WORKED EXAMPLE 4.2 Computing Travel Time

In this Worked Example, we develop a hand calculation to compute travel time that we then use to develop pseudocode and program statements that will perform the calculation.

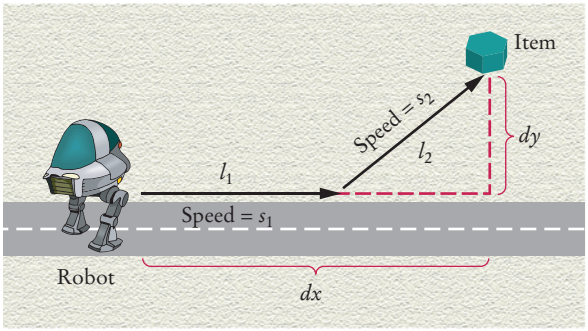
Problem Statement A robot needs to retrieve an item that is located in rocky terrain adjacent to a road. The robot can travel at a faster speed on the road than on the rocky terrain, so it will want to do so for a certain distance before moving on a straight line to the item. Your task is to compute the total time taken by the robot to reach its goal.

Courtesy NASA.

Step 1 Understand the problem: What are the inputs? What are the desired outputs?

You will be given the following inputs:

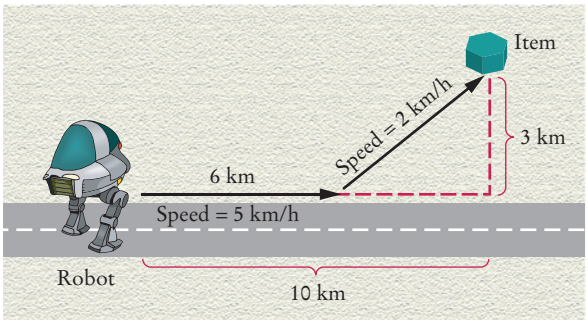
- The distance between the robot and the item in the x- and y-direction (dx and dy)
- The speed of the robot on the road and the rocky terrain (s_1 and s_2)
- The length l_1 of the first segment (on the road)



You are expected to compute the total travel time.

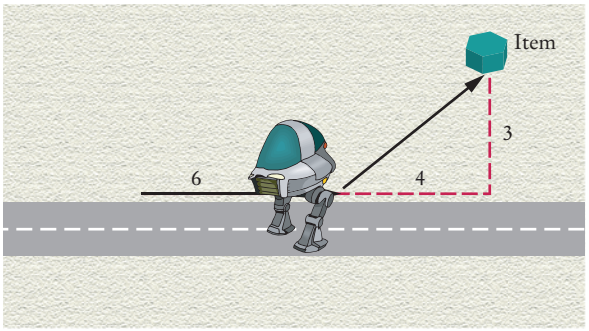
Step 2 Work out examples by hand.

To calculate an example by hand, let's assume the following dimensions:



The total time is the time for traversing both segments. The time to traverse the first segment is simply the length of the segment divided by the speed: 6 km divided by 5 km/h, or 1.2 hours.

To compute the time for the second segment, we first need to know its length. It is the hypotenuse of a right triangle with side lengths 3 and 4.



Therefore, its length is $\sqrt{3^2 + 4^2} = 5$. At 2 km/h, it takes 2.5 hours to traverse it. That makes the total travel time 3.7 hours.

Step 3 Write pseudocode for implementing the computation.

Look again at the steps in the hand calculation. The steps didn't depend on the particular values. Therefore, you can reformulate them as pseudocode by replacing the actual values with their names:

```
Time for segment 1 = l1 / s1
Length of segment 2 = square root of (dx - l1)^2 + dy^2
Time for segment 2 = length of segment 2 / s2
Total time = time for segment 1 + time for segment 2
```

Step 4 Translate the pseudocode into Java.

When you do hand calculations, it is convenient to use short variable names such as *dx* or s_1. In your program, you should change them to names that are longer and more descriptive.

Translated into Java, the computations are

```
double segment1Time = segment1Length / segment1Speed;
double segment2Length = Math.sqrt(
   Math.pow(xDistance - segment1Length, 2)
   + Math.pow(yDistance, 2));
double segment2Time = segment2Length / segment2Speed;
double totalTime = segment1Time + segment2Time;
```

You can find the complete program in the `ch04/worked_example_2` directory of the book's companion code.