CSC121H Lab 1

Congratulations on getting started with the CSC121 labs. Now it’s time for you to do some programming! To earn your 1% lab mark, you must work hard with a partner to finish the lab exercise. If you finish before the end of the lab, show your TA your work. Make sure your TA has marked you as present in the lab before you leave.
In this lab, you will be setting up your Teaching Labs account if you don’t have one, and using the R Console to run some basic code. If you have time at the end of the lab, you can get help installing R and RStudio on your own computer if you need assistance.

1 Objectives

1. Learn how to program in pairs as driver and navigator
2. Define driver and navigator
3. Practise working with expressions in the R Console
4. Practise working with variables
5. Use some mathematical functions

2 Driver and navigator

You are required to find a lab partner to work with and to work in a group of two, using one computer together. We encourage pair programming as it helps when you are stuck. We will use the terms driver and navigator. Here are the definitions of the two roles:

**driver:** The person typing at the keyboard.
**navigator:** The person watching for mistakes, and thinking ahead.

Here is the most important rule for this and all future labs:

**The navigator must not touch the keyboard or mouse.** The driver’s role is to work with the computer, and the navigator’s is to think about what is happening on the screen, and about the upcoming issues related to the problem being solved. The navigator can tell the driver what they’re thinking and if there’s something the driver should notice or has missed.

In every lab handout, we’ll call you two s1 and s2, and s1 will be the first driver, and you will switch as you go along.

Although you can bring your laptop do the lab on it, we recommend doing your work on the lab computers, so that both partners can see everything on the big screen.

3 Logging In

Whether or not you want to use your own computer to to your work, you need to activate your Teaching Labs account if you haven’t done so yet.
Both you and your partner need to activate your account, so take some time before you continue with the lab to do so by logging into your lab computer using the credentials Username: account, Password: account. Follow the instructions to set up your account.
4 Opening RStudio in the Teaching Labs

After you’ve logged in (with either partner’s account), you can work on the Teaching Labs computers. To open RStudio on the lab machines, please follow the instructions in the screenshots that can be found on the course website:

http://www.teach.cs.toronto.edu/~csc121h/winter/

Check the ‘Lectures’ page for this week and click on ‘RStudio screenshots’. They can also be found on the ‘Labs’ page.

Follow the instructions there to open RStudio.

At the end of the lab, you may have time to get help installing R on your computer. For now, work on the teaching lab computers with your partner.

5 Numerical expressions in the R Console

Now that the administrative details are out of the way, we can get started with the fun part of the lab! Many of you will be programming for the first time; that’s exciting, but may also be a bit overwhelming. Don’t hesitate to ask your TA or your labmates in the room for help. You may also refer to your notes and the lectures page of the course website.

To begin, make sure you have opened RStudio (refer to the screenshots in section 4 if you haven’t done so yet). For this lab, we’ll start by working in the RStudio Console.

Choose your driver/navigator roles (explained on page 1) – one student is s1 and the other is s2. s1 drives and s2 navigates. You will switch later.

R has many calculator-like features. Try evaluating the following expressions in the shell. Before you write the expressions in the R console, first write your guess as to what value R will give you for each expression in the ‘Your Value Guess’ section. Then write the expression in the R console and note down the actual value. If there are differences between your guess and the actual value, think about why that is the case. s1 (the driver) will write the expressions into the console.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Your Value Guess</th>
<th>Actual Value in R Console</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 + 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 - 2.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 / 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 % 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5 * 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 % 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 % 3 (notice the / in the middle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 * 3 + 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 * (3 + 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 % 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switch roles: s2 is now the driver and writes into the R console.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Your Value Guess</th>
<th>Actual Value in R Console</th>
</tr>
</thead>
<tbody>
<tr>
<td>as.integer(28 / 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>as.double(28 / 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>as.double(as.integer(28 / 6))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>as.integer(as.double(28 / 6))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>typeof(28 / 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>typeof(as.integer(28 / 6))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>typeof(as.double(28 / 6))</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Checking your understanding:

- Which of the previous expressions would you not see on a calculator? Explain to your partner why that is the case. Now have your partner explain it to you.

6 Variables

The values in the expressions that we are working with often have more meaning than the numbers alone reveal. For example, the expression \(0.5 \times 10 \times 5\), might be the area of a triangle, where the value 10 is the base and 5 is the height. To associate a name with those values, we use variables.

The general form of an assignment statement is: `variable <- expression`

Perform the following steps in the R console.

**Switch roles: s1 drives and s2 navigates.**

- Assign the value 10 to a variable named `base` and the value 5 to a variable `height`.
- Now rewrite the expression \(0.5 \times 10 \times 5\) so that it uses variables `base` and `height`.
- Next, assign the expression to a variable named `area`.
- Reassign variables `base` and `height` the values 8 and 4, respectively. What is the value of `area` now? Type `area` and the return key to see `area`'s value. If the value of `area` is not what you expected, and you can’t figure out why, call your TA over for help.
- Verify the current variable values by typing each variable in the console followed by the return key. Now recalculate the area (using the variables) and check its value.
- **RStudio Console Tip:** Try using the up/down arrows of your keyboard. See what happens if you press any one of them multiple times.

7 Using math functions

In the previous section, we calculated the area of a triangle. Let’s now see what else we can do with math in R.

Perform the following steps in the R console.

**Switch roles: s2 drives and s1 navigates.**

R has some built-in functions and pre-defined variables that are useful for doing math.

- Type the variable `pi` and hit enter. What is its value?
- Define a variable called `radius`, and give it the value 4.
- The area of a circle with radius \(r\) is defined as \(\pi r^2\), where \(r\) is the radius. Write an R expression in the console that will calculate the area of the circle with the variable `radius`.
- Let’s look at a function called `abs`. Try calling the `abs` function with different numbers, including negative numbers. Can you explain to your partner with this function does?
- The `sqrt` function returns the square root of the given number. Try `sqrt(4)` and `sqrt(25)`.
- Define a variable called `a` with the value 3. Define another variable called `b` with the value 4.
• The length of a right triangle’s longest side, \( c \), is defined as: \( c = \sqrt{a^2 + b^2} \), where \( a \) and \( b \) are the lengths of the other sides.

Write an expression in the R console that will calculate the length of the longest side of a triangle with the other lengths as \( a \) and \( b \) (the variables you previously defined).
Assign this expression to the variable \( c \). Make sure \( c \) has the value you expect it to.

8 Setting up RStudio on your own computer

If you managed to install R and RStudio on your personal computer/laptop, you can skip this section. Otherwise, if you brought your laptop with you, you can follow the directions on the ‘Software’ page of the course website. If you have any issues during this process, ask your TA (or other students around you in the class) for assistance.

When you are done the lab, show your TA your work. Make sure you are marked present on the attendance sheet.

If you did not finish, or you have questions, finish the lab at home this week, and get any questions answered in office hours or on the discussion board.