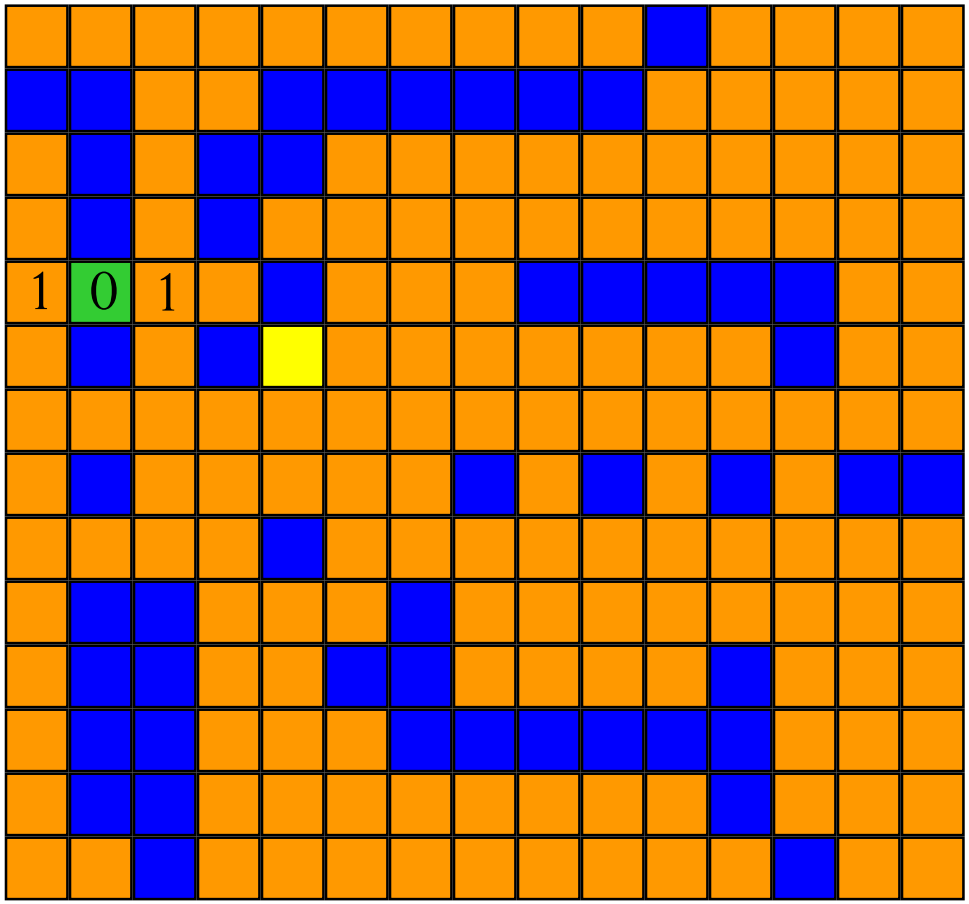
Wire Routing: Lee's Algorithm

- A **queue** of reachable squares from the start pin is used.
- The cell of the start pin is set with a distance value of 0.
- It is enqueued into an initial empty queue.
- **While** the queue is not empty.
  - A cell is **dequeued** from the queue and made the **examine cell**.
  - Is the examine cell the end pin? If yes, path found and return.
  - Otherwise, all **unreached unblocked** squares adjacent to the **examine cell** are marked with their distance (this is 1 more than the distance value of the **examine cell**) and **enqueued**.
- When queue becomes empty but not reach end pin yet, means no path found.

Illustration of Lee's Algorithm

start pin

end pin



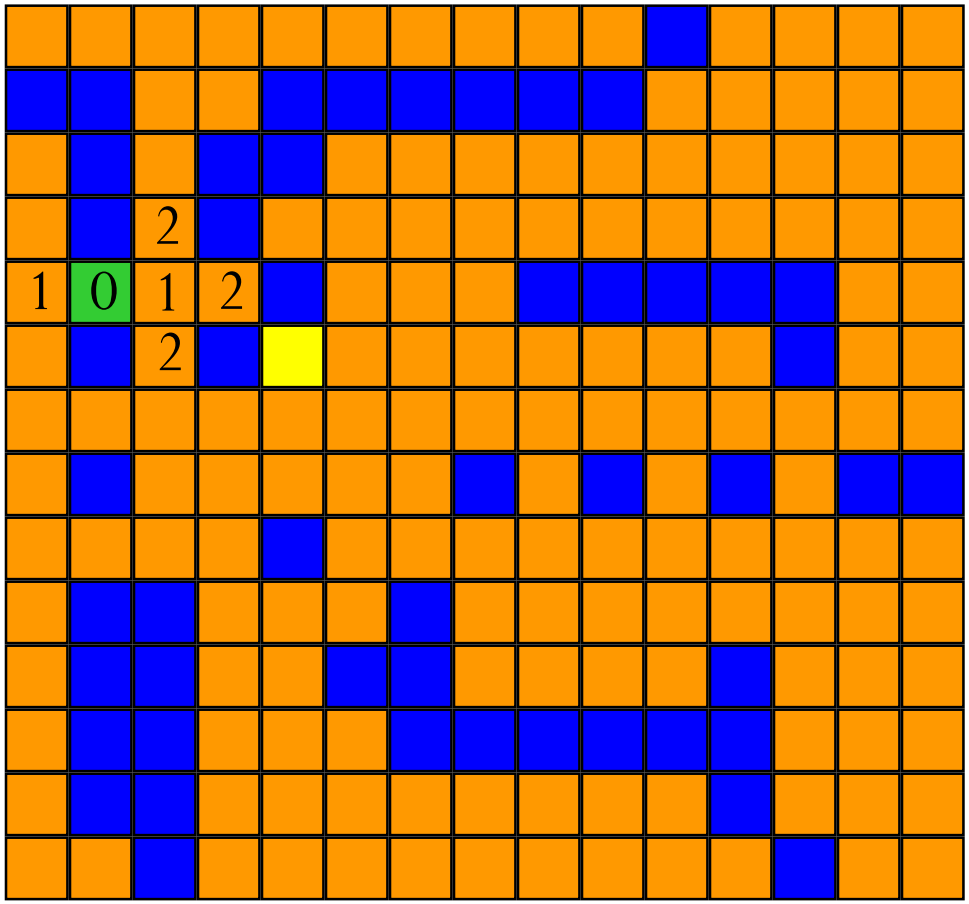
Expand "0"

queue: 0

Illustration of Lee's Algorithm

start pin

end pin



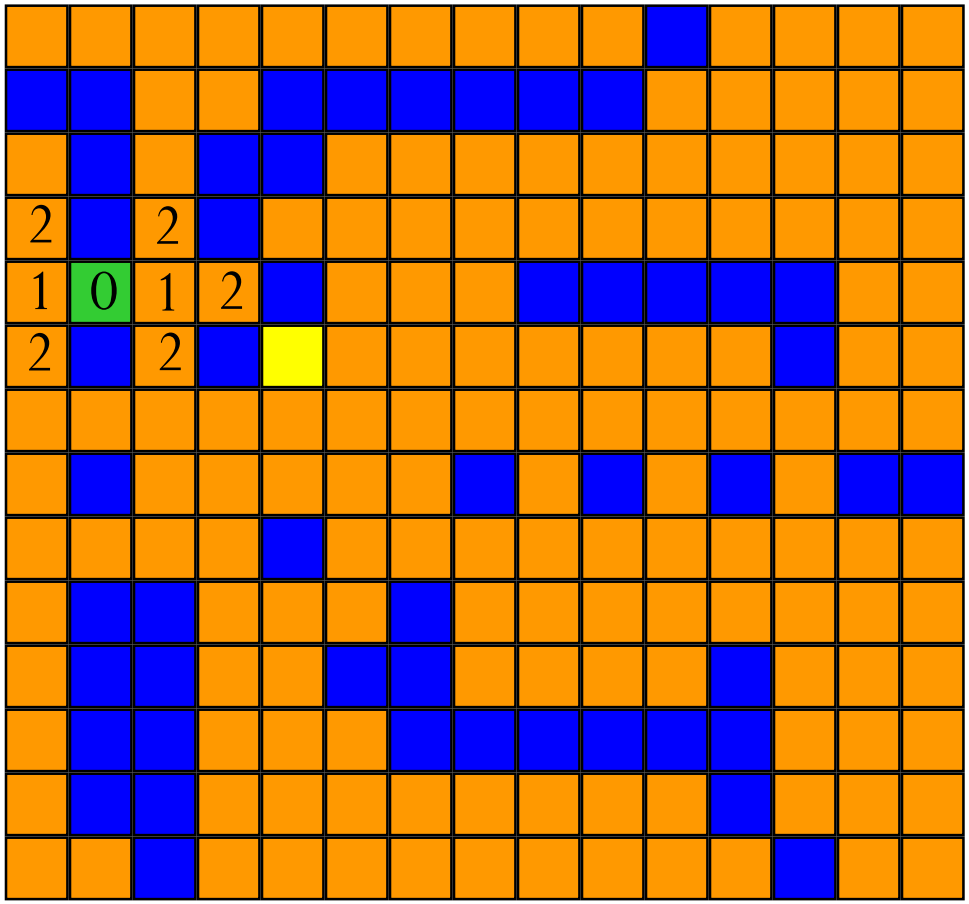
Expand right "1"

queue: 1, 1

Illustration of Lee's Algorithm

start pin

end pin



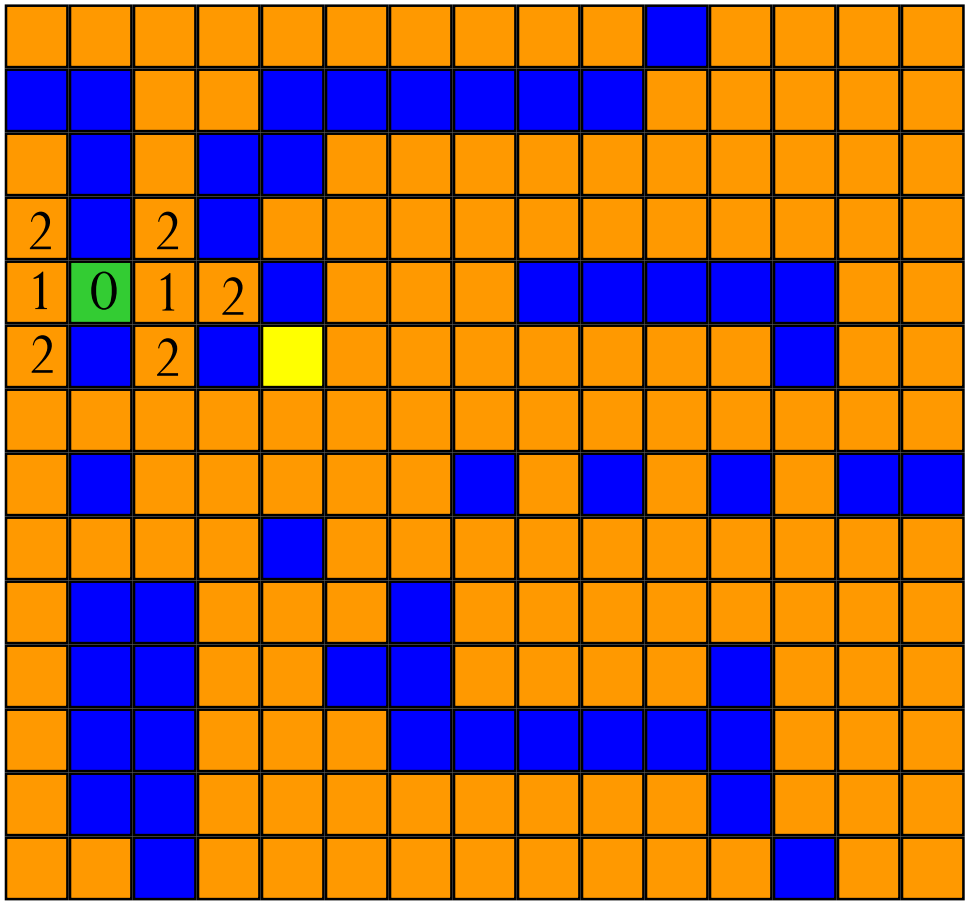
Expand left "1"

queue: 1,2,2,2

Illustration of Lee's Algorithm

start pin

end pin

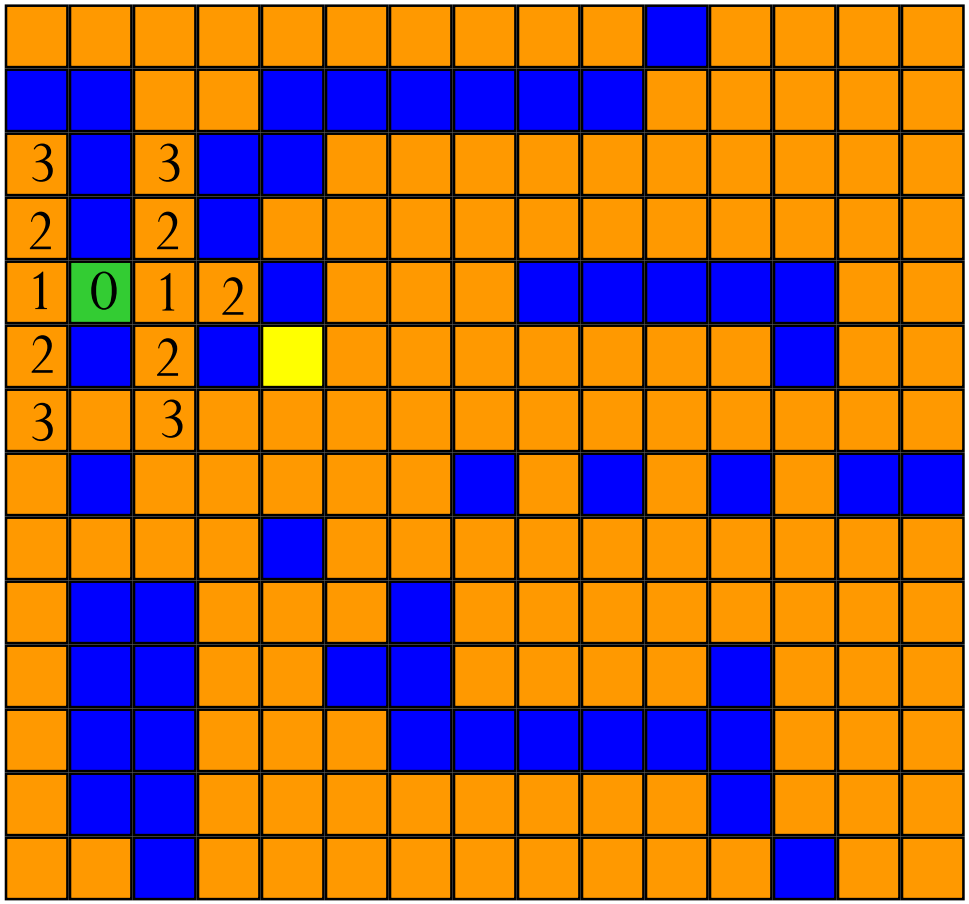


Expand and reach all squares 3 units from start.

Illustration of Lee's Algorithm

start pin

end pin

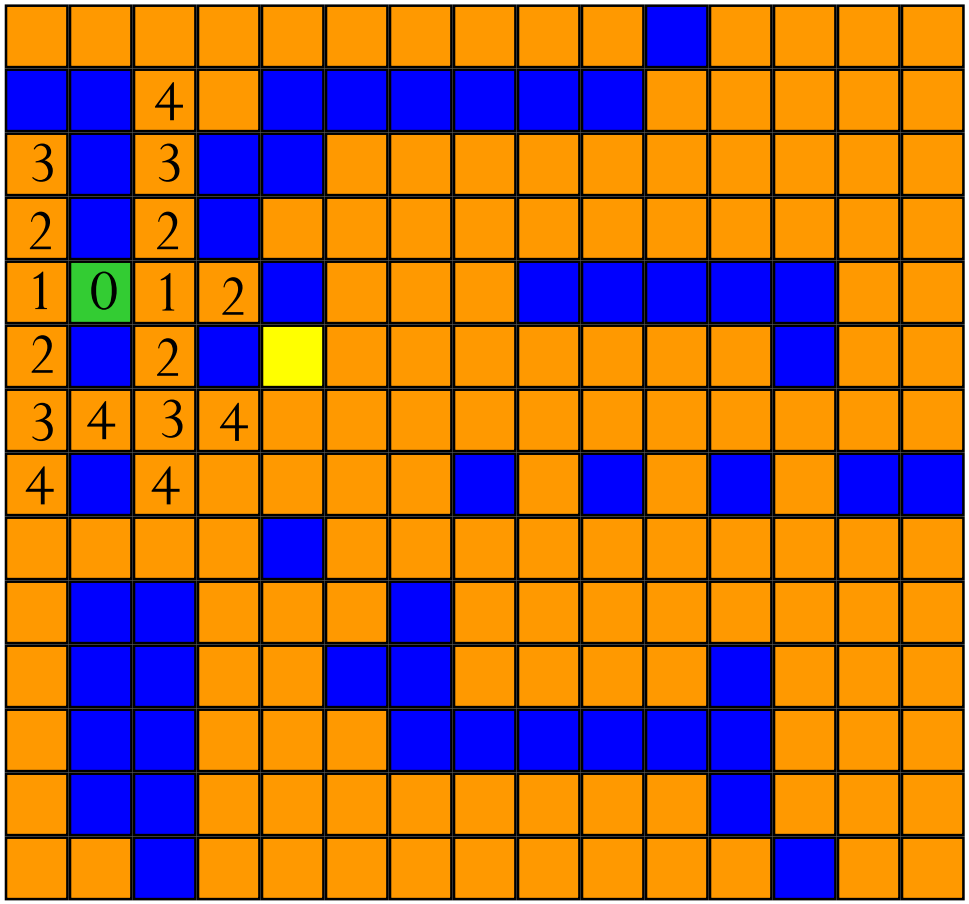


Expand and reach all squares 4 units from start.

Illustration of Lee's Algorithm

start pin

end pin

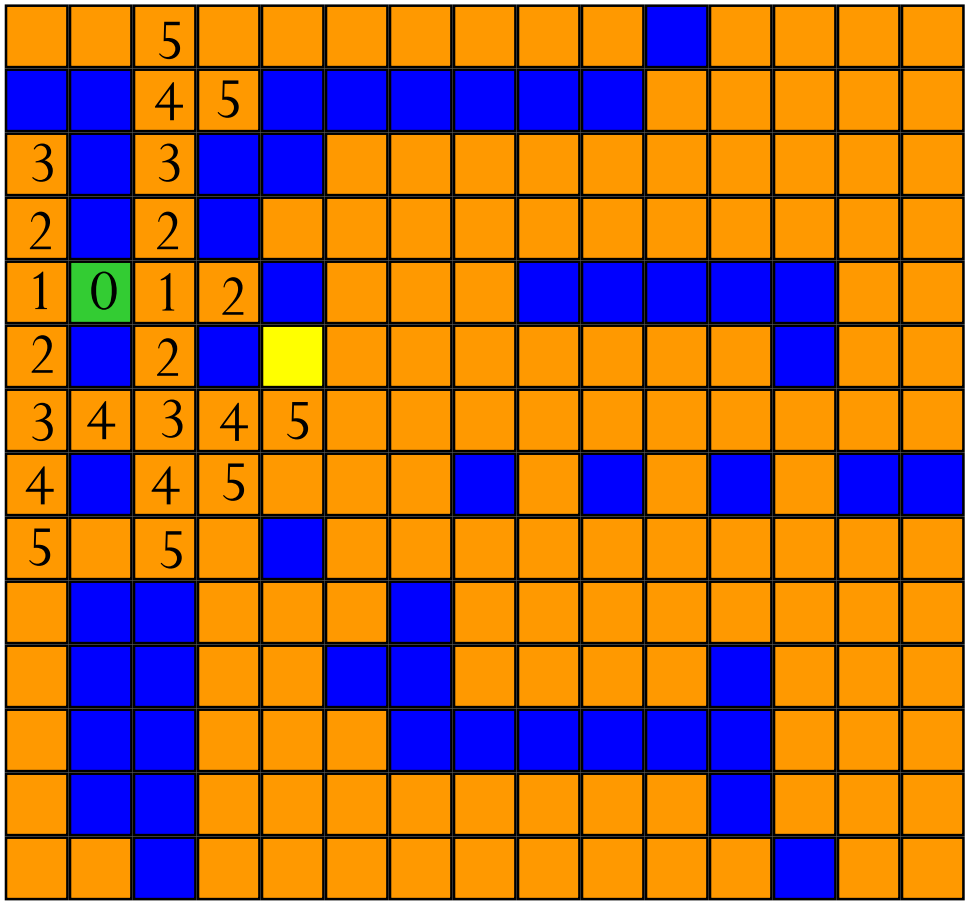


Expand and reach all squares 5 units from start.

Illustration of Lee's Algorithm

start pin

end pin

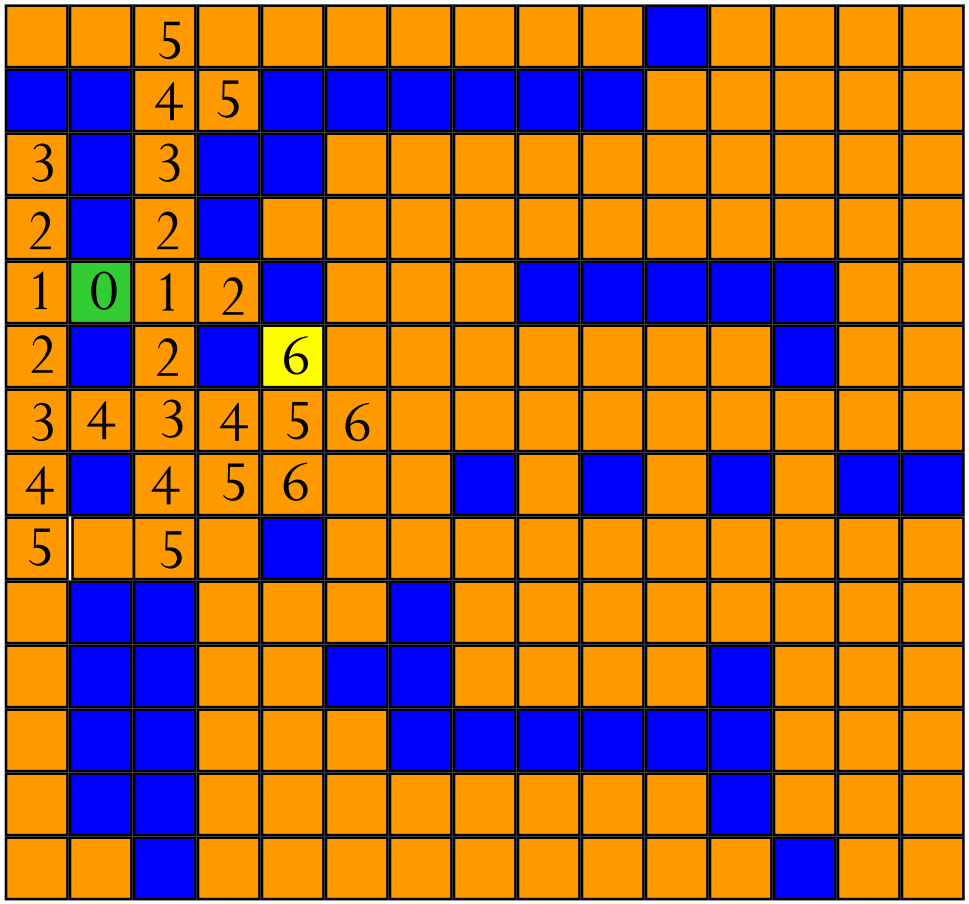


Expand and reach all squares 6 units from start.

Illustration of Lee's Algorithm

start pin

end pin



End pin reached. Trace back.

Illustration of Lee's Algorithm

start pin

end pin