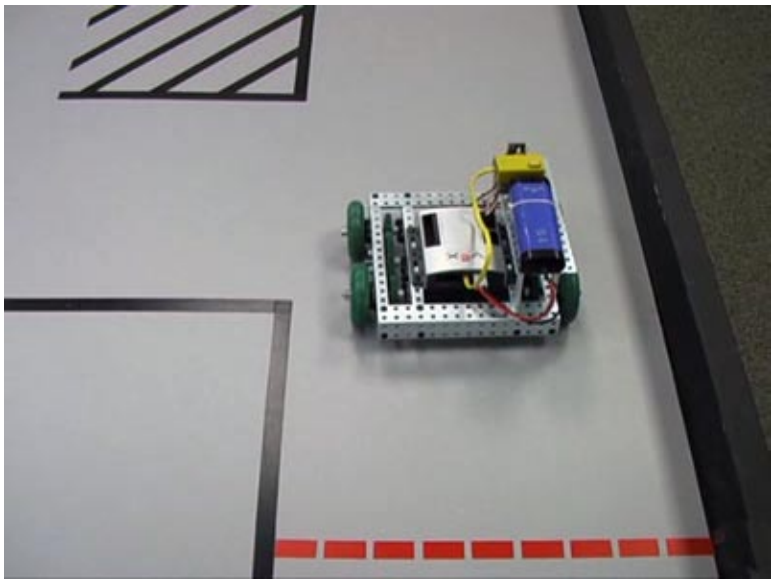
Thinking About Programming Programmer & Robot

In this lesson, you will learn about the roles of the programmer and the robot, and how the two need to work together in order to accomplish their goals.

Robots are made to perform useful tasks. Each one is designed to solve a specific problem, in a specific way.

Robotic Tractor
Problem:
Drive safely through a field which may contain obstacles

Solution:
Move towards the destination, making small detours if any obstacles are detected



Labyrinth Robot
Problem:
Get through the maze.

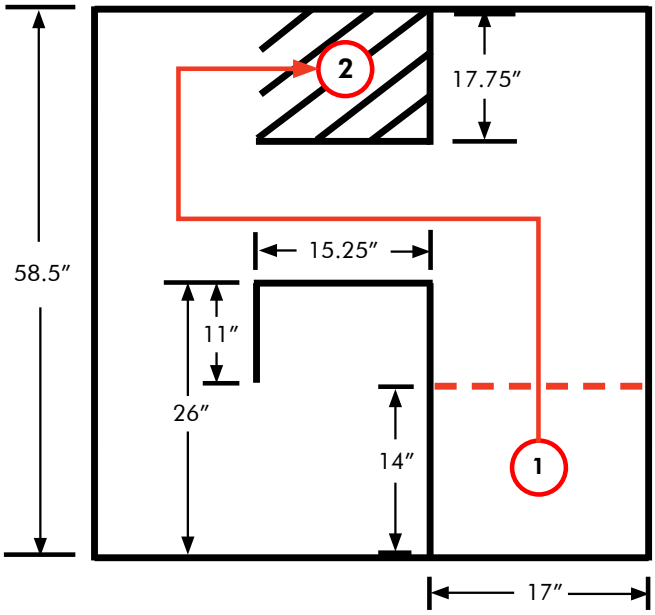
Solution:
Move along a predetermined path in timed segments.

Thinking about Programming Programmer & Robot *(cont.)*

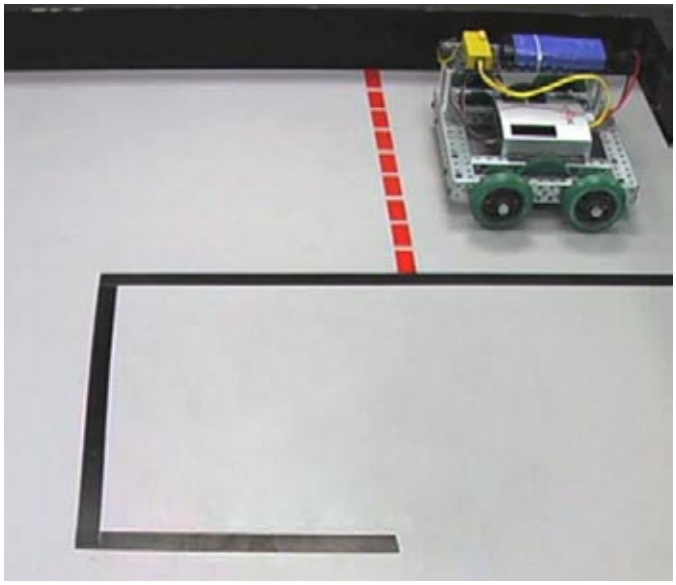
Let's take a closer look at the Labyrinth robot. How does it find its way through the maze? How does it know how to do that?

Problem → ?????? → **Goal Reached**

Creating a successful robot takes a team effort between humans and machines.



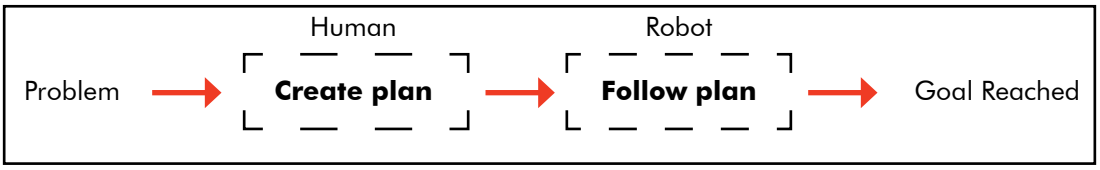
Role of the Robot
The robot follows the instructions it is given, thereby carrying out the plan.



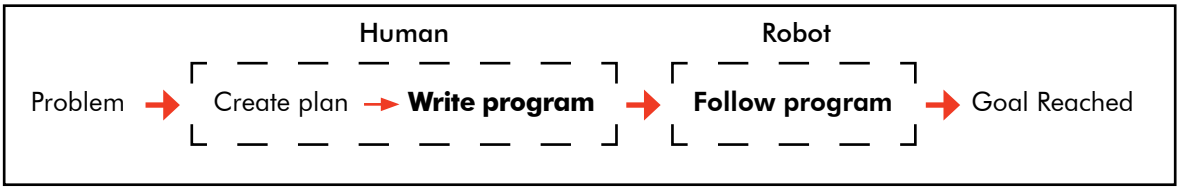
Role of the Programmer
The human programmer identifies the task and plans a solution, then explains to the robot what it needs to do to reach the goal.

Thinking about Programming Programmer & Robot *(cont.)*

The human and the robot accomplish the task together by dividing up the responsibilities. The human programmer must *come up with the plan* and *communicate* it to the robot. The robot must *follow the plan*.



Because humans and robots don't normally speak the same language, a special language must be used to translate the necessary instructions from human to robot. These human-to-robot languages are called **programming languages.** Instructions written in them are called **programs**. ROBOTC is just one of many such programming languages that humans use to talk to machines.



End of Section.

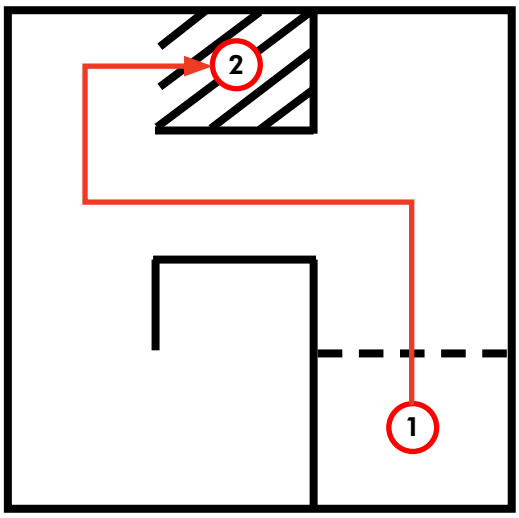
Humans and robots communicate by using **programming languages** such as ROBOTC. A human who writes a program is called a **programmer**. The programmer's job is to identify the *problem* that the robot must solve, create a **plan** to solve it, and turn that plan into a **program** that the robot can understand. The robot will then run the program and follow its instructions to perform the task.

A robot can only follow its program. *It cannot think for itself!* Just as it can be *no stronger than it is built*, the robot can be *no smarter than the program* that a human programmer gave it. You, as programmer, will be responsible for planning and describing to the robot exactly what it needs to do to accomplish its task.

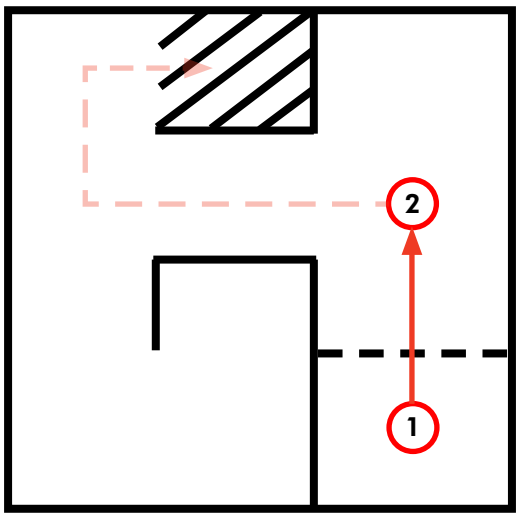
Thinking About Programming Planning & Behaviors

In this lesson, you will learn how thinking in terms of "behaviors" can help you to see the logic behind your robot's actions, and break a big plan down into practical parts.

Behaviors are a convenient way to talk about what a robot is doing and what it must do. Moving forward, stopping, turning, looking for an obstacle… these are all behaviors.



Complex Behavior
Some behaviors are big, like "solve the maze."



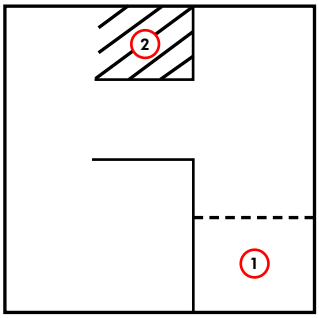
Basic or Simple Behavior
Some behaviors are small, like "go forward for 3 seconds." Big behaviors are actually made up of these smaller ones.

As you start programming, you should also start thinking about the robot's actions in terms of behaviors. Recall that as programmer, your primary responsibilities are:

- First, to come up with a **plan** for the robot to reach the goal.
- Second, to translate that plan into a **program** that the robot can follow.

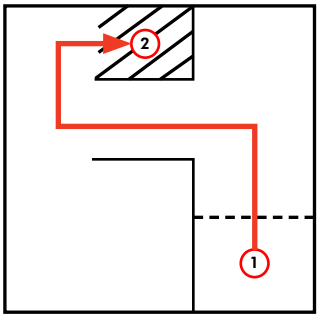
The plan will simply be *the sequence of behaviors that the robot needs to follow*. The program will be those behaviors translated into the programming language.

Thinking about Programming Planning & Behaviors *(cont.)*



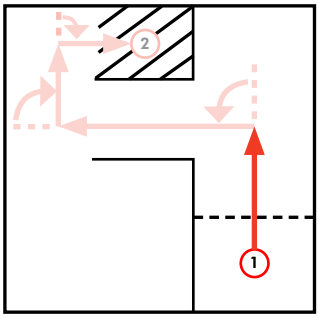
1. ***Examine problem***
To find a solution, start by examining the problem.

Here, the problem is to get from the starting point (1) to the goal (2).



2. ***Broad solution***
Try to see what the robot needs to do, at a high level, to accomplish the goal.

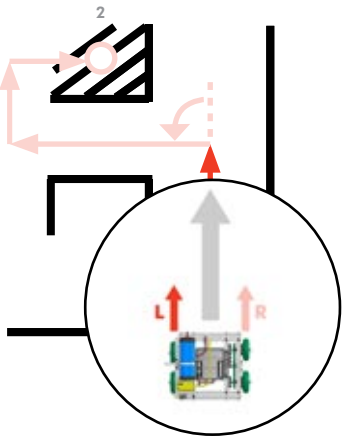
Having the robot follow the path shown on the left, for example, would solve the problem. You've just identified the first behavior you need! Write it down.

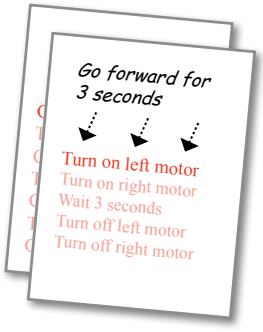


3. ***Break solution into smaller behaviors***
Now, start trying to break that behavior down into smaller parts.

Following this path involves moving forward, then turning, then moving forward for a different distance, then turning the other way, and so on. Each of these smaller actions is also a behavior.

Write them down as well. Make sure you keep them in the correct sequence!



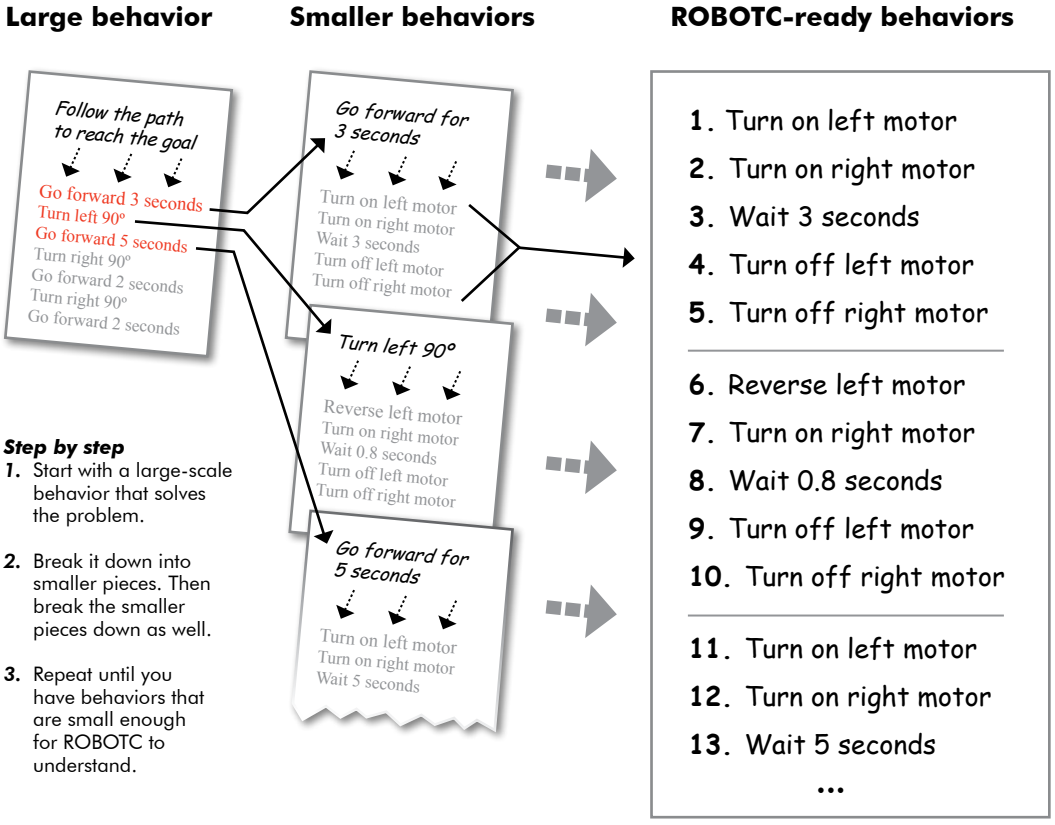


4. ***Break into even smaller pieces***
If you then break down these behaviors into even smaller pieces, you'll get smaller and smaller behaviors with more and more detail. Keep track of them as you go.

Eventually, you'll reach commands that you can express directly in the programming language.

For example, ROBOTC has a command to turn on one motor. When you reach a behavior that says to turn on one motor, you can stop breaking it down because it's now ready to translate.

Thinking about Programming Planning & Behaviors *(cont.)*



Step by step

1. Start with a large-scale behavior that solves the problem.
2. Break it down into smaller pieces. Then break the smaller pieces down as well.
3. Repeat until you have behaviors that are small enough for ROBOTC to understand.

When all the pieces have reached a level of detail that ROBOTC can work with – like the ones in the "ROBOTC-ready behaviors" list above – take a look at the list you've made. These behaviors, in the order and way that you've specified them, are the plan that the robot must follow to accomplish the goal.

Because these steps are still written in English, they should be relatively easy for the human programmer to understand.

As the programmer becomes more experienced, the organization of the behaviors in English will start to include important techniques from the programming language itself, like if-else statements and loops. This hybrid language, halfway between English and the programming language, is called **pseudocode**. It is an important tool in helping to keep larger programs understandable.

```
1. Turn on left motor
2. Turn on right motor
3. Wait 3 seconds
4. Turn off left motor
5. Turn off right motor
```

Simple pseudocode
Your list of behaviors to perform in a specific order are a simple form of pseudocode.

```
if (the light sensor sees light)
{
   turn on left motor
   hold right motor still
}
```

Later pseudocode
As your programming skills grow, your pseudocode will include more complex logic. But it will still serve the same purpose: to help you find and express the necessary robot behaviors in simple English.

Thinking about Programming Planning & Behaviors *(cont.)*

End of Section

Start with a very large solution behavior and break it down into smaller and smaller sub-behaviors. This gives you a logical way to figure out what the robot needs to do to accomplish its task.

Recording the robot's behaviors in English is the first step toward writing good **pseudocode**. It allows you to easily review these behaviors and their organization as you prepare to translate them into program code.

The only step remaining is to translate your behaviors from English pseudocode into the ROBOTC programming language.