R programming (dplyr)

Welcome to the tidyverse

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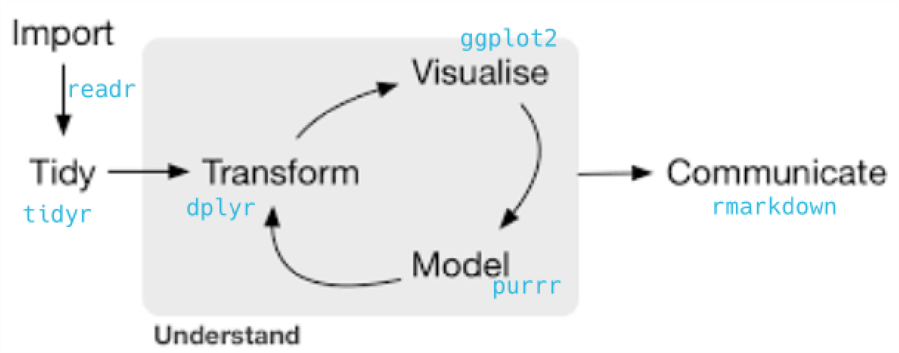
The tidyverse

The **tidyverse** is a collection of R packages designed for data science, as a suite aimed at easening the data analysis in all its steps.

Created by Hadley Wickham, chief scientist of RStudio, and author of more than 30 R packages (`readr`, `ggplot2`, `plyr`, `devtools`, `roxygen2`, `rmarkdown`...)

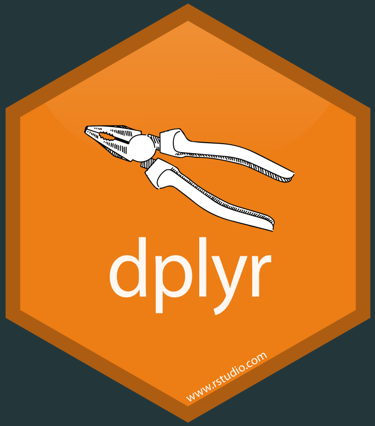
All packages share an underlying design philosophy, grammar, and data structures.



So what's exactly *in* the tidyverse?

- `ggplot2` a system for creating graphics, based on the Grammar of Graphics
- `readr` a fast and friendly way to read rectangular data (csv, txt...)
- `tibble` a tibble is a re-imagining version of the data frame, keeping what time has proven to be effective and throwing out what has not
- `stringr` provides a cohesive set of functions designed to make working with strings as easy as possible
- `forcats` provides a suite of useful tools that solve common problems with factors
- `dplyr` provides a grammar of data manipulation, providing a consistent set of verbs that solve the most common data manipulation challenges
- `tidyr` provides a set of functions that help you get to tidy data
- `purrr` enhances R’s functional programming (FP) toolkit by providing a complete and consistent set of tools for working with functions and vectors

dplyr



5 main verbs of dplyr

- `filter`: keep the rows that match a condition
- `select`: keep columns by name
- `arrange`: sort rows
- `mutate`: transform existent variables or create new ones
- `summarise`: do some summary statistics and reduce data

common structure

(for most of the tidyverse)

```
verb(data, ... )
```

- first argument: data (as data.frame or tbl_df)
- the rest of arguments specify what to do with the data frame
- output is always another data frame (tbl_df or data.frame)
- unless we are assigning (`←`), never modifies the original data frame

`filter`

Data

Let's work with some data. `dplyr` comes with some example data to get the feeling:

```
# install.packages(dplyr)
# install.packages(babynames)
library(dplyr)
library(babynames)
babynames
```

```
## # A tibble: 1,924,665 × 5
##     year sex   name          n   prop
##    <dbl> <chr> <chr>     <int>  <dbl>
##  1  1880 F     Mary       7065 0.0724
##  2  1880 F     Anna       2604 0.0267
##  3  1880 F     Emma       2003 0.0205
##  4  1880 F     Elizabeth  1939 0.0199
##  5  1880 F     Minnie     1746 0.0179
##  6  1880 F     Margaret   1578 0.0162
##  7  1880 F     Ida        1472 0.0151
##  8  1880 F     Alice      1414 0.0145
##  9  1880 F     Bertha     1320 0.0135
## 10  1880 F     Sarah      1288 0.0132
## # i 1,924,655 more rows
```

Selecting rows (filter)

```
filter(babynames, name == 'Alice')
```

```
## # A tibble: 241 × 5
##      year sex   name      n      prop
##     <dbl> <chr> <chr> <int>     <dbl>
##   1  1880 F     Alice  1414 0.0145
##   2  1881 F     Alice  1308 0.0132
##   3  1881 M     Alice     7 0.0000646
##   4  1882 F     Alice  1542 0.0133
##   5  1883 F     Alice  1488 0.0124
##   6  1883 M     Alice     6 0.0000533
##   7  1884 F     Alice  1732 0.0126
##   8  1885 F     Alice  1681 0.0118
##   9  1885 M     Alice     9 0.0000776
##  10  1886 F     Alice  1811 0.0118
## # i 231 more rows
```

Selecting rows (`filter`)

```r
filter(babynames, year > 2016)
```

```
## # A tibble: 32,469 × 5
##     year sex   name          n    prop
##    <dbl> <chr> <chr>     <int>   <dbl>
##  1  2017 F     Emma      19738 0.0105
##  2  2017 F     Olivia    18632 0.00994
##  3  2017 F     Ava       15902 0.00848
##  4  2017 F     Isabella  15100 0.00805
##  5  2017 F     Sophia    14831 0.00791
##  6  2017 F     Mia       13437 0.00717
##  7  2017 F     Charlotte 12893 0.00688
##  8  2017 F     Amelia    11800 0.00629
##  9  2017 F     Evelyn    10675 0.00569
## 10  2017 F     Abigail   10551 0.00563
## # i 32,459 more rows
```

Selecting rows (filter)

```r
filter(babynames, name %in% c('Ada', 'Leon'))
```

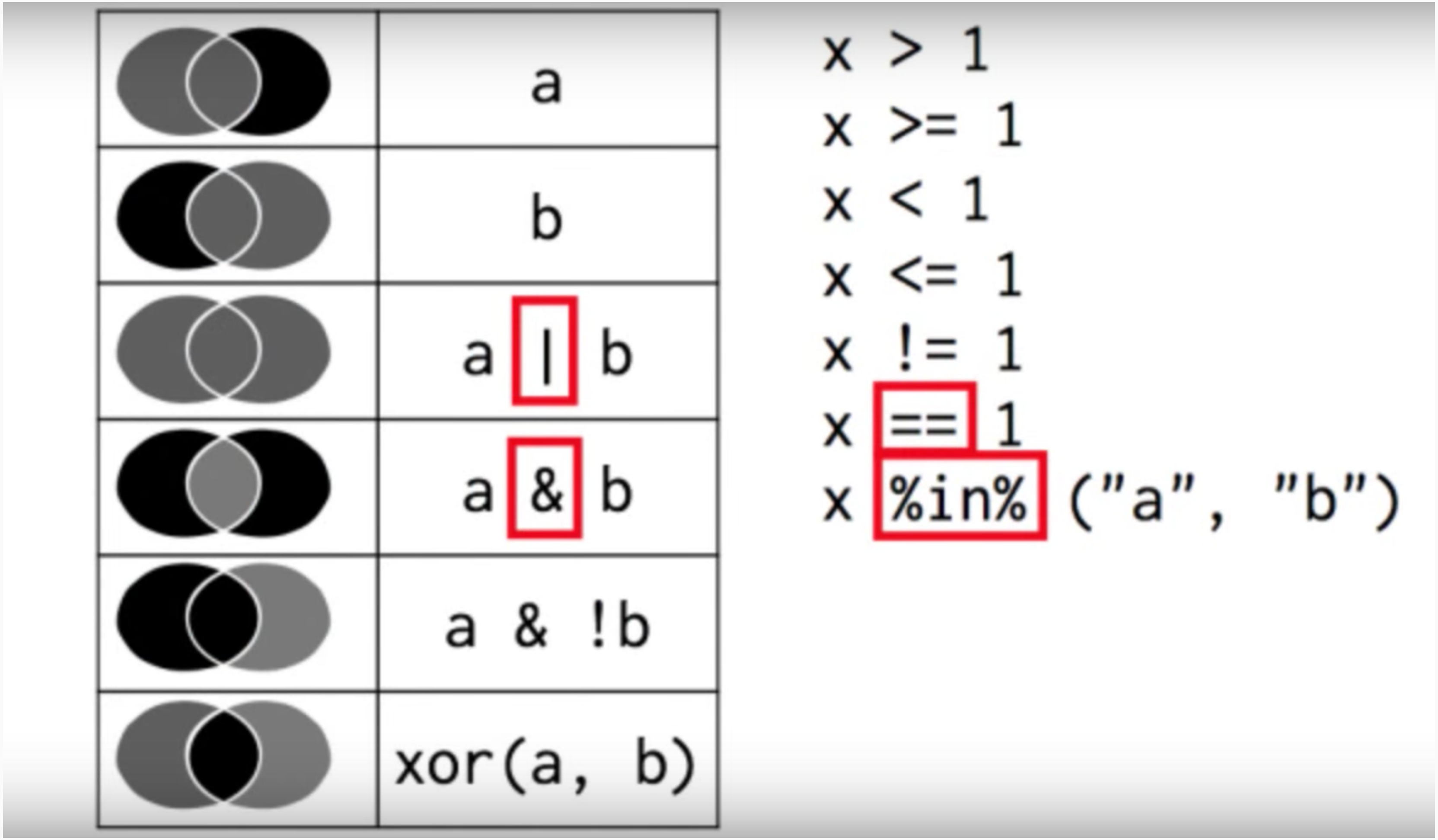
```
## # A tibble: 411 × 5
##     year sex   name      n     prop
##    <dbl> <chr> <chr> <int>    <dbl>
##  1  1880 F     Ada     652 0.00668 
##  2  1880 M     Leon    118 0.000997
##  3  1881 F     Ada     628 0.00635 
##  4  1881 M     Leon    121 0.00112 
##  5  1882 F     Ada     689 0.00596 
##  6  1882 M     Leon    131 0.00107 
##  7  1883 F     Ada     778 0.00648 
##  8  1883 M     Leon    140 0.00124 
##  9  1884 F     Ada     854 0.00621 
## 10  1884 M     Leon    150 0.00122 
## # i 401 more rows
```

Selecting rows (`filter`)

```r
filter(
  babynames,
  sex == 'F',
  prop > 0.07
)
```

```
## # A tibble: 2 × 5
##    year sex   name      n   prop
##   <dbl> <chr> <chr> <int>  <dbl>
## 1  1880 F     Mary   7065 0.0724
## 2  1882 F     Mary   8148 0.0704
```

Selecting rows (`filter`)



```
a
b
a | b
a & b
a & !b
xor(a, b)
```

```
x > 1
x >= 1
x < 1
x <= 1
x != 1
x == 1
x %in% ("a", "b")
```

`select`

Selecting columns (select)

```r
select(babynames, year)
```

```
## # A tibble: 1,924,665 × 1
##       year
##      <dbl>
##    1  1880
##    2  1880
##    3  1880
##    4  1880
##    5  1880
##    6  1880
##    7  1880
##    8  1880
##    9  1880
##   10  1880
## # i 1,924,655 more rows
```

Selecting columns (`select`)

```
select(babynames, -prop)
```

```
## # A tibble: 1,924,665 × 4
##      year sex   name          n
##     <dbl> <chr> <chr>     <int>
##  1  1880 F     Mary       7065
##  2  1880 F     Anna       2604
##  3  1880 F     Emma       2003
##  4  1880 F     Elizabeth  1939
##  5  1880 F     Minnie     1746
##  6  1880 F     Margaret   1578
##  7  1880 F     Ida        1472
##  8  1880 F     Alice      1414
##  9  1880 F     Bertha     1320
## 10  1880 F     Sarah      1288
## # i 1,924,655 more rows
```

Selecting columns (select)

```
select(babynames, sex, name)
```

```
## # A tibble: 1,924,665 × 2
##    sex   name
##    <chr> <chr>
##  1 F     Mary
##  2 F     Anna
##  3 F     Emma
##  4 F     Elizabeth
##  5 F     Minnie
##  6 F     Margaret
##  7 F     Ida
##  8 F     Alice
##  9 F     Bertha
## 10 F     Sarah
## # i 1,924,655 more rows
```

Selecting columns (select)

```
select(babynames, sex:n)
```

```
## # A tibble: 1,924,665 × 3
##    sex   name          n
##    <chr> <chr>     <int>
##  1 F     Mary       7065
##  2 F     Anna       2604
##  3 F     Emma       2003
##  4 F     Elizabeth  1939
##  5 F     Minnie     1746
##  6 F     Margaret   1578
##  7 F     Ida        1472
##  8 F     Alice      1414
##  9 F     Bertha     1320
## 10 F     Sarah      1288
## # i 1,924,655 more rows
```

Selecting columns (`select`)

Special functions:

- `starts_with(x)`: names that start with x
- `ends_with(x)`: names that end with x
- `contains(x)`: selects all variables whose name contains x
- `matches(x)`: selects all variables whose name contains the regular expression x
- `num_range("x", 1:5, width = 2)`: selects all variables (numerically) from x01 to x05
- `one_of("x", "y", "z")`: selects variables provided in a character vector
- `everything()`: selects all variables

Selecting columns (select)

```
select(babynames, starts_with('n'))
```

```
## # A tibble: 1,924,665 × 2
##    name          n
##    <chr>     <int>
##  1 Mary       7065
##  2 Anna       2604
##  3 Emma       2003
##  4 Elizabeth  1939
##  5 Minnie     1746
##  6 Margaret   1578
##  7 Ida        1472
##  8 Alice      1414
##  9 Bertha     1320
## 10 Sarah      1288
## # i 1,924,655 more rows
```

`arrange`

Sorting rows (arrange)

```
arrange(babynames, prop)
```

```
## # A tibble: 1,924,665 × 5
##     year sex   name            n       prop
##    <dbl> <chr> <chr>       <int>      <dbl>
##  1  2007 M     Aaban           5 0.00000226
##  2  2007 M     Aareon          5 0.00000226
##  3  2007 M     Aaris           5 0.00000226
##  4  2007 M     Abd             5 0.00000226
##  5  2007 M     Abdulazeez      5 0.00000226
##  6  2007 M     Abdulhadi       5 0.00000226
##  7  2007 M     Abdulhamid      5 0.00000226
##  8  2007 M     Abdulkadir      5 0.00000226
##  9  2007 M     Abdulraheem     5 0.00000226
## 10  2007 M     Abdulrahim      5 0.00000226
## # i 1,924,655 more rows
```

Sorting rows (arrange)

```
arrange(babynames, desc(prop))
```

```
## # A tibble: 1,924,665 × 5
##      year sex   name          n   prop
##     <dbl> <chr> <chr>     <int>  <dbl>
##   1  1880 M     John       9655 0.0815
##   2  1881 M     John       8769 0.0810
##   3  1880 M     William    9532 0.0805
##   4  1883 M     John       8894 0.0791
##   5  1881 M     William    8524 0.0787
##   6  1882 M     John       9557 0.0783
##   7  1884 M     John       9388 0.0765
##   8  1882 M     William    9298 0.0762
##   9  1886 M     John       9026 0.0758
##  10  1885 M     John       8756 0.0755
## # i 1,924,655 more rows
```

`mutate`

Transforming variables (mutate)

```
mutate(
  babynames,
  total = n / prop
)
```

```
## # A tibble: 1,924,665 × 6
##     year sex   name          n   prop  total
##    <dbl> <chr> <chr>     <int>  <dbl>  <dbl>
##  1  1880 F     Mary       7065 0.0724 97605.
##  2  1880 F     Anna       2604 0.0267 97605.
##  3  1880 F     Emma       2003 0.0205 97605.
##  4  1880 F     Elizabeth  1939 0.0199 97605.
##  5  1880 F     Minnie     1746 0.0179 97605.
##  6  1880 F     Margaret   1578 0.0162 97605.
##  7  1880 F     Ida        1472 0.0151 97605.
##  8  1880 F     Alice      1414 0.0145 97605.
##  9  1880 F     Bertha     1320 0.0135 97605.
## 10  1880 F     Sarah      1288 0.0132 97605.
## # i 1,924,655 more rows
```

Transforming variables (mutate)

```r
mutate(
  babynames,
  year_diff = 2018 - year,
  months_diff = year_diff * 12
)
```

```
## # A tibble: 1,924,665 × 7
##     year sex   name          n   prop year_diff months_diff
##    <dbl> <chr> <chr>     <int>  <dbl>     <dbl>       <dbl>
##  1  1880 F     Mary       7065 0.0724       138        1656
##  2  1880 F     Anna       2604 0.0267       138        1656
##  3  1880 F     Emma       2003 0.0205       138        1656
##  4  1880 F     Elizabeth  1939 0.0199       138        1656
##  5  1880 F     Minnie     1746 0.0179       138        1656
##  6  1880 F     Margaret   1578 0.0162       138        1656
##  7  1880 F     Ida        1472 0.0151       138        1656
##  8  1880 F     Alice      1414 0.0145       138        1656
##  9  1880 F     Bertha     1320 0.0135       138        1656
## 10  1880 F     Sarah      1288 0.0132       138        1656
## # i 1,924,655 more rows
```

`summarise`

Reducing variables (summarise)

```
summarise(babynames, max_prop = max(prop))
```

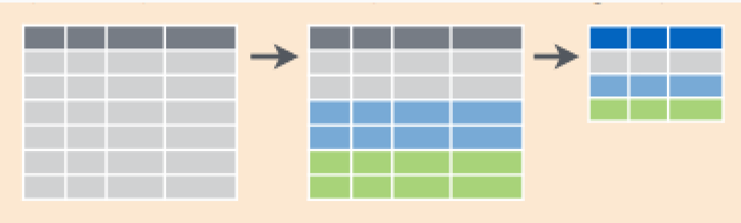
```
## # A tibble: 1 × 1
##   max_prop
##      <dbl>
## 1   0.0815
```

Reducing variables (`summarise`)

Summary functions

- `min(x)`, `max(x)`, `quantile(x, p)`
- `mean(x)`, `median(x)`,
- `sd(x)`, `var(x)`, `IQR(x)`
- `n()`, `n_distinct(x)`
- `sum(x > 10)`, `mean(x > 10)`

`grouped summarise`



Reducing variables (summarise)

Grouped summarise

```
by_year ← group_by(babynames, year)
by_year
```

```
## # A tibble: 1,924,665 × 5
## # Groups:   year [138]
##     year sex   name          n   prop
##    <dbl> <chr> <chr>     <int>  <dbl>
##  1  1880 F     Mary       7065 0.0724
##  2  1880 F     Anna       2604 0.0267
##  3  1880 F     Emma       2003 0.0205
##  4  1880 F     Elizabeth  1939 0.0199
##  5  1880 F     Minnie     1746 0.0179
##  6  1880 F     Margaret   1578 0.0162
##  7  1880 F     Ida        1472 0.0151
##  8  1880 F     Alice      1414 0.0145
##  9  1880 F     Bertha     1320 0.0135
## 10  1880 F     Sarah      1288 0.0132
## # i 1,924,655 more rows
```

Reducing variables (`summarise`)

Grouped summarise

```
summarise(
  by_year,
  max_prop = max(prop)
)
```

```
## # A tibble: 138 × 2
##      year max_prop
##     <dbl>    <dbl>
##  1  1880   0.0815
##  2  1881   0.0810
##  3  1882   0.0783
##  4  1883   0.0791
##  5  1884   0.0765
##  6  1885   0.0755
##  7  1886   0.0758
##  8  1887   0.0742
##  9  1888   0.0712
## 10  1889   0.0718
## # i 128 more rows
```

Reducing variables (`summarise`)

Grouped summarise

```r
by_year_sex <- group_by(babynames, year, sex)

summarise(
  by_year_sex,
  max_prop = max(prop)
)
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
## # A tibble: 276 × 3
## # Groups:   year [138]
##     year sex   max_prop
##    <dbl> <chr>    <dbl>
##  1  1880 F       0.0724
##  2  1880 M       0.0815
##  3  1881 F       0.0700
##  4  1881 M       0.0810
##  5  1882 F       0.0704
##  6  1882 M       0.0783
##  7  1883 F       0.0667
##  8  1883 M       0.0791
##  9  1884 F       0.0670
## 10  1884 M       0.0765
```

pipes

Data pipelines (▷)

- Often, we want to use several verbs (filter, arrange, group_by, summarise...)
- Multiple operations are difficult to read, or require to create multiple intermediate objects:

```
year_1880 <- summarise(
  group_by(
    filter(
      babynames, year == 1880
    ),
    sex
  ),
  max = max(n),
  prop = max(prop)
)
```

```
year_1880 <- filter(
  babynames, year == 1880
)
year_1880_grouped <- group_by(
  year_1880, sex
)
summarised_year_1880 <- summarise(
  year_1880_grouped,
  max = max(n),
  prop = max(prop)
)
```

Data pipelines (▷)

- Alternative (cleaner and easy to read): *pipe* operator (`▷`) in R base

- The result of the left side is passed to the function in the right as first argument:

  `f(x, y)` is the same as `x ▷ f(y)`
  `f(x, y, z)` is the same as `x ▷ f(y, z)`

- In the tidyverse `▷` makes each function to be applied to the data frame resulting from the previous step

  `filter(df, color == 'blue')` is the same as `df ▷ filter(color == 'blue')`
  `mutate(df, double = 2*value)` is the same as `df ▷ mutate(double = 2*value)`

Data pipelines (|>)

Nested functions

```
year_1880 <- summarise(
  group_by(
    filter(
      babynames, year == 1880
    ),
    sex
  ),
  max = max(n),
  prop = max(prop)
)
```

Pipeline

```
year_1880 <- babynames |>
  filter(year == 1880) |>
  group_by(sex) |>
  summarise(
    max = max(n),
    prop = max(prop)
  )
```

Applying all together

How do you do to get the names with the maximum proportion for each year and sex? We also want to explore the time span each names dominates.

```r
babynames |>
  group_by(year, sex) |>
  filter(prop == max(prop)) |>
  arrange(desc(prop)) |>
  mutate(total_n = n*100/prop)
```

Applying all together

How do you do to get the names with the maximum proportion for each year and sex? We also want to explore the time span each names dominates.

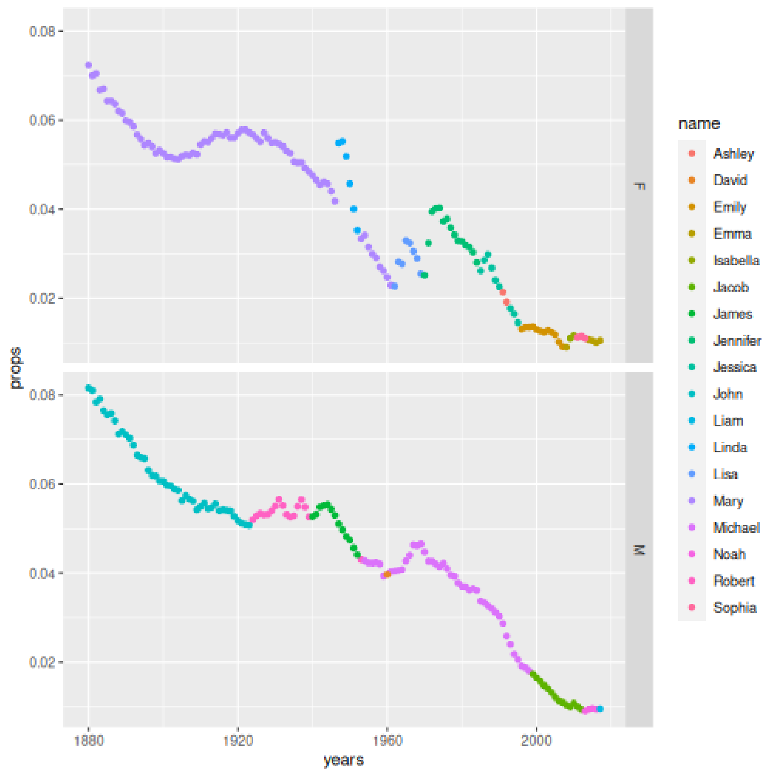
```r
common_names_by_year_sex <- babynames |>
  group_by(year, sex) |>
  filter(prop == max(prop)) |>
  mutate(total_n = n*100/prop) |>
  group_by(sex, name) |>
  summarise(
    n = n(),
    years = list(year),
    props = list(prop),
    min_year = min(year),
    max_year = max(year),
    mean_prop = mean(prop)
  ) |>
  # arrange(sex, desc(n))
  arrange(sex, min_year)
```

```
## `summarise()` has grouped output by 'sex'. You can override using the `.groups` argument.
```

Applying all together

And graphically (we see more of ggplot tomorrow):

```
common_names_by_year_sex ▷
  tidyr::unnest(cols = c(years, props)) ▷
  ggplot(aes(years, props, colour = name)) +
  geom_point() +
  facet_grid(rows = vars(sex))
```



Other useful verbs

- `pull`
- `case_when`
- `bind_cols`, `bind_rows`
- `left_join`, `inner_join` and other joins (not explained today)

Pulling variables to vectors (`pull`)

```r
babynames |>
  pull(name) |>
  unique()
```

```
##    [1] "Mary"       "Anna"       "Emma"       "Elizabeth"  "Minnie"     "Margaret"   "Ida"
##   [12] "Clara"      "Ella"       "Florence"   "Cora"       "Martha"     "Laura"      "Nellie"
##   [23] "Bessie"     "Jennie"     "Gertrude"   "Julia"      "Hattie"     "Edith"      "Mattie"
##   [34] "Lillie"     "Helen"      "Jessie"     "Louise"     "Ethel"      "Lula"       "Myrtle"
##   [45] "Edna"       "Maggie"     "Pearl"      "Daisy"      "Fannie"     "Josephine"  "Dora"
##   [56] "Nora"       "May"        "Mamie"      "Blanche"    "Stella"     "Ellen"      "Nancy"
##   [67] "Lizzie"     "Flora"      "Susie"      "Maud"       "Mae"        "Etta"       "Harriet"
##   [78] "Elsie"      "Kate"       "Susan"      "Mollie"     "Alma"       "Addie"      "Georgia"
##   [89] "Amanda"     "Belle"      "Charlotte"  "Rebecca"    "Ruth"       "Viola"      "Olive"
##  [100] "Emily"      "Matilda"    "Irene"      "Kathryn"    "Esther"     "Willie"     "Henrietta
##  [111] "Estella"    "Theresa"    "Augusta"    "Ora"        "Pauline"    "Josie"      "Lola"
##  [122] "Ann"        "Beulah"     "Callie"     "Lou"        "Delia"      "Eleanor"    "Barbara"
##  [133] "Evelyn"     "Estelle"    "Nina"       "Betty"      "Marion"     "Bettie"     "Dorothy"
##  [144] "Allie"      "Millie"     "Janie"      "Cornelia"   "Victoria"   "Ruby"       "Winifred"
##  [155] "Birdie"     "Harriett"   "Mable"      "Myra"       "Sophie"     "Tillie"     "Isabel"
##  [166] "Sally"      "Ina"        "Essie"      "Bertie"     "Nell"       "Alberta"    "Katharine
##  [177] "Mathilda"   "Abbie"      "Eula"       "Dollie"     "Hettie"     "Eunice"     "Fanny"
##  [188] "Lelia"      "Nelle"      "Sue"        "Johanna"    "Lilly"      "Lucinda"    "Minerva"
##  [199] "Hilda"      "Hulda"      "Bernice"    "Genevieve"  "Jean"       "Cordelia"   "Marian"
##  [210] "Leah"       "Lois"       "Lura"       "Mittie"     "Hallie"     "Isabella"   "Olga"
##  [221] "Lina"       "Winnie"     "Claudia"    "Marguerite" "Vera"       "Cecelia"    "Bess"
##  [232] "Myrtie"     "Cecilia"    "Elva"       "Olivia"     "Ophelia"    "Georgie"    "Elnora"
##  [243] "Loretta"    "Madge"      "Polly"      "Virgie"     "Eugenia"    "Lucile"     "Lucille"
```

Conditional cases (case_when)

```
iris ▷
  mutate(
    flower_index = Petal.Width / Petal.Length,
    flower_shape = case_when(
      flower_index < 0.1 ~ "long_flower",
      flower_index ⩾ 0.4 ~ "round_flower",
      .default = "normal_flower"
    )
  )
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width    Species flower_index   flower_shape
## 1            5.1         3.5          1.4         0.2     setosa   0.14285714 normal_flower
## 2            4.9         3.0          1.4         0.2     setosa   0.14285714 normal_flower
## 3            4.7         3.2          1.3         0.2     setosa   0.15384615 normal_flower
## 4            4.6         3.1          1.5         0.2     setosa   0.13333333 normal_flower
## 5            5.0         3.6          1.4         0.2     setosa   0.14285714 normal_flower
## 6            5.4         3.9          1.7         0.4     setosa   0.23529412 normal_flower
## 7            4.6         3.4          1.4         0.3     setosa   0.21428571 normal_flower
## 8            5.0         3.4          1.5         0.2     setosa   0.13333333 normal_flower
## 9            4.4         2.9          1.4         0.2     setosa   0.14285714 normal_flower
## 10           4.9         3.1          1.5         0.1     setosa   0.06666667   long_flower
## 11           5.4         3.7          1.5         0.2     setosa   0.13333333 normal_flower
## 12           4.8         3.4          1.6         0.2     setosa   0.12500000 normal_flower
## 13           4.8         3.0          1.4         0.1     setosa   0.07142857   long_flower
## 14           4.3         3.0          1.1         0.1     setosa   0.09090909   long_flower
## 15           5.8         4.0          1.2         0.2     setosa   0.16666667 normal_flower
## 16           5.7         4.4          1.5         0.4     setosa   0.26666667 normal_flower
```

Binding dataframes (bind_cols,

```
babynames_1950 ← filter(babynames, year < 1951)
babynames_2018 ← filter(babynames, year ⩾ 1951)

bind_rows(babynames_1950, babynames_2018)
```

```
## # A tibble: 1,924,665 × 5
##     year sex   name          n   prop
##    <dbl> <chr> <chr>     <int>  <dbl>
##  1  1880 F     Mary       7065 0.0724
##  2  1880 F     Anna       2604 0.0267
##  3  1880 F     Emma       2003 0.0205
##  4  1880 F     Elizabeth  1939 0.0199
##  5  1880 F     Minnie     1746 0.0179
##  6  1880 F     Margaret   1578 0.0162
##  7  1880 F     Ida        1472 0.0151
##  8  1880 F     Alice      1414 0.0145
##  9  1880 F     Bertha     1320 0.0135
## 10  1880 F     Sarah      1288 0.0132
## # i 1,924,655 more rows
```

Binding dataframes (bind_cols,

```
babynames_names ← select(babynames, year, sex, name)
babynames_stats ← select(babynames, n, prop)

bind_cols(babynames_names, babynames_stats)
```

```
## # A tibble: 1,924,665 × 5
##     year sex   name          n   prop
##    <dbl> <chr> <chr>     <int>  <dbl>
##  1  1880 F     Mary       7065 0.0724
##  2  1880 F     Anna       2604 0.0267
##  3  1880 F     Emma       2003 0.0205
##  4  1880 F     Elizabeth  1939 0.0199
##  5  1880 F     Minnie     1746 0.0179
##  6  1880 F     Margaret   1578 0.0162
##  7  1880 F     Ida        1472 0.0151
##  8  1880 F     Alice      1414 0.0145
##  9  1880 F     Bertha     1320 0.0135
## 10  1880 F     Sarah      1288 0.0132
## # i 1,924,655 more rows
```

Exercise

Explore the `starwars` example dataset provided by `dplyr`. We are gonna check if starwars characters are healthy or not ;)

Tasks:

1. Remove any Droid from the dataset

2. Add a column to the dataset with the BMI value.
   BMI can be calculated as weight in kg divided by squared height in meters

$$BMI = mass/height^2$$

3. Calculate the BMI statistics (mean, standard deviation, min and max value) for each gender

4. Classify the BMI median of each gender as "underweight", "normal" and "overweight", taken into account that BMIs under 18.5 are "underweight" and BMIs over 25 are "overweight"

Exercise

```
## # A tibble: 2 × 7
##   gender    BMI_mean BMI_sd BMI_median BMI_min BMI_max BMI_class
##   <chr>        <dbl>  <dbl>      <dbl>   <dbl>   <dbl> <chr>
## 1 feminine      19.2   3.69       18.1    14.8    27.5 underweight
## 2 masculine     34.9  62.6        24.7    12.9   443.  normal
```

Thank you!

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