

Assignment #1: Email/Survey and Karel the Robot

Karel problems due: 1:30pm on Friday, October 5th

Email and online survey due: 11:59pm on Sunday, October 7th

This assignment should be done individually (not in pairs)

Based on a handout by Eric Roberts, with additional text by Keith Schwarz and Mehran Sahami.

Part I—Email

Email is really the preferred communications medium in CS106A. We will expect you to read your mail regularly through the quarter and encourage you to use email to communicate with the course staff. Although many of you probably do so much more often (and I do mean *much, much* more often), you should be sure to check your mailbox at least once every day. You should also make sure to get enough fruits and vegetables in your diet, but that's not important right now. You will find this part of the assignment should only take you about a few minutes!

Using any electronic mail program that you like (for example, GMail, Hotmail, or Microsoft Outlook), send a message to me (sahami@cs.stanford.edu), the head TA Brahm Capoor (brahm@stanford.edu), and your section leader. Note that you won't know your section leader's email address until after your first section, which is why we don't make this part of the assignment due until Sunday, October 7th. Please make sure that the subject line of your email says "CS106A Email: <your name>", where "<your name>" is actually filled in with your name. The message should also include answers to the questions below.

Questions to answer in your email to us:

1. What is your name?
2. What do you do for fun?
3. Tell a quick anecdote about something that you feel makes you unique... a talent, experience, anything.

This email is just for us to get to know you a little better and have something to remember you by. You don't spend a lot of time here, just give us some semi-interesting answers.

Part II—Online survey

We would like you to complete a very brief online survey to help us get a better sense of the class overall. A link to the survey is available on the main CS106A web page: <http://cs106a.stanford.edu> (click on the link called "Assignment 1 Survey"). You will then need to login with your SUNetID to get to a page that contains a link to the actual survey. This survey won't take you longer than a minute. Really.

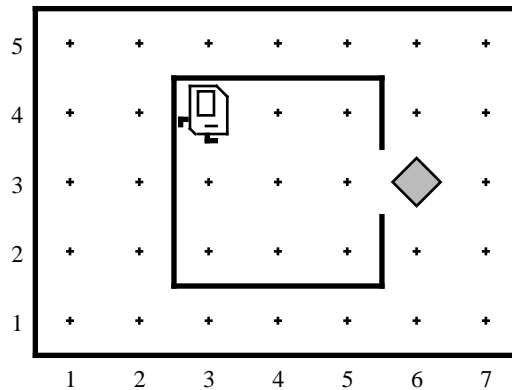
Part III—The REAL Assignment: Karel problems (due 1:30pm, Friday, Oct. 5th)

The real problem solving portion of this assignment consists of four Karel programs. There is a starter project including all of these problems on the CS106A web site in the area for Assignment 1. When you want to work on these programs, you need to download that starter folder as described in Handout #6 (Using Karel in Eclipse). From there, you need to edit the program files so that the assignment actually does what it's supposed to do, which will involve a cycle of coding, testing, and debugging until everything works. The final step is to submit your assignment using the **Submit Project** entry under the **Stanford Menu** to create your project submission and then upload your project submission to the Paperless website. Remember that you can submit your programs as you finish them and that you can submit more than one version of your project. If you discover an error after you've submitted one of these problems, just fix your program and submit a new copy. **Also, please remember that your Karel programs must limit themselves to the language features described in *Karel the Robot Learns Java* in the Karel and SuperKarel classes. You may not use other features of Java, even though the Eclipse-based version of Karel accepts them.**

The four Karel problems to solve are described on the following pages.

Problem 1

Your first task is to solve a simple story-problem in Karel's world. Suppose that Karel has settled into its house, which is the square area in the center of the following diagram:



Karel starts off in the northwest corner of its house as shown in the diagram. The problem you need to get Karel to solve is to collect the newspaper—represented (as all objects in Karel's world are) by a beeper—from outside the doorway and then to return to its initial position.

This exercise is extremely simple and exists just to get you started. You can assume that every part of the world looks just as it does in the diagram. The house is exactly this size, the door is always in the position shown, and the beeper is just outside the door. Thus, all you have to do is write the sequence of commands necessary to have Karel

1. Move to the newspaper,
2. Pick it up, and
3. Return to its starting point.

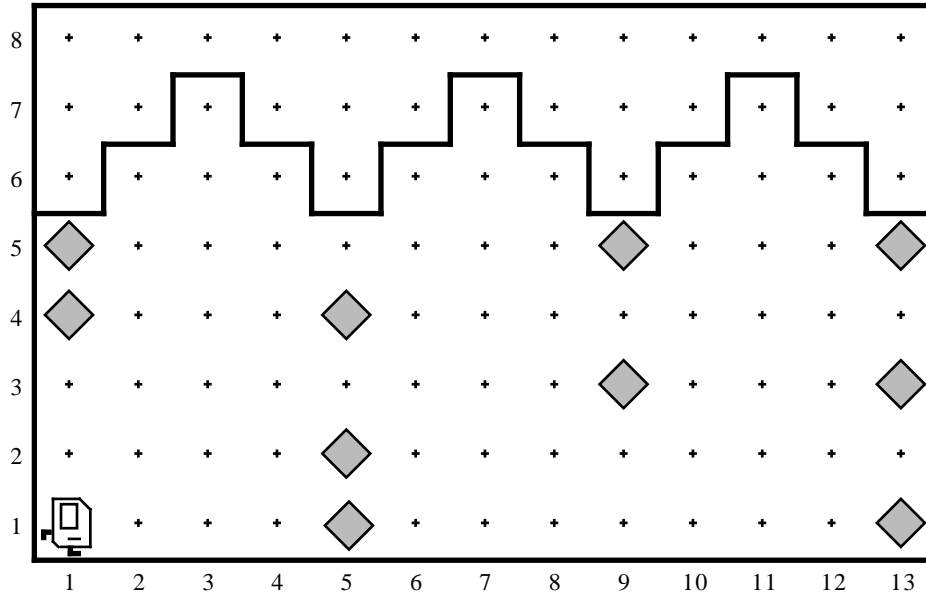
Even though the program is only a few lines, it is still worth getting at least a little practice in decomposition. In your solution, include a private method for each of the steps shown in the outline.

A Word of Advice

Before you go on to the harder problems on this assignment, why don't you try submitting your project as soon as you are done with this first problem? Every year, a handful of students run into some kind of problem with the electronic submission option provided in the Stanford version of Eclipse. If you wait until 1:00P.M. on Friday before you submit any of your work, you may discover that there is some aspect of the submission process that you didn't quite understand only after it's too late to get any help. So right now, as soon as you've got this first program working, go ahead and hit the submit button to make sure that you can ship things off. Once you've done so, you'll know that you've got the submission process under control. Remember, we only look at the last submission you make before the due date, so it doesn't hurt to submit new versions of your solution as you finish them.

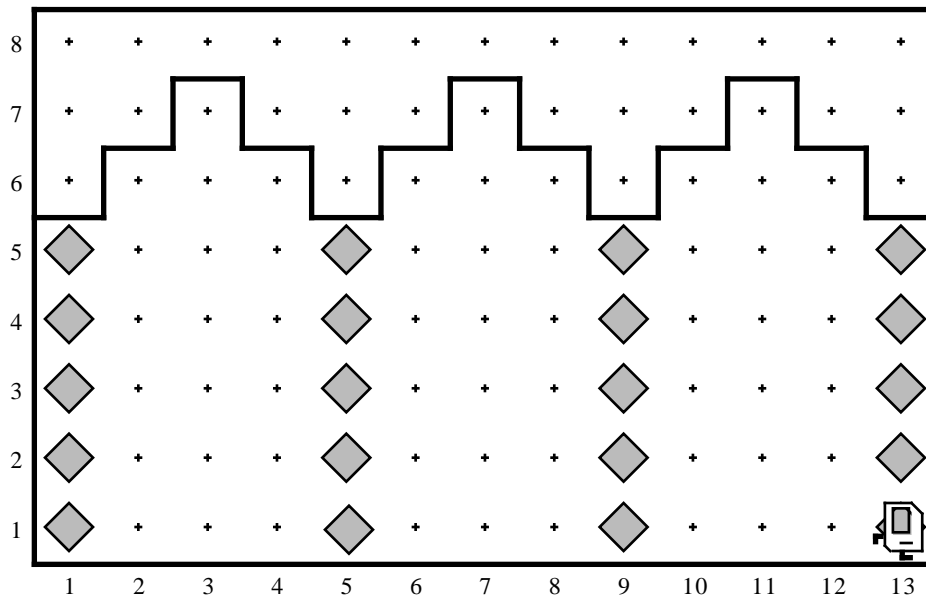
Problem 2

Karel has been hired to repair the damage done to the Quad in the 1989 earthquake. In particular, Karel is to repair a set of arches where some of the stones (represented by beepers, of course) are missing from the columns supporting the arches, as follows:



Your program should work on the world shown above, but it should be general enough to handle any world that meets certain basic conditions as outlined at the end of this problem. There are several example worlds in the starter folder, and your program should work correctly with all of them.

When Karel is done, the missing stones in the columns should be replaced by beepers, so that the final picture resulting from the world shown above would look like this:



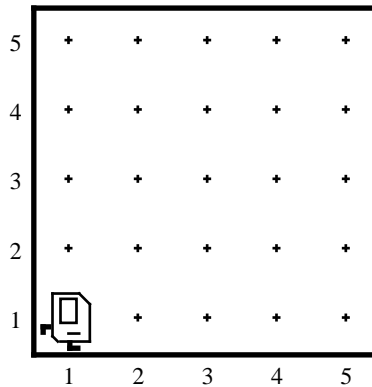
Karel's final location and the final direction he is facing at end of the run do not matter.

Karel may count on the following facts about the world, listed below:

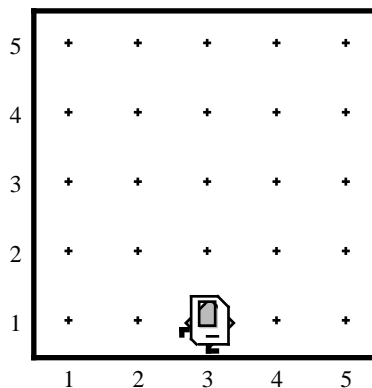
- Karel starts at 1st Avenue and 1st Street, facing east, with an infinite number of beepers in Karel's beeper bag.
- The columns are exactly four units apart, on 1st, 5th, 9th Avenue, and so forth.
- The end of the columns is marked by a wall immediately after the final column. This wall section appears after 13th Avenue in the example, but your program should work for any number of columns.
- The top of the column is marked by a wall, but Karel cannot assume that columns are always five units high, or even that all columns are the same height.
- Some of the corners in the column may already contain beepers representing stones that are still in place. Your program should not put a second beeper on these corners.

Problem 3

As an exercise in solving algorithmic problems, program Karel to place a single beeper at the center of 1st Street. For example, if Karel starts in the world



it should end with Karel standing on a beeper in the following position:



Note that the final configuration of the world should have only a single beeper at the midpoint of 1st Street. Along the way, Karel is allowed to place additional beepers wherever it wants to, but must pick them all up again before it finishes. Similarly, if Karel paints/colors any of the corners in the world, they must all be uncolored before Karel finishes.

In solving this problem, you may count on the following facts about the world:

- Karel starts at 1st Avenue and 1st Street, facing east, with an infinite number of beepers in its bag.
- The initial state of the world includes no interior walls or beepers.
- The world need not be square, but you may assume that it is at least as tall as it is wide.

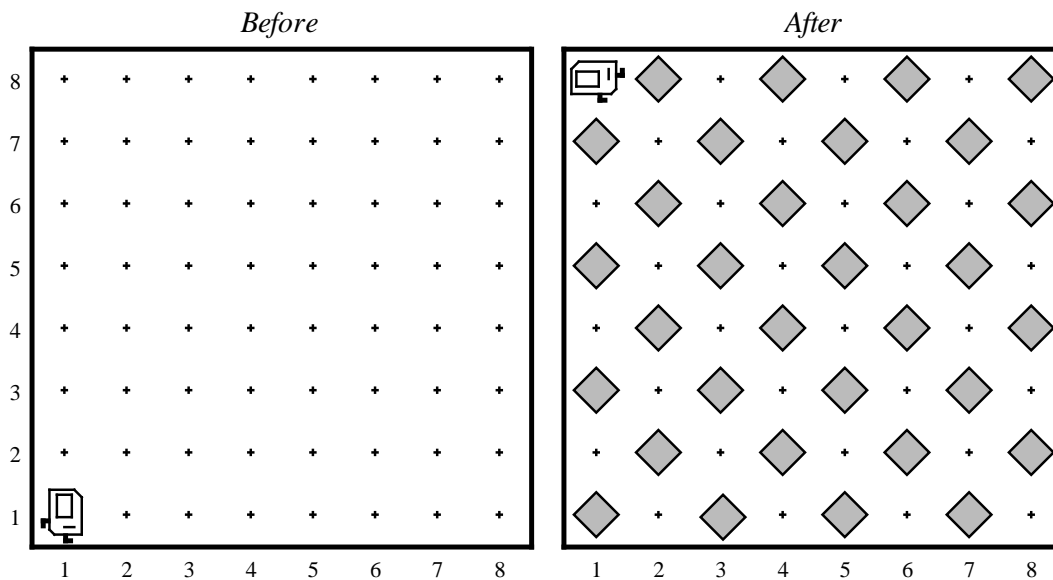
Your program, moreover, can assume the following simplifications:

- If the width of the world is odd, Karel must put the beeper in the center square. If the width is even, Karel may drop the beeper on either of the two center squares.
- It does not matter which direction Karel is facing at the end of the run.

There are many different algorithms you can use to solve this problem. The interesting part of this assignment is to come up with a strategy that works.

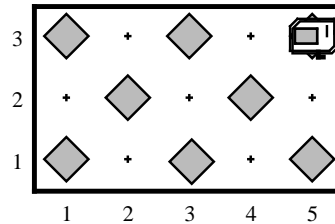
Problem 4

In this exercise, your job is to get Karel to create a checkerboard pattern of beepers inside an empty rectangular world, as illustrated in the following before-and-after diagram. (Karel's final location and the final direction it is facing at end of the run do not matter.)



This problem has a nice decomposition structure along with some interesting algorithmic issues. As you think about how you will solve the problem, you should make sure that your solution works with checkerboards that are different in size from the standard 8x8 checkerboard shown in the example above. Some examples of such cases are discussed below.

Odd-sized checkerboards are tricky, and you should make sure that your program generates the following pattern in a 5×3 world:



Another special case you need to consider is that of a world which is only one column wide or one row high. The starter folder contains several sample worlds that test these special cases, and you should make sure that your program works for each of them.

Advice, Tips, and Tricks

All of the Karel problems you will solve, except for `CollectNewspaperKarel1`, should be able to work in a variety of different worlds that match the problem specifications. When you first run your Karel programs, you will be presented with a sample world in which you can get started writing and testing your solution. However, we will test your solutions to each of the Karel programs, except for `CollectNewspaperKarel1`, in a variety of test worlds. Unfortunately, each quarter, many students submit Karel programs that work brilliantly in the default worlds but which fail catastrophically in some of the other test worlds. Before you submit your Karel programs, **be sure to test them out in as many different worlds as you can.** We've provided several test worlds in which you can experiment, but you should also develop your own worlds for testing.

When writing your Karel programs, to the maximum extent possible, try to use the top-down design techniques we developed in class. Break the task down into smaller pieces until each subtask is something that you know how to do using the basic Karel commands and control statements. These Karel problems are somewhat tricky, but appropriate use of top-down design can greatly simplify them.

As mentioned in class, it is just as important to write clean and readable code as it is to write correct and functional code. A portion of your grade on this assignment (and the assignments that follow) will be based on how well-styled your code is. Before you submit your assignment, take a minute to review your code to check for stylistic issues like those mentioned on the next page.

Have you added comments to your methods? To make your program easier to read, you can add comments before and inside your methods to make your intention clearer. Good comments give the reader a clue about what a method does and, in some cases, how it works. Did you add comments to your methods to indicate what they do?

Not-so-Good Code	Good Code
<pre>public void fillRowWithBeepers() { while (frontIsClear()) { putBeeper(); move(); } putBeeper(); }</pre>	<pre>/* Makes Karel move to the end of * the row, dropping a beeper * before each step he takes. * * Precondition: None * Postcondition: Karel is facing * the same direction as before, * and every step between Karel's * old position and new position * has had a beeper added to it. */ public void fillRowWithBeepers() { while (frontIsClear()) { putBeeper(); move(); } putBeeper(); }</pre>

Is your code indented properly? In Java, each line of code can be indented by any amount. Does your indentation help show how the different pieces of code are related to one another? For example:

Not-so-Good Code	Good Code
<pre>public void run() { move(); while (frontIsClear()) { move(); turnRight(); if (beepersPresent()) { pickBeeper(); } } }</pre>	<pre>public void run() { move(); while (frontIsClear()) { move(); turnRight(); if (beepersPresent()) { pickBeeper(); } } }</pre>

Did you decompose the problem? There are many ways to break these Karel problems down into smaller, more manageable pieces. Decomposing the problem elegantly into smaller sub-problems will result in a small number of easy-to-read methods, each of which performs just one small task. Decomposing the problem in other ways may result in methods that are trickier to understand and test. Look over your code and check to see whether you've decomposed the problem into smaller pieces. Does your code consist of a few enormous methods (not so good), or many smaller methods (good)?

This is not an exhaustive list of stylistic conventions, but it should help you get started. As always, if you have any questions on what constitutes good style, feel free to stop by to see the course helpers in Tresidder with questions, come visit us during office hours, or email your section leader with questions!