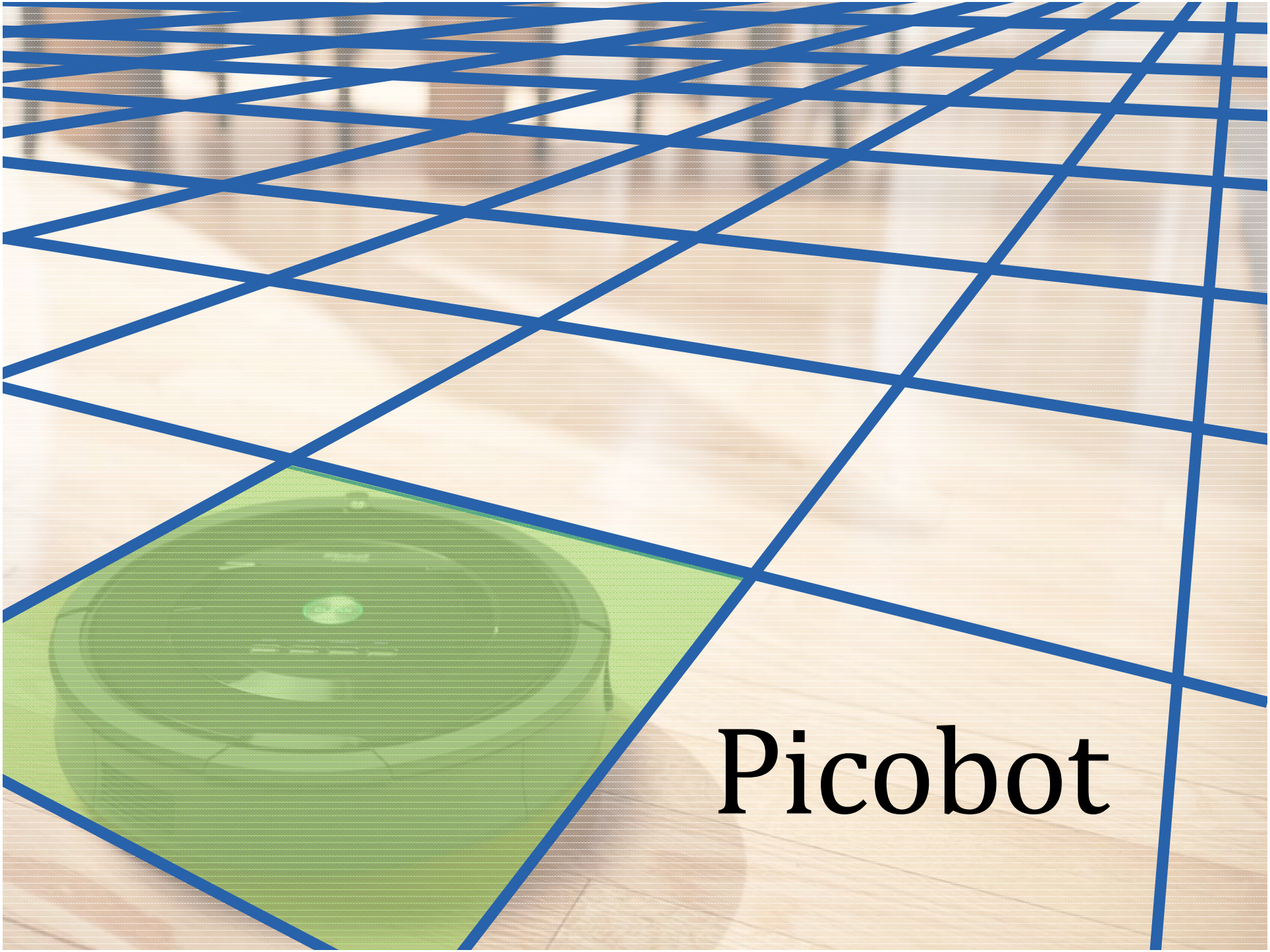

Picobot

Two languages in 4 weeks??

Python

General-purpose language

you might see 30% by the end of the program

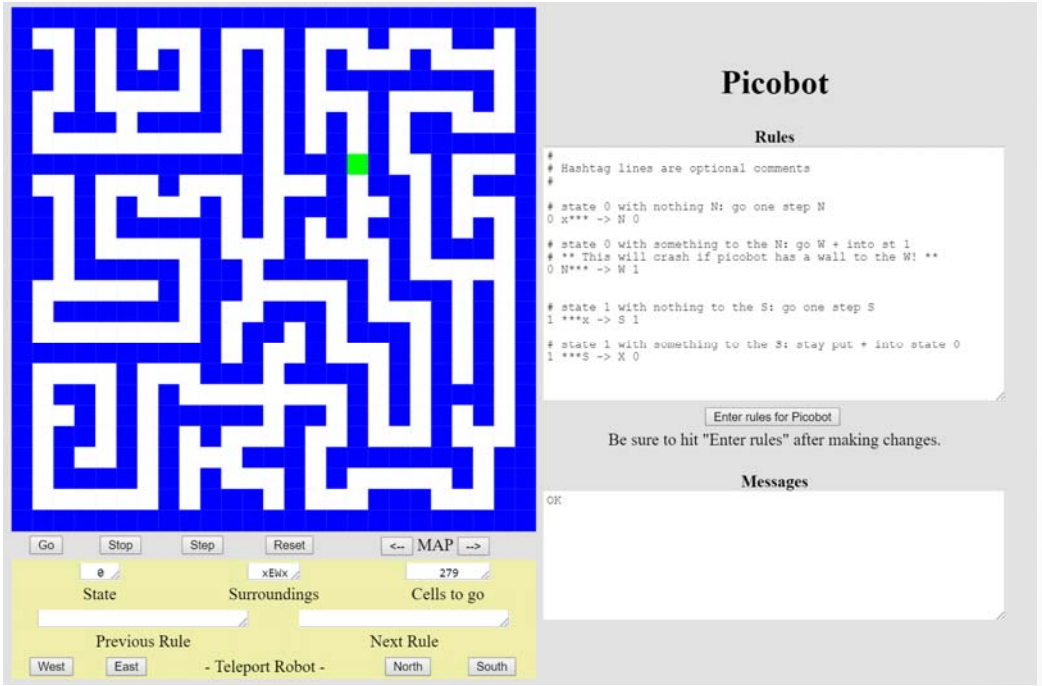
only 1% of its libraries!

Picobot

Special-purpose language

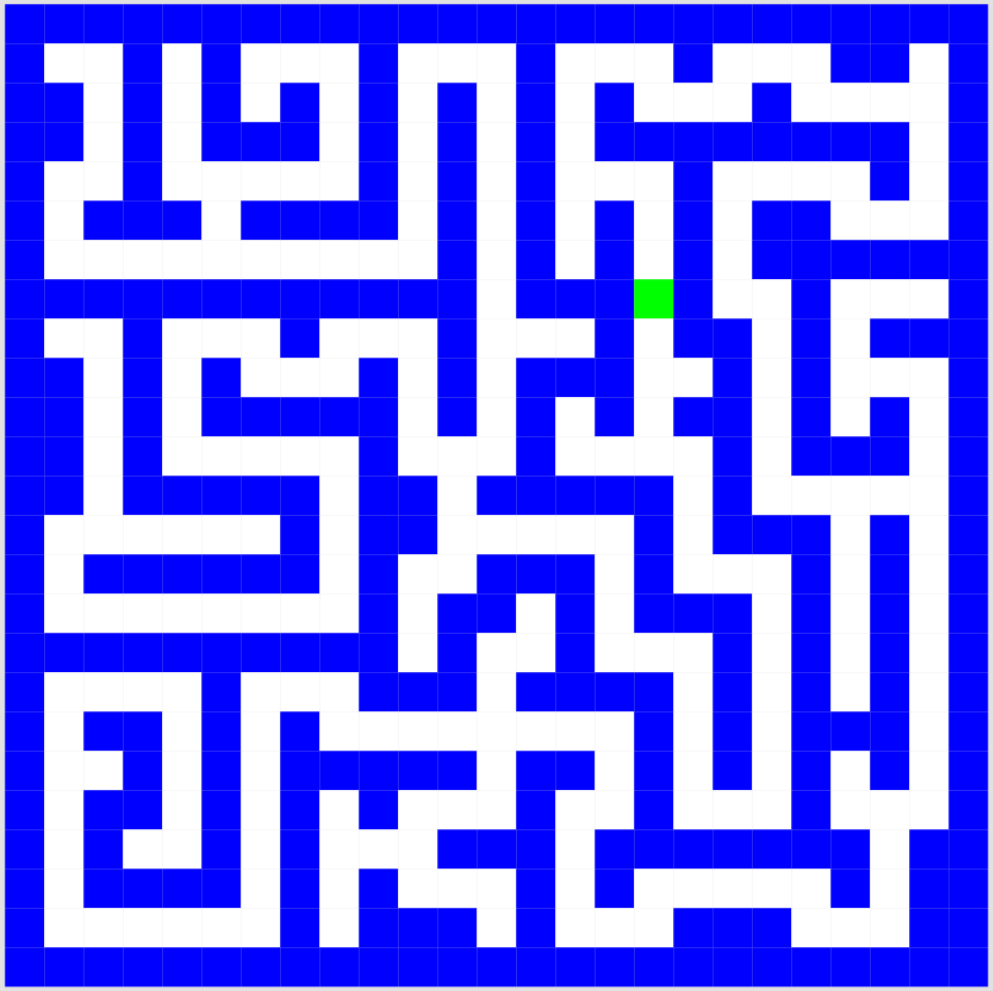
you'll see 100% in the next 10 minutes and learn everything about it in the next 1 hour

Picobot!



The Picobot simulator

`www.cs.hmc.edu/picobot`



Go | Stop | Step | Reset | <-- | MAP | -->

0	xEWx	279
State	Surroundings	Cells to go

Previous Rule | Next Rule

West | East | - Teleport Robot - | North | South

Picobot

Rules

```
#
# Hashtag lines are optional comments
#

# state 0 with nothing N: go one step N
0 x*** -> N 0

# state 0 with something to the N: go W + into st 1
# ** This will crash if picobot has a wall to the W! **
0 N*** -> W 1


# state 1 with nothing to the S: go one step S
1 ***x -> S 1

# state 1 with something to the S: stay put + into state 0
1 ***S -> X 0
```

Enter rules for Picobot

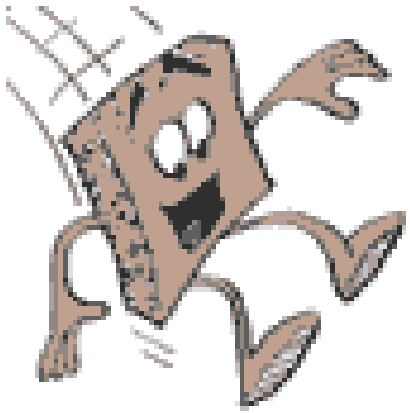
Be sure to hit "Enter rules" after making changes.

Messages

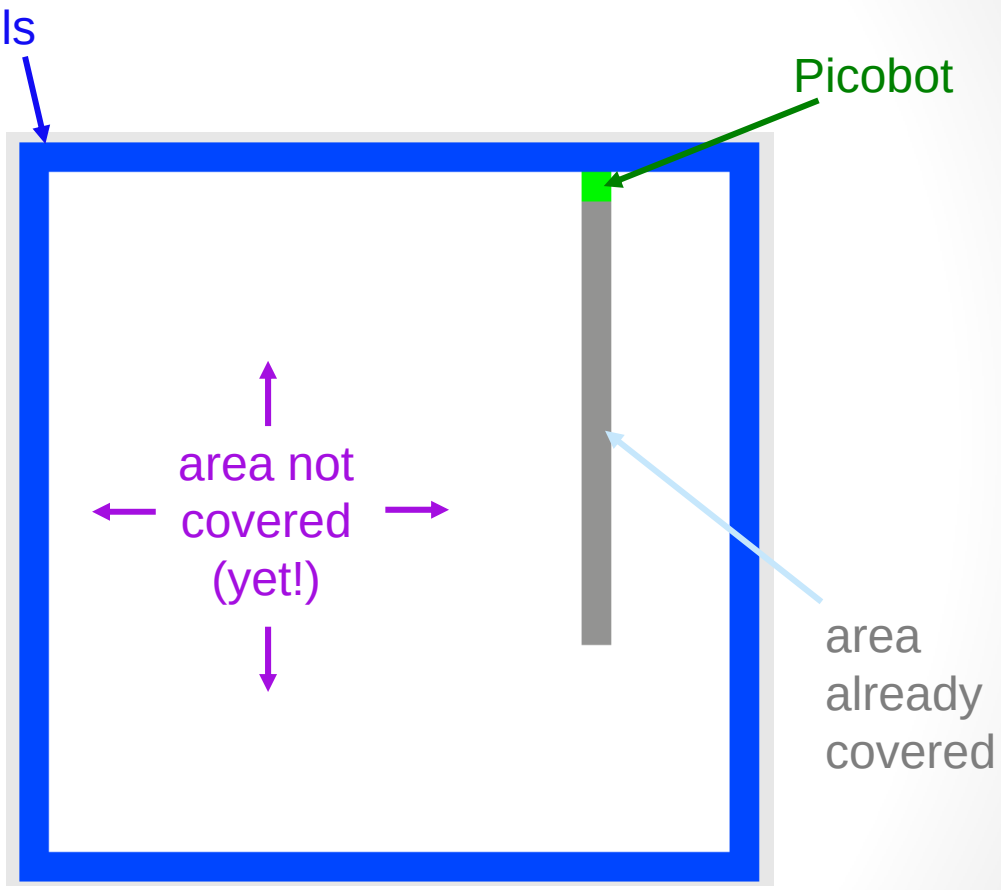
```
OK
```

Picobot

An extreme close-up of Picobot in action...



inspiration?

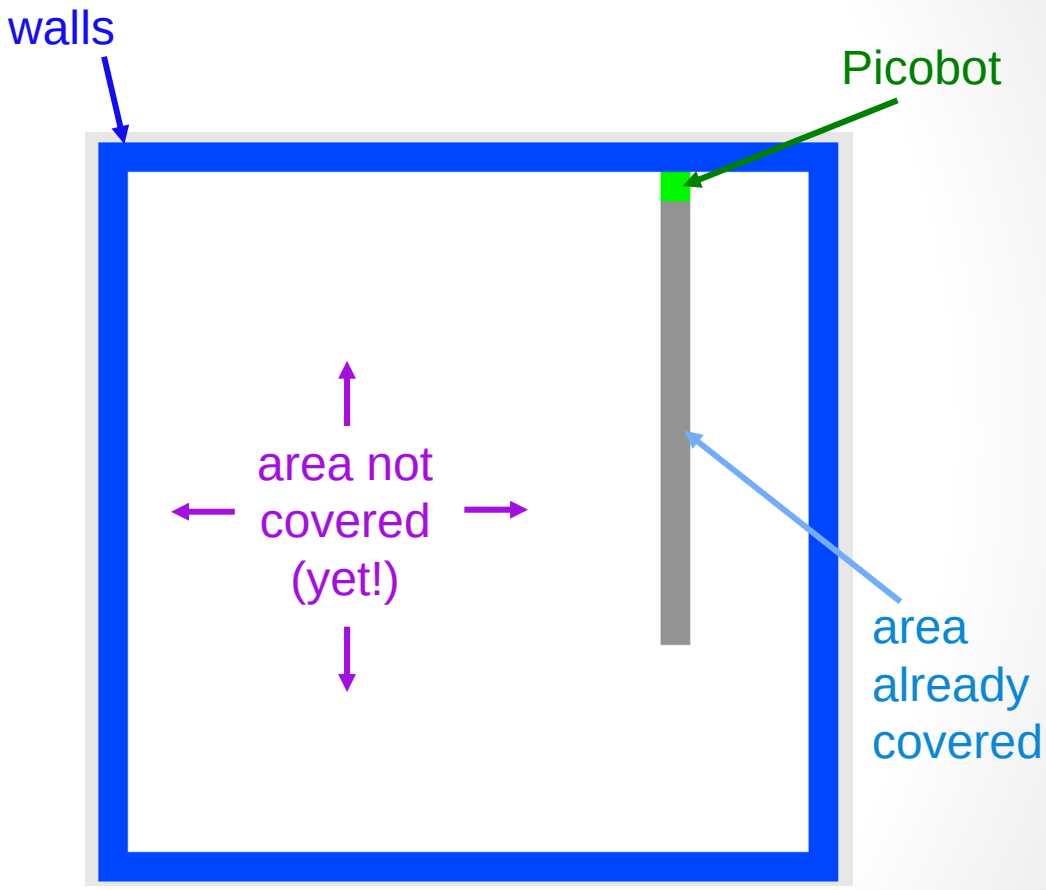


Goal: whole-environment coverage with only ***local sensing***…

Picobot's inspiration

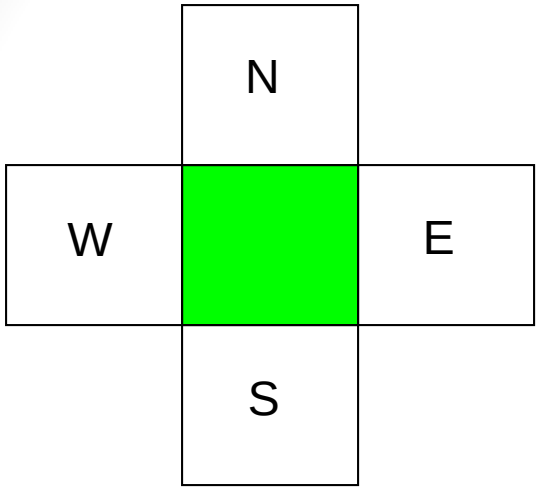
Picobot == Roomba

- may re-cover an area
- can't tell "vacuumed" from "unvacuumed" area



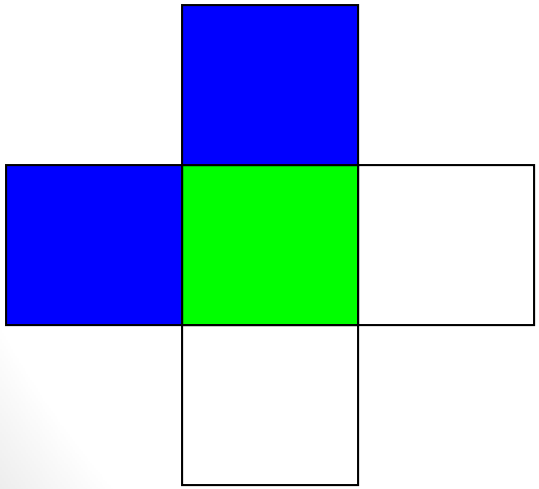
Goal: whole-environment coverage with only ***local sensing***…

Surroundings



Picobot can only sense things directly to the N, E, W, and S

For example, here its surroundings are



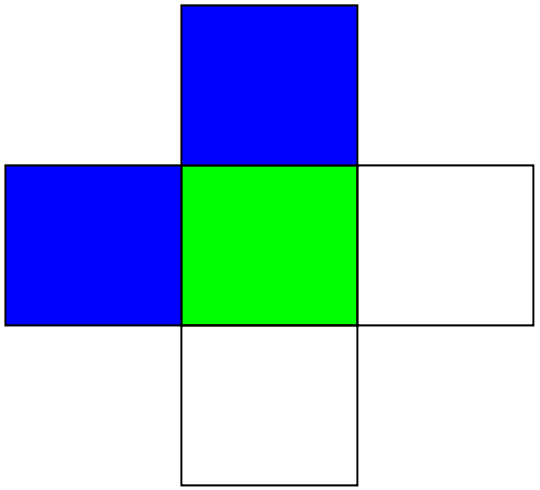
NxWx

N E W S

Surroundings are always in NEWS order.

What are these surroundings?

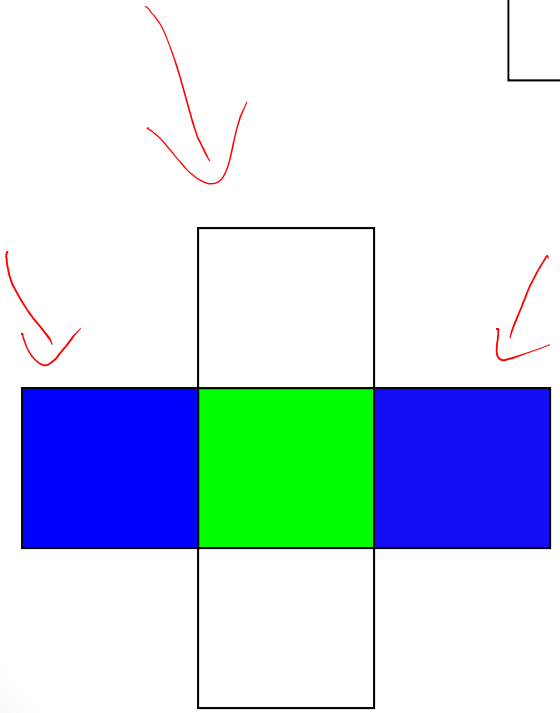
Surroundings are always in NEWS order.



N E W S

NxWx

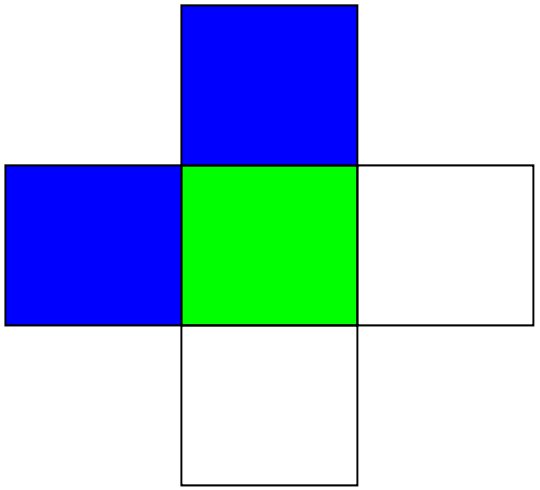
xEWx



A. NxWx
B. xEWx
C. ExWx
D. NEWS
E. None of these

What are these surroundings?

Surroundings are always in NEWS order.

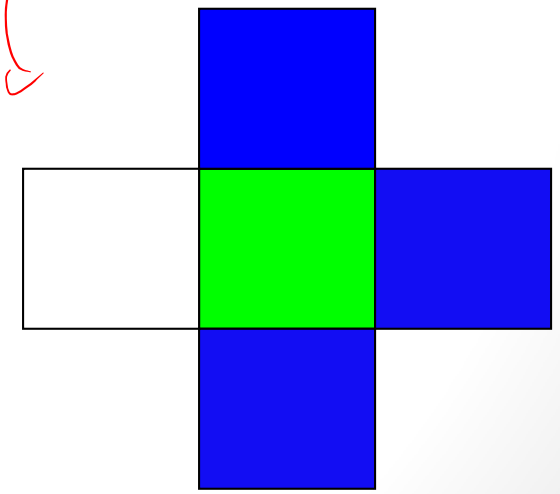


N E W S

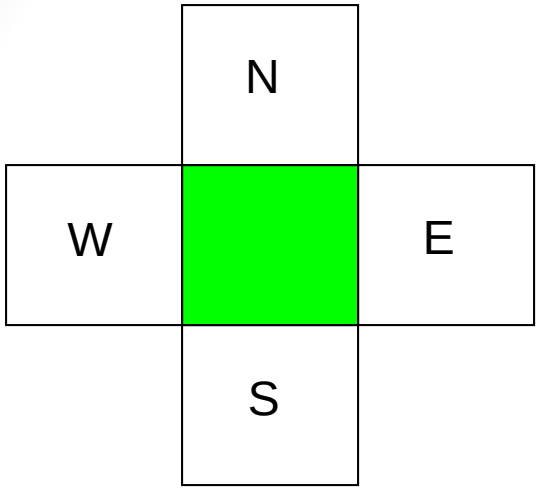
NxWx

N E x S

A. NEWx
B. NExS
C. NxWS
D. xxWx
E. None of these



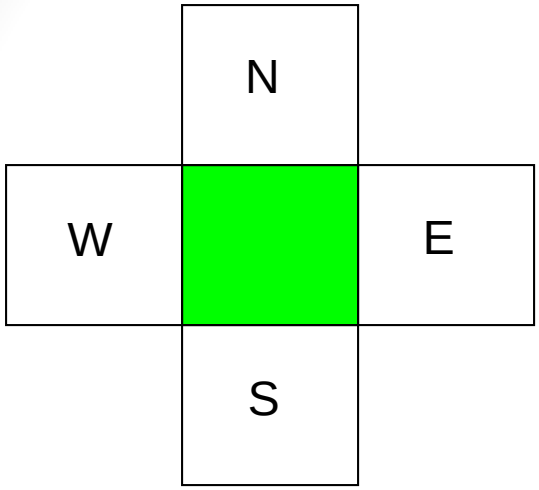
Surroundings



How many distinct surroundings are there?

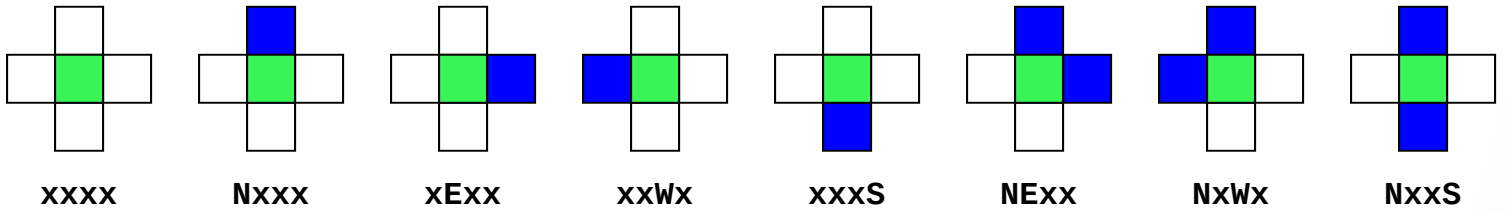
A. 4
B. 8
C. 16
D. 32
E. 128

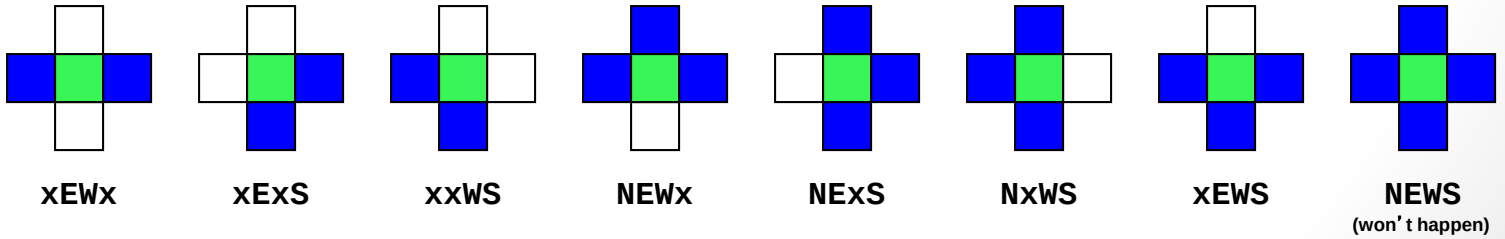
Surroundings



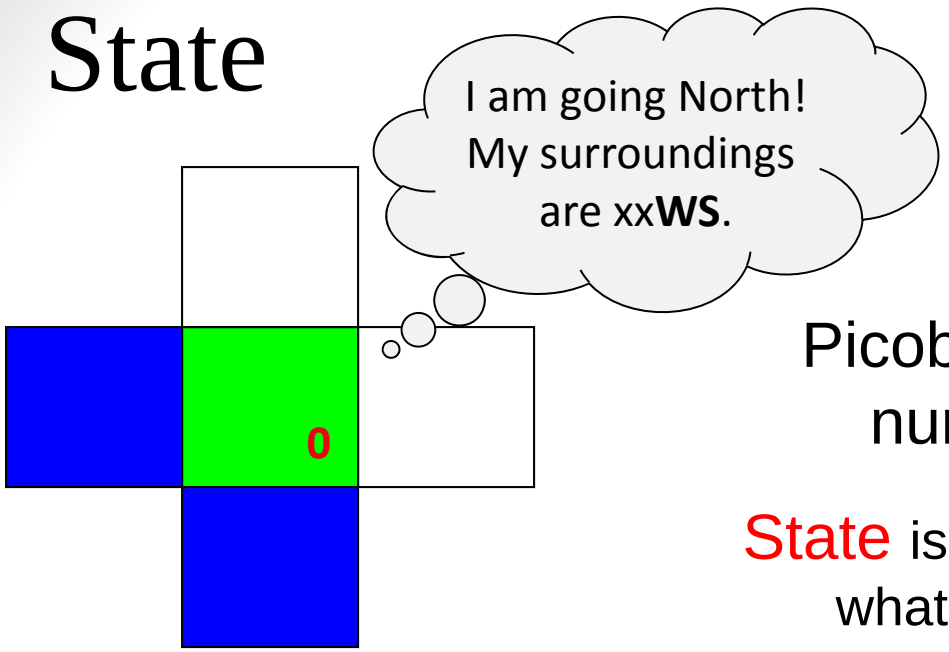
How many distinct surroundings are there?

2^4 == 16 possible …





State



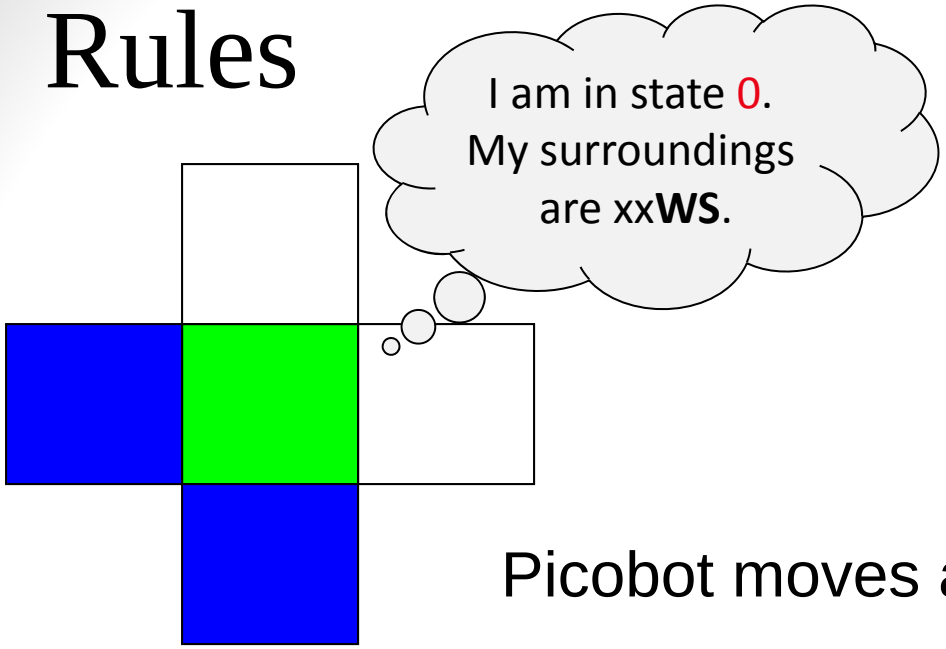
Picobot's memory is a single number, called its state.

State is picobot's way of remembering what has happened in the past!

Picobot always starts in state 0.

State and **`surroundings`** represent everything Picobot knows about the world

Rules

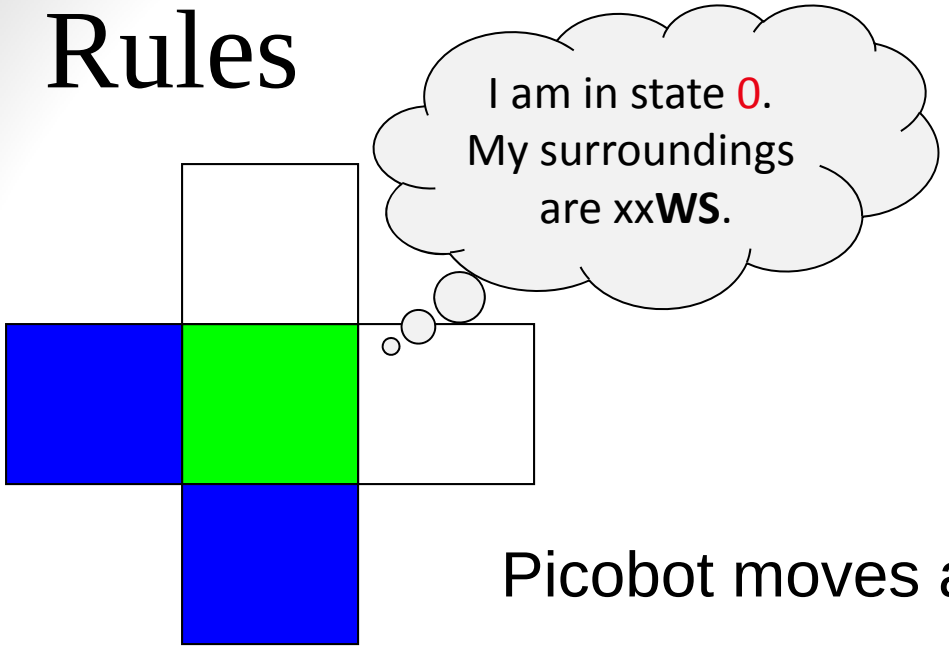


Picobot moves according to a set of rules:

state	surroundings		direction	new state
0	xx**WS**	→	N	0

What does this rule mean? Summarize in your own words.

Rules



Aha!
I should move N.
I should enter state 0.

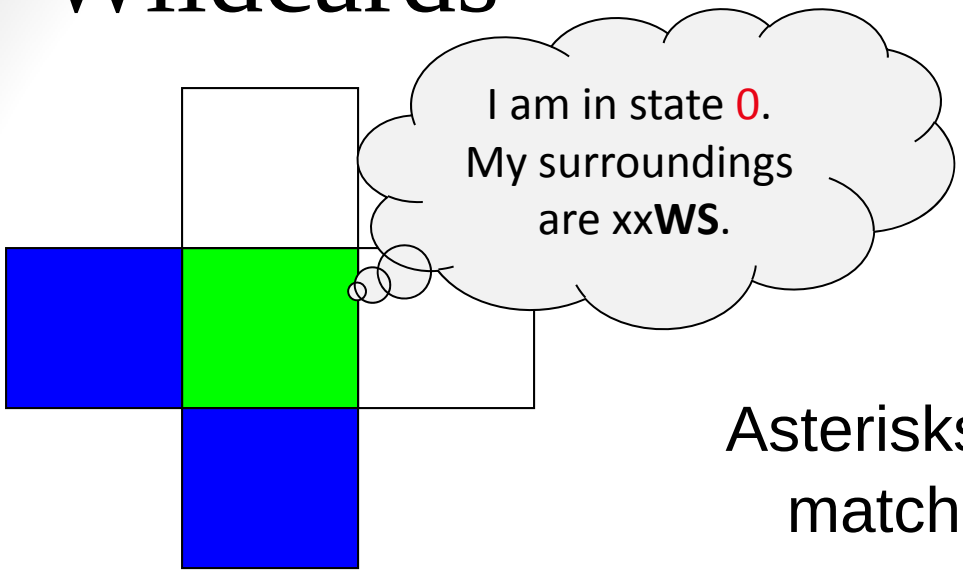
Picobot moves according to a set of rules:

state	surroundings		direction	new state
0	xx**WS**	→	N	0

If I'm in state 0
seeing xx**WS**,

Then I move **N***orth, and*
"change" to state 0*.*

Wildcards



Aha!
This matches the
surroundings x***

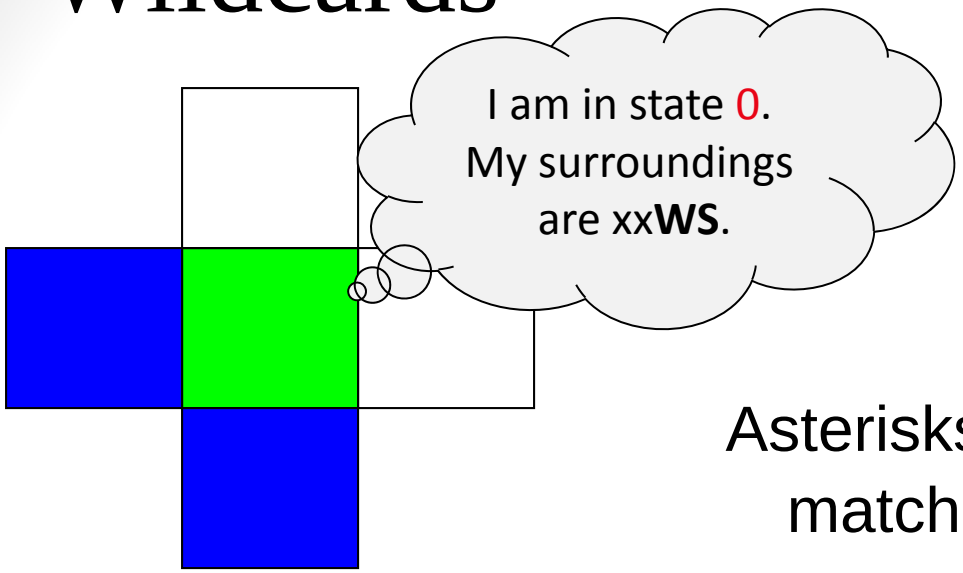
Asterisks * are wild cards. They match walls ***or*** empty space:

state	surroundings		direction	new state
0	x***	→	N	0

N must be empty

EWS may be wall ***or*** empty space

Wildcards



Aha!
This matches the
surroundings x***

Asterisks * are wild cards. They match walls ***or*** empty space:

state	surroundings		direction	new state
0	x***	→	N	0

(1) *What is a program that sends Picobot to the North (top) of the empty room ?*

	state	surroundings		direction	new state
A:	0	**x*****	->	N	0
B:	0	**xEW***	->	N	0
C:	0	**x**x**	->	N	0
D:	0	*****x**	->	S	0

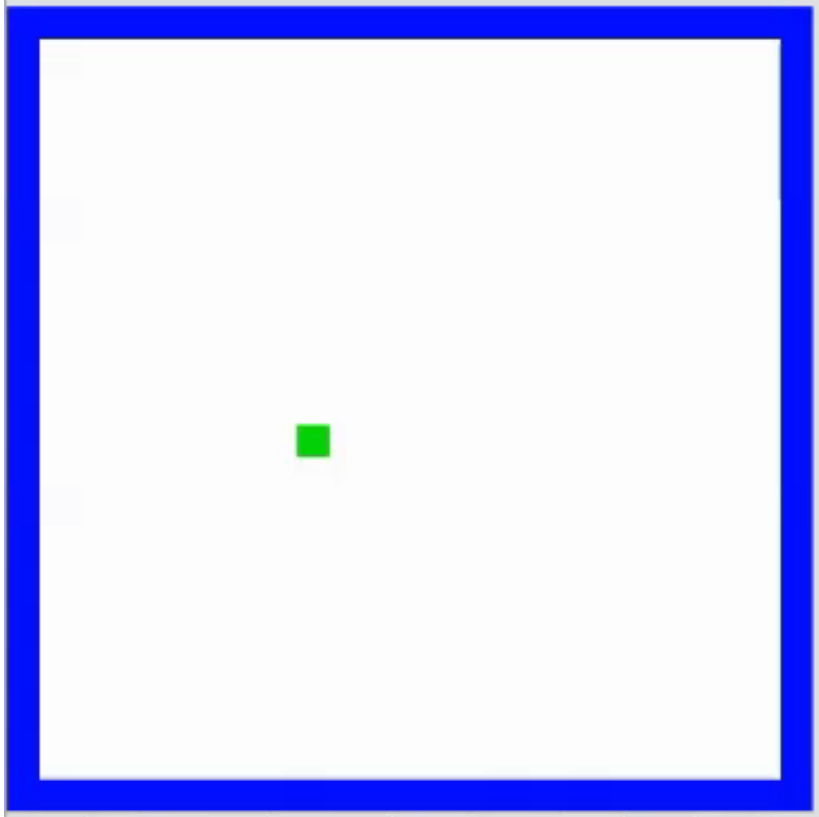
Model

Picobot checks its rules from the top each time.

When it finds a matching rule, that rule runs.

Only one rule is allowed per state and surroundings.

Picobot



Go | Stop | Step | Reset | <-- MAP -->

0	xxxx	528
State	Surroundings	Cells to go

none	none
Previous Rule	Next Rule

Robot - North South

Rules

```
#
# Hashtag lines are optional comments
#

0 x*** -> N 0
```

Enter rules for Picobot

Be sure to hit "Enter rules" after making changes.

Messages

OK

(1) *What is a program that sends Picobot to the North (top) of the empty room ?*

	state	surroundings		direction	new state
	0	x***	->	N	0
A:	0	x***	->	N	1
B:	0	N***	->	N	1
C:	0	N***	->	X	1
D:	0	***x	->	X	1

(2) *stop, don't crash!*

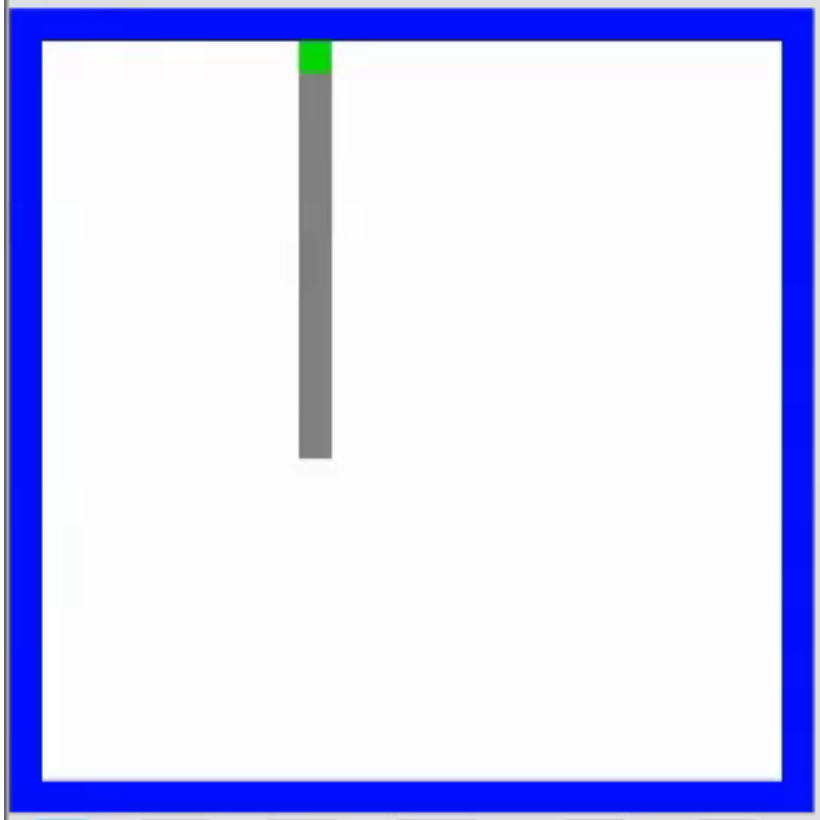
Model

Picobot checks its rules from the top each time.

When it finds a matching rule, that rule runs.

Only one rule is allowed per state and surroundings.

Picobot



Go | Stop | Step | Reset | <-- MAP -->

0	Nxxx	516
State	Surroundings	Cells to go

none	none
Previous Rule	Next Rule

Robot - North | South

Rules

```
#
# Hashtag lines are optional comments
#

0 x*** -> N 0
```

Enter rules for Picobot

Be sure to hit "Enter rules" after making changes.

Messages

```
No rule for state 0 and surr Nxxx
Stopping.
```

(1) *What is a program that sends Picobot to the North (top) of the empty room ?*

state	surroundings		direction	new state
0	x***	->	N	0
0	N***	->	X	1

(2) *stop, don't crash!*

1	~~x x x x~~	->	S	1
1	***S	->	X	0

(3) *How could we get back down?*

(4) *And continue…?*

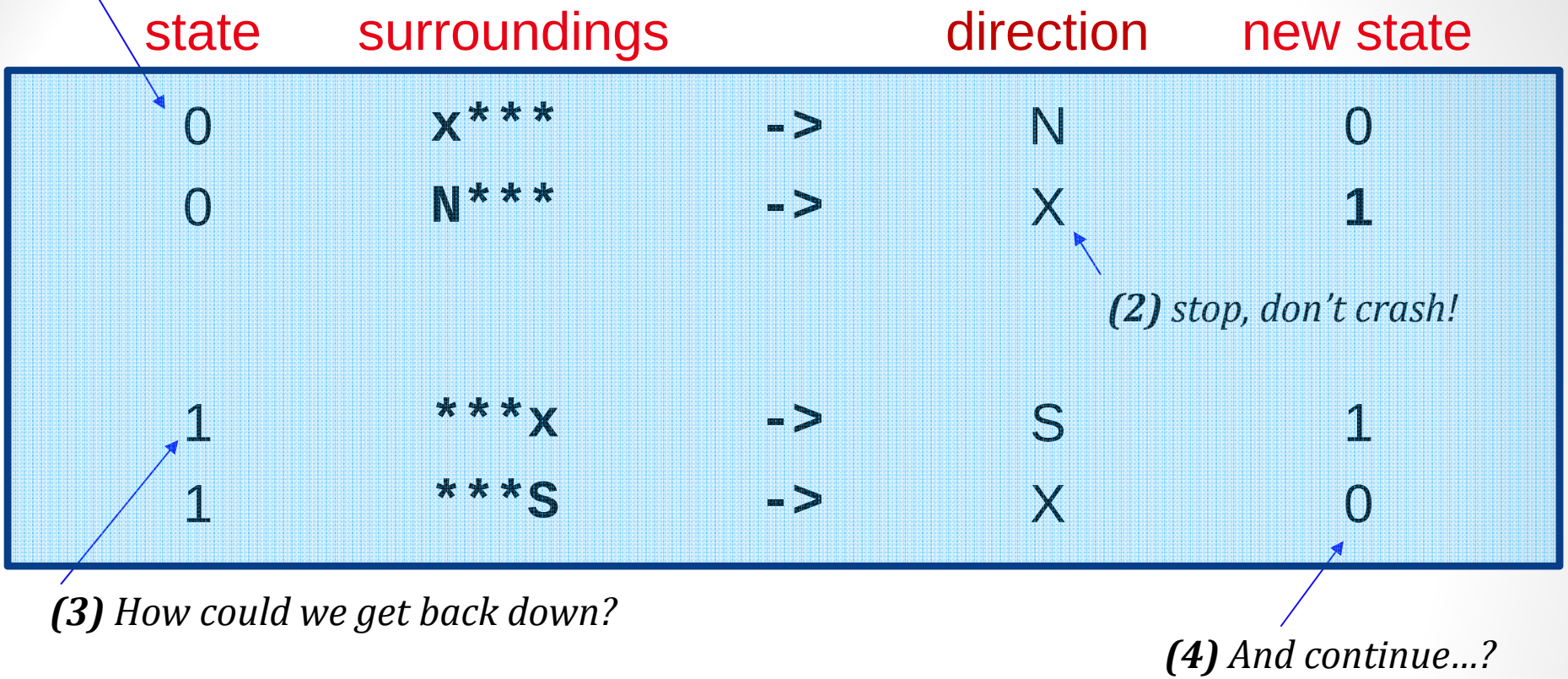
Model

Picobot checks its rules from the top each time.

When it finds a matching rule, that rule runs.

Only one rule is allowed per state and surroundings.

(1) *What is a program that sends Picobot to the North (top) of the empty room ?*



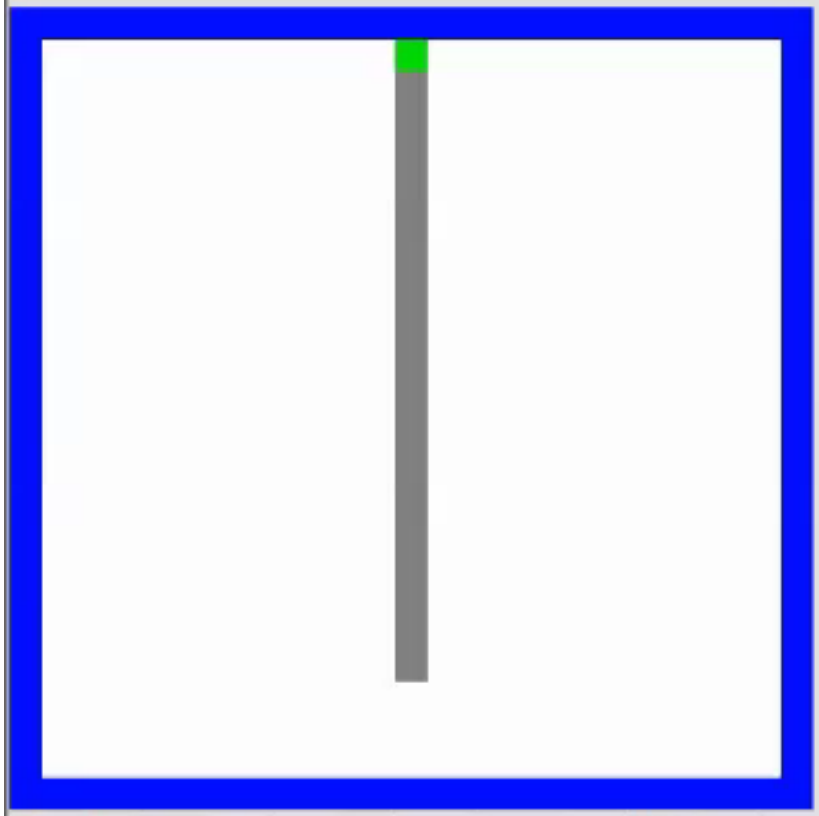
Model

Picobot checks its rules from the top each time.

When it finds a matching rule, that rule runs.

Only one rule is allowed per state and surroundings.

Picobot



Go | Stop | Step | Reset | <-- MAP -->

State	Surroundings	Cells to go
1	Nxxx	509

Previous Rule	Next Rule
none	none

Picobot Robot - North | South

Rules

```
#
# Hashtag lines are optional comments
#

0 x*** -> N 0

0 N*** -> X 1

1 ***x -> S 1

1 ***S -> X 0
```

Enter rules for Picobot

Be sure to hit "Enter rules" after making changes.

Messages

```
No rule for state 1 and surr Nxxx
Stopping.
```

Issues

state	surroundings		direction	new state
0	**x*****	->	N	0
0	**N*****	->	X	1
0	**N*W***	->	S	0
1	**N*****	->	S	1
1	**x**S**	->	S	0

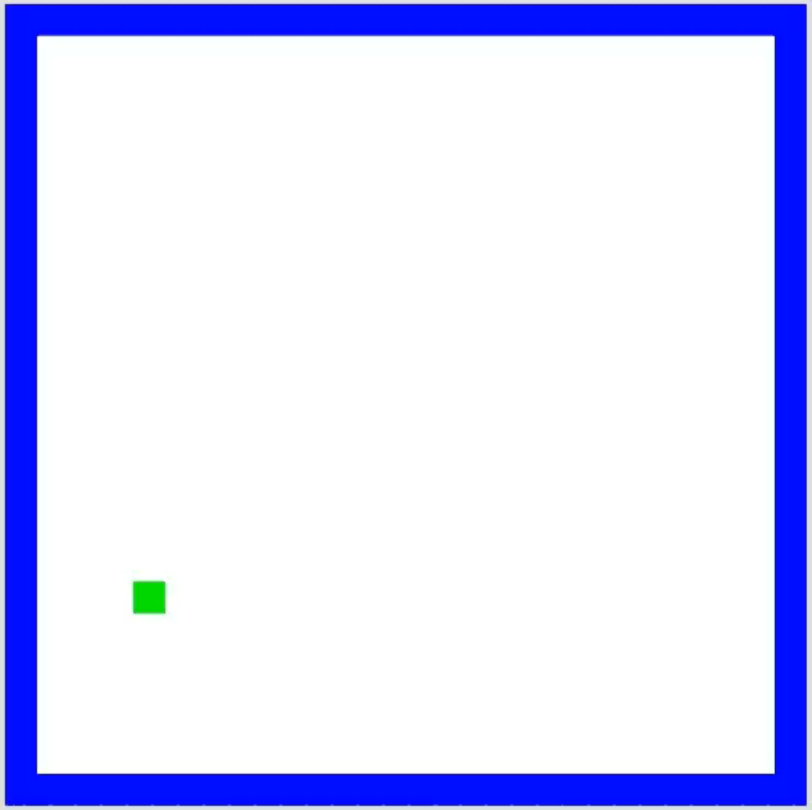
Issues

state	surroundings		direction	new state
0	**x*****	->	N	0
0	**N*****	->	X	1
0	**N*W***	->	S	0
1	**N*****	->	S	1
1	**x**S**	->	S	0

1 x**x not defined

0 N*W* defined twice

Go south when it is blocked



Go | Stop | Step | Reset | <-- | MAP | -->

0	xxxx	528
State	Surroundings	Cells to go

1 X**S -> S 0	1 X**S -> S 0
Previous Rule	Next Rule

West | East | - Teleport Robot - | North | South

Rules

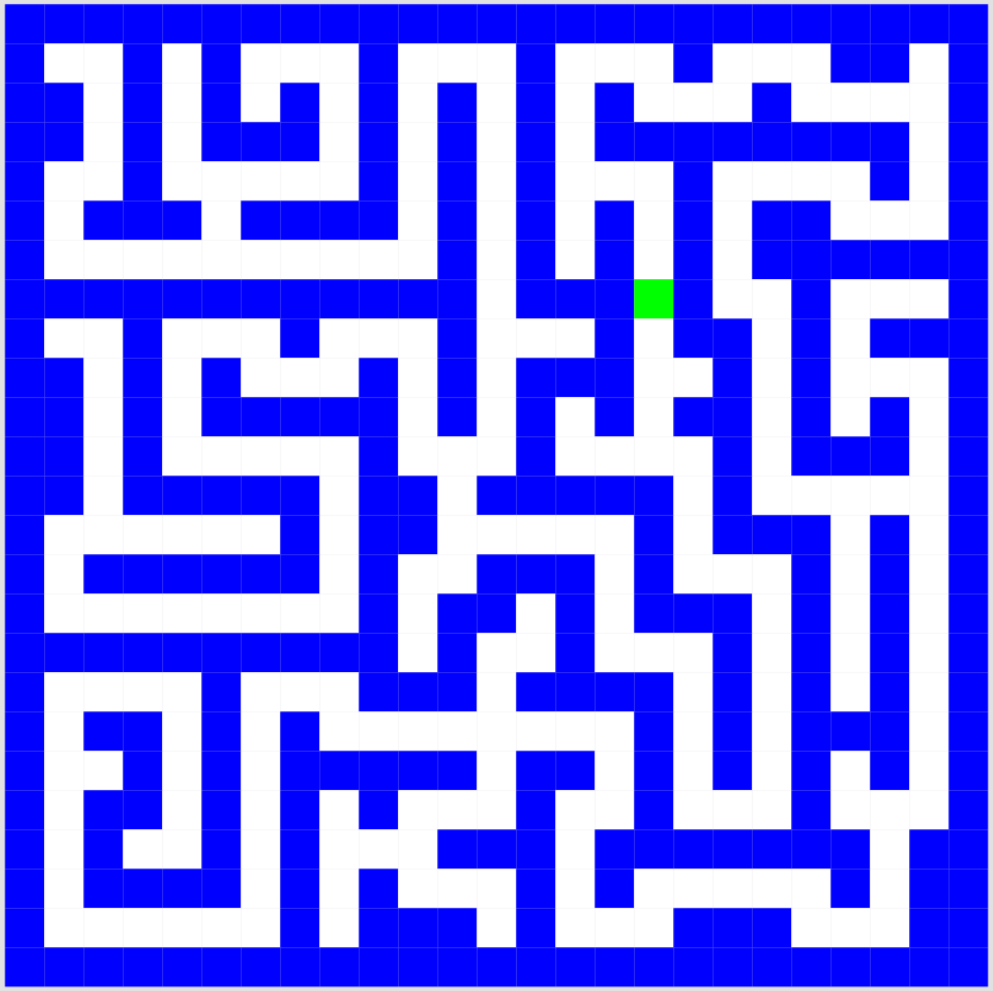
```
#
# Hashtag lines are optional comments
#

0 x*** -> N 0
0 N*** -> X 1
0 N*W* -> S 0
1 N*** -> S 1
1 x**S -> S 0
```

Enter rules for Picobot

Be sure to hit "Enter rules" after making changes.

Messages

```
OK
```



Go | Stop | Step | Reset | <-- | MAP | -->

0	xEWx	279
State	Surroundings	Cells to go

Previous Rule | Next Rule

West | East | - Teleport Robot - | North | South

Picobot

Rules

```
#
# Hashtag lines are optional comments
#

# state 0 with nothing N: go one step N
0 x*** -> N 0

# state 0 with something to the N: go W + into st 1
# ** This will crash if picobot has a wall to the W! **
0 N*** -> W 1


# state 1 with nothing to the S: go one step S
1 ***x -> S 1

# state 1 with something to the S: stay put + into state 0
1 ***S -> X 0
```

Enter rules for Picobot

Be sure to hit "Enter rules" after making changes.

Messages

```
OK
```