

Week-3: Code-along

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I. Code to edit and execute

To be submitted on canvas before attending the tutorial

Loading packages

```
# Load package tidyverse
library(tidyverse)
```

```
## — Attaching core tidyverse packages — tidyverse 2.0.0 —
## ✓ dplyr      1.1.2      ✓ readr      2.1.4
## ✓ forcats    1.0.0      ✓ stringr    1.5.0
## ✓ ggplot2    3.4.3      ✓ tibble     3.2.1
## ✓ lubridate  1.9.2      ✓ tidyr      1.3.0
## ✓ purrr      1.0.2
## — Conflicts — tidyverse_conflicts() —
## ✗ dplyr::filter() masks stats::filter()
## ✗ dplyr::lag()     masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to be
come errors
```

Assigning values to variables

```
# Example a.: execute this example
x <- 'A'
x
```

```
## [1] "A"
```

```
# Complete the code for Example b and execute it
x <- "Banana"
x
```

```
## [1] "Banana"
```

```
# Complete the code for Example c and execute it
x <- FALSE
x
```

```
## [1] FALSE
```

```
# Complete the code for Example d and execute it
x <- 5L
x
```

```
## [1] 5
```

```
# Complete the code for Example e and execute it
x <- 5
x
```

```
## [1] 5
```

```
# Complete the code for Example f and execute it
x <- 1i
x
```

```
## [1] 0+1i
```

```
class(x)
```

```
## [1] "complex"
```

```
typeof(x) # they do the same thing!
```

```
## [1] "complex"
```

Checking the type of variables

```
# Example a.: execute this example
x <- 'A'
typeof(x)
```

```
## [1] "character"
```

```
# Complete the code for Example b and execute it
x <- "Banana"
typeof(x)
```

```
## [1] "character"
```

```
# Complete the code for Example c and execute it
x <- FALSE
typeof(x)
```

```
## [1] "logical"
```

```
# Complete the code for Example d and execute it  
x <- 5L  
typeof(x)
```

```
## [1] "integer"
```

```
# Complete the code for Example e and execute it  
typeof(x)
```

```
## [1] "integer"
```

```
# Complete the code for Example f and execute it  
x <- 1i  
typeof(x)
```

```
## [1] "complex"
```

Need for data types

```
# import the cat-lovers data from the csv file you downloaded from canvas  
cat_lovers <- read_csv("cat-lovers.csv")
```

```
# Compute the mean of the number of cats: execute this command  
mean(cat_lovers$number_of_cats)
```

```
## Warning in mean.default(cat_lovers$number_of_cats): argument is not numeric or  
## logical: returning NA
```

```
## [1] NA
```

```
# Get more information about the mean() command using ? operator  
?mean()
```

```
# Convert the variable number_of_cats using as.integer()  
mean(as.integer(cat_lovers$number_of_cats))
```

```
## Warning in mean(as.integer(cat_lovers$number_of_cats)): NAs introduced by  
## coercion
```

```
## [1] NA
```

```
# Display the elements of the column number_of_cats  
cat_lovers$number_of_cats
```

```
## [1] "0"
## [2] "0"
## [3] "1"
## [4] "3"
## [5] "3"
## [6] "2"
## [7] "1"
## [8] "1"
## [9] "0"
## [10] "0"
## [11] "0"
## [12] "0"
## [13] "1"
## [14] "3"
## [15] "3"
## [16] "2"
## [17] "1"
## [18] "1"
## [19] "0"
## [20] "0"
## [21] "1"
## [22] "1"
## [23] "0"
## [24] "0"
## [25] "4"
## [26] "0"
## [27] "0"
## [28] "0"
## [29] "0"
## [30] "0"
## [31] "0"
## [32] "0"
## [33] "0"
## [34] "0"
## [35] "0"
## [36] "0"
## [37] "0"
## [38] "0"
## [39] "0"
## [40] "0"
## [41] "0"
## [42] "0"
## [43] "1"
## [44] "3"
## [45] "3"
## [46] "2"
## [47] "1"
## [48] "1.5 - honestly I think one of my cats is half human"
## [49] "0"
## [50] "0"
## [51] "1"
## [52] "0"
## [53] "1"
## [54] "three"
## [55] "1"
```

```
## [56] "1"  
## [57] "1"  
## [58] "0"  
## [59] "0"  
## [60] "2"
```

```
# Display the elements of the column number_of_cats after converting it using as.numeric()  
as.numeric(cat_lovers$number_of_cats)
```

```
## Warning: NAs introduced by coercion
```

```
## [1] 0 0 1 3 3 2 1 1 0 0 0 0 1 3 3 2 1 1 0 0 1 1 0 0 4  
## [26] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 3 3 2 1 NA 0 0  
## [51] 1 0 1 NA 1 1 1 0 0 2
```

```
as.numeric("1.5")
```

```
## [1] 1.5
```

```
as.integer("1.5")
```

```
## [1] 1
```

Create an empty vector

```
# Empty vector  
x <- vector()  
# Type of the empty vector  
typeof(x)
```

```
## [1] "logical"
```

Create vectors of type logical

```
# Method 1  
x <- vector("logical", length=5)  
# Display the contents of x  
print(x)
```

```
## [1] FALSE FALSE FALSE FALSE FALSE
```

```
# Display the type of x  
print(typeof(x))
```

```
## [1] "logical"
```

```
# Method 2
x<-logical(5)
# Display the contents of x
print(x)
```

```
## [1] FALSE FALSE FALSE FALSE FALSE
```

```
# Display the type of x
print(typeof(x))
```

```
## [1] "logical"
```

```
# Method 3
x<-c(TRUE,FALSE,TRUE,FALSE,TRUE)
# Display the contents of x
print(x)
```

```
## [1] TRUE FALSE TRUE FALSE TRUE
```

```
# Display the type of x
print(typeof(x))
```

```
## [1] "logical"
```

Create vectors of type character

```
# Method 1
x<-vector("character",length=5)
# Display the contents of x
x
```

```
## [1] "" "" "" "" ""
```

```
# Display the type of x
#coercion = conversion
print(typeof(x))
```

```
## [1] "character"
```

```
# Method 2
x <- character(5)
# Display the contents of x
print(x)
```

```
## [1] "" "" "" "" ""
```

```
# Display the type of x  
typeof(x)
```

```
## [1] "character"
```

```
# Method 3  
x <- c('A')  
# Display the contents of x  
x
```

```
## [1] "A"
```

```
# Display the type of x  
typeof(x)
```

```
## [1] "character"
```

Create vectors of type integer

```
# Method 1  
x <- vector("integer", length = 3)  
# Display the contents of x  
x
```

```
## [1] 0 0 0
```

```
# Display the type of x  
print(typeof(x))
```

```
## [1] "integer"
```

```
# Method 2  
x <- integer(5)  
# Display the contents of x  
print(x)
```

```
## [1] 0 0 0 0 0
```

```
# Display the type of x  
typeof(x)
```

```
## [1] "integer"
```



```
# Method 3
x <- c(1, 2, 3, 4)
# Display the contents of x
x
```

```
## [1] 1 2 3 4
```

```
# Display the type of x
typeof(x)
```

```
## [1] "double"
```

```
# Method 4
x <- seq(from=1, to=5, by=0.1)
# Display the contents of x
x
```

```
## [1] 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8
## [20] 2.9 3.0 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7
## [39] 4.8 4.9 5.0
```

```
# Display the type of x
typeof(x)
```

```
## [1] "double"
```

```
# Method 5
x <- 1:5
# Display the contents of x
x
```

```
## [1] 1 2 3 4 5
```

```
# Display the type of x
typeof(x)
```

```
## [1] "integer"
```

Create vectors of type double

```
# Method 1
x <- vector("double", length = 5)
# Display the contents of x
x
# Display the type of x
typeof(x)
```

```
# Method 2
x <- double(5)
# Display the contents of x
x
# Display the type of x
typeof(x)
```

```
# Method 3
x <- c(1.787, 0.85895, 89360.83, 9)
# Display the contents of x
x
```

```
## [1]      1.78700      0.85895 89360.83000      9.00000
```

```
# Display the type of x
typeof(x)
```

```
## [1] "double"
```

Implicit coercion

Example 1

```
# Create a vector
x <- c(1.8)
# Check the type of x
typeof(x)
```

```
## [1] "double"
```

```
# Add a character to the vector
x <- c(x, 'a')
# Check the type of x
typeof(x)
```

```
## [1] "character"
```

Example 2

```
# Create a vector
x <- c('A')
# Check the type of x
typeof(x)
```

```
## [1] "character"
```

```
# Add a number to the vector
x <- as.numeric(x)
```

```
## Warning: NAs introduced by coercion
```

```
# Check the type of x  
typeof(x)
```

```
## [1] "double"
```

```
x
```

```
## [1] NA
```

Example 3

```
# Create a vector  
x <- c('a')  
# Check the type of x  
typeof(x)
```

```
## [1] "character"
```

```
# Add a logical value to the vector  
x <- (x, TRUE)  
# Check the type of x  
typeof(x)
```

Example 4

```
# Create a vector  
x <- c(1L)  
# Check the type of x  
typeof(x)
```

```
## [1] "integer"
```

```
# Add a logical value to the vector  
x <- c(x, 2)  
# Check the type of x  
typeof(x)
```

```
## [1] "double"
```

Explicit coercion

Example 1

```
# Create a vector
x <- c(1L)
# Check the type of x
typeof(x)
```

```
## [1] "integer"
```

```
# Convert the vector to type character
as.character(x)
```

```
## [1] "1"
```

```
# Check the type of x
typeof(x)
```

```
## [1] "integer"
```

Example 2

```
# Create a vector
x <- c('A')
# Check the type of x
typeof(x)
```

```
## [1] "character"
```

```
# Convert the vector to type double
as.double(x)
```

```
## Warning: NAs introduced by coercion
```

```
## [1] NA
```

```
# Check the type of x
typeof(x)
```

```
## [1] "character"
```

Accessing elements of the vector

```
# Create a vector
x <- c(1, 2, 691461375, 787, 8989, 1, 787, 191)
```

```
# Access one element with index 3
x[3]
```

```
## [1] 691461375
```

```
# Access elements with consecutive indices, 2 to 4: 2,3,4  
x[2:4]
```

```
## [1]          2 691461375          787
```

```
# Access elements with non-consecutive indices, 1,3,5  
x[c(1,3,5)]
```

```
## [1]          1 691461375          8989
```

```
# Access elements using logical vector  
x[c(TRUE,FALSE,FALSE,TRUE,FALSE,FALSE,TRUE)] #returns the TRUEs and not the FALSE
```

```
## [1]    1 787 787 191
```

```
# Access elements using the conditional operator <  
x[x<10]
```

```
## [1] 1 2 1
```

Examining vectors

```
# Display the length of the vector  
print(length(x))
```

```
## [1] 8
```

```
# Display the type of the vector  
print(typeof(x))
```

```
## [1] "double"
```

```
# Display the structure of the vector  
print(str(x))
```

```
##  num [1:8] 1.00 2.00 6.91e+08 7.87e+02 8.99e+03 ...  
## NULL
```

Lists

```
# Initialise a named list
my_pie = list(type="key lime", diameter=7, is.vegetarian=TRUE)
# display the list
my_pie
```

```
## $type
## [1] "key lime"
##
## $diameter
## [1] 7
##
## $is.vegetarian
## [1] TRUE
```

```
# Print the names of the list
names(my_pie)
```

```
## [1] "type"          "diameter"      "is.vegetarian"
```

```
# Retrieve the element named type
my_pie$type
```

```
## [1] "key lime"
```

```
# Retrieve a truncated list
my_pie["type"]
```

```
## $type
## [1] "key lime"
```

```
# Retrieve the element named type
my_pie[["type"]] #not list
```

```
## [1] "key lime"
```

Exploring data-sets

```
# Install package
#installed in console already
# Load the package
library(openintro)
```

```
## Loading required package: airports
```

```
## Loading required package: cherryblossom
```

```
## Loading required package: usdata
```

```
# Load package  
library(tidyverse)
```

```
# Catch a glimpse of the data-set: see how the rows are stacked one below another  
glimpse(loans_full_schema)
```

```

## Rows: 10,000
## Columns: 55
## $ emp_title                <chr> "global config engineer ", "warehouse...
## $ emp_length               <dbl> 3, 10, 3, 1, 10, NA, 10, 10, 10, 3, 1...
## $ state                   <fct> NJ, HI, WI, PA, CA, KY, MI, AZ, NV, I...
## $ homeownership           <fct> MORTGAGE, RENT, RENT, RENT, RENT, OWN...
## $ annual_income            <dbl> 90000, 40000, 40000, 30000, 35000, 34...
## $ verified_income          <fct> Verified, Not Verified, Source Verifi...
## $ debt_to_income           <dbl> 18.01, 5.04, 21.15, 10.16, 57.96, 6.4...
## $ annual_income_joint      <dbl> NA, NA, NA, NA, 57000, NA, 155000, NA...
## $ verification_income_joint <fct> , , , , Verified, , Not Verified, , ,...
## $ debt_to_income_joint     <dbl> NA, NA, NA, NA, 37.66, NA, 13.12, NA,...
## $ delinq_2y                <int> 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0...
## $ months_since_last_delinq <int> 38, NA, 28, NA, NA, 3, NA, 19, 18, NA...
## $ earliest_credit_line     <dbl> 2001, 1996, 2006, 2007, 2008, 1990, 2...
## $ inquiries_last_12m      <int> 6, 1, 4, 0, 7, 6, 1, 1, 3, 0, 4, 4, 8...
## $ total_credit_lines       <int> 28, 30, 31, 4, 22, 32, 12, 30, 35, 9,...
## $ open_credit_lines        <int> 10, 14, 10, 4, 16, 12, 10, 15, 21, 6,...
## $ total_credit_limit       <int> 70795, 28800, 24193, 25400, 69839, 42...
## $ total_credit_utilized    <int> 38767, 4321, 16000, 4997, 52722, 3898...
## $ num_collections_last_12m <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ num_historical_failed_to_pay <int> 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0...
## $ months_since_90d_late    <int> 38, NA, 28, NA, NA, 60, NA, 71, 18, N...
## $ current_accounts_delinq  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ total_collection_amount_ever <int> 1250, 0, 432, 0, 0, 0, 0, 0, 0, 0, 0,...
## $ current_installment_accounts <int> 2, 0, 1, 1, 1, 0, 2, 2, 6, 1, 2, 1, 2...
## $ accounts_opened_24m      <int> 5, 11, 13, 1, 6, 2, 1, 4, 10, 5, 6, 7...
## $ months_since_last_credit_inquiry <int> 5, 8, 7, 15, 4, 5, 9, 7, 4, 17, 3, 4,...
## $ num_satisfactory_accounts <int> 10, 14, 10, 4, 16, 12, 10, 15, 21, 6,...
## $ num_accounts_120d_past_due <int> 0, 0, 0, 0, 0, 0, 0, NA, 0, 0, 0, 0, ...
## $ num_accounts_30d_past_due <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ num_active_debit_accounts <int> 2, 3, 3, 2, 10, 1, 3, 5, 11, 3, 2, 2,...
## $ total_debit_limit        <int> 11100, 16500, 4300, 19400, 32700, 272...
## $ num_total_cc_accounts    <int> 14, 24, 14, 3, 20, 27, 8, 16, 19, 7, ...
## $ num_open_cc_accounts     <int> 8, 14, 8, 3, 15, 12, 7, 12, 14, 5, 8,...
## $ num_cc_carrying_balance  <int> 6, 4, 6, 2, 13, 5, 6, 10, 14, 3, 5, 3...
## $ num_mort_accounts        <int> 1, 0, 0, 0, 0, 3, 2, 7, 2, 0, 2, 3, 3...
## $ account_never_delinq_percent <dbl> 92.9, 100.0, 93.5, 100.0, 100.0, 78.1...
## $ tax_liens                <int> 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ public_record_bankrupt   <int> 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0...
## $ loan_purpose               <fct> moving, debt_consolidation, other, de...
## $ application_type         <fct> individual, individual, individual, i...
## $ loan_amount              <int> 28000, 5000, 2000, 21600, 23000, 5000...
## $ term                     <dbl> 60, 36, 36, 36, 36, 36, 60, 60, 36, 3...
## $ interest_rate            <dbl> 14.07, 12.61, 17.09, 6.72, 14.07, 6.7...
## $ installment              <dbl> 652.53, 167.54, 71.40, 664.19, 786.87...
## $ grade                    <fct> C, C, D, A, C, A, C, B, C, A, C, B, C...
## $ sub_grade                <fct> C3, C1, D1, A3, C3, A3, C2, B5, C2, A...
## $ issue_month              <fct> Mar-2018, Feb-2018, Feb-2018, Jan-201...
## $ loan_status              <fct> Current, Current, Current, Current, C...
## $ initial_listing_status    <fct> whole, whole, fractional, whole, whol...
## $ disbursement_method      <fct> Cash, Cash, Cash, Cash, Cash, Cash, C...
## $ balance                  <dbl> 27015.86, 4651.37, 1824.63, 18853.26,...
## $ paid_total               <dbl> 1999.330, 499.120, 281.800, 3312.890,...
## $ paid_principal           <dbl> 984.14, 348.63, 175.37, 2746.74, 1569...

```



```
## $ paid_interest      <dbl> 1015.19, 150.49, 106.43, 566.15, 754....
## $ paid_late_fees      <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
```

```
# Selecting numeric variables
loans <- loans_full_schema %>% # <-- pipe operator
  select(paid_total, term, interest_rate,
         annual_income, paid_late_fees, debt_to_income)
# View the columns stacked one below another
glimpse(loans)
```

```
## Rows: 10,000
## Columns: 6
## $ paid_total      <dbl> 1999.330, 499.120, 281.800, 3312.890, 2324.650, 873.130...
## $ term            <dbl> 60, 36, 36, 36, 36, 36, 60, 60, 36, 36, 60, 60, 36, 60,...
## $ interest_rate    <dbl> 14.07, 12.61, 17.09, 6.72, 14.07, 6.72, 13.59, 11.99, 1...
## $ annual_income    <dbl> 90000, 40000, 40000, 30000, 35000, 34000, 35000, 110000...
## $ paid_late_fees    <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0...
## $ debt_to_income    <dbl> 18.01, 5.04, 21.15, 10.16, 57.96, 6.46, 23.66, 16.19, 3...
```

```
# Selecting categoric variables
loans <- loans_full_schema %>%
  select(grade, state, homeownership, disbursement_method) # type the chosen columns as in the lecture slide
# View the columns stacked one below another
glimpse(loans)
```

```
## Rows: 10,000
## Columns: 4
## $ grade      <fct> C, C, D, A, C, A, C, B, C, A, C, B, C, B, D, D, D,...
## $ state      <fct> NJ, HI, WI, PA, CA, KY, MI, AZ, NV, IL, IL, FL, SC...
## $ homeownership <fct> MORTGAGE, RENT, RENT, RENT, RENT, OWN, MORTGAGE, M...
## $ disbursement_method <fct> Cash, Cash, Cash, Cash, Cash, Cash, Cash, Cash, Ca...
```