What is r statistical programming language

R is an open-source statistical programming language and framework that's used for a wide range of scientific applications, including machine learning. R is a popular skill requirement for job openings in artificial intelligence and data science.R is considered to be a well-developed programming language, although it is known to be fairly unconventional when compared to other popular software development languages such as C++ or Java. What makes R stand out from most other languages is that the framework provides developers with an interactive statistical environment for analyzing and visualizing data.Users can compile and run R on various operating systems including Windows, Unix, Mac OS X and Linux. New code and statistical techniques are shared through groups such as the Comprehensive R Archive Network (CRAN). Although R is known as a programming language, many programmers refer to it as software that contains a language as well as a runtime environment. It includes conditionals, loops and user-defined recursive functions, as well as and input and output facilities that facilitate the use of predictive analytics. R, which was developed by Ross Ihaka and Robert Gentleman in the 1990s, is sometimes referred to as an open source implementation of the S programming language. The name R was chosen to reflect the creators' first names. RStudioRStudio is an open source integrated development environment (IDE) for for data manipulation, calculation and graphical display. It includes R console, a code editor, file browser, help files and graphical display. Share this Term Basic Combined Programming Language Data Scientist R is a language and environment for statistical computing and graphics. It is a GNU project which is similar to the S language and environment which was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues. R can be considered as a different implementation of S. There are some important differences, but much code written for S runs unaltered under R. R provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, …) and graphical techniques, and is highly extensible. The S language is often the vehicle of choice for research in statistical methodology, and R provides an Open Source route to participation in that activity. One of R’s strengths is the ease with which well-designed publication-quality plots can be produced, including mathematical symbols and formulae where needed. Great care has been taken over the defaults for the minor design choices in graphics, but the user retains full control. R is available as Free Software under the terms of the Free Software Foundation’s GNU General Public License in source code form. It compiles and runs on a wide variety of UNIX platforms and similar systems (including FreeBSD and Linux), Windows and MacOS. The R environment R is an integrated suite of software facilities for data manipulation, calculation and graphical display. It includes an effective data handling and storage facility, a suite of operators for calculations on arrays, in particular matrices, a large, coherent, integrated collection of intermediate tools for data analysis, graphical facilities for data analysis and display either on-screen or on hardcopy, and a well-developed, simple and effective programming language which includes conditionals, loops, user-defined recursive functions and input and output facilities. The term “environment” is intended to characterize it as a fully planned and coherent system, rather than an incremental accretion of very specific and inflexible tools, as is frequently the case with other data analysis software. R, like S, is designed around a true computer language, and it allows users to add additional functionality by defining new functions. Much of the system is itself written in the R dialect of S, which makes it easy for users to follow the algorithmic choices made. For computationally-intensive tasks, C, C++ and Fortran code can be linked and called at run time. Advanced users can write C code to manipulate R objects directly. Many users think of R as a statistics system. We prefer to think of it as an environment within which statistical techniques are implemented. R can be extended (easily) via packages. There are about eight packages supplied with the R distribution and many more are available through the CRAN family of Internet sites covering a very wide range of modern statistics. R has its own LaTeX-like documentation format, which is used to supply comprehensive documentation, both on-line in a number of formats and in hardcopy. R is a programming language and software environment for statistical analysis, graphics representation and reporting. R was created by Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand, and is currently developed by the R Development Core Team. R is freely available under the GNU General Public License, and pre-compiled binary versions are provided for various operating systems like Linux, Windows and Mac. This programming language was named R, based on the first letter of first name of the two R authors (Robert Gentleman and Ross Ihaka), and partly a play on the name of the Bell Labs Language S. Audience This tutorial is designed for software programmers, statisticians and data miners who are looking forward for developing statistical software using R programming. If you are trying to understand the R programming language as a beginner, this tutorial will give you enough understanding on almost all the concepts of the language from where you can take yourself to higher levels of expertise. Prerequisites Before proceeding with this tutorial, you should have a basic understanding of Computer Programming terminologies. A basic understanding of any of the programming languages will help you in understanding the R programming concepts and move fast on the learning track. We should take advantage of this time to learn a new skill if we can. I have been learning the programming language R during the past few weeks.This article aims to provide an overview of the R programming language along with all of the main concepts which every data scientist must be familiar withMotivationThe field of data science and quantitative development requires us to constantly adapt and learn new skills because of its highly dynamic and demanding nature. There comes a time in a data scientist's professional life when it becomes important to learn more than one programming language. Subsequently, I have chosen to learn R.This article will aim to outline all of the key main areas and will explain everything from the basics. It assumes that the reader is not familiar or has a beginner level understanding of the programming language R.I highly recommend R for many reasons that I will highlight in this articlePhoto by Cris DiNoto on UnsplashR is gaining popularity and it is one of the most popular programming languages. R was written for statisticians by statisticians. It integrates well with other programming languages such as C++, Java, SQL. Furthermore, R is mainly seen as a statistical programming language. As a result, a number of financial institutions and large quantitative organisations use the R programming language during their research and development.Python is a general-purpose language and R can be seen as an analytical programming language.1. Article AimThis article will explain the following key areas about R:What Is R?How To Install R?Where To Code R?What Is A R Package and R Script?What Are The Different R Data Types?How To Declare Variables And Their Scope In R?How To Write Comments?What Are Vectors?What Are Matrix?What Are Lists?What Are Data Frames?Different Logical Operations In RFunctions In RLoops In RRead And Write External Data In RPerforming Statistical Calculations In RPlotting In RObject-Oriented Programming in RFamous R LibrariesHow To Install External R LibrariesPlotting In RLet’s Start ….I will explain the programming language from the basics in a manner that would make the language easier to understand. Having said that, the key to advancing in programming is to always practice as much as possible.This article should form a solid foundation for the readers2. What Is R?R is a free programming language under GNU license. In a nutshell, R is a statistical environment.R is mainly used for statistical computing. It offers a range of algorithms which are heavily used in machine learning domain such as time series analysis, classification, clustering, linear modeling, etc.R is also an environment that includes a suite of software packages that can be used for performing a numerical calculation to chart plotting to data manipulation.R is heavily used in statistical research projects.R is very similar to the S programming language.R is compiled and runs on UNIX, Windows, MacOS, FreeBSD and Linux platforms.R has a large number of data structures, operators and features. It offers from arrays to matrices to loops to recursion along with integration with other programming languages such as C, C++, and Fortran.C programming language can be used to update R objects directly.New R packages can be implemented to extend.R interpreterR was inspired by S+, therefore if you are familiar with S then it will be a straightforward task to learn R.Along with the benefits listed above, R is:Straightforward to learnA large number of packages are available for statistical, analytics and graphics which are open-source and freeA wealth of academic papers with their implementation in R are availableWorld’s top universities teach their students the R programming language, therefore, it has now become an accepted standard and thus, R will continue to grow.Integration capabilities with other languagesPlus there is a large community supportLimitations Of R:There are a handful of limitations too:R isn’t as fast as C++, plus security and memory management is an issue too.R has a large number of namespaces, sometimes that could appear to be too many. However, it is getting better.R is a statistician language thus it is not as intuitive as Python. It’s not as straightforward to create OOP as it is with Python.Let’s Start Learning RI will now be presenting the language R in quick-to-follow sections.Photo by Jonas Jacobsson on Unsplash3. How To Install R?You can install R on:UbuntoMacWindowsFedoraDebianSLESOpenSUSEThe first step is to download R:Open an internet browserGo to www.r-project.org.The latest R version at the point of writing this article is 3.6.3 (Holding the Windsock). It was released on 2020–02–29.These are the links:Download R for LinuxDownload R for (Mac) OS XDownload R for Windows4. Where To Code R?There are multiple graphical interfaces available. I highly recommend R-StudioA screenshot of R-StudioDownload RStudio Desktop:It usually installs R Studio in the following location if you are using Windows:C:\Program Files\RStudio5. What Is R Package And R Script?R package and R script are the two key components of R. This section will provide an overview of the concepts.R PackageSince R is an open-source programming language, it is important to understand what packages are. A package essentially groups and organises code and other functions. A package is a library that can contain a large number of files.Data scientists can contribute and share their code with others either by creating their own or enhancing others’ packages. Packages allow data scientists to reuse code and distribute it to others.Packages are created to contain functions and data setsA data scientist can create a package to organise code, documentation, tests, data sets etc. and the package can then be shared with others.There are tens of thousands of R packages available on the internet. These packages are located in the central repository. There are a number of repositories available such as CRAN, Bioconductor, Github etc.One repository worth mentioning is CRAN. It is a network of servers that store a large number of versions of code and documentation for R.A package contains a description file where one would state the date, dependencies, author, and version of the package amongst other information. The description file helps the consumers get meaningful information about the package.To load a package, type in:To use a function of a package, type in the name of the package::name of the function.For example, if we want to use the function “AdBCDOne” of the package “carat” then we can do:R Script:R script is where a data scientist can write the statistical code. It is a text file with an extension .R e.g. we can call the script as tutorial.RWe can create multiple R scripts in a package.As an instance, if you have created two R scripts:And if you want to call the functions of publication.R in blog.R then you can use the source(“target R script”) command to import publication.R into blog.R:Create R Package Of A R ScriptThe process is relatively simple. In a nutshellCreate a Description fileCreate the R.scripts and add any data sets, documentation, tests that are required for the packageWrite your functionality in R scriptsWe can use devtools and roxygen2 to create R packages by using the command:6. What Are The Different R Data Types?It is vital to understand the different data types and structures in R to be able to use the R programming language efficiently. This section will illustrate the concepts.Data Types:These are the basic data types in R:character: such as “abc” or “a”integer: such as 5Lnumeric: such as 10.5logical: TRUE or FALSEcomplex: such as 5+4iWe can use the typeof(variable) to find the type of a variable.To find the metadata, such as attributes of a type, use the attributes(variable) command.Data Structures:A number of data structures exist in R. The most important data structures are:vector: the most important data structure that is essentially a collection of elements.matrix: A table-like structure with rows and columnsdata frame: A tabular data structure to perform statistical operationslists: A collection that can hold a combination of data types.factors: to represent categorical dataI will explain all of these data types and data structures in this article as we start building the basics.7. How To Declare Variables?We can create a variable and assign it a value. A variable could be of any of the data types and data structures that are listed above. There are other data structures available too. Additionally, a developer can create their own custom classes.A variable is used to store a value that can be changed in your code.As a matter of understanding, it is vital to remember what an environment in R is. Essentially, an environment is where the variables are stored. It is a collection of pairs where the first item of the pair is the symbol (variable) and the second item is its value.Environments are hierarchical (tree structure), hence an environment can have a parent and multiple children. The root environment is the one with an empty parent.We have to declare a variable and assign it a value using →This will set the value of “my variable” to the variable x. The print() function will output the value of x, which is “my variable”.Every time we declare a variable and call it, it is searched in the current environment and is recursively searched in the parent environments until the symbol is found.To create a collection of integers, we can do:1 is the first value and 5 is the last value of the collection.This will print 1 2 3 4 5Note, R-Studio IDE keeps track of the variables:Screenshot of R StudioThe ls() function can be used to show the variables and functions in the current environment.8. How To Write Comments?Comments are added in the code to help the readers, other data scientists and yourself understand the code.Note: Always ensure the comments are not polluting your scripts.We can add a single line comment:We can add the multiline comments using the double quotes:Note: In R-Studio, select the code you want to comment and then press Ctrl+Shift+CIt will automatically comment on the code for you.9. What Are Vectors?Vector is one of the most important data structures in R. Essentially, a vector is a collection of elements where each element is required to have the same data type e.g. logical (TRUE/FALSE), Numeric, character.We can also create an empty vector:By default, the type of vector is logical, such as True/False. The line below will print logical as the type of vector:To create a vector with your elements, you can use the concatenate function (c):This will print:[1] “Farhad” [2] “Malik” [3] “FinTechExplained”If we want to find the length of a vector, we can use the length() function:This will print 3 as there are three elements in the vector.To add elements into a vector, we can combine an element with a vector.For example, to add “world” at the start of a vector with one element “hello”:This will print “world” “hello”If we mix the types of elements then R will accommodate the type of the vector too. The type (mode) of the vector will become whatever it considers being the most suitable for the vector:Although the second element is a logical value, the type will be printed as “character”.Operations can also be performed on vectors.As an instance, to multiply a scalar to a vector:This will print 2,4,6We can also add two vectors together:This will print 5 7 9If the vectors are characters and we want to add them together:It will output:Error in x + y : non-numeric argument to binary operator10. What Are Matrix?Matrix is also one of the most common data structures in R.It can be considered as an extension of a vector. A matrix can have multiple rows and columns. All of the elements of a matrix must have the same data type.To create a matrix, use the matrix() constructor and pass in nrow and ncol to indicate the columns and rows:This will create a matrix variable, named x, with 4 rows and 4 columns.A vector can be transformed into a matrix by passing a matrix in the constructor. The resultant matrix will be filled column-wise:This will create a matrix with 1 column and 3 rows (one for each element):[,1][1,] 1[2,] 2[3,] 3If we want to fill a matrix by row or column then we can explicitly pass in the number of rows and columns along with the byrow parameter:The above code created a matrix with 2 columns and rows. The matrix is filled by row.[,1] [,2][1,] 1 2[2,] 3 411. What Are Lists And Factors?If we want to create a collection that can contain elements of different types then we can create a list.Lists:Lists are one of the most important data structures in R. To create a list, use the list() constructor:The code snippet above illustrates how a list is created with three elements of different data types.We can access any element by using the index e.g.:This will print “hello”We can also give each element a name e.g.Factors:Factors are categorical data e.g. Yes, No or Male, Female or Red, Blue, Green, etc.A factor data type can be created to represent a factor data set:Factors can be ordered too:We can also print the factors in tabular format:This will print:We have covered half of the article. Let’s move on to more statistical learning12. What Are Data Frames?Most, if not all of the data science projects require input data in tabular format. Data frames data structure can be used to represent tabular data in R. Each column can contain a list of elements and each column can be of a different type than each other.To create a data frame of 2 columns and 5 rows each, simply do:13. Different Logical Operators In RThis section provides an overview of the common operators:OR: one | twoThis will check if one or two is true.AND: one & twoThis will check if one and two are true.NOT: !inputThis will return true if the input is FalseWe can also use , isTRUE(input) etc.14. Functions In R And Variables ScopeSometimes we want the code to perform a set of tasks. These tasks can be grouped as functions. The functions are essentially objects in R.Arguments can be passed to a function in R and a function can return an object too.R is shipped with a number of in-built functions such as length(), mean(), etc.Every time we declare a function (or variable) and call it, it is searched in the current environment and is recursively searched in the parent environments until the symbol is found.A function has a name. This is stored in the R environment. The body of the function contains the statements of a function.A function can return value and can optionally accept a number of arguments.To create a function, we need the following syntax:For example, we can create a function that takes in two integers and returns a sum:To call the function, we can pass in the arguments:This will print 3.We can also set default values to an argument so that its value is taken if a value for an argument is not provided:The default value of y is 2, therefore, we can call the function without passing in a value for y.The key to note is the use of the curly brackets {…}Let’s look at a complex case whereby we will use a logical operatorLet’s consider that we want to create a function that accepts the following arguments: Mode, x and y.If the Mode is True then we want to add x and y.If the Mode is False then we want to subtract x and y.To call the function to add the values of x and y, we can do:This will print 6Let’s review the code below. In particular, see where print(z) is:The key to note is that z is being printed after the brackets are closed.Will the variable z be available there? This brings us to the topic of scope in functions!A function can be declared within another function:In the example above, some_func and another_func are the two functions. another_func is declared inside some_func. As a result, another_func() is private to some_func(). Hence, it not accessible to the outside world.If I execute another_func() outside of some_func as shown below:We will experience the error:Error in another_func() : could not find function “another_func”On the other hand, we can execute another_func() inside some_func() and it will work as expected.Now consider this code to understand how scope works in R.some_func_variable is accessible to both some_func and another_func functions.another_func_variable is only accessible to the another_func functionRunning the above code will throw an exception in R-Studio:> some_func()[1] “DEF”Error in print(“outside another func” + another_func_variable) : object ‘another_func_variable’ not foundAs the error states, another_func_variable is not found. We can see DEF was printed which was the value assigned to the variable some_func_variable.If we want to access and assign values to a global variable, use the

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