Data wrangling

Working with multiple data frames

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The following content is based on Mine Çetinkaya-Rundel's excellent book Data Science in a Box

We...

have multiple data frames

want to bring them together

Data: Women in science

Information on 10 women in science who changed the world

name
Ada Lovelace
Marie Curie
Janaki Ammal
Chien-Shiung Wu
Katherine Johnson
Rosalind Franklin
Vera Rubin
Gladys West
Flossie Wong-Staal
Jennifer Doudna

Source: Discover Magazine

Inputs

professions | dates | works

```
dates
```

```
## # A tibble: 8 x 3
##   name                birth_year death_year
##   <chr>                    <dbl>      <dbl>
## 1 Janaki Ammal              1897       1984
## 2 Chien-Shiung Wu           1912       1997
## 3 Katherine Johnson         1918       2020
## 4 Rosalind Franklin         1920       1958
## 5 Vera Rubin                1928       2016
## 6 Gladys West               1930         NA
## 7 Flossie Wong-Staal        1947         NA
## 8 Jennifer Doudna           1964         NA
```

Desired output

```
## # A tibble: 10 x 5
##    name     profession    birth_year death_year known_for
##    <chr>    <chr>              <dbl>      <dbl> <chr>
##  1 Ada Lov… Mathematician         NA         NA first computer a…
##  2 Marie C… Physicist an…         NA         NA theory of radioa…
##  3 Janaki … Botanist            1897       1984 hybrid species, …
##  4 Chien-S… Physicist           1912       1997 confim and refin…
##  5 Katheri… Mathematician       1918       2020 calculations of …
##  6 Rosalin… Chemist             1920       1958 <NA>
##  7 Vera Ru… Astronomer          1928       2016 existence of dar…
##  8 Gladys … Mathematician       1930         NA mathematical mod…
##  9 Flossie… Virologist a…       1947         NA first scientist …
## 10 Jennife… Biochemist          1964         NA one of the prima…
```

Inputs, reminder

```
names(professions)
```

```
## [1] "name"       "profession"
```

```
names(dates)
```

```
## [1] "name"       "birth_year" "death_year"
```

```
names(works)
```

```
## [1] "name"      "known_for"
```

```
nrow(professions)
```

```
## [1] 10
```

```
nrow(dates)
```

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

```
nrow(works)
```

```
## [1] 9
```

Joining data frames

Joining data frames

```
something_join(x, y)
```

- `left_join()`: all rows from x
- `right_join()`: all rows from y
- `full_join()`: all rows from both x and y
- `semi_join()`: all rows from x where there are matching values in y, keeping just columns from x
- `inner_join()`: all rows from x where there are matching values in y, return all combination of multiple matches in the case of multiple matches
- `anti_join()`: return all rows from x where there are not matching values in y, never duplicate rows of x
- ...

Setup

For the next few slides...

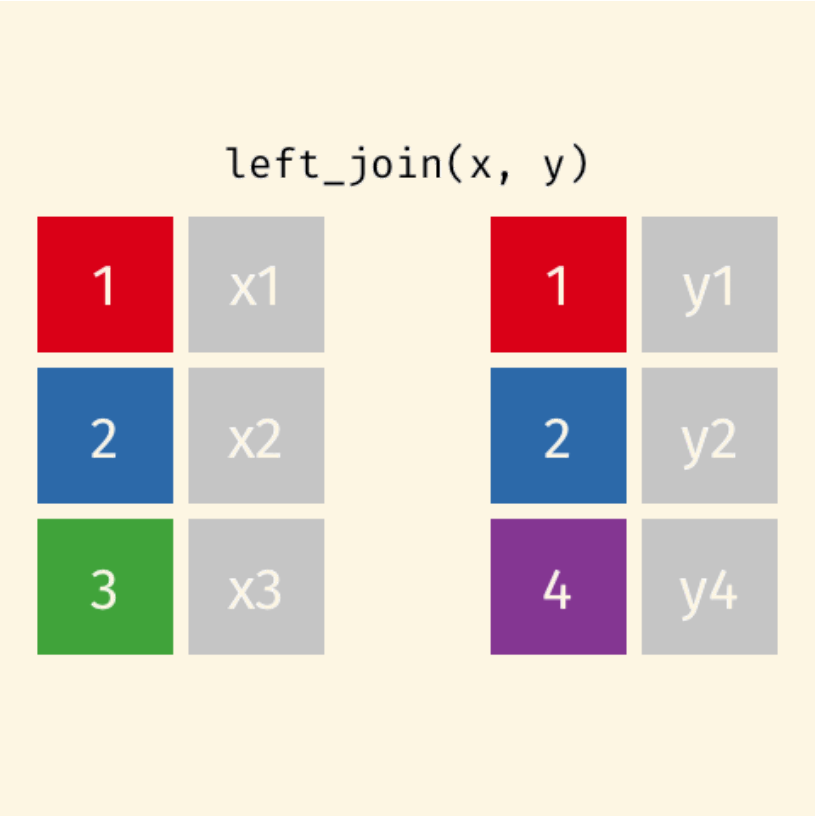
```
x
```

```
## # A tibble: 3 x 2
##      id value_x
##   <dbl> <chr>
## 1     1 x1
## 2     2 x2
## 3     3 x3
```

```
y
```

```
## # A tibble: 3 x 2
##      id value_y
##   <dbl> <chr>
## 1     1 y1
## 2     2 y2
## 3     4 y4
```

left_join()




```
left_join(x, y)
```

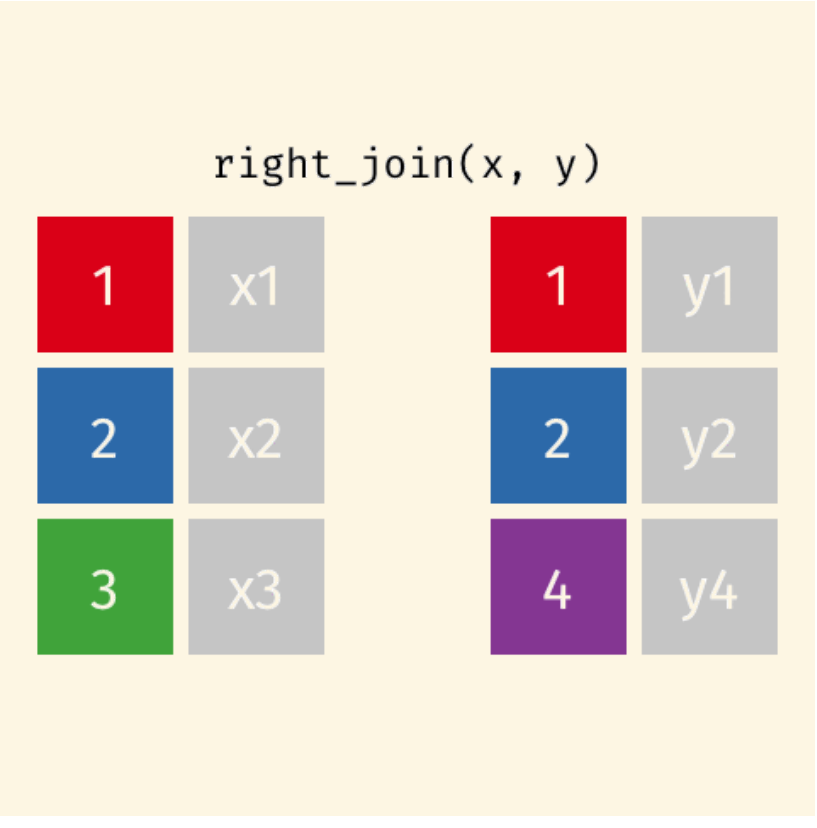
```
## # A tibble: 3 x 3
##       id value_x value_y
##    <dbl> <chr>   <chr>
## 1      1 x1      y1
## 2      2 x2      y2
## 3      3 x3      <NA>
```

left_join()

```
professions %>%
  left_join(dates)
```

```
## # A tibble: 10 x 4
##    name           profession                birth_year death_year
##    <chr>          <chr>                          <dbl>      <dbl>
##  1 Ada Lovelace   Mathematician                     NA         NA
##  2 Marie Curie    Physicist and Chemist             NA         NA
##  3 Janaki Ammal   Botanist                        1897       1984
##  4 Chien-Shiung … Physicist                       1912       1997
##  5 Katherine Joh… Mathematician                   1918       2020
##  6 Rosalind Fran… Chemist                         1920       1958
##  7 Vera Rubin     Astronomer                      1928       2016
##  8 Gladys West    Mathematician                   1930         NA
##  9 Flossie Wong-… Virologist and Molecular…       1947         NA
## 10 Jennifer Doud… Biochemist                      1964         NA
```

right_join()




```
right_join(x, y)
```

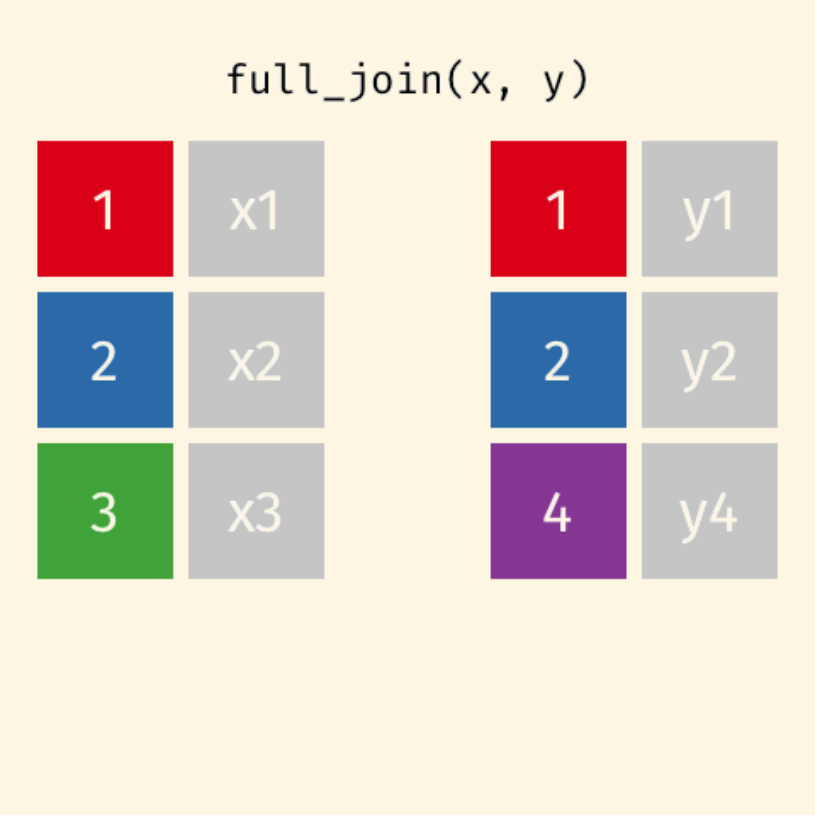
```
## # A tibble: 3 x 3
##       id value_x value_y
##    <dbl> <chr>   <chr>
## 1      1 x1      y1
## 2      2 x2      y2
## 3      4 <NA>    y4
```

right_join()

```
professions %>%
  right_join(dates)
```

```
## # A tibble: 8 x 4
##   name           profession                  birth_year death_year
##   <chr>          <chr>                            <dbl>      <dbl>
## 1 Janaki Ammal   Botanist                          1897       1984
## 2 Chien-Shiung … Physicist                         1912       1997
## 3 Katherine Joh… Mathematician                     1918       2020
## 4 Rosalind Fran… Chemist                           1920       1958
## 5 Vera Rubin     Astronomer                        1928       2016
## 6 Gladys West    Mathematician                     1930         NA
## 7 Flossie Wong-… Virologist and Molecular …        1947         NA
## 8 Jennifer Doud… Biochemist                        1964         NA
```

full_join()




```
full_join(x, y)
```

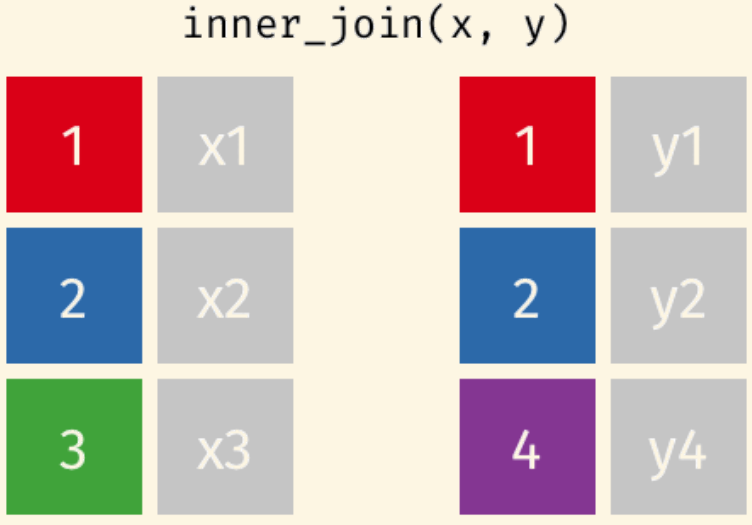
```
## # A tibble: 4 x 3
##      id value_x value_y
##   <dbl> <chr>   <chr>
## 1     1 x1      y1
## 2     2 x2      y2
## 3     3 x3      <NA>
## 4     4 <NA>    y4
```

full_join()

```
dates %>%
  full_join(works)
```

```
## # A tibble: 10 x 4
##    name       birth_year death_year known_for
##    <chr>           <dbl>      <dbl> <chr>
##  1 Janaki Am…       1897       1984 hybrid species, biodiversity…
##  2 Chien-Shi…       1912       1997 confim and refine theory of …
##  3 Katherine…       1918       2020 calculations of orbital mech…
##  4 Rosalind …       1920       1958 <NA>
##  5 Vera Rubin       1928       2016 existence of dark matter
##  6 Gladys We…       1930         NA mathematical modeling of the…
##  7 Flossie W…       1947         NA first scientist to clone HIV…
##  8 Jennifer …       1964         NA one of the primary developer…
##  9 Ada Lovel…         NA         NA first computer algorithm
## 10 Marie Cur…         NA         NA theory of radioactivity,  di…
```

inner_join()




```
inner_join(x, y)
```

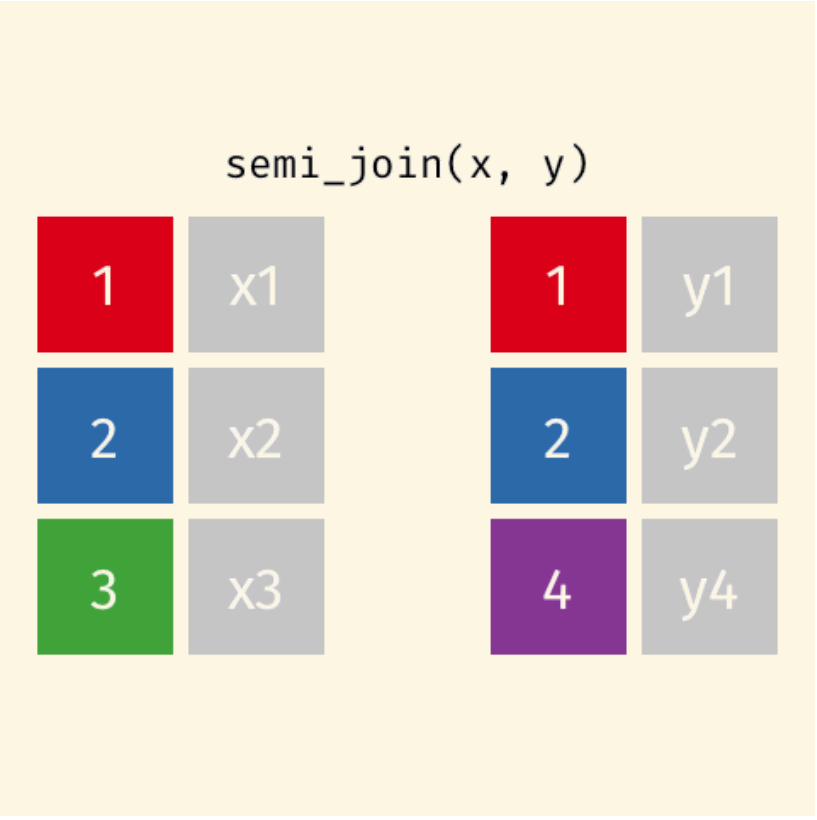
```
## # A tibble: 2 x 3
##      id value_x value_y
##   <dbl> <chr>   <chr>
## 1     1 x1      y1
## 2     2 x2      y2
```

inner_join()

```
dates %>%
  inner_join(works)
```

```
## # A tibble: 7 x 4
##   name        birth_year death_year known_for
##   <chr>            <dbl>      <dbl> <chr>
## 1 Janaki Amm…       1897       1984 hybrid species, biodiversity…
## 2 Chien-Shiu…       1912       1997 confim and refine theory of …
## 3 Katherine …       1918       2020 calculations of orbital mech…
## 4 Vera Rubin        1928       2016 existence of dark matter
## 5 Gladys West       1930         NA mathematical modeling of the…
## 6 Flossie Wo…       1947         NA first scientist to clone HIV…
## 7 Jennifer D…       1964         NA one of the primary developer…
```

semi_join()




```
semi_join(x, y)
```

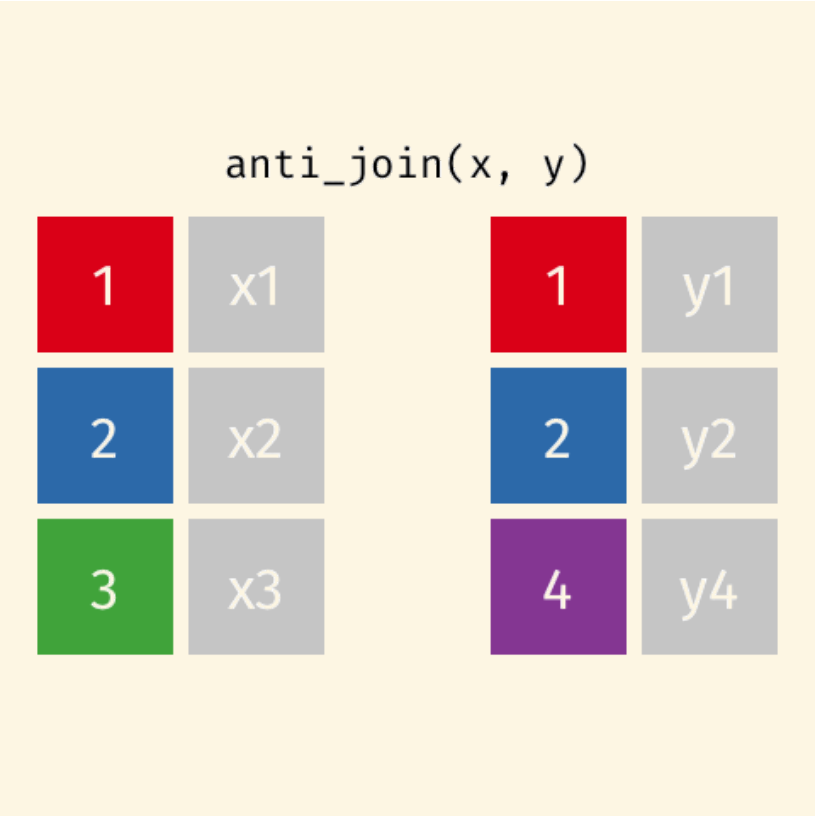
```
## # A tibble: 2 x 2
##       id value_x
##    <dbl> <chr>
## 1     1 x1
## 2     2 x2
```

semi_join()

```
dates %>%
  semi_join(works)
```

```
## # A tibble: 7 x 3
##   name                birth_year death_year
##   <chr>                    <dbl>      <dbl>
## 1 Janaki Ammal              1897       1984
## 2 Chien-Shiung Wu           1912       1997
## 3 Katherine Johnson         1918       2020
## 4 Vera Rubin                1928       2016
## 5 Gladys West               1930         NA
## 6 Flossie Wong-Staal        1947         NA
## 7 Jennifer Doudna           1964         NA
```

anti_join()




```
anti_join(x, y)
```

```
## # A tibble: 1 x 2
##      id value_x
##   <dbl> <chr>
## 1     3 x3
```

anti_join()

```
dates %>%
  anti_join(works)
```

```
## # A tibble: 1 x 3
##   name              birth_year death_year
##   <chr>                  <dbl>      <dbl>
## 1 Rosalind Franklin       1920       1958
```

Putting it altogether

```
professions %>%
  left_join(dates) %>%
  left_join(works)
```

```
## # A tibble: 10 x 5
##    name     profession    birth_year death_year known_for
##    <chr>    <chr>              <dbl>      <dbl> <chr>
##  1 Ada Lov… Mathematician         NA         NA first computer a…
##  2 Marie C… Physicist an…         NA         NA theory of radioa…
##  3 Janaki … Botanist            1897       1984 hybrid species, …
##  4 Chien-S… Physicist           1912       1997 confim and refin…
##  5 Katheri… Mathematician       1918       2020 calculations of …
##  6 Rosalin… Chemist             1920       1958 <NA>
##  7 Vera Ru… Astronomer          1928       2016 existence of dar…
##  8 Gladys … Mathematician       1930         NA mathematical mod…
##  9 Flossie… Virologist a…       1947         NA first scientist …
## 10 Jennife… Biochemist          1964         NA one of the prima…
```

Case study: Student records

Student records

- **Have**:
  - `enrolment`: official university enrolment records
  - `survey`: Student provided info; missing students who never filled it out; and including students who filled it out but dropped the class
- Want: Survey info for all enrolled in class

```
enrolment
```

```
## # A tibble: 3 x 2
##      id name
##   <dbl> <chr>
## 1     1 Dave Friday
## 2     2 Hermine
## 3     3 Sura Selvarajah
```

```
survey
```

```
## # A tibble: 4 x 3
##      id name    username
##   <dbl> <chr>   <chr>
## 1     2 Hermine bakealongwithhermine
## 2     3 Sura    surasbakes
## 3     4 Peter   peter_bakes
## 4     5 Mark    thebakingbuddha
```

Student records

In class | Survey missing | Dropped

```
survey %>%
  anti_join(enrolment, by = "id")
```

```
## # A tibble: 2 x 3
##      id name  username
##   <dbl> <chr> <chr>
## 1     4 Peter peter_bakes
## 2     5 Mark  thebakingbuddha
```

Case study: Grocery sales

Grocery sales

- Have:
  - Purchases: One row per customer per item, listing purchases they made
  - Prices: One row per item in the store, listing their prices
- Want: Total revenue

```
purchases
```

```
## # A tibble: 5 x 2
##   customer_id item
##         <dbl> <chr>
## 1           1 bread
## 2           1 milk
## 3           1 banana
## 4           2 milk
## 5           2 toilet paper
```

```
prices
```

```
## # A tibble: 5 x 2
##   item         price
##   <chr>        <dbl>
## 1 avocado       0.5
## 2 banana        0.15
## 3 bread         1
## 4 milk          0.8
## 5 toilet paper  3
```

Grocery sales

Total revenue | Revenue per customer

```
purchases %>%
  left_join(prices)
```

```
## # A tibble: 5 x 3
##   customer_id item         price
##         <dbl> <chr>        <dbl>
## 1           1 bread          1
## 2           1 milk           0.8
## 3           1 banana         0.15
## 4           2 milk           0.8
## 5           2 toilet paper   3
```

```
purchases %>%
  left_join(prices) %>%
  summarise(total_revenue = sum(price))
```

```
## # A tibble: 1 x 1
##   total_revenue
##           <dbl>
## 1          5.75
```