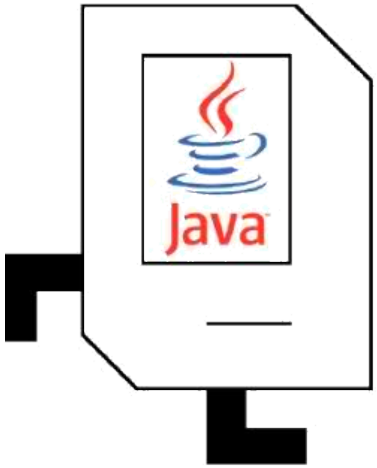
CS 106A, Lecture 2
Programming with Karel

suggested reading:

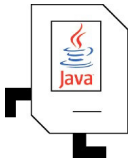
Karel, Ch. 3-4

Plan For Today

- Announcements
- (Re)Meet Karel the Robot
- Control Flow
  - For loops
  - While loops
  - If/else statements



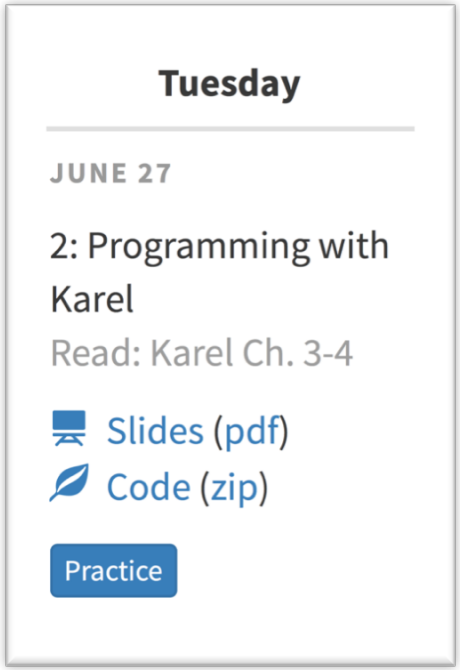
Plan For Today

- Announcements 

- (Re)Meet Karel the Robot
- Control Flow
  - For loops
  - While loops
  - If/else statements

Announcements

- Section assignments
- Office Hours
- Karel Handout (#3)
- Lecture Feedback
- Extra Practice



Plan For Today

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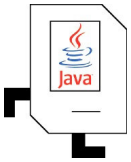
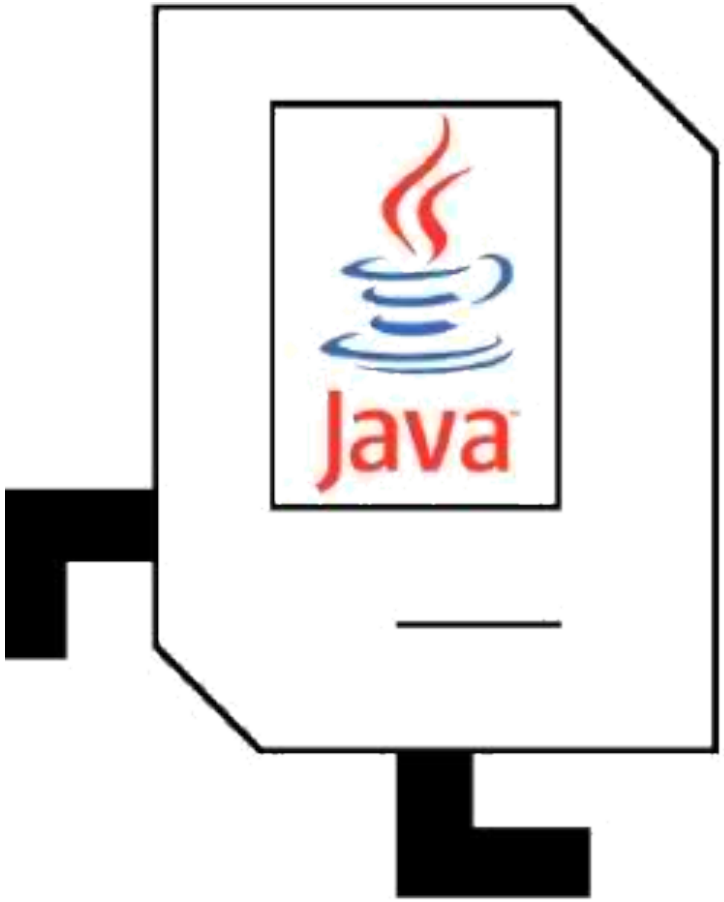
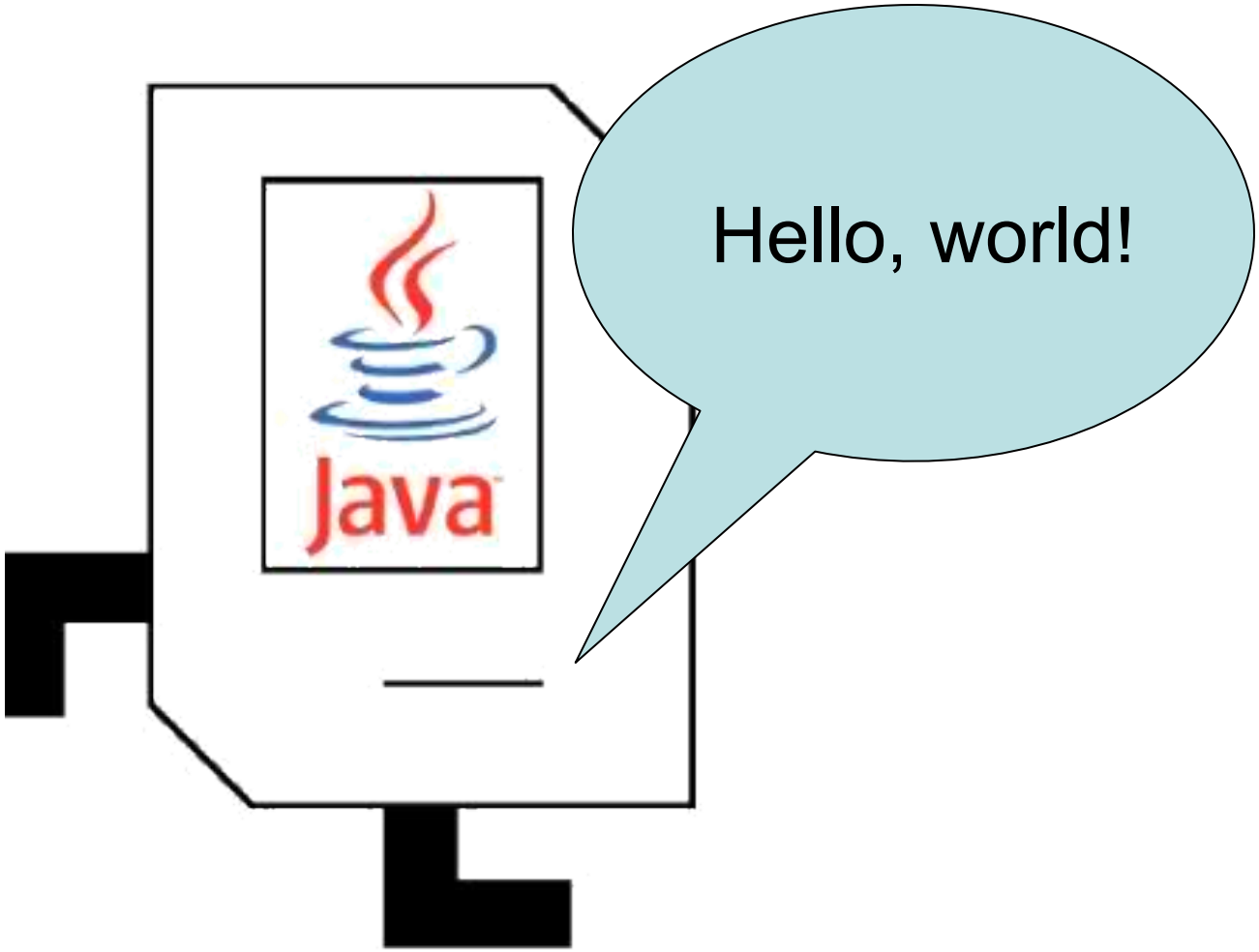
- (Re)Meet Karel the Robot 

- Control Flow
  - For loops
  - While loops
  - If/else statements

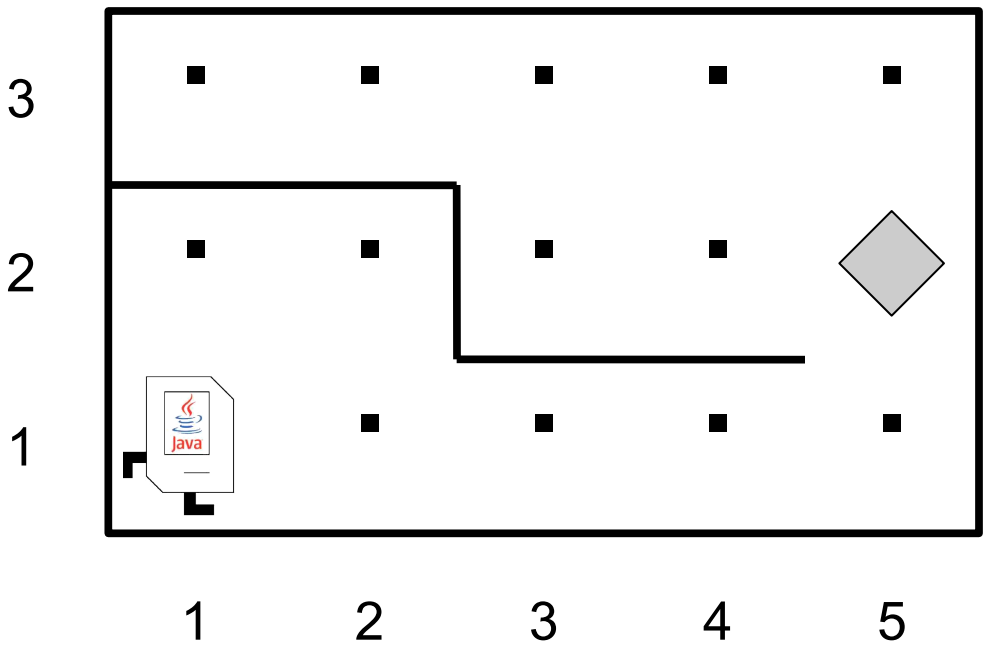
Meet Karel the Robot!



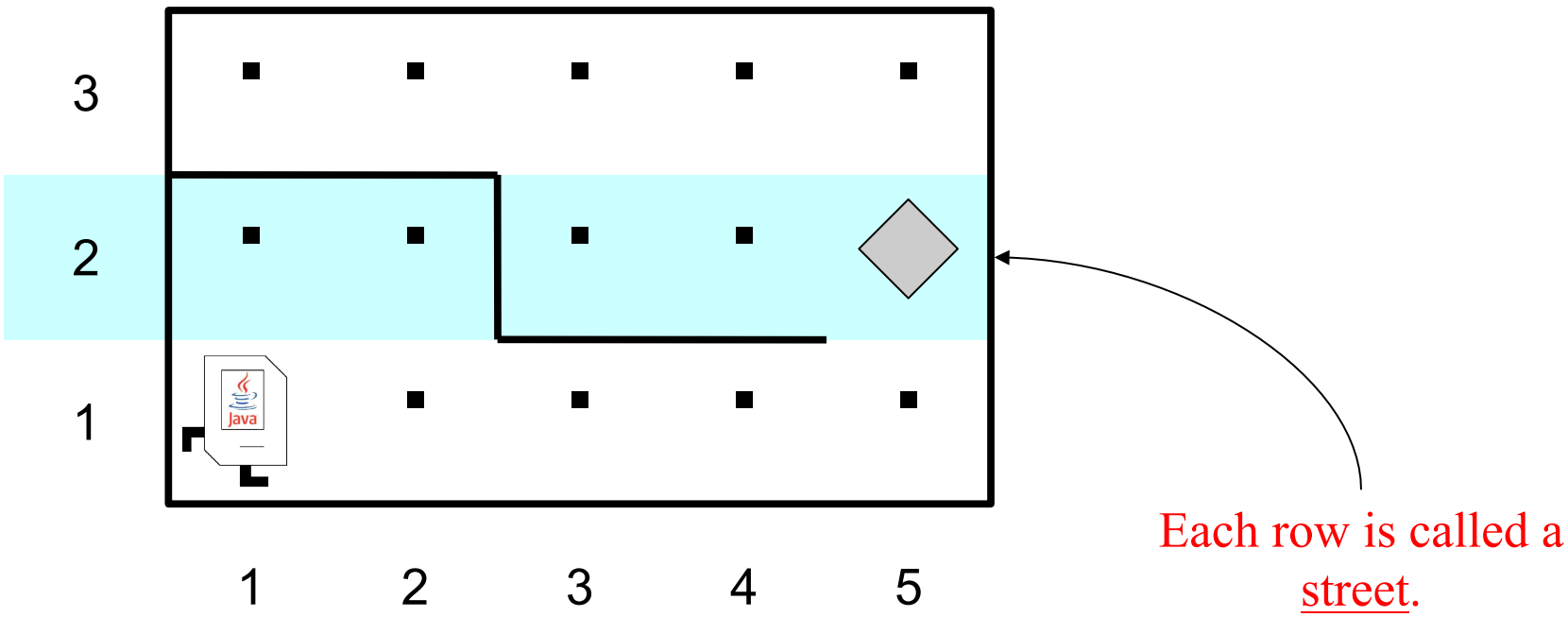
Meet Karel the Robot!



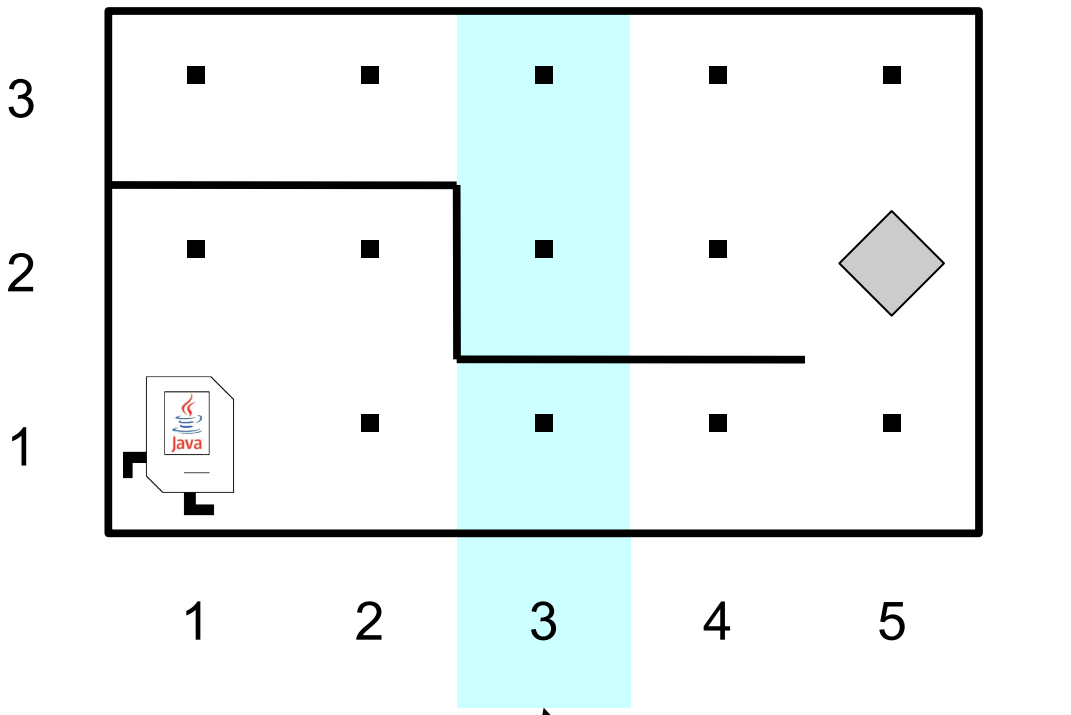
Karel's World



Streets (rows)

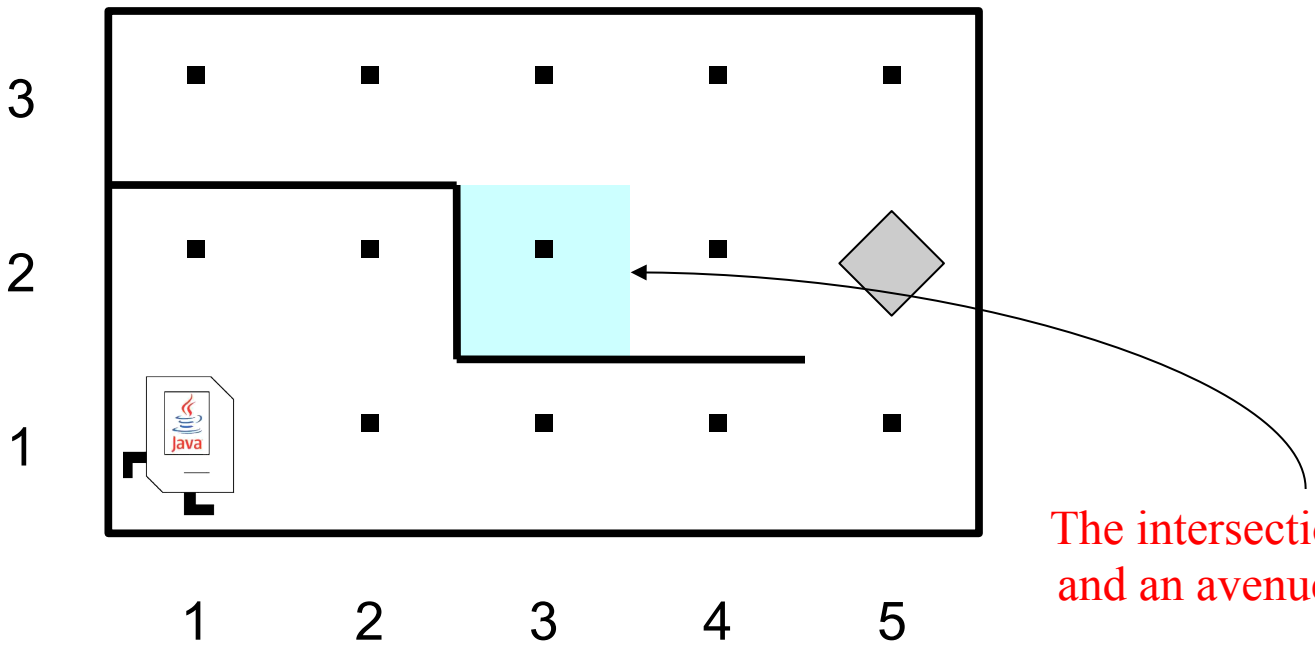


Avenues (columns)



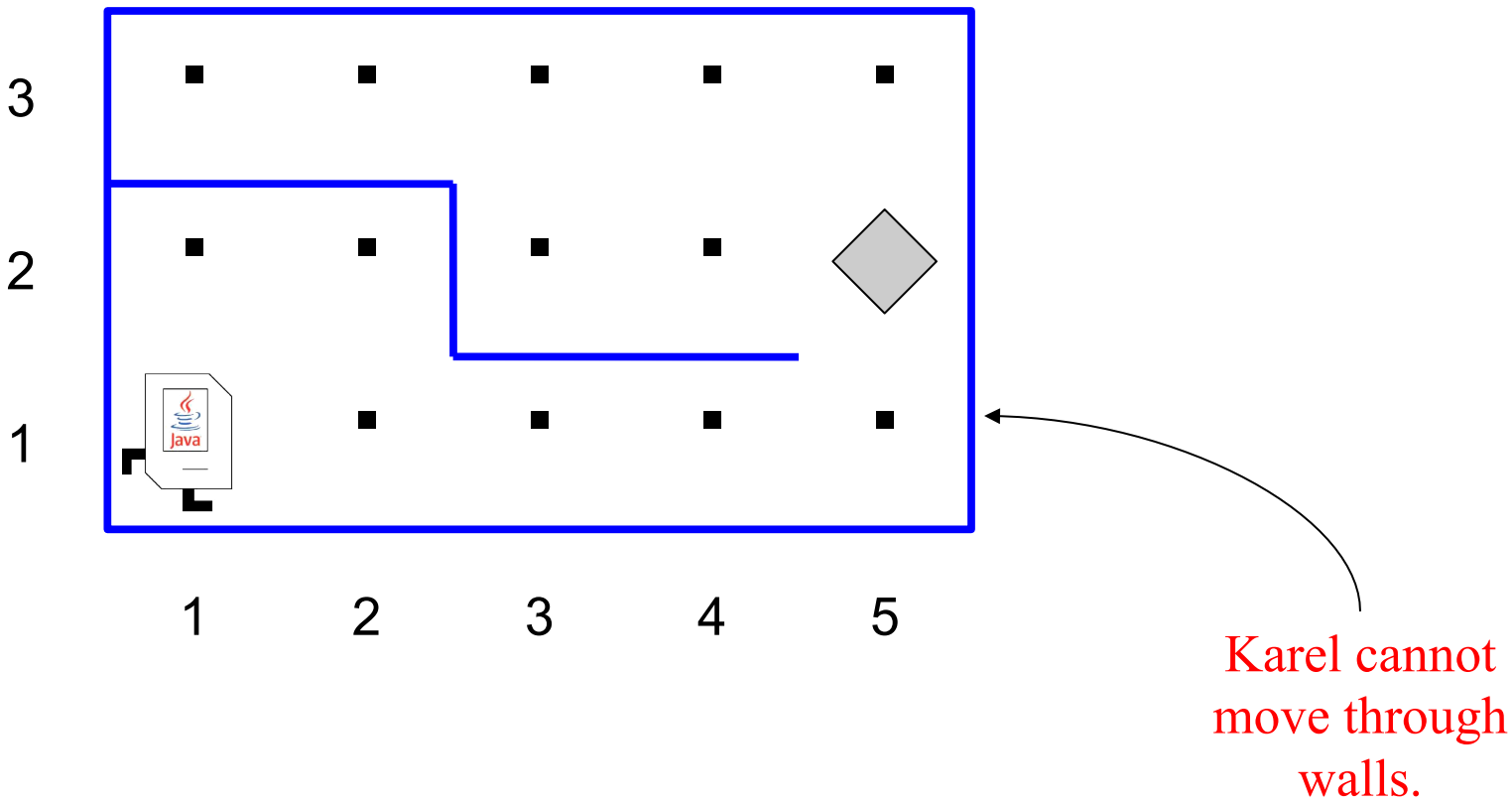
Each column is called an avenue.

Corners (locations)

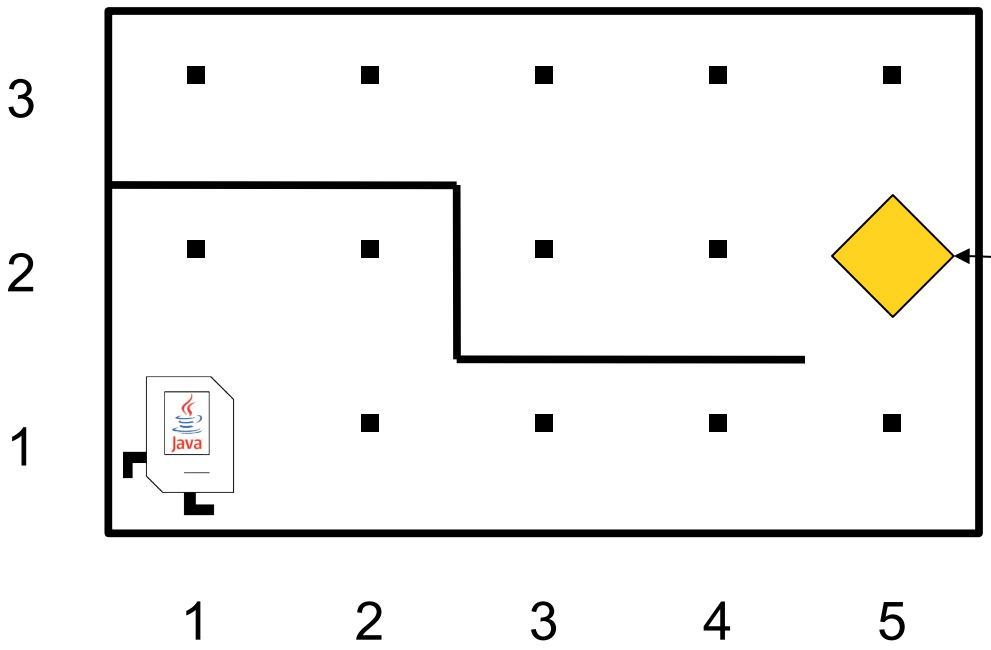


The intersection of a street and an avenue is a corner.

Walls



Beepers



Beepers mark locations in Karel's world. Karel can pick them up and put them down.

Karel Knows 4 Commands

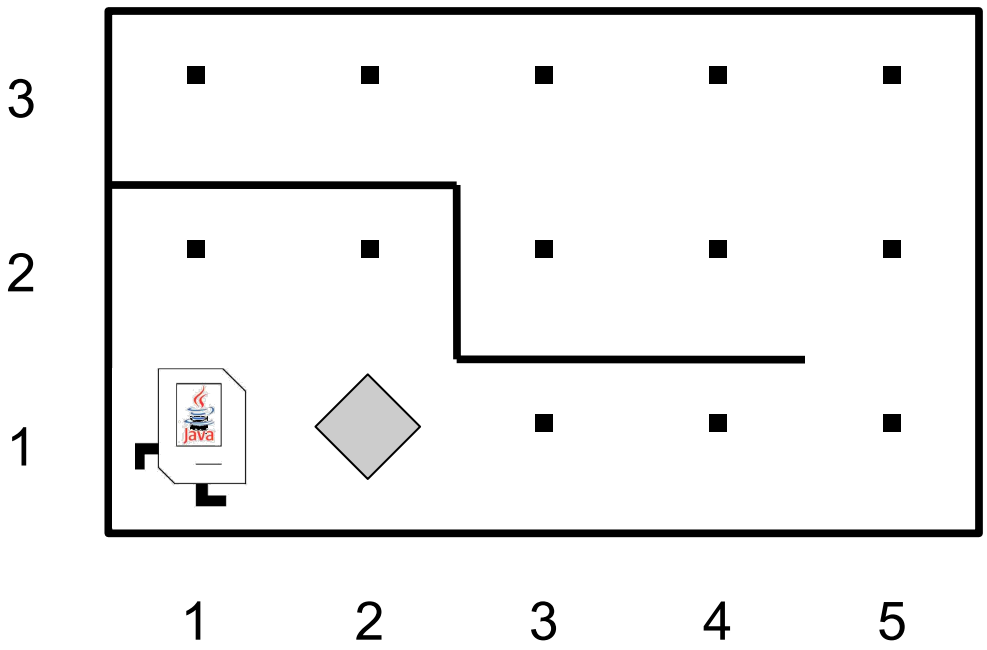
```
move

turnLeft

putBeeper

pickBeeper
```

Karel Knows 4 Commands

```
move
turnLeft
putBeeper
pickBeeper
```

"methods"

Commands: move



Karel Commands

`move`

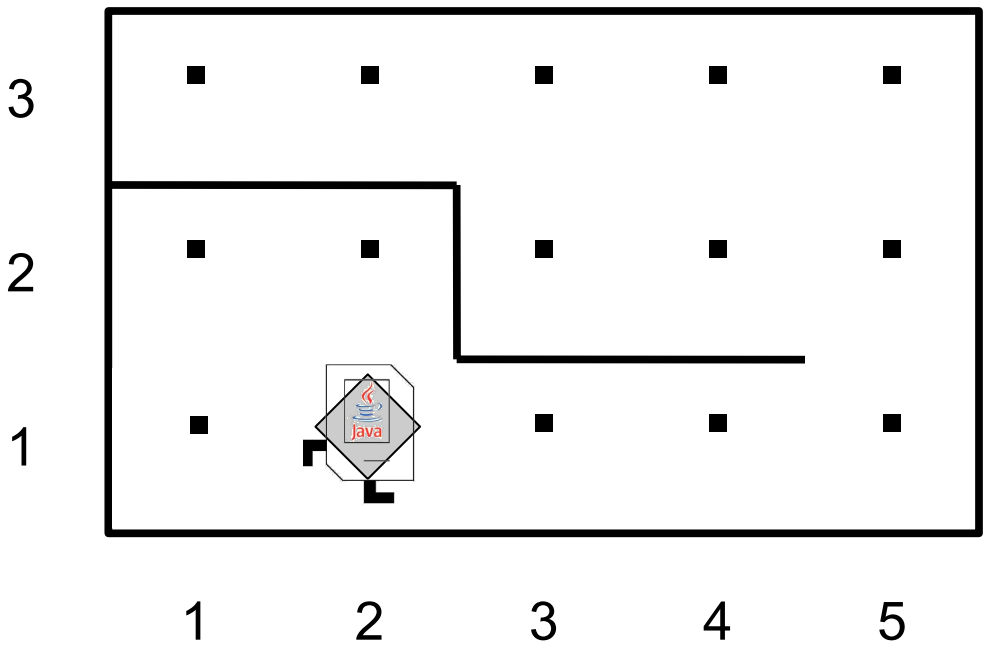
`turnLeft`

`pickBeeper`

`putBeeper`

– `move` makes Karel move forward one square in the direction it is facing.

Commands: move



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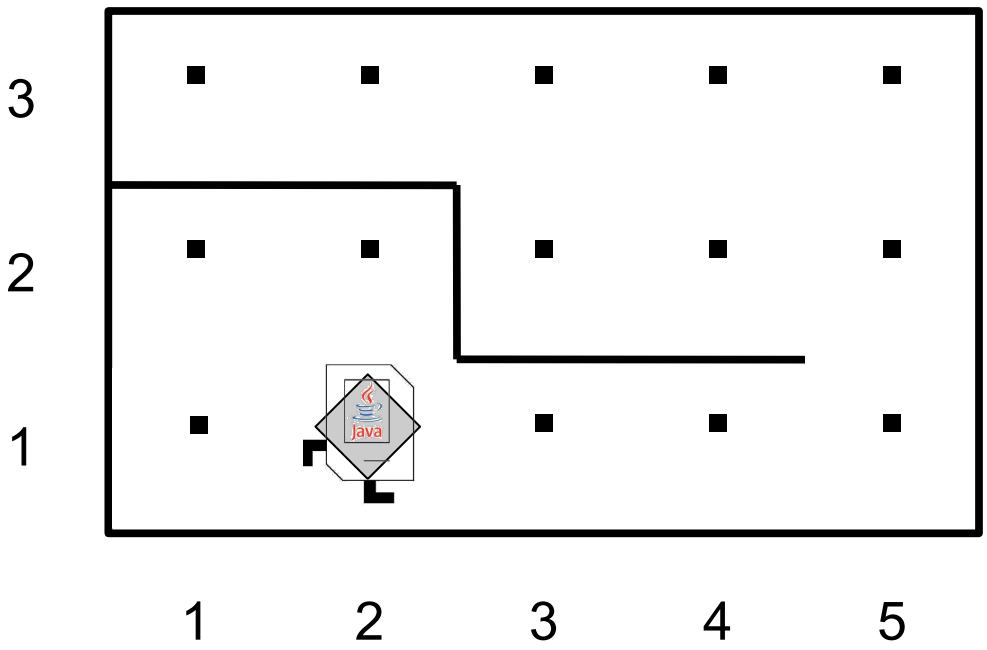
Commands: turnLeft

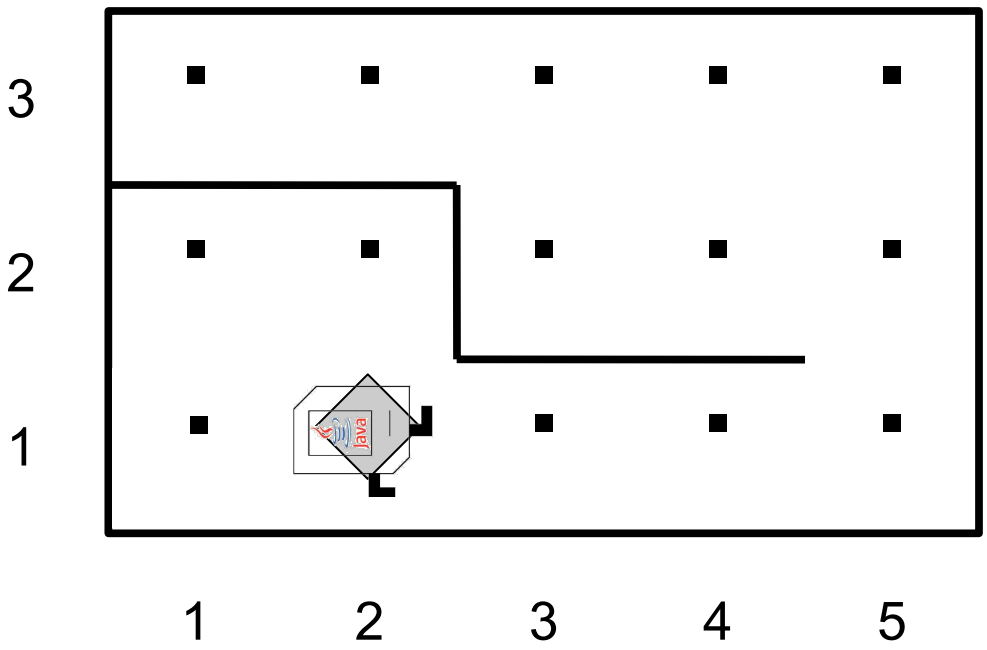


Karel Commands

`move`
`turnLeft`
`pickBeeper`
`putBeeper`

- `turnLeft` makes Karel rotate 90° counter-clockwise.
- There is no `turnRight` command. (Why not?)

Commands: turnLeft



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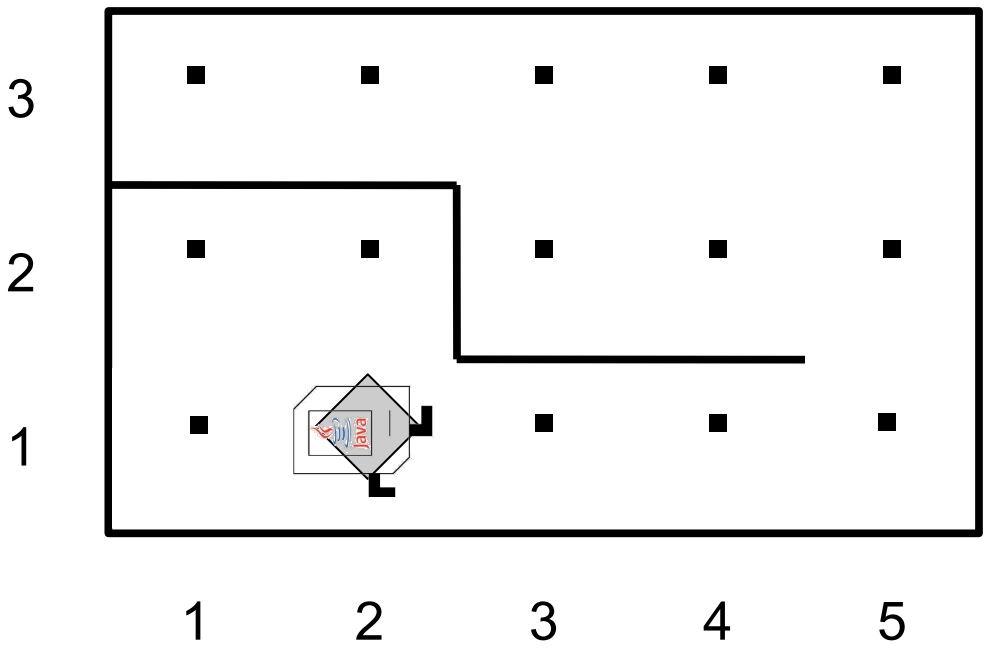


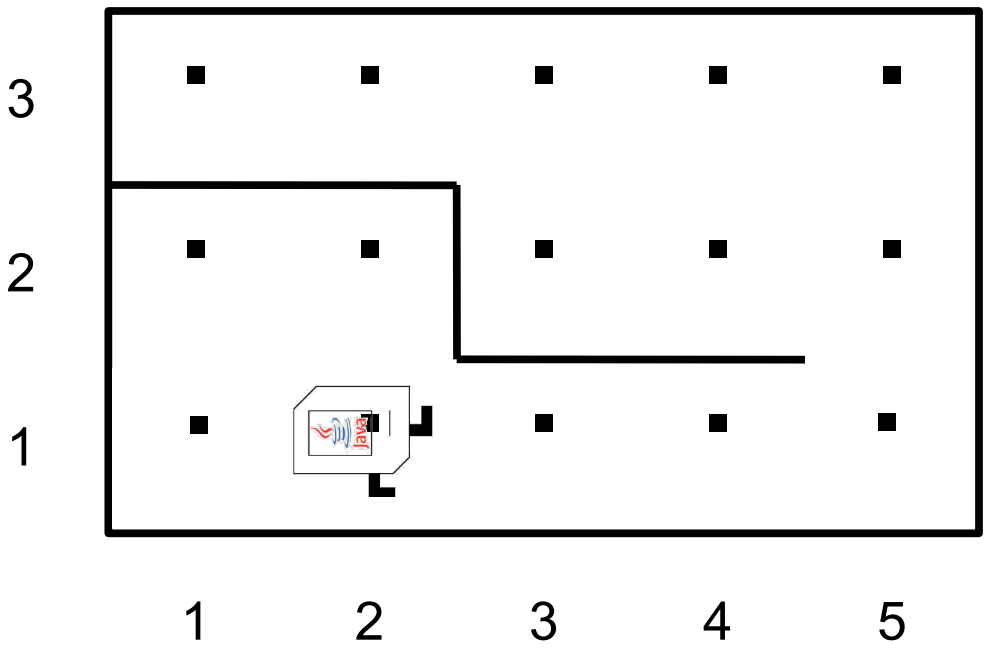
Karel Commands

---

move
turnLeft
pickBeeper
putBeeper

- `pickBeeper` makes Karel pick up the beeper at the current corner. Karel can hold multiple beepers at a time in its "beeper bag".

Commands: pickBeeper



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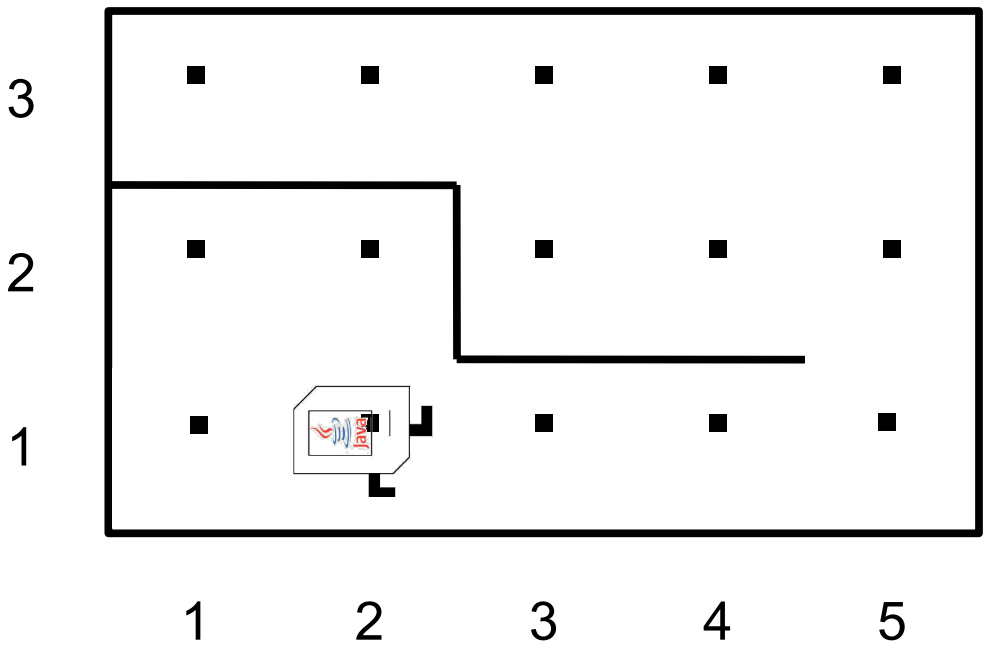
Commands: putBeeper



Karel Commands

`move`
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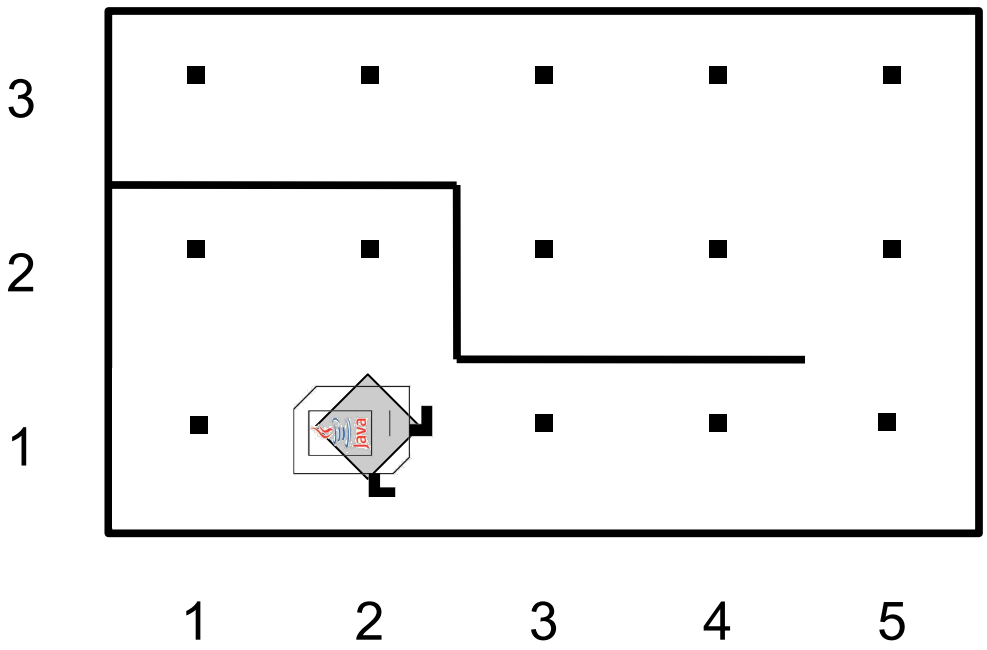
`pickBeeper`
`putBeeper`

- `putBeeper` makes Karel put a beeper down at its current location.
  - `pickBeeper` and `putBeeper` are used to move beepers around.

Commands: putBeeper



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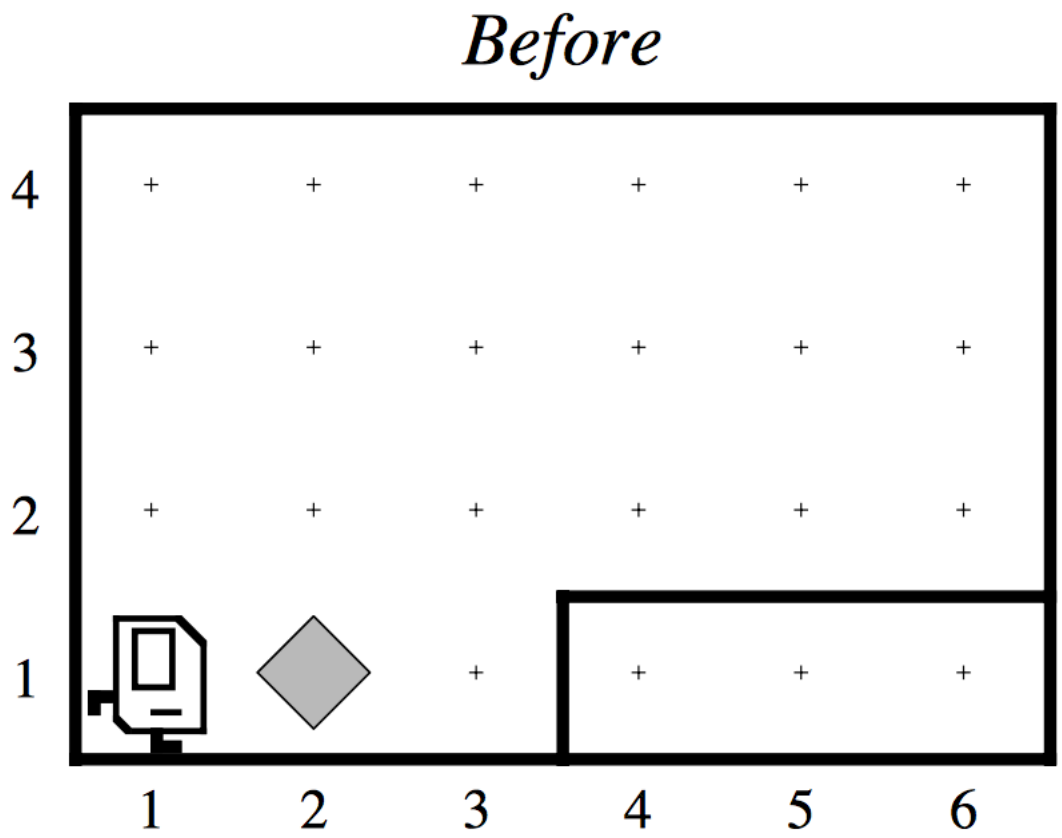
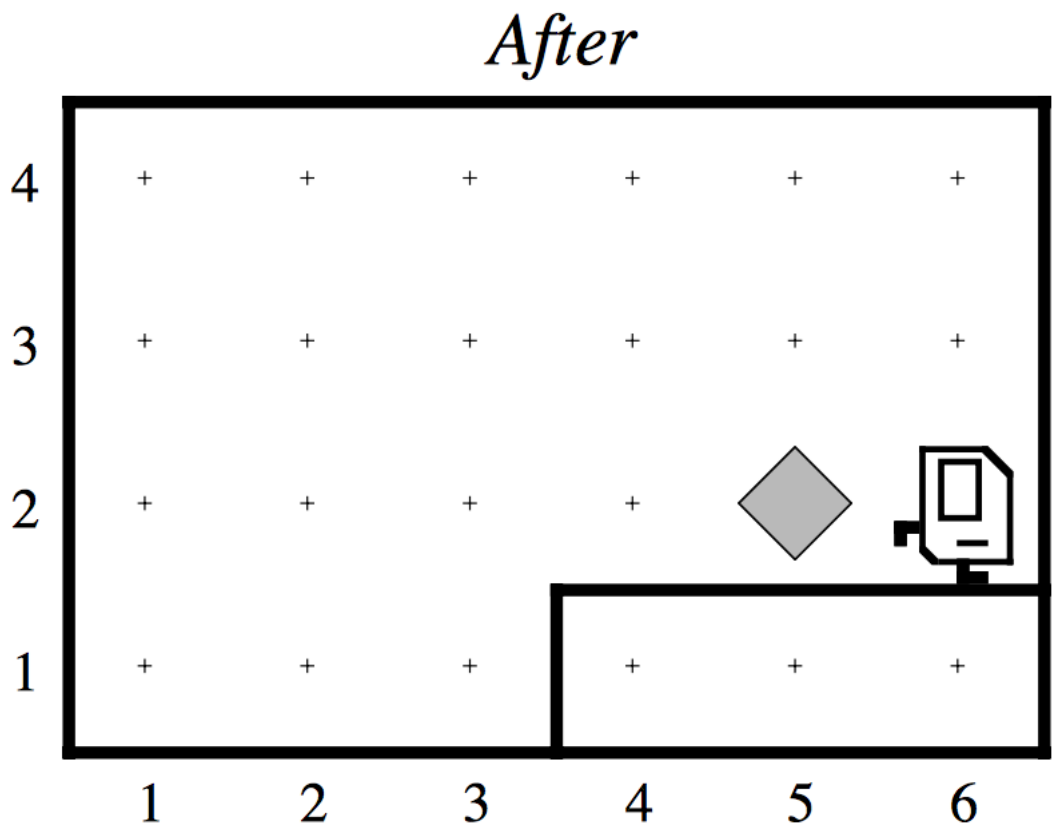
Our First Karel Program



Our First Karel Program



Demo

Defining New Commands

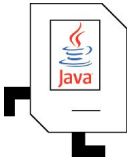
We can make new commands (or **methods**) for Karel. This lets us *decompose* our program into smaller pieces that are easier to understand.

```
private void name() {
      statement;
      statement;
      ...
}
```

For example:

```
private void turnRight() {
      turnLeft();
      turnLeft();
      turnLeft();
}
```

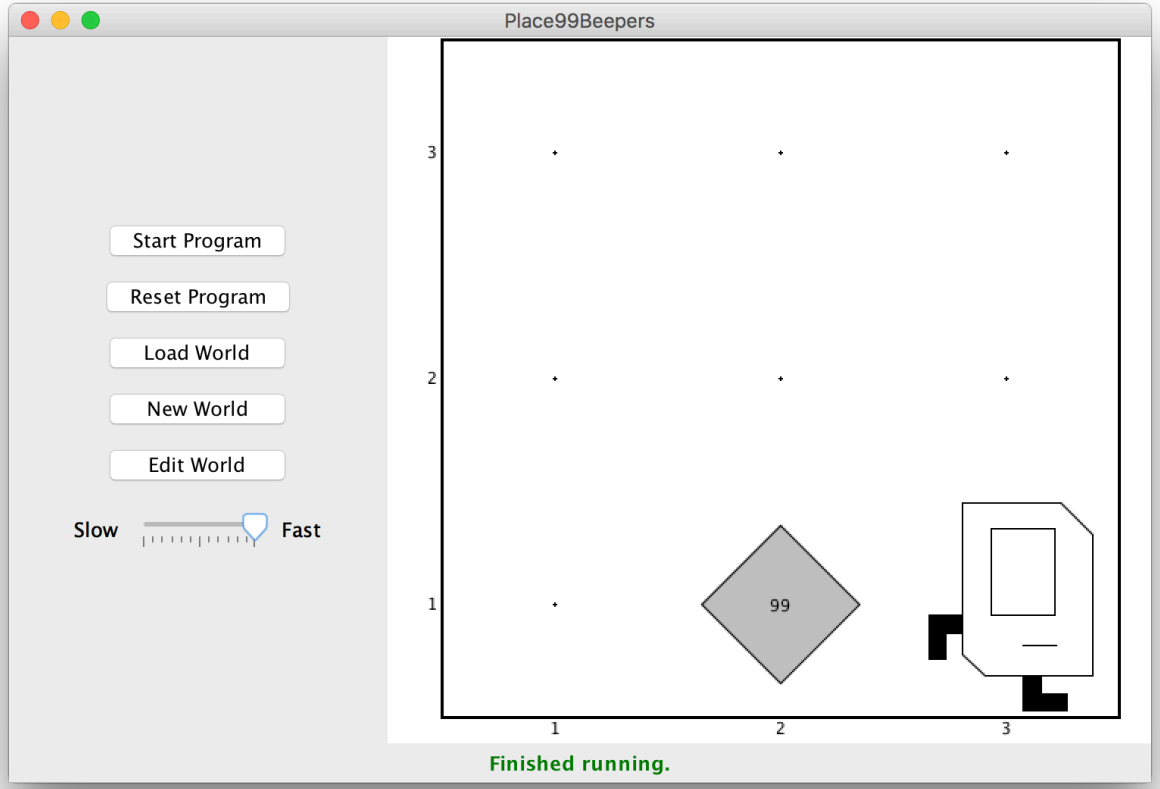
Plan For Today

- Announcements
- (Re)Meet Karel the Robot
- Control Flow
  - For loops 

  - While loops
  - If/else statements

Control Flow: For Loops

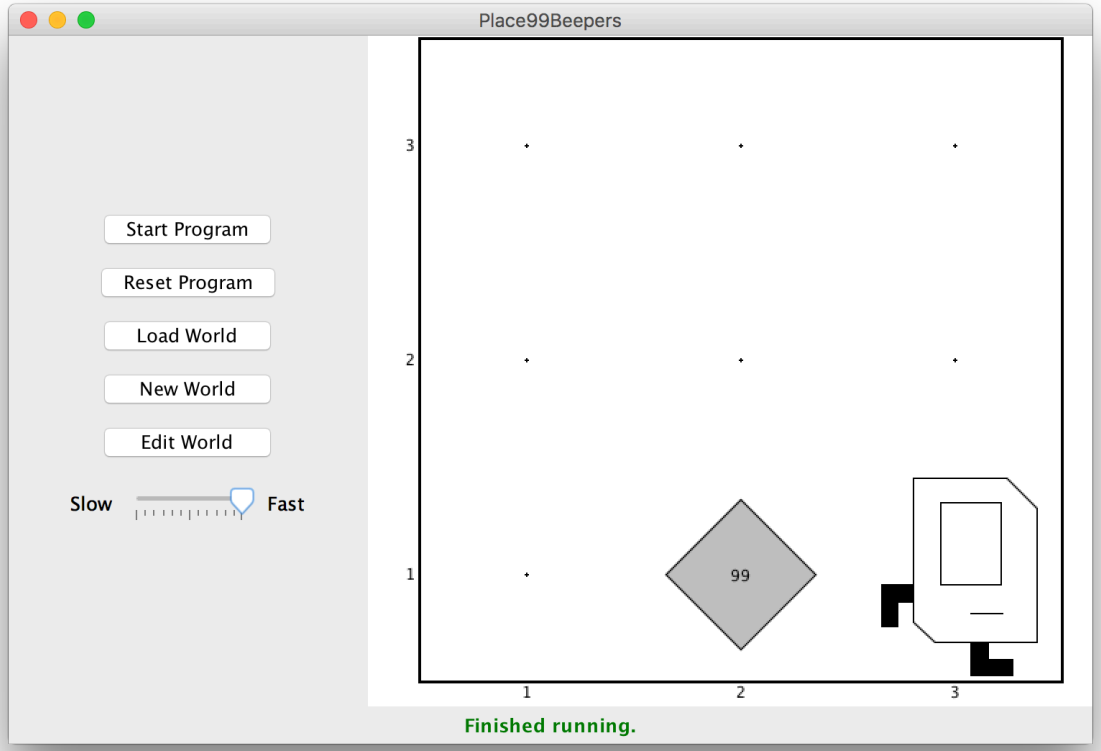
- I want to make Karel put 99 beepers down on a corner. How do I do this?



Control Flow: For Loops

Can't just say:

```
move();
putBeeper();
putBeeper();
putBeeper();
...
move();
```



This is too repetitive! Plus, it's difficult to change (e.g. to 25 beepers).

Control Flow: For Loops

Instead, use a **for** loop:

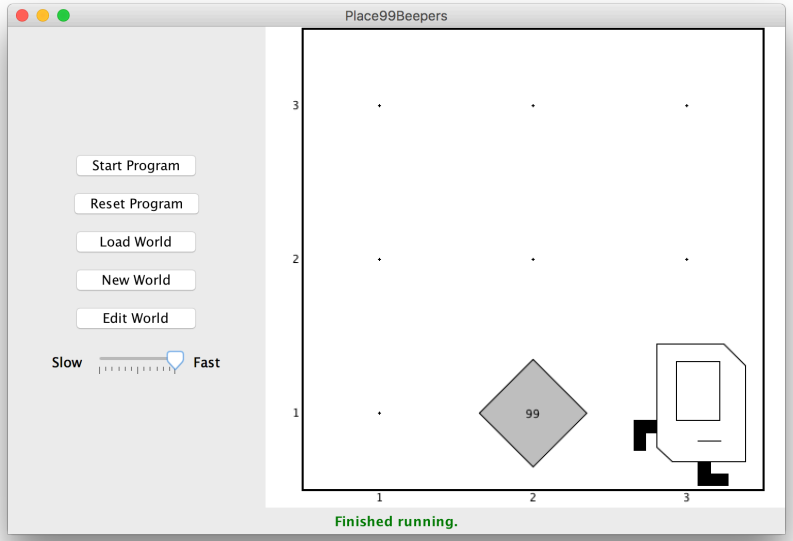
```
for (int i = 0; i < max; i++) {
    statement;
    statement;
    ...
}
```

Repeats the statements in the body ***max*** times.

Control Flow: For Loops

Now we can say:

```
move();
for (int i = 0; i < 99; i++) {
    putBeeper();
}
move();
```



This is less repetitive, and is easier to change (e.g. to 25 beepers).

Control Flow: For Loops

Some examples of using **for** loops:

```
// turns Karel right
for (int i = 0; i < 3; i++) {
     turnLeft();
}

// Moves Karel in a square
for (int i = 0; i < 4; i++) {
     move();
     turnLeft();
}
```

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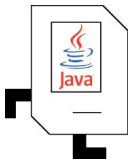
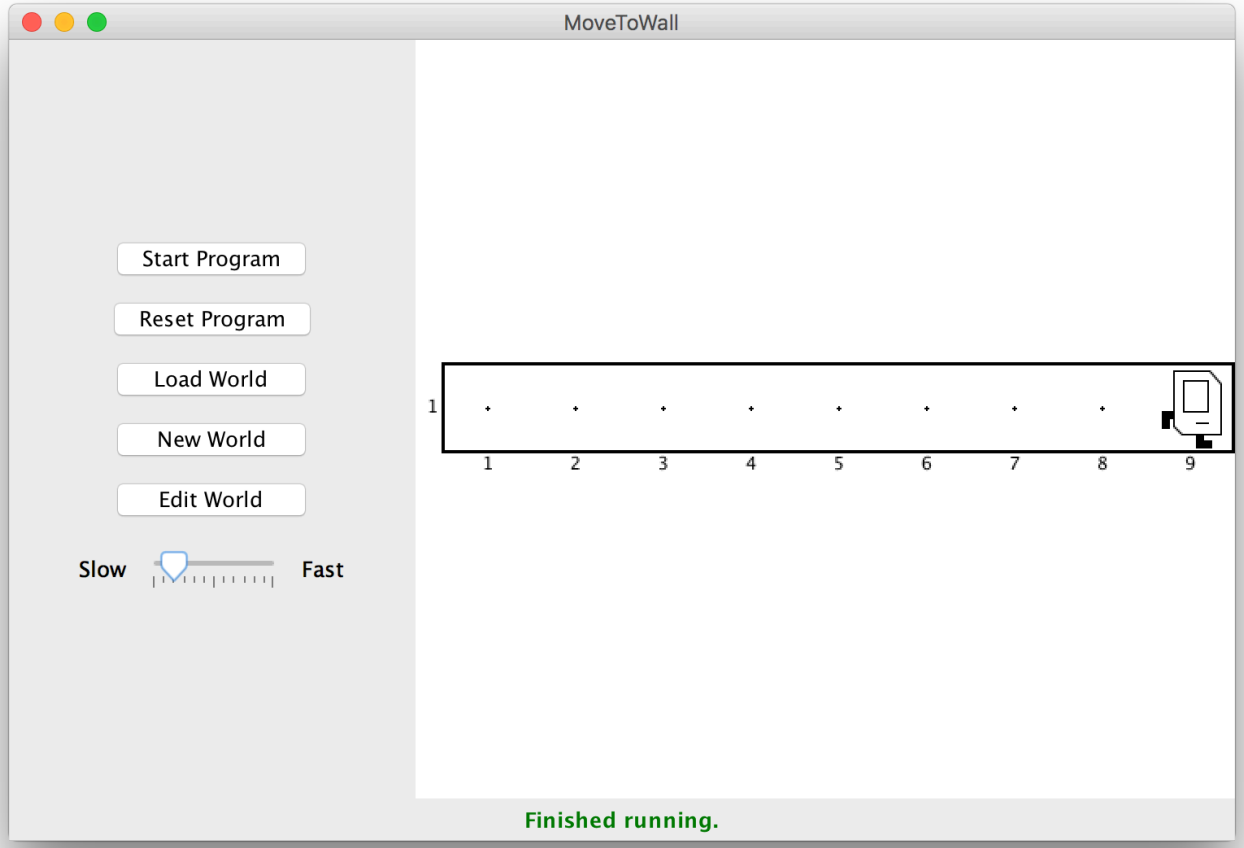
  - While loops 

  - If/else statements

Control Flow: While Loops

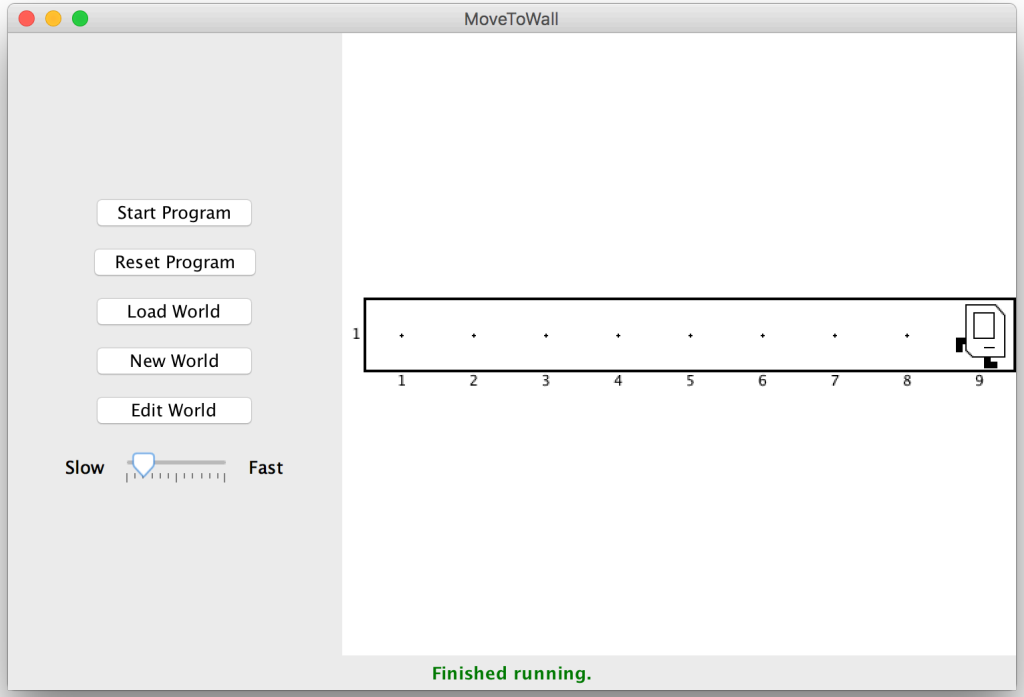
- I want Karel to move until it gets to a wall. How do I do this?



Control Flow: While Loops

Can't just say:

```
move();
move();
move();
move();
...
```



This is too repetitive! Also, we might not know how far away a wall is. Plus, we want our program to be as *generalized* as possible and work in many different worlds.

Control Flow: While Loops

Instead, use a **while** loop:

```
while (condition) {
    statement;
    statement;
    ...
}
```

Repeats the statements in the body until ***condition*** is no longer true.

Each time, Karel executes *all statements*, and **then** checks the condition.

Possible Conditions

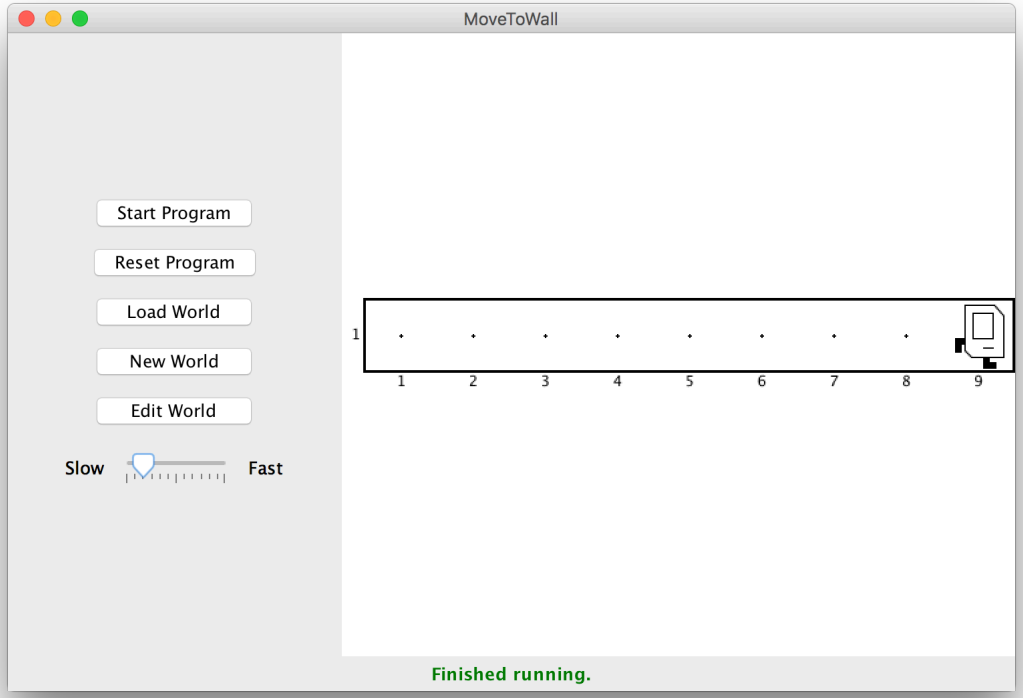
Test	*Opposite*	*What it checks*
`frontIsClear()`	`frontIsBlocked()`	Is there a wall in front of Karel?
`leftIsClear()`	`leftIsBlocked()`	Is there a wall to Karel's left?
`rightIsClear()`	`rightIsBlocked()`	Is there a wall to Karel's right?
`beepersPresent()`	`noBeepersPresent()`	Are there beepers on this corner?
`beepersInBag()`	`noBeepersInBag()`	Any there beepers in Karel's bag?
`facingNorth()`	`notFacingNorth()`	Is Karel facing north?
`facingEast()`	`notFacingEast()`	Is Karel facing east?
`facingSouth()`	`notFacingSouth()`	Is Karel facing south?
`facingWest()`	`notFacingWest()`	Is Karel facing west?

*This is **Table 1** on page 18 of the Karel coursereader.*

Control Flow: While Loops

Now we can say:

```
while (frontIsClear()) {
    move();
}
```



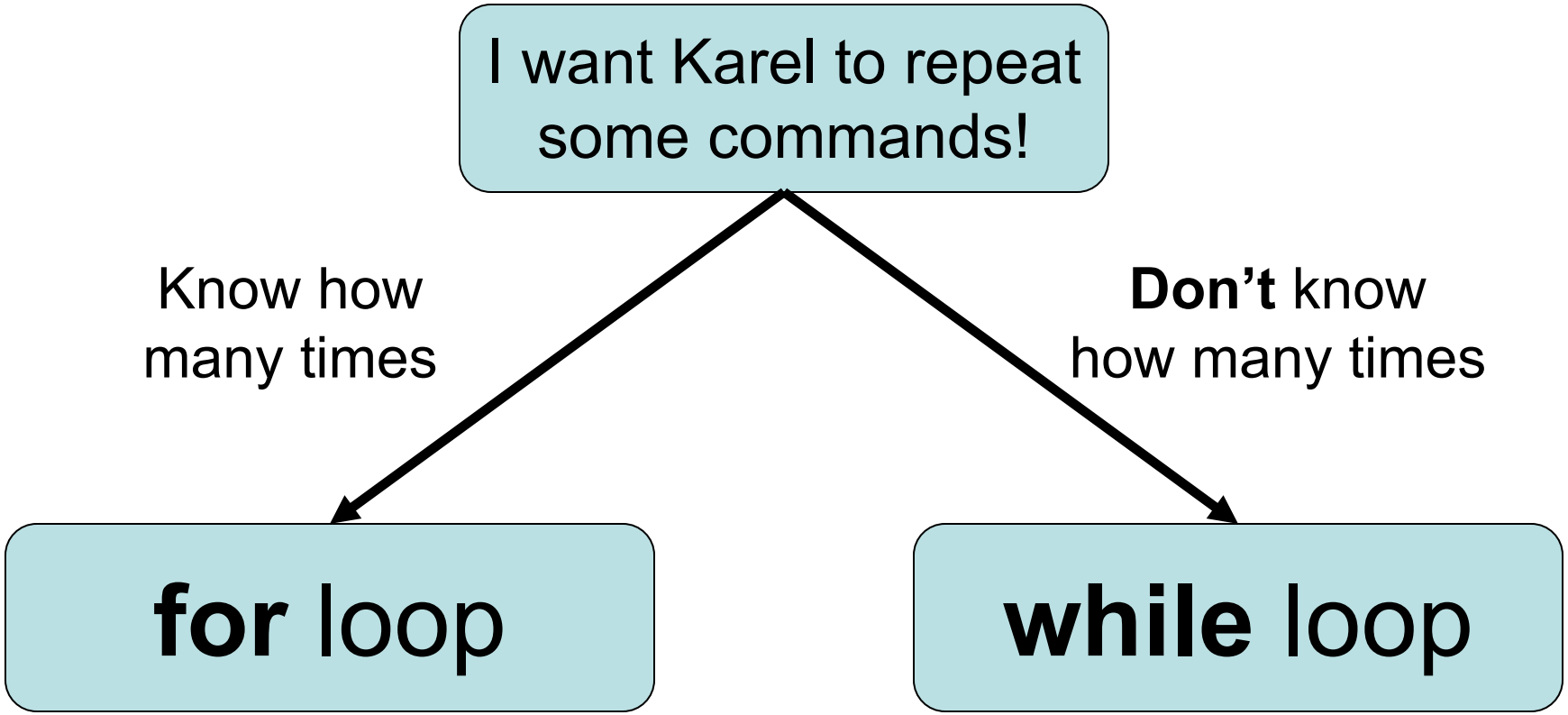
This is less repetitive, and it works in *any size* world!

Control Flow: While Loops

while loops can have *compound* conditions as well:

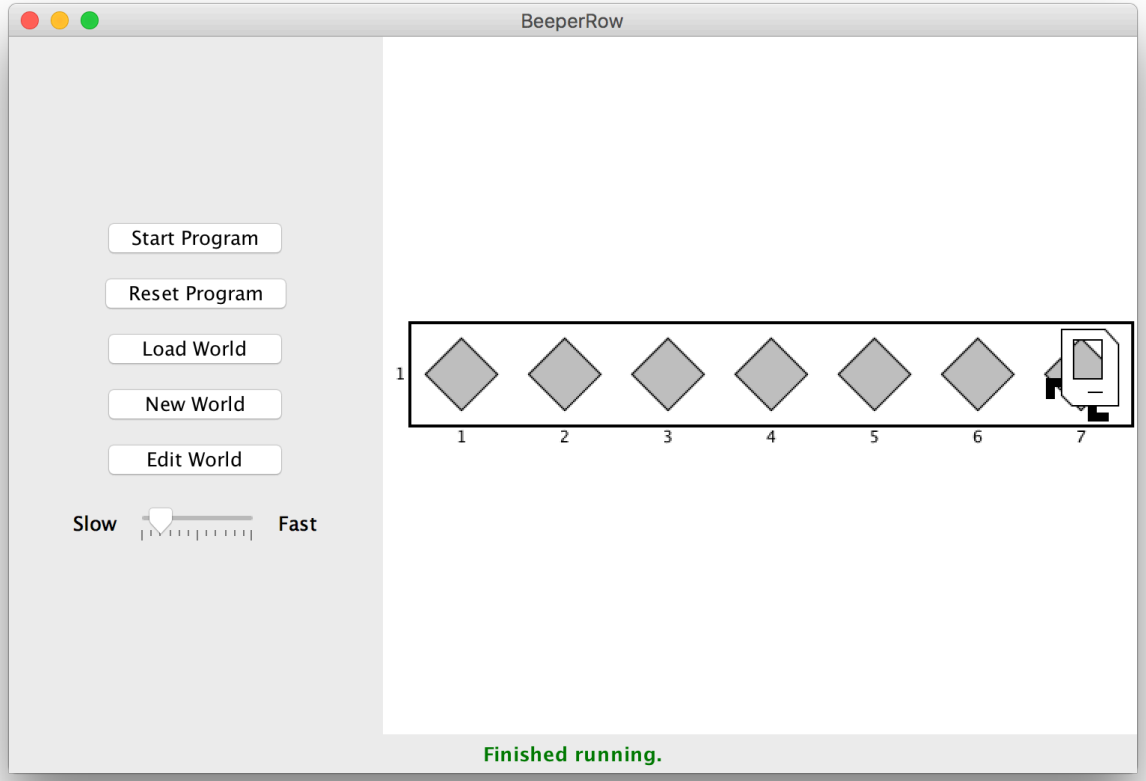
```
// "and"
while (frontIsClear() && beepersPresent()) {
    ...
}

// "or"
while (leftIsClear() || rightIsClear()) {
    ...
}
```

Loops Overview



Loops Overview

- I want Karel to put down a row of beepers until it reaches a wall. How do I do this?



Demo

Fencepost Problem

8 fence segments, but 9 posts!

Fencepost Structure

The fencepost structure is useful when you want to loop a set of statements, but do one part of that set 1 *additional* time.

```
putBeeper();                    // post
while (frontIsClear()) {
    move();                     // fence
    putBeeper();                // post
}

while (frontIsClear()) {
    putBeeper();                // post
    move();                     // fence
}
putBeeper();                    // post
```

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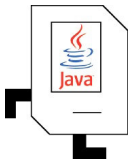
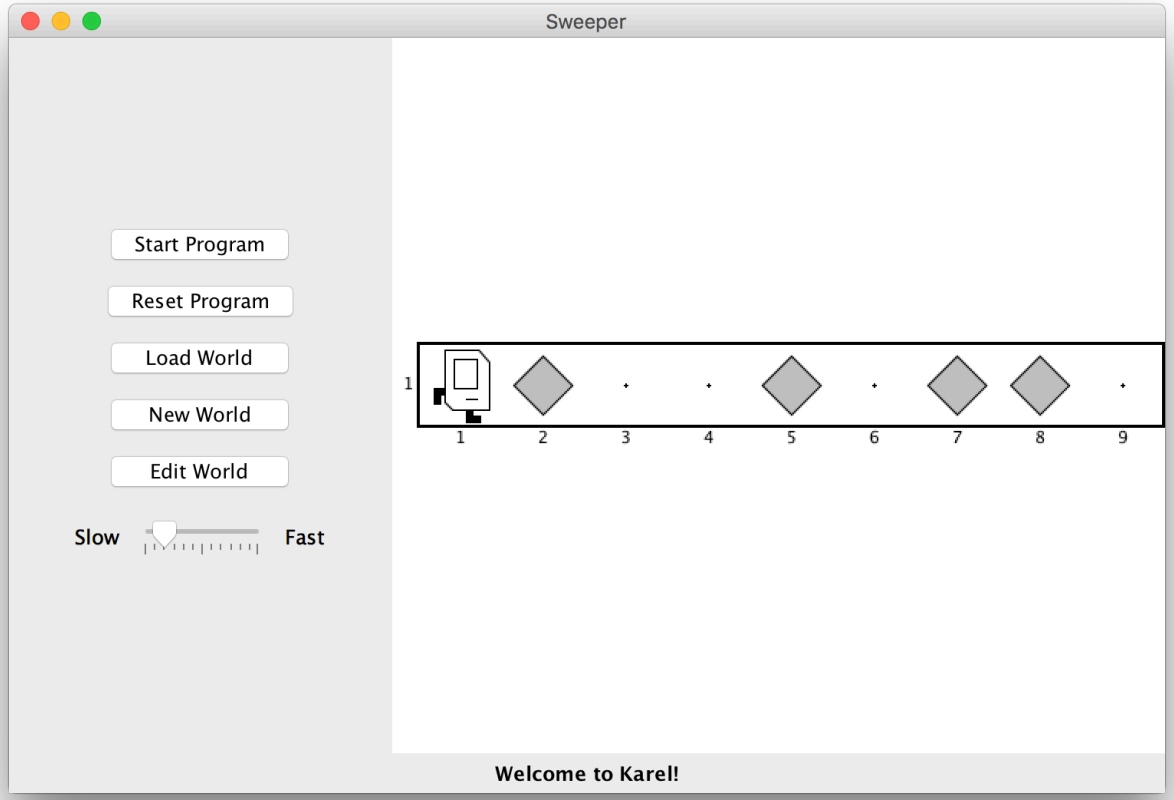


If/Else Statements

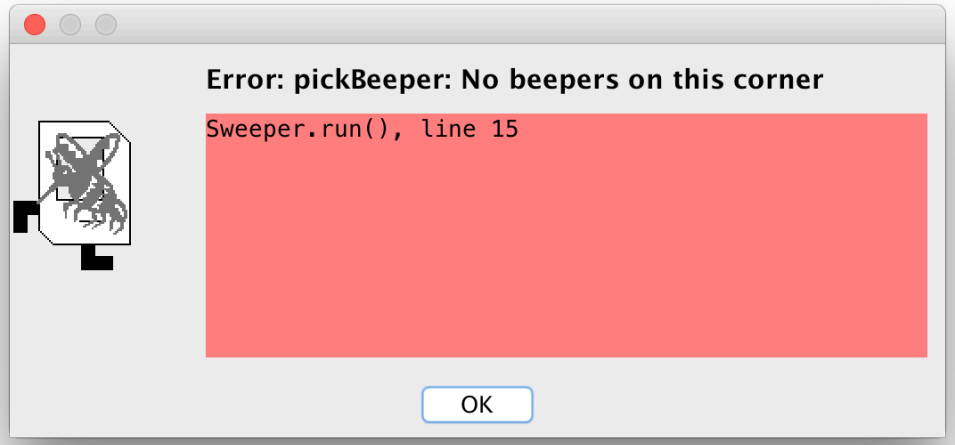
- I want to make Karel clean up all beepers in front of it until it reaches a wall. How do I do this?



If/Else Statements

Can't just say:

```
while (frontIsClear()) {
    move();
    pickBeeper();
}
```



This may crash, because Karel *cannot pick up beepers if there aren't any*. We don't **always** want Karel to pick up beepers; just when there is a beeper to pick up.

If/Else Statements

Instead, use an **if** statement:

```
if (condition) {
    statement;
    statement;
    ...
}
```

Runs the statements in the body *once* if ***condition*** is true.

If/Else Statements

You can also add an **else** statement:

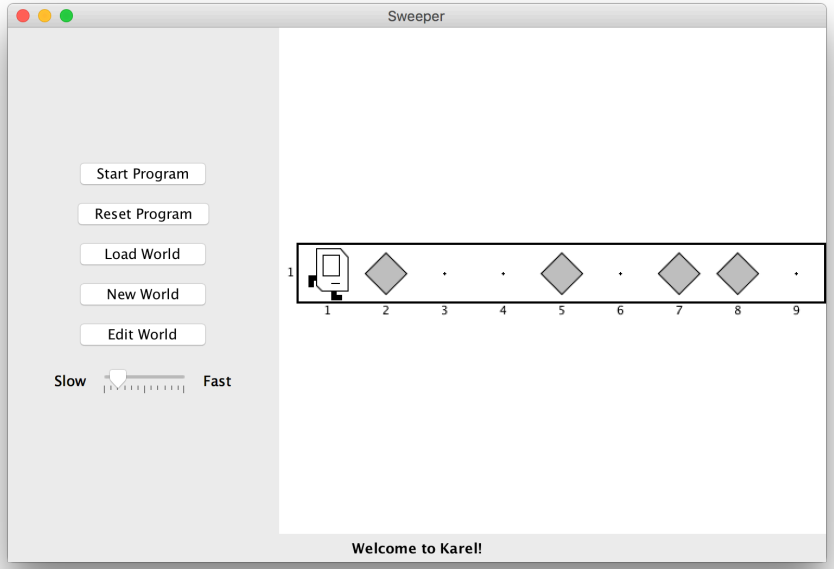
```
if (condition) {
    statement;
    statement;
    ...
} else {
    statement;
    statement;
    ...
}
```

Runs the first group of statements if ***condition*** is true; otherwise, runs the second group of statements.

If/Else Statements

Now we can say:

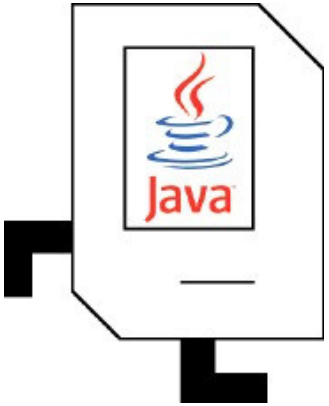
```
while (frontIsClear()) {
    if (beepersPresent()) {
        pickBeeper();
    }
}
```



Now, Karel won't crash because it will only pickBeeper if there is one.

Recap

- Announcements
- (Re)Meet Karel the Robot
- Control Flow
  - For loops
  - While loops
  - If/else statements



Next time: Karel Problem-Solving