The Roomba coverage problem

- Empty Room
  - Observation: you already know how to get to a corner and how to cover rows or columns

- Step-by-step Decomposition
  - (Each step is one or more states)
  - Go to the top left corner
  - Paint the top row going East
  - Move down one
  - Paint the next row going West
  - Move down one
  - Repeat

The Roomba coverage problem

▸ **Step-by-step Decomposition**

  ▸ Go to the top left corner

```
0 X*** -> N 0
0 N*** -> X 1
1 **X* -> W 1
1 **W* -> X 2
```

  ▸ Paint the top row going East

```
2 *X** -> E 2
2 *E** -> X 3
```

  ▸ Move down one

```
3 **** -> S 4
```

  ▸ Paint the next row going West

```
4 **X* -> W 4
4 **W* -> X 5
```

  ▸ Move down one, and repeat from 2

```
5 **** -> S 2
```

Simplify!

Step-by-step Decomposition

- Go to the top left corner
  ```
  0 X*** -> N 0
  0 N*** -> X 1
  1 **X* -> W 1
  1 **W* -> X 2
  ```
- Paint the top row going East
  ```
  2 *X** -> E 2
  2 *E** -> X 3
  ```
- Move down one
  ```
  3 **** -> S 4
  ```
- Paint the next row going West
  ```
  4 **X* -> W 4
  4 **W* -> X 5
  ```
- Move down one, and repeat from 2
  ```
  5 **** -> S 2
  ```

Simplified by combining rules

- Go to the top left corner
  ```
  0 X*** -> N 0
  0 N*X* -> W 0
  0 N*W* -> X 1
  ```
- Paint the top row going East, *and move down one*
  ```
  1 *X** -> E 1
  1 *E** -> S 2
  ```
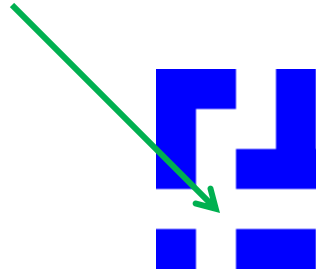- Paint the next row going West, *and move down one*
  ```
  2 **X* -> W 2
  2 **W* -> S 1
  ```
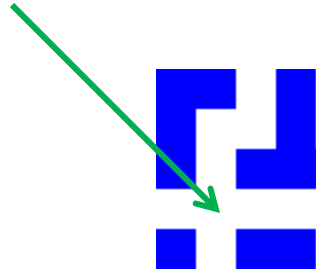
The maze coverage problem

▸ Keep your right hand on a wall at all times

▸ Strategy: start considering possible *cases* or *scenarios*

▸ If you are here, which way do you go?

The maze coverage problem

‣ Keep your right hand on a wall at all times

‣ Strategy: start considering possible *cases* or *scenarios*

‣ If you are here, which way do you go?

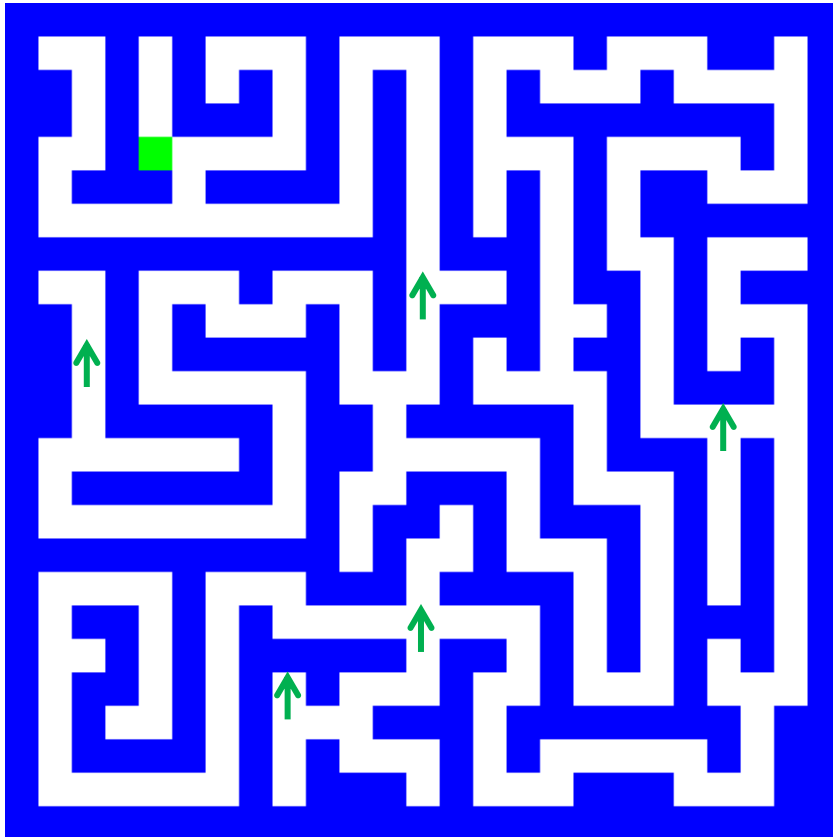
‣ Answer: depends on which way you are *facing*

  ‣ The environment is XXXX (no blocking) no matter what

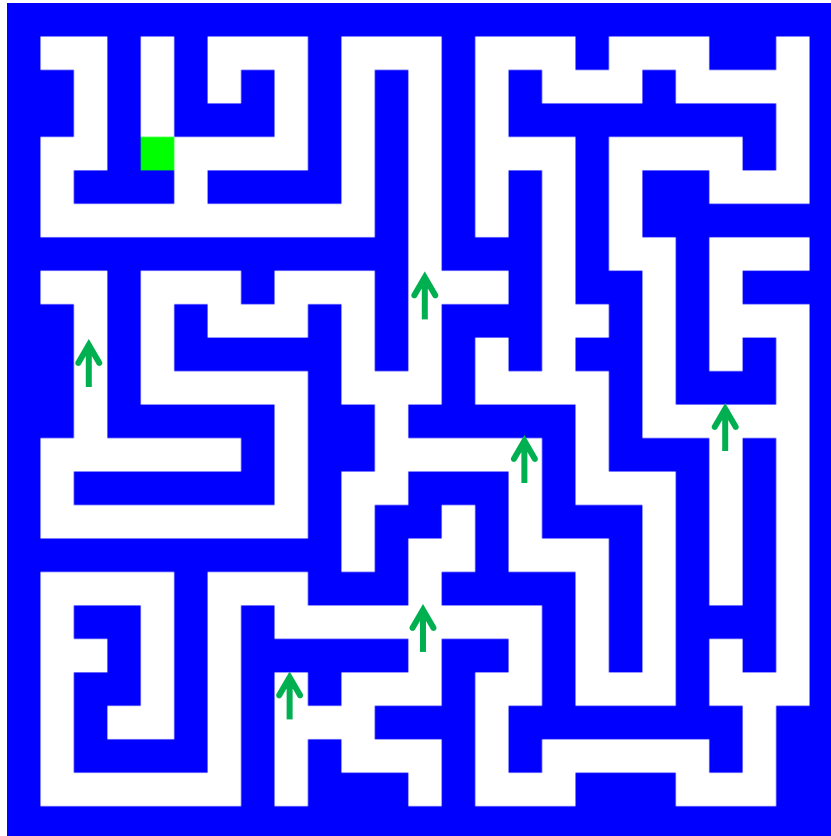 ‣ So use state to represent differences in facing!

The maze coverage problem

- Keep your right hand on a wall at all times

The maze coverage problem

▸ Keep your right hand on a wall at all times

Open to the right, turn right

Blocked right, move forward

Blocked right and forward, turn left
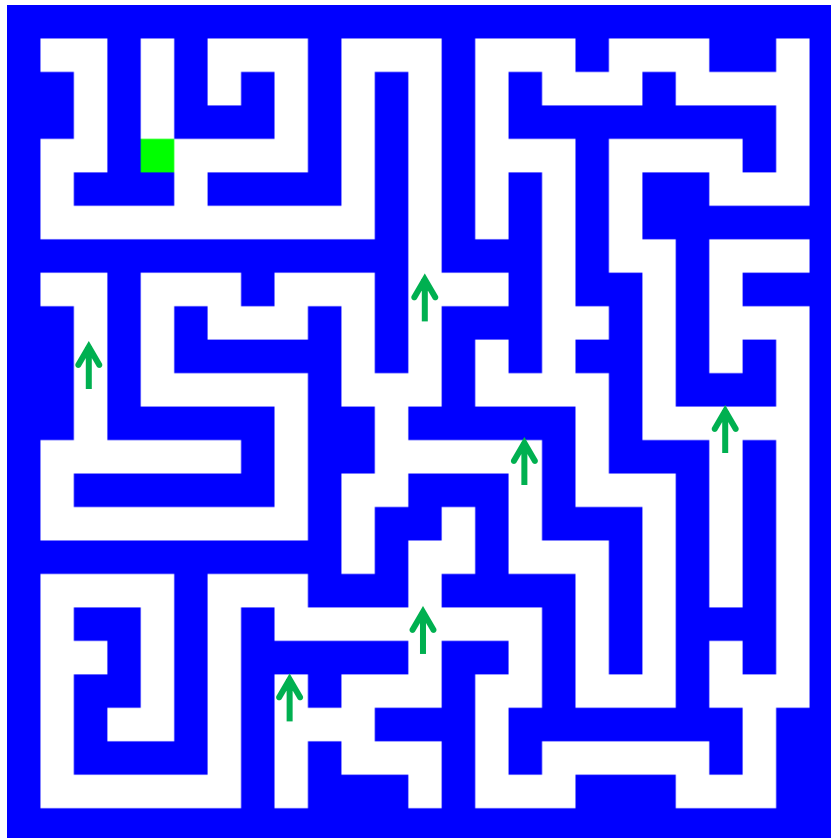
Blocked right, forward and left, turn back

The maze coverage problem

▸ Keep your right hand on a wall at all times

State 0 is facing N, 1 is E, 2 is S and 3 is W

Open to the right, turn right

```
0 *x** -> E 1
```

Blocked right, move forward

```
0 xE** -> N 0
```

Blocked right and forward, turn left

```
0 NEx* -> W 3
```
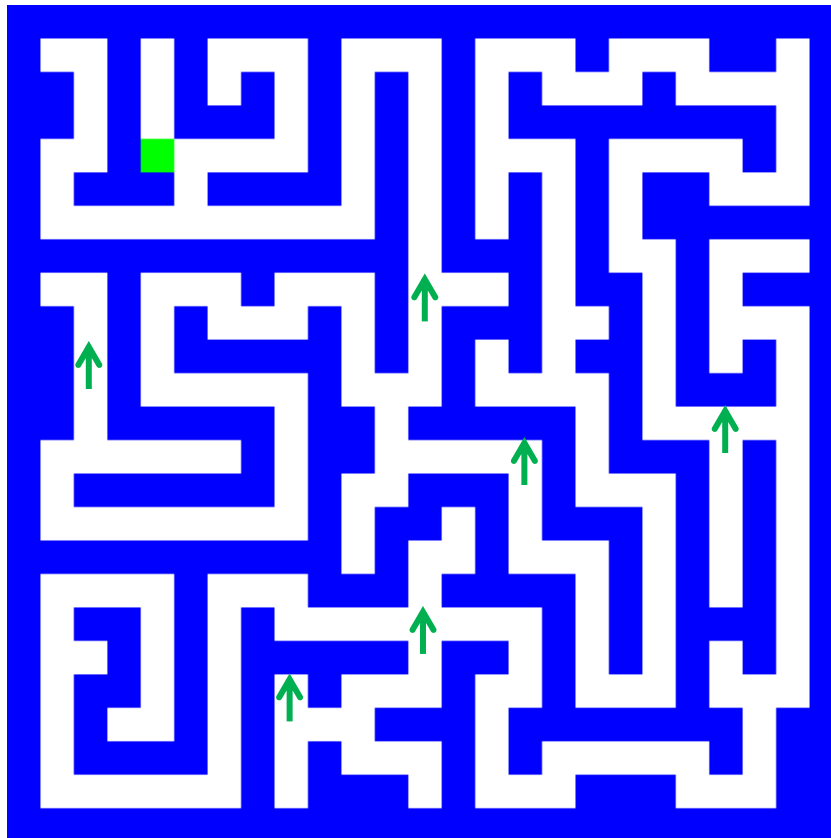
Blocked right, forward and left, turn back

```
0 NEW* -> S 2
```

The maze coverage problem

- Keep your right hand on a wall at all times


```
0 *x** -> E 1
0 xE** -> N 0
0 NEx* -> W 3
0 NEW* -> S 2

1 ***x -> S 2
1 *x*S -> E 1
1 xE*S -> N 0
1 NE*S -> W 3

2 **x* -> W 3
2 **Wx -> S 2
2 *xWS -> E 1
2 *EWS -> N 0

3 x*** -> N 0
3 N*x* -> W 3
3 N*Wx -> S 2
3 N*WS -> E 1
```

Surely this can be simplified!

(the creator's record is 8 rules)