Programming Languages

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In-Class Exercise (15 minutes)

- Plot a graph in C or C++
  - On X-axis, plot the student ids: 1, 2, 3, 4, 5
  - On Y-axis, plot the scores of the students: 10, 3, 7, 10 , 1
    - Student 1 has score 10, student 2 has score 3, and so on
- You can display the data as the line graph or bar-chart for this exercise
- Email your solutions to ritu@wayne.edu

What is R?

- R is a statistical tool used for data analysis and visualization
  - It has packages supporting not only statistical functions but additional functions also like those for data analysis, plotting graphs, etc.

- R also has support for writing programs (implementing your own functions)
  - Caution: programs written in R can be slow
  - For some domain specialists, this might be a very user-friendly environment though

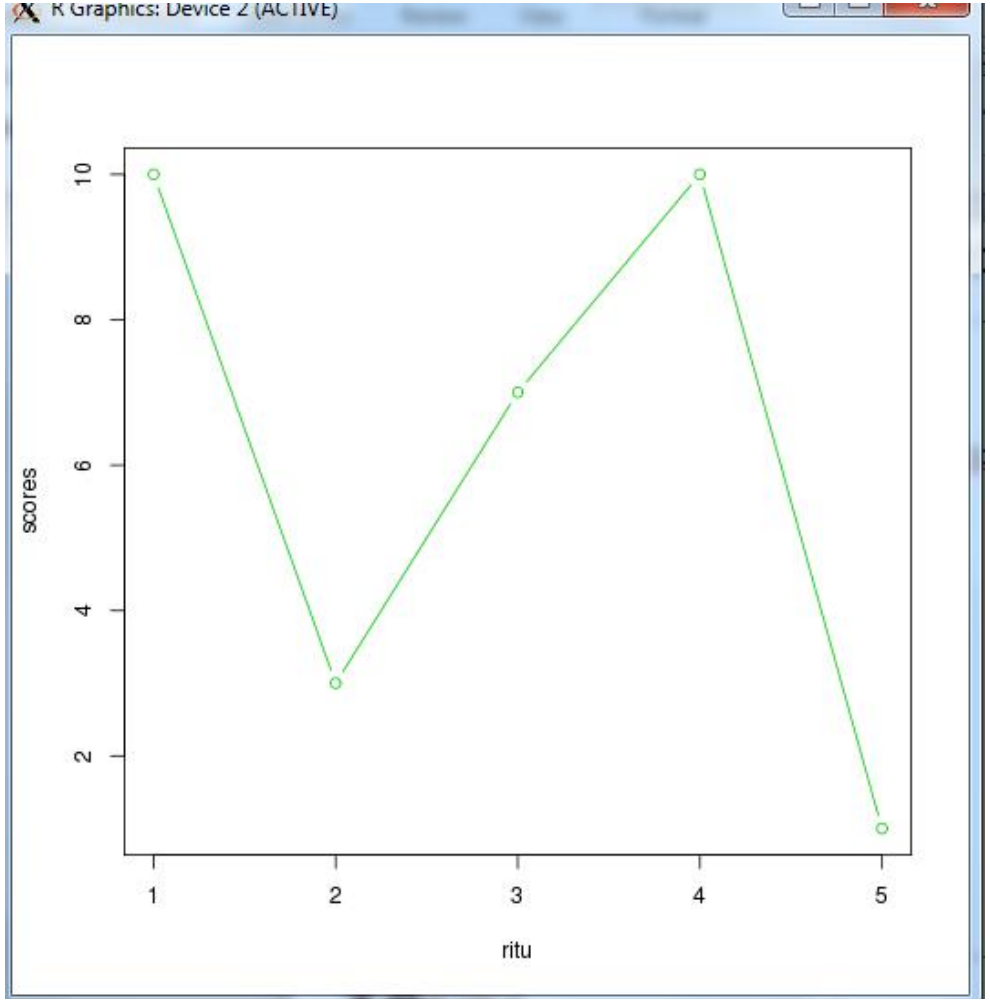
Examples of Using R for Statistical Analysis

- R consists of ready-to-use smaller programs (functions basically)

```
> ritu=c(1,2,3,4,5)
> sum(ritu)
[1] 15
> mean(ritu)
[1] 3
> min(ritu)
[1] 1
> max(ritu)
[1] 5
> range(ritu)
[1] 1 5
```

Example of Using R for Plotting Graphs

```
> ritu=c(1,2,3,4,5)
> scores=c(10,3,7,10,1)
> plot(scores~ritu,typ="b",col=3)
```



Examples of using R as a Calculator

- You can do calculations directly at the command prompt

```
> 1+2
[1] 3
> 2-1
[1] 1
> log2(2)
[1] 1
> 2^-1
[1] 0.5
>
```

Variables in R (1)

- You can create character (or strings using characters), numeric (like double or real), integer, logical, or complex variables in R

- You can either use “=” or “<-” for assigning values to the variables

```
# numeric
x <- 10.5

# integer
x <- 1000L

# complex
x <- 9i + 3

# character/string
x <- "R is exciting"

# logical/Boolean
x <- TRUE
```

- You can assign values to multiple variables at the same time

  var1 = var2 = var3 = “Hello"

Variables in R (2)

- You can check the data types in R by using class or typeof functions

```r
# numeric
x <- 10.5
class(x)

# integer
x <- 1000L
class(x)

# complex
x <- 9i + 3
class(x)

# character/string
x <- "R is exciting"
class(x)

# logical/boolean
x <- TRUE
class(x)
```

Some Examples of Operations on Vectors

```
> vec2
[1] 1 2 3 4 5
> vec2+2
[1] 3 4 5 6 7
> vec2*3
[1]  3  6  9 12 15
> vec2^2
[1]  1  4  9 16 25
> 2^vec2
[1]  2  4  8 16 32
> sort(vec2, decreasing=T)
[1] 5 4 3 2 1
> vec2[3]
[1] 3
```

Examples on Creating and Using Matrices

```
> vec1
[1] 1 2 3 4 5
> vec2
[1] 1 2 3 4 5
> m1=cbind(vec1, vec2)
> m1
     vec1 vec2
[1,]    1    1
[2,]    2    2
[3,]    3    3
[4,]    4    4
[5,]    5    5
> t(m1)
     [,1] [,2] [,3] [,4] [,5]
vec1    1    2    3    4    5
vec2    1    2    3    4    5
```

Printing Output in R

- You can output code in R without using a print function (just type the name of the variable to print its value), however, R does have a print function

```
print("Hello World!")
```

Comments in R

- In R comments start with a #

```
# This is a comment
"Hello World!"
```

- Question: How are comments provided in Bash, C, C++?

Conditions/”if Statements” in R

- An "if statement" is used to specify a block of code to be executed if a condition is TRUE
- Operator supported are

  ==
  !=
  >
  >=
  <=

  Example:

```
a <- 7
b <- 8

if (b > a) {
  print("b is greater than a")
}else{
  print(“a is greater than b")
}
```

References

- http://bio.fsu.edu/miller/docs/Tutorials/Tutorial5_IntroProgramming.pdf
- https://www.tacc.utexas.edu/c/document_library/get_file?uuid=2730b001-0036-4c28-9f31-52169dddeb6a&groupId=13601
- http://www.statmethods.net/management/functions.html
- http://math.illinoisstate.edu/dhkim/rstuff/rtutor.html
- https://www.w3schools.com/r/