Introduction to the tidyverse

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The `tidyverse` is not an R package - it is, rather, as set of tightly integrated packages via similar syntax, a unified concept of data management, and consistency in argument types and function outputs. The main premise of the packages that make up the `tidyverse` is to facilitate data analysis through concatenating operations on datasets. Many `tidyverse` functions are useful by themselves, of course, but we will see how chaining operations together provides a different way of looking at data analysis. This chaining relies in the use of the pipe operator, `%>%`, which redirects the output of the function (or data) to its left as the input of the function to its right.

```
# load the package bundle
library(tidyverse)

# read the earthquake dataset
eq <- read.csv2(file = "../data/earthquakes.csv")

# these two notations are equivalent
summary(eq)
eq %>% summary()
```

With this toolset, we can concatenate as many operations as we need

```
eq %>%
  drop_na() %>%
  nrow()

eq %>%
  filter(!is.na(Dep)) %>%
  summary()
```

This syntax can be very convenient to apply sequential operations of filtering, ordenation, grouping, etc. As a first example, we will use the `iris` dataset to gather some species-level information.

```
avg.values <- iris %>%
  group_by(Species) %>%
  summarise(mean.sepal.length = mean(Sepal.Length),
            mean.petal.length = mean(Petal.Length))
```

We may also create new columns in the original dataset

```
iris2 <- iris %>%
  mutate(new_col = Sepal.Length * Sepal.Width)
```

Of course, all these operations can be coded in the style of base R. However, the `tidyverse` syntax increases flexibility, compactness, and for some of us, it also makes the core more readable.

Let's now see a full-fledged example, in which we want to obtain the average magnitude and depth of earthquakes in each country. For doing so, we need to assign the earthquake observations to country names. So, let's define a function that returns a country name given a pair of latitude and longitude numbers.

https://stackoverflow.com/questions/14334970/convert-latitude-and-longitude-coordinates-to-country-name-in-r

```
# we need these two packages
library(sp)
library(rworldmap)

# points is a dataframe with values longitude (column 1) y latitude (c2)
coords2country <- function(points){
  countriesSP <- rworldmap::getMap(resolution='low')

  #setting CRS directly to that from rworldmap
  pointsSP = sp::SpatialPoints(points,
                               proj4string=sp::CRS(sp::proj4string(countriesSP)))

  # use 'over' to get indices of the Polygons object containing each point
  indices = sp::over(pointsSP, countriesSP)

  # return the ADMIN names of each country
  indices$ADMIN
  #indices$ISO3 # returns the ISO3 code
  #indices$continent   # returns the continent (6 continent model)
  #indices$REGION   # returns the continent (7 continent model)
}
```

We can also create an equivalent function to return the continent of a given point

```
coords2continent <- function(points){
  countriesSP <- rworldmap::getMap(resolution='low')

  #setting CRS directly to that from rworldmap
  pointsSP = sp::SpatialPoints(points,
                               proj4string=sp::CRS(sp::proj4string(countriesSP)))

  # use 'over' to get indices of the Polygons object containing each point
  indices = sp::over(pointsSP, countriesSP)

  # return the ADMIN names of each country
  # indices$ADMIN
  #indices$ISO3 # returns the ISO3 code
  indices$continent   # returns the continent (6 continent model)
  #indices$REGION   # returns the continent (7 continent model)
}
```

Now let's apply these functions

```
eq.country <- eq %>%
  mutate(country = coords2country(data.frame(Lon,Lat)),
         continent = coords2continent(data.frame(Lon,Lat)))

table(eq.country$continent)
```

```
##
##        Africa    Antarctica     Australia       Eurasia North America
##            17             0            10           257            19
## South America
```

```
##           164
```

```
table(eq.country$country)
```

```
##
##                               Afghanistan
##                                         5
##                                     Aland
##                                         0
##                                   Albania
##                                         0
##                                   Algeria
##                                         7
##                            American Samoa
##                                         0
##                                   Andorra
##                                         0
##                                    Angola
##                                         0
##                                  Anguilla
##                                         0
##                                Antarctica
##                                         0
##                       Antigua and Barbuda
##                                         0
##                                 Argentina
##                                         6
##                                   Armenia
##                                         0
##                                     Aruba
##                                         0
##               Ashmore and Cartier Islands
##                                         0
##                                 Australia
##                                         1
##                                   Austria
##                                         0
##                                Azerbaijan
##                                         3
##                                   Bahrain
##                                         0
##                                Bangladesh
##                                         3
##                                  Barbados
##                                         0
##                                   Belarus
##                                         0
##                                   Belgium
##                                         0
##                                    Belize
##                                         0
##                                     Benin
##                                         0
##                                   Bermuda
##                                         0
```

```
##                                 Bhutan
##                                     0
##                               Bolivia
##                                     0
##                 Bosnia and Herzegovina
##                                     0
##                              Botswana
##                                     0
##                                Brazil
##                                     0
##          British Indian Ocean Territory
##                                     0
##                 British Virgin Islands
##                                     0
##                                Brunei
##                                     0
##                              Bulgaria
##                                     0
##                          Burkina Faso
##                                     0
##                               Burundi
##                                     0
##                              Cambodia
##                                     0
##                              Cameroon
##                                     0
##                                Canada
##                                     2
##                            Cape Verde
##                                     0
##                         Cayman Islands
##                                     0
##               Central African Republic
##                                     0
##                                  Chad
##                                     0
##                                 Chile
##                                    21
##                                 China
##                                    60
##                              Colombia
##                                     8
##                               Comoros
##                                     0
##                          Cook Islands
##                                     0
##                            Costa Rica
##                                     9
##                               Croatia
##                                     0
##                                  Cuba
##                                     1
##                               Curacao
##                                     0
```

```
##                                  Cyprus
##                                       0
##                            Czech Republic
##                                       0
##         Democratic Republic of the Congo
##                                       1
##                                 Denmark
##                                       0
##                                Djibouti
##                                       0
##                                Dominica
##                                       0
##                          Dominican Republic
##                                       6
##                               East Timor
##                                       0
##                                 Ecuador
##                                       8
##                                   Egypt
##                                       1
##                               El Salvador
##                                      21
##                           Equatorial Guinea
##                                       0
##                                 Eritrea
##                                       2
##                                 Estonia
##                                       0
##                                Ethiopia
##                                       2
##                            Falkland Islands
##                                       0
##                               Faroe Islands
##                                       0
##           Federated States of Micronesia
##                                       0
##                                    Fiji
##                                       0
##                                Finland
##                                       0
##                                 France
##                                       1
##                               French Guiana
##                                       0
##                            French Polynesia
##                                       0
##      French Southern and Antarctic Lands
##                                       0
##                                  Gabon
##                                       0
##                                Gambia
##                                       0
##                                  Gaza
##                                       0
```

```
##                                 Georgia
##                                       0
##                                 Germany
##                                       0
##                                   Ghana
##                                       0
##                                  Greece
##                                       4
##                                Greenland
##                                       0
##                                 Grenada
##                                       0
##                                    Guam
##                                       0
##                                Guatemala
##                                      28
##                                Guernsey
##                                       0
##                                  Guinea
##                                       0
##                           Guinea Bissau
##                                       0
##                                  Guyana
##                                       0
##                                   Haiti
##                                       3
##        Heard Island and McDonald Islands
##                                       0
##                                Honduras
##                                       1
##                        Hong Kong S.A.R.
##                                       0
##                                 Hungary
##                                       0
##                                 Iceland
##                                       1
##                                   India
##                                       8
##                Indian Ocean Territories
##                                       0
##                               Indonesia
##                                      14
##                                    Iran
##                                      21
##                                    Iraq
##                                       2
##                                 Ireland
##                                       0
##                              Isle of Man
##                                       0
##                                  Israel
##                                       3
##                                   Italy
##                                       5
```

```
##                         Ivory Coast
##                                   0
##                             Jamaica
##                                   1
##                               Japan
##                                  32
##                              Jersey
##                                   0
##                              Jordan
##                                   0
##                           Kazakhstan
##                                   3
##                               Kenya
##                                   0
##                            Kiribati
##                                   0
##                              Kosovo
##                                   0
##                              Kuwait
##                                   0
##                           Kyrgyzstan
##                                   0
##                                Laos
##                                   0
##                              Latvia
##                                   0
##                             Lebanon
##                                   4
##                             Lesotho
##                                   0
##                             Liberia
##                                   0
##                               Libya
##                                   1
##                       Liechtenstein
##                                   0
##                           Lithuania
##                                   0
##                          Luxembourg
##                                   0
##                        Macau S.A.R
##                                   0
##                           Macedonia
##                                   0
##                          Madagascar
##                                   0
##                              Malawi
##                                   0
##                            Malaysia
##                                   0
##                            Maldives
##                                   0
##                                Mali
##                                   0
```

```
##                                 Malta
##                                     0
##                       Marshall Islands
##                                     0
##                            Mauritania
##                                     0
##                             Mauritius
##                                     0
##                                Mexico
##                                    19
##                               Moldova
##                                     0
##                                Monaco
##                                     0
##                              Mongolia
##                                     2
##                            Montenegro
##                                     0
##                            Montserrat
##                                     0
##                               Morocco
##                                     1
##                            Mozambique
##                                     0
##                               Myanmar
##                                     3
##                               Namibia
##                                     0
##                                 Nauru
##                                     0
##                                 Nepal
##                                     2
##                           Netherlands
##                                     0
##                         New Caledonia
##                                     0
##                           New Zealand
##                                     7
##                             Nicaragua
##                                    10
##                                 Niger
##                                     0
##                               Nigeria
##                                     0
##                                  Niue
##                                     0
##                          Norfolk Island
##                                     0
##                             North Korea
##                                     1
##                        Northern Cyprus
##                                     0
##                 Northern Mariana Islands
##                                     0
```

```
##                                 Norway
##                                      0
##                                   Oman
##                                      0
##                               Pakistan
##                                      2
##                                  Palau
##                                      0
##                                 Panama
##                                      2
##                       Papua New Guinea
##                                      2
##                               Paraguay
##                                      0
##                                   Peru
##                                     14
##                            Philippines
##                                      8
##                       Pitcairn Islands
##                                      0
##                                 Poland
##                                      0
##                               Portugal
##                                      0
##                            Puerto Rico
##                                      1
##                                  Qatar
##                                      0
##                     Republic of Serbia
##                                      0
##                   Republic of the Congo
##                                      0
##                                Romania
##                                     21
##                                 Russia
##                                      5
##                                 Rwanda
##                                      0
##                       Saint Barthelemy
##                                      0
##                           Saint Helena
##                                      0
##                   Saint Kitts and Nevis
##                                      0
##                             Saint Lucia
##                                      0
##                            Saint Martin
##                                      0
##                Saint Pierre and Miquelon
##                                      0
##         Saint Vincent and the Grenadines
##                                      0
##                                   Samoa
##                                      0
```

```
##                              San Marino
##                                       0
##                     Sao Tome and Principe
##                                       0
##                             Saudi Arabia
##                                       2
##                                  Senegal
##                                       0
##                               Seychelles
##                                       0
##                           Siachen Glacier
##                                       0
##                              Sierra Leone
##                                       0
##                                 Singapore
##                                       0
##                              Sint Maarten
##                                       0
##                                  Slovakia
##                                       0
##                                 Slovenia
##                                       0
##                           Solomon Islands
##                                       0
##                                  Somalia
##                                       0
##                                Somaliland
##                                       0
##                              South Africa
##                                       0
## South Georgia and South Sandwich Islands
##                                       0
##                                South Korea
##                                       0
##                                South Sudan
##                                         1
##                                     Spain
##                                       0
##                                  Sri Lanka
##                                       0
##                                     Sudan
##                                       0
##                                  Suriname
##                                       0
##                                 Swaziland
##                                       0
##                                    Sweden
##                                       0
##                                Switzerland
##                                       0
##                                     Syria
##                                       8
##                                    Taiwan
##                                       2
```

```
##                             Tajikistan
##                                      0
##                               Thailand
##                                      0
##                           The Bahamas
##                                      0
##                                   Togo
##                                      0
##                                 Tonga
##                                      0
##                     Trinidad and Tobago
##                                      0
##                                Tunisia
##                                      0
##                                 Turkey
##                                     31
##                             Turkmenistan
##                                      1
##                  Turks and Caicos Islands
##                                      0
##                                Tuvalu
##                                      0
##                                Uganda
##                                      0
##                               Ukraine
##                                      0
##                    United Arab Emirates
##                                      0
##                           United Kingdom
##                                      0
##                United Republic of Tanzania
##                                      1
##                   United States of America
##                                     17
##               United States Virgin Islands
##                                      0
##                               Uruguay
##                                      0
##                             Uzbekistan
##                                      0
##                               Vanuatu
##                                      0
##                               Vatican
##                                      0
##                              Venezuela
##                                      5
##                               Vietnam
##                                      0
##                         Wallis and Futuna
##                                      0
##                              West Bank
##                                      0
##                           Western Sahara
##                                      0
```

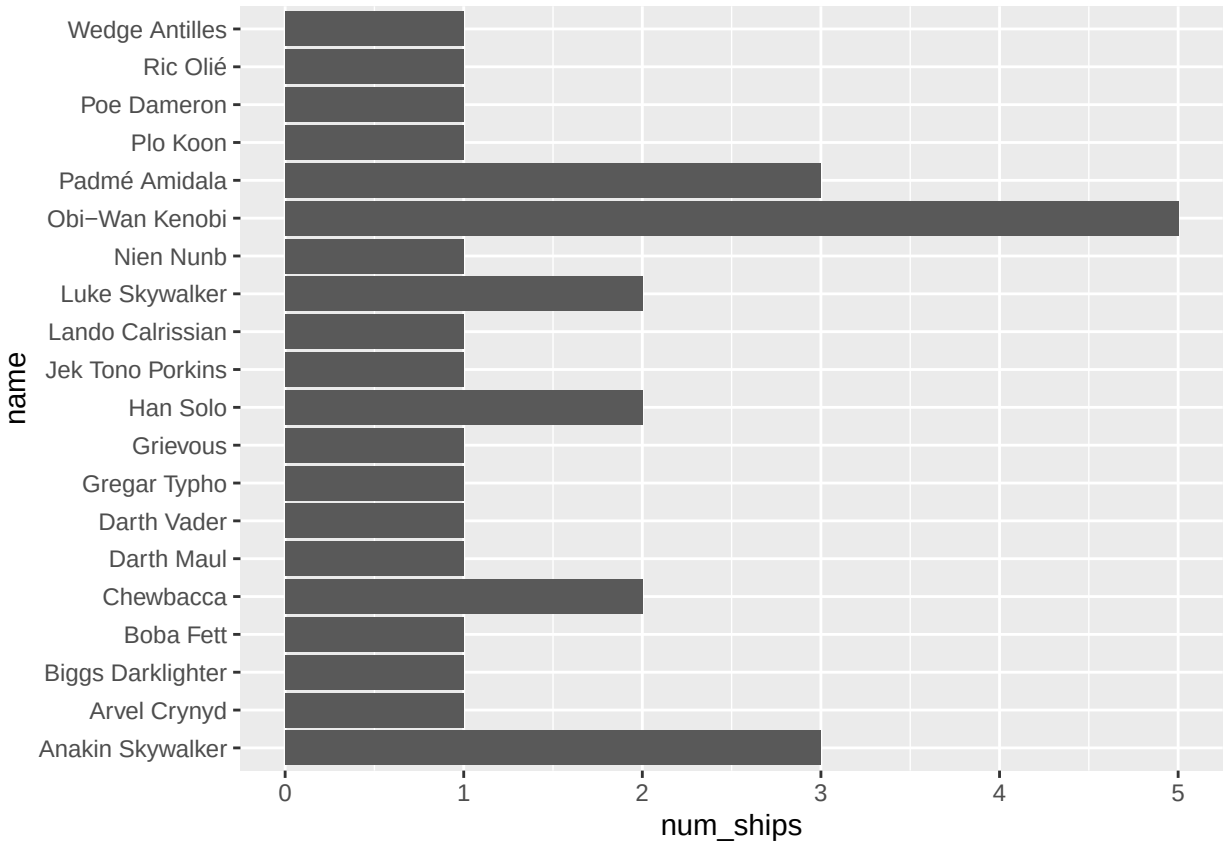
```
##                                     Yemen
##                                         0
##                                    Zambia
##                                         0
##                                  Zimbabwe
##                                         0
```

and generate a dataframe with the relevant columns

```
magnitude.eurasia <- eq.country %>%
  filter(continent == "Eurasia") %>%
  summarise(mean.magnitude = mean(M),
            sd.magnitude = sd(M),
            min.year = min(Year))

# this can be automated
magnitude.continents <- eq.country %>%
  group_by(continent )%>%
  summarise(mean.magnitude = mean(M),
            sd.magnitude = sd(M),
            num.eq = n(),
            min.year = min(Year))
```

Other important functions:

```
# the join family

sw1 <- read.csv2("../data/starwars_info_characters.csv")
sw2 <- read.csv2("../data/starwars_spaceships.csv")

sw.full.1 <- left_join(sw1,sw2)
sw.full.2 <- left_join(sw2,sw1)

# pivot - longer and wider

sw.ships <- sw2 %>%
  pivot_longer(X.wing:H.type.Nubian.yacht,
               names_to = "spaceship_name",
               values_to = "can_pilot")

# now the data is easier to work with, e.g. in ggplot
sw.ships %>%
  group_by(name) %>%
  summarise(num_ships = sum(can_pilot)) %>%
  filter(num_ships > 0) %>%
  ggplot(aes(x = name, y = num_ships)) +
  geom_col() +
  coord_flip()
```




```
sw.char.wide <- sw1 %>%
  select(name,species_group) %>%
  mutate(tt = TRUE) %>%
  pivot_wider(names_from = species_group,
              values_from = tt,
              values_fill = NA)

# across
sw.char.wide.clean <- sw.char.wide %>%
  mutate(across(-name, ~ replace_na(.x,FALSE)))
```