



CodeHS

Intro to Programming with Karel

offline



Introduction to Programming with Karel

This offline lesson plan introduces students to the fundamentals of computer science and programming. The lesson plan consists of five parts, each covering a specific topic. The entire five-part Introduction to Programming with Karel is designed to run approximately one hour.

Parts 1 and 2 present a broad overview of computing and programming. These lessons include discussion material, vocabulary, and questions. After completing these sections, students will be prepared to write their own programs. Part 3 details two coding activities for the class to complete together, while Part 4 gives students the chance to write their own programs and try them out with other students. Part 5 wraps up the lesson with a brief review.

What You'll Need

Photocopies of the Karel world template sheets for students to use.

(Optional) If you'd like to have a life-sized version of Karel's world:

- ◆ a stuffed animal or other toy for Karel
- ◆ a stack of blank paper to use as spots in Karel's grid world
- ◆ some tennis balls or other objects for Karel to pick up and put down



TOPIC

Computers are all around us. They're in our phones, cars, microwaves... everywhere! But computers by themselves are not very useful. Computers need to be told exactly what tasks to perform. These instructions are called programs.

Programs are like lists of instructions that we give to a computer. The better we are at making these instructions, the better the programs we can make! Instead of writing out computer instructions in a language like English or Spanish, we write programs in code.

DISCUSSION

We use lists of instructions all the time! Ask the students when they might have used or followed a list of instructions.

Some examples are:

-Driving directions, color by number activities, doing laundry, building a toy model or Lego set, following a recipe, learning a new dance

You can think of these instructions as *programs* that we follow.

VOCABULARY

- **Code:** Code is the name for the instructions you write to a computer in a program.
- **Computer:** A person or device that makes calculations, stores data, and executes instructions according to a program.
- **Computer program:** A list of code instructions a computer follows in order to perform a task.
- **Computing:** Executing instructions, calculating, or using a computer.

QUESTIONS

- What is programming?
- What is a computer? What are they used for? How are humans like a computer?
- How are instructions used to execute simple tasks?



TOPIC

Giving commands to a dog is similar to giving commands to a computer. We'll practice with Karel the Dog! We can write out lists of instructions, or programs, for Karel to follow.

Karel only knows a few basic commands:

- move**: move forward one spot
- turn left**: turns Karel 90 degrees counter clockwise
- put ball**: put down a tennis ball
- take ball**: pick up a tennis ball

DISCUSSION

Introduce students to Karel's grid world.

Karel the dog lives in a small grid world. The world has streets (or, rows) and avenues (or, columns). Karel can move around this world and put down tennis balls. But watch out -- Karel doesn't want to crash into the wall!

Go over Karel's basic commands with the students. It could be helpful to write these commands where the students can see them. Once students are comfortable with Karel's world and commands, move onto the next lesson.

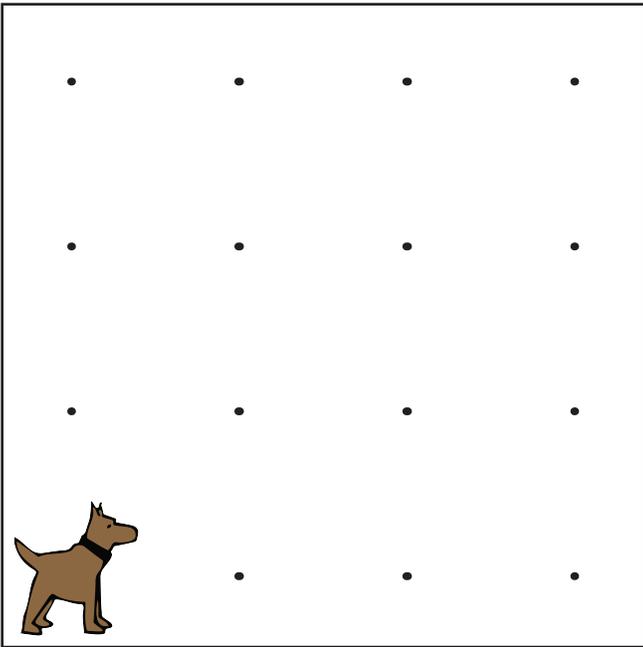
VOCABULARY

- Command**: A command is an instruction you can give to Karel.
- **Grid world**: A "world" or "Karel World" is a grid that Karel lives in. It is made up of streets and avenues (rows and columns).
- **Karel**: Karel is a dog who listens to your commands.

QUESTIONS

- What are Karel's four basic commands?
- In what kind of world does Karel the dog live?
- What is a computer program? How is writing computer programs like giving commands to Karel the dog?

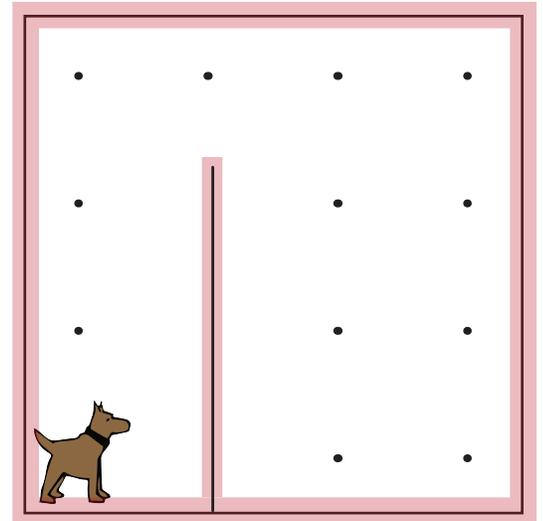
Karel in the grid world



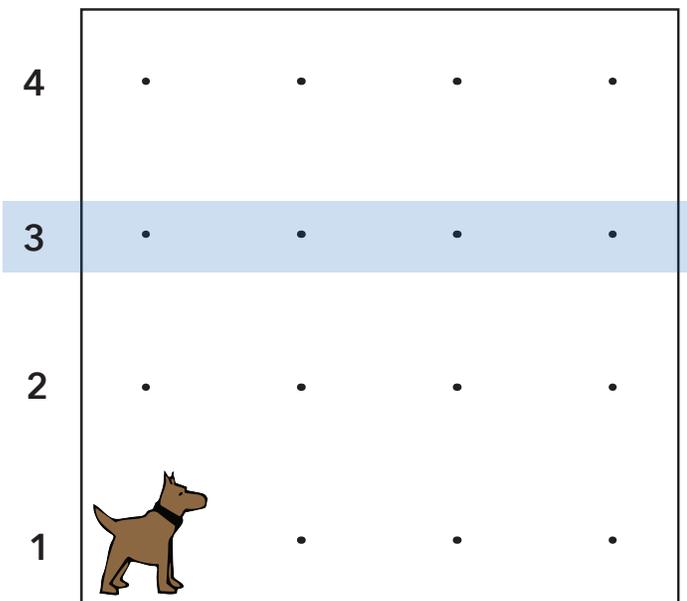
Tennis Ball



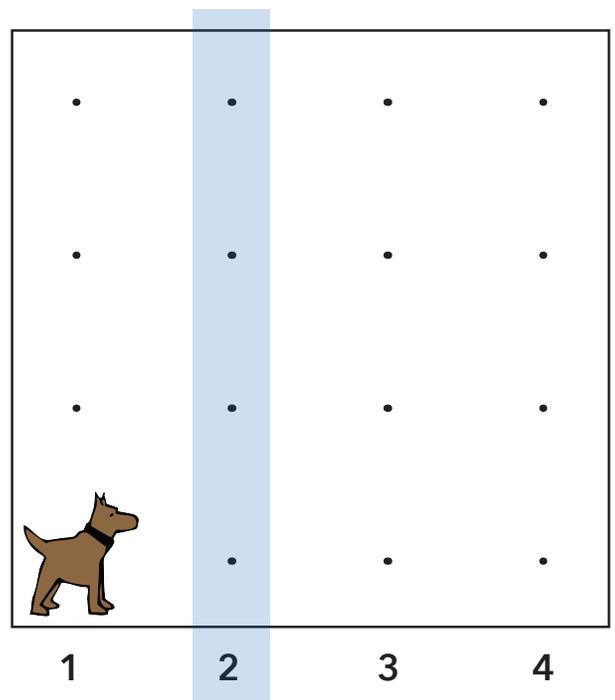
Walls



3rd street



2nd avenue





TOPIC

Now that students have learned the basics, it's time to put them into practice! This classroom activity will give the class a chance to solve some puzzles with Karel.

The first puzzle has Karel move to a tennis ball and pick it up. The second is slightly more challenging -- Karel will put down tennis balls in two different corners, then finish by moving to a third corner.

SETUP

Photocopy and cut out the included grid world, Karel, and tennis ball templates. Use these to set up your paper grid world to look like the world in the Before picture. The goal is to write a set of commands to get Karel to achieve the result world.

If you have a large table or space on the floor, you can make a "life-size" grid world using blank sheets of paper for each grid world spot, a stuffed animal or other prop for Karel, and tennis balls or similar objects for Karel to pick up and put down.

1. Your First Karel Program

DISCUSSION

Review Karel's basic commands with the students. Even though these commands are quite simple, Karel can use them to solve some pretty tricky puzzles!

EXERCISE

Set up your grid world (using either paper on the floor or table, or with one of the provided grid world) to match the Before world:

- place the Karel toy in the bottom left corner
- place the tennis ball in the bottom right corner
- using only Karel's basic commands, get Karel to move over the ball and take it

Have students call out the necessary Karel commands. Write these commands out on the board or one of the provided "code editor" sheets so that it is a list of commands. Each Karel command should go on its own line, like items in a list. Karel will read these commands from top to bottom.

Once you have a completed program, walk Karel through the list of commands step by step to ensure that Karel achieves the correct result world.

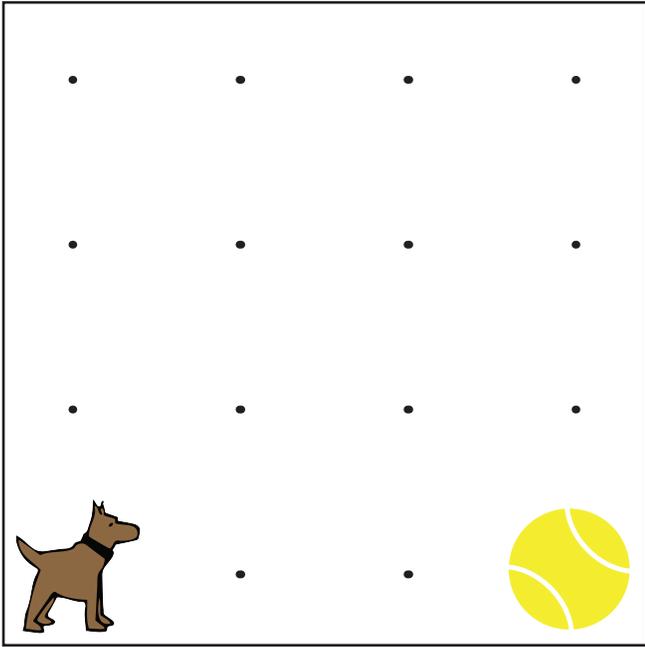
SOLUTION

```
move
move
move
take ball
```

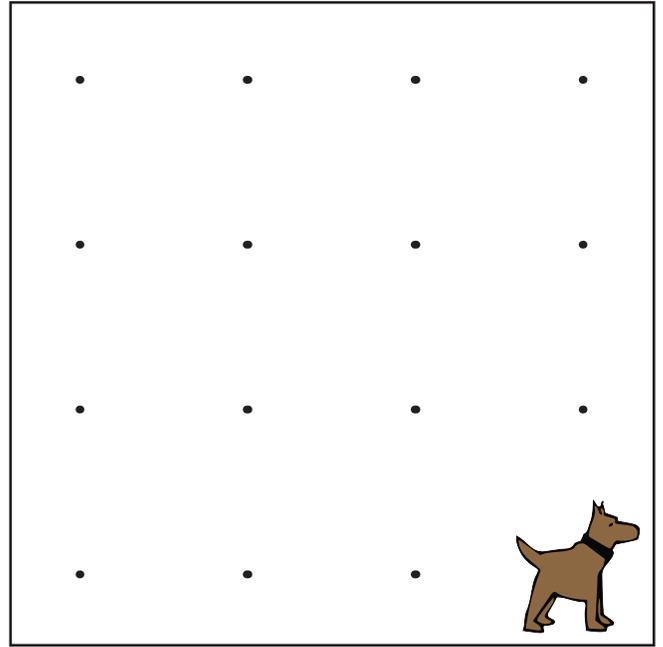
QUESTIONS

- What are Karel's four basic commands?
- What happens if you go through the program backwards, from the bottom of the list up? Or if you jump randomly from line to line?

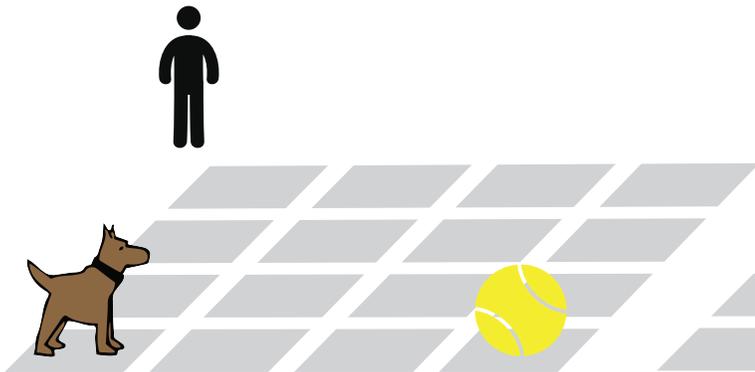
BEFORE



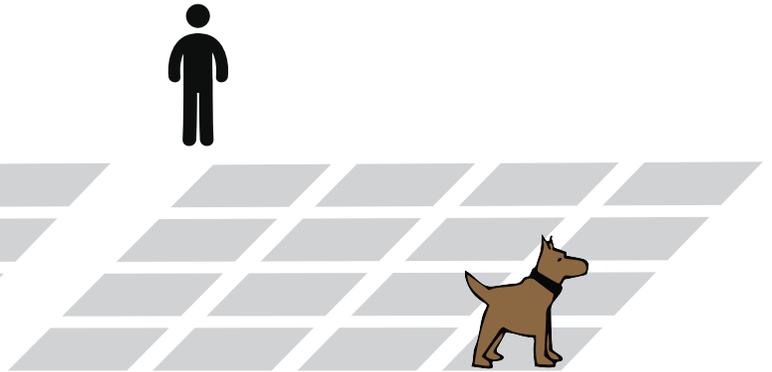
AFTER



BEFORE



AFTER

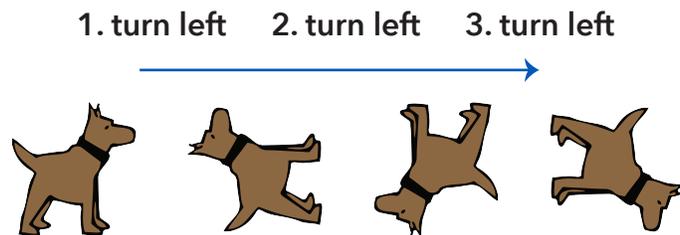


2. Moving and Turning

DISCUSSION

Now try a more difficult program. In this one, Karel needs to put down a ball in the bottom left corner, then move up to the top left and put down another ball, then move to the top right. This means Karel will need to make a right turn. But wait, "turn right" is not one of Karel's commands! How can we get Karel to turn right? Ask students to think about how Karel can turn right using only the same four basic commands.

Turning right is the same as turning left three times:



EXERCISE

Set up your grid world to match the Before world.

Have students call out the necessary Karel commands. Write these commands out on the board or one of the provided "code editor" sheets so that it is a list of commands. Karel will read these commands from top to bottom.

Once you have a completed program, walk Karel through the list of commands step by step to ensure that Karel achieves the correct result world.

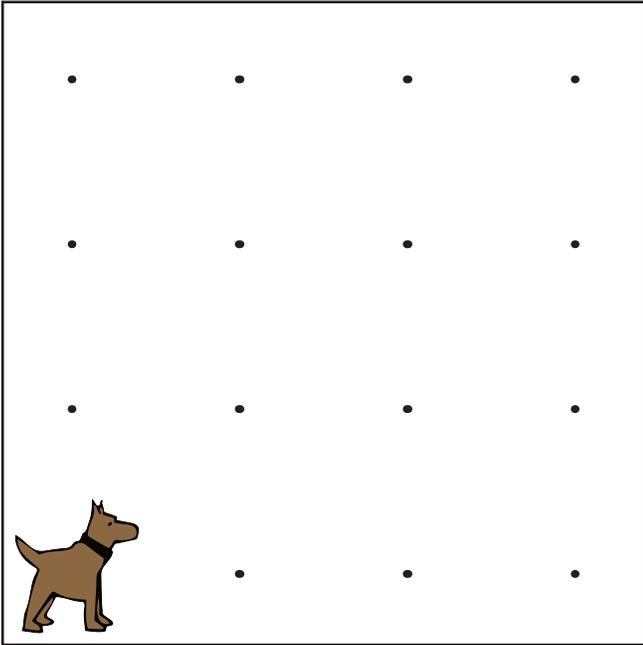
SOLUTION

```
put ball
turn left
move
move
move
put ball
turn left
turn left
turn left * note: Remember,
Karel doesn't know a "turn
right" command! *
move
move
move
```

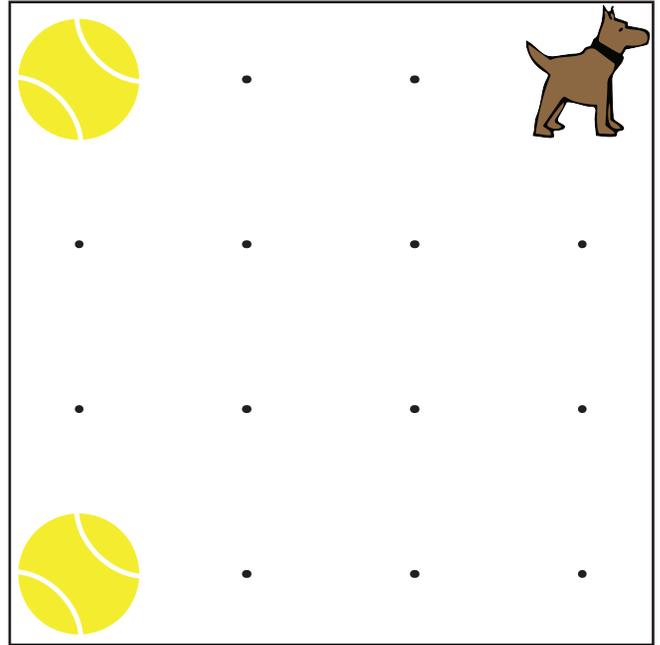
QUESTIONS

- What are Karel's four basic commands?
- What happens if you go through the program backwards, from the bottom of the list up? Or if you jump randomly from line to line?

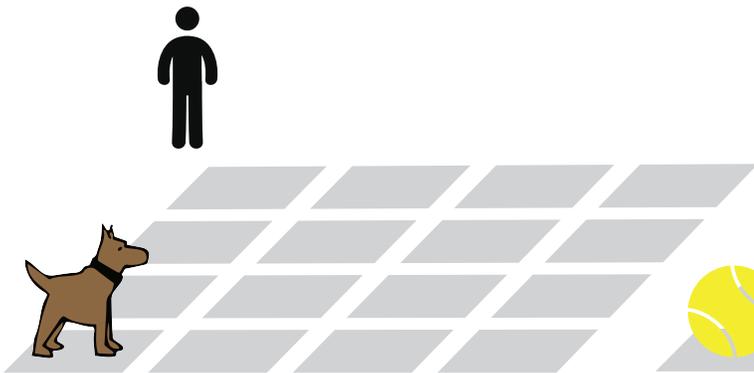
BEFORE



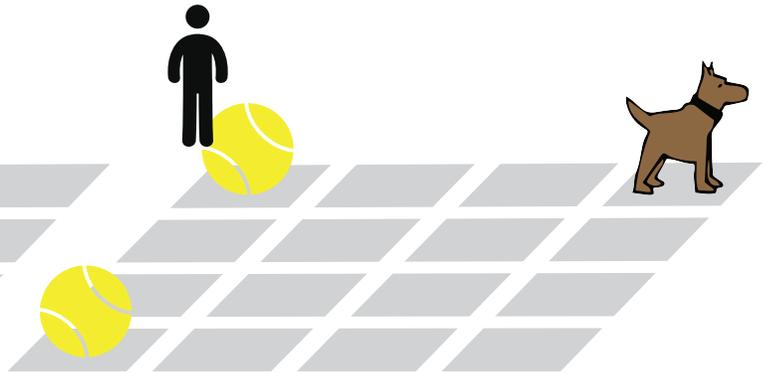
AFTER



BEFORE



AFTER





TOPIC

Now that students have had some practice with Karel's grid world and basic commands, it's time for them to make their own programs!

SETUP

Divide students into small groups of two or three and give each group its own copy of the Karel grid world, Karel the dog, and a some tennis balls. Or, if you have enough props, students can make big grid worlds on the floor. Also give each group their own "code editor" where they can write their code commands.

Have the students set up their own starting and result worlds. Once they've created their "before" and "after" worlds, they can write the code needed to have Karel make the result world.

Once each group has written a program, have the groups pair up with another group. Group A will set up the starting position for Karel in their program and then give Group B their "text editor" with the code instructions to follow. The students in Group B follows those instructions and should get to the result world that Group A intended.

Switch and have Group A run through Group B's program.



TOPIC

Computers are a key part of our modern world. Computers, like Karel the dog, follow basic lists of instructions called programs. A program can have a computer complete a task as simple as having Karel pick up a tennis ball, or as complicated as landing a robot on Mars. Learning how to write programs for computers means that you will be able to influence the world around you.

Programming with Karel the dog is a good way to practice writing code to accomplish tasks. Despite living in a grid world and only knowing four commands, Karel can solve some interesting puzzles.

To continue learning with Karel the dog, visit www.CodeHS.com

DISCUSSION QUESTIONS

Part 1

- What is programming?
- What is a computer? What are they used for? How are humans like a computer?
- How are instructions used to execute simple tasks?

Part 2

- What are Karel's four basic commands?
- In what kind of world does Karel the dog live?
- What is a computer program? How is writing computer programs like giving commands to Karel the dog?

Part 3

- What are Karel's four basic commands?
- What happens if you go through the program backwards, from the bottom of the list up? Or if you jump randomly from line to line?

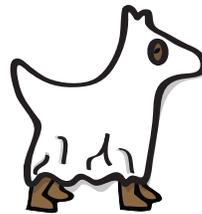
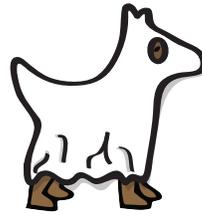
VOCABULARY

Part 1

- Code: Code is the name for the instructions you write to a computer in a program.
- Computer: A person or device that makes calculations, stores data, and executes instructions according to a program.
- Computer program: a list of code instructions a computer follows in order to perform a task.
- Computing: Executing instructions, calculating, or using a computer.

Part 2

- Move: move forward one spot
- Turn left: turns Karel 90 degrees counter clockwise
- Put ball: put down a tennis ball
- take ball: pick up a tennis ball
- Command: A command is an instruction you can give to Karel.
- Grid world: A "world" or "Karel World" is a grid that Karel lives in. It is made up of streets and avenues (rows and columns).
- Karel: Karel is a dog who listens to your commands.



CODE EDITOR

Exercise Name _____

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

