More data wrangling with **dplyr**

Stat 133 with Gaston Sanchez

Data Wrangling Pipelines

Toy Data

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

```
dat <- data.frame(
  name = c('Anakin', 'Padme', 'Luke', 'Leia'),
  gender = c('male', 'female', 'male', 'female'),
  height = c(1.88, 1.65, 1.72, 1.50)
)
```

Function calls in dplyr

dplyr functional calls

An “ugly” side of dplyr is that if you want to do many operations at once, it does not lead to particularly elegant code.

You either have to do computations, step-by-step, with separate commands…

Or you have to wrap several function calls inside each other (making your code hard to read)

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

output

gender	avg	sd
male	1.8	0.113
female	1.58	0.106

Example: For each gender category, get the average and standard deviation of height, arranging output by average in descending order.

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

gender	avg	sd
male	1.8	0.113
female	1.58	0.106

Step-by-step computations

```
dat1 = group_by(dat, gender)
dat2 = summarise(dat1,
  avg = mean(height), sd = sd(height))
dat3 = arrange(dat2, desc(avg))
dat3
```

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

gender	avg	sd
male	1.8	0.113
female	1.58	0.106

Function calls inside each other

```
arrange(
  summarise(group_by(dat, gender),
    avg = mean(height),
    sd = sd(height)),
  desc(avg))
```

Pipe Operators

|> or **%>%**

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

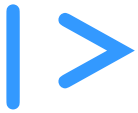
dat3

gender	avg	sd
male	1.8	0.113
female	1.58	0.106

Pipeline of commands: easier to write and understand

```
dat3 = dat |>
   group_by(gender) |>
   summarise(avg = mean(height),
             sd = sd(height)) |>
   arrange(desc(avg))
```

Pipe operators



Base R

magrittr

Pipe operators

A pipe operator lets you write:

```
f(x, y)
```

as:

```
x |> f(y)
```

or equivalently as:

```
x %>% f(y)
```

Example

```
x = c(2, 4, 6, NA)

# without the pipe
mean(x, na.rm = TRUE)

# with the pipe
x |> mean(na.rm = TRUE)
```

Another example

Generate n = 10 random numbers with runif(),

Round them to 2 decimal digits,

Take their absolute values,

And add them all up.

Another example

Generate n = 10 random numbers with runif(),

Round them to 2 decimal digits,

Take their absolute values,

And add them all up.

```
set.seed(12345)
n = 10
x1 = runif(n, min = -3, max = 3)
x2 = round(x1, 2)
x3 = abs(x2)
x4 = sum(x3)
```

```
set.seed(12345)
n = 10
x1 = runif(n, min = -3, max = 3)
x2 = round(x1, 2)
x3 = abs(x2)
x4 = sum(x3)
x4
```

no pipe

```
set.seed(12345)
10 |>
  runif(min = -3, max = 3) |>
  round(2) |>
  abs() |>
  sum()
```

pipeline

Pipe Operators: `%>%` and `|>`

Pipe operators, denoted as `%>%` and also as `|>`, allow you to write function calls in a more human-readable way.

These operators are heavily used among the ecosystem of "tidyverse" packages, and they are becoming more common in traditional R code.

Technically speaking, `%>%` is known as the "**magrittr**" pipe operator (from its homonym package, introduced in 2014).

In turn, `|>` is the **base R pipe operator** (introduced in May 2021 with R version 4.1.0.)

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

name	gender	height
Padme	female	1.65
Leia	female	1.50

```
filter(dat, gender == "female")

# is equivalent to
dat |> filter(gender == "female")
```

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

name	gender
Anakin	male
Padme	female
Luke	male
Leia	female

```
select(dat, name:gender)

# is equivalent to
dat |> select(name:gender)
```

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

name	gender	height
Anakin	male	1.88
Luke	male	1.72
Padme	female	1.65
Leia	female	1.50

```
arrange(dat, desc(height))

# is equivalent to
dat |> arrange(desc(height))
```

`dat`

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

?

Example: number of non-male individuals with heights greater than 1.40 meters

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

2

```
dat |>
   filter(gender != "male") |>
   filter(height > 1.4) |>
   summarise(n())
```

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

?

Example: convert height into inches, and display name and height (inches) of male individuals, arranging content by height in descending order.

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

name	ht_in
Anakin	74.0156
Luke	67.7164

```
dat |>
   mutate(ht_in = height * 39.37) |>
   filter(gender == "male") |>
   select(name, ht_in) |>
   arrange(desc(ht_in))
```

dat

name	gender	height
Anakin	male	1.88
Padme	female	1.65
Luke	male	1.72
Leia	female	1.50

name	ht_in
Anakin	74.0156
Luke	67.7164

Equivalent pipeline

```
dat |>
   filter(gender == "male") |>
   mutate(ht_in = height * 39.37) |>
   select(name, ht_in) |>
   arrange(desc(ht_in))
```

Merging Tables with joins()

Data Tables

tbl1

id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

Data Tables

```
tbl1 <- data.frame(
  id = c('Luke', 'Leia', 'Han'),
  year = c(1, 3, 4),
  coffee = c('no', 'yes', 'yes')
)

tbl2 <- data.frame(
  id = c('Padme', 'Leia', 'Luke', 'Obi-Wan'),
  gpa = c(3.9, 4.0, 3.7, 3.8),
  lunch = c('pizza', 'tacos', 'burrito', 'pad thai')
)
```

tbl1

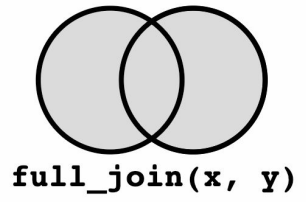
id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# keeps all observations in tbl1 and tbl2
full_join(tbl1, tbl2, by = "id")
```

id	year	coffee	gpa	lunch
Luke	1	no	3.7	burrito
Leia	3	yes	4.0	tacos
Han	4	yes	NA	NA
Padme	NA	NA	3.9	pizza
Obi-Wan	NA	NA	3.8	pad thai



tbl1

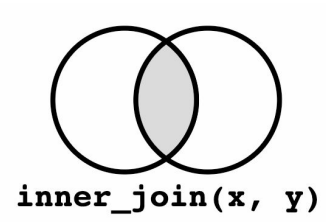
id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# keeps obs in tbl1 that have matching key in tbl2
inner_join(tbl1, tbl2, by = "id")
```

id	year	coffee	gpa	lunch
Luke	1	no	3.7	burrito
Leia	3	yes	4.0	tacos



tbl1

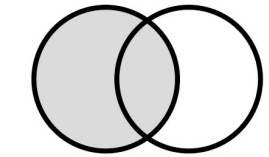
id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# keeps all observations tbl1
left_join(tbl1, tbl2, by = "id")
```

id	year	coffee	gpa	lunch
Luke	1	no	3.7	burrito
Leia	3	yes	4.0	tacos
Han	4	yes	NA	NA



tbl1

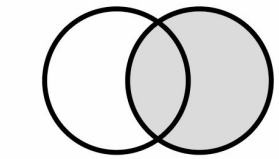
id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# keeps all observations in tbl2
right_join(tbl1, tbl2, by = "id")
```

id	year	coffee	gpa	lunch
Luke	1	no	3.7	burrito
Leia	3	yes	4.0	tacos
Padme	NA	NA	3.9	pizza
Obi-Wan	NA	NA	3.8	pad thai



tbl1

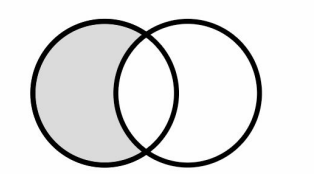
id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# return rows from tbl1 without a match in tbl2
anti_join(tbl1, tbl2, by = "id")
```

id	year	coffee
Han	4	yes



tbl1

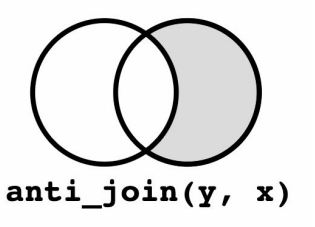
id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# return rows from tbl2 without a match in tbl1
anti_join(tbl2, tbl1, by = "id")
```

id	gpa	lunch
Padme	3.9	pizza
Obi-Wan	3.8	pad thai



tbl1

id	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

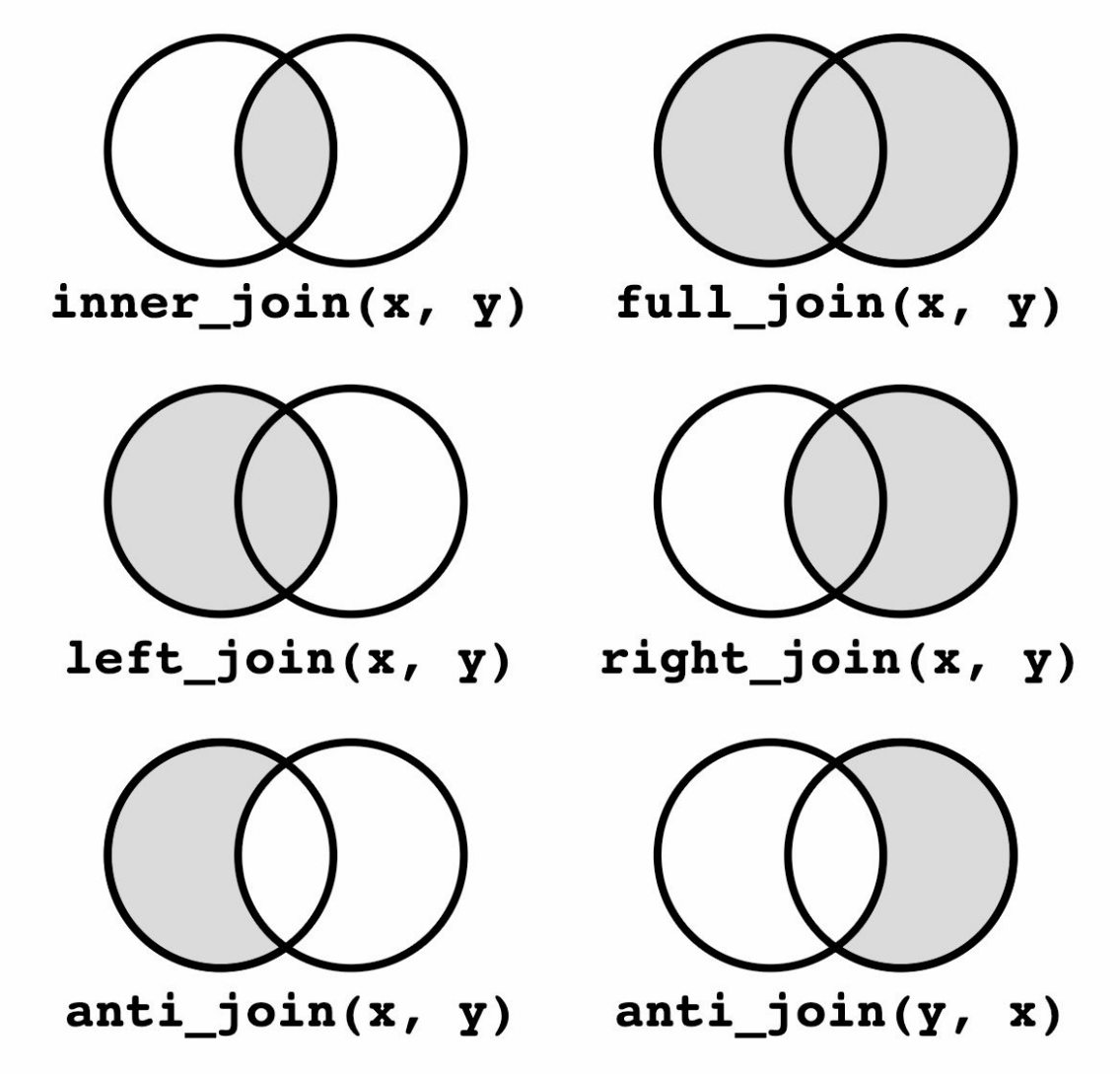
tbl2

id	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# return rows from tbl1 with a match in tbl2
semi_join(tbl1, tbl2, by = "id")
```

id	year	coffee
Luke	1	no
Leia	3	yes

Joins


inner_join(x, y)
full_join(x, y)
left_join(x, y)
right_join(x, y)
anti_join(x, y)
anti_join(y, x)

What if tables had keys with different names?

Tables with different key names

tbl1

id1	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id2	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

Data Tables

```
tbl1 <- data.frame(
  id1 = c('Luke', 'Leia', 'Han'),
  year = c(1, 3, 4),
  coffee = c('no', 'yes', 'yes')
)

tbl2 <- data.frame(
  id2 = c('Padme', 'Leia', 'Luke', 'Obi-Wan'),
  gpa = c(3.9, 4.0, 3.7, 3.8),
  lunch = c('pizza', 'tacos', 'burrito', 'pad thai')
)
```

tbl1

id1	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id2	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# keeps all observations in tbl1 and tbl2
full_join(tbl1, tbl2, join_by("id1" == "id2"))
```

id1	year	coffee	gpa	lunch
Luke	1	no	3.7	burrito
Leia	3	yes	4.0	tacos
Han	4	yes	NA	NA
Padme	NA	NA	3.9	pizza
Obi-Wan	NA	NA	3.8	pad thai

tbl1

id1	year	coffee
Luke	1	no
Leia	3	yes
Han	4	yes

tbl2

id2	gpa	lunch
Padme	3.9	pizza
Leia	4.0	tacos
Luke	3.7	burrito
Obi-Wan	3.8	pad thai

```
# equivalent command
full_join(tbl1, tbl2, by = c("id1" = "id2"))
```

id1	year	coffee	gpa	lunch
Luke	1	no	3.7	burrito
Leia	3	yes	4.0	tacos
Han	4	yes	NA	NA
Padme	NA	NA	3.9	pizza
Obi-Wan	NA	NA	3.8	pad thai