Analysis Using Multiple Tables: Joins

SSEP 2022 Afternoon Day 2

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Slides based on slides courtesy of Jordan Crouser: https://jcrouser.github.io/MassMutual-IntroR/, https://jcrouser.github.io/MassMutual-DataVis/, https://beanumber.github.io/sds192/

Data Consisting of Multiple Tables

Multiple Tables

Relational Data

- Data from two or more tables that is *related*
- Ex. `nycflights13` data in R

```
library(nycflights13)
```

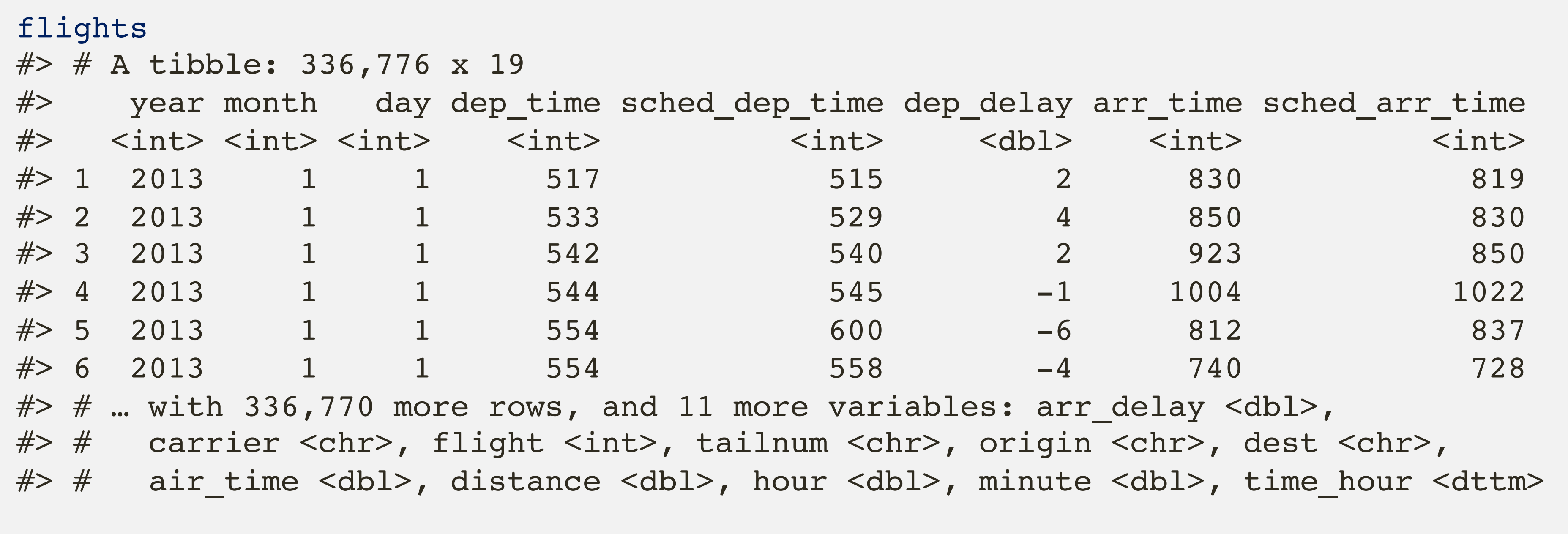
```
## Warning: package
'nycflights13' was built
under R version 3.6.2
    •  flights
    •  airports
    •  airlines
    •  planes
    •  weather
```

- Dataset (`nycflights13`) is made up of multiple tables of data
- All tables have data related to NYC flights in 2013
- Some tables repeat columns

Multiple Tables

nycflights13 Data

- flights, airports, airlines, planes, weather

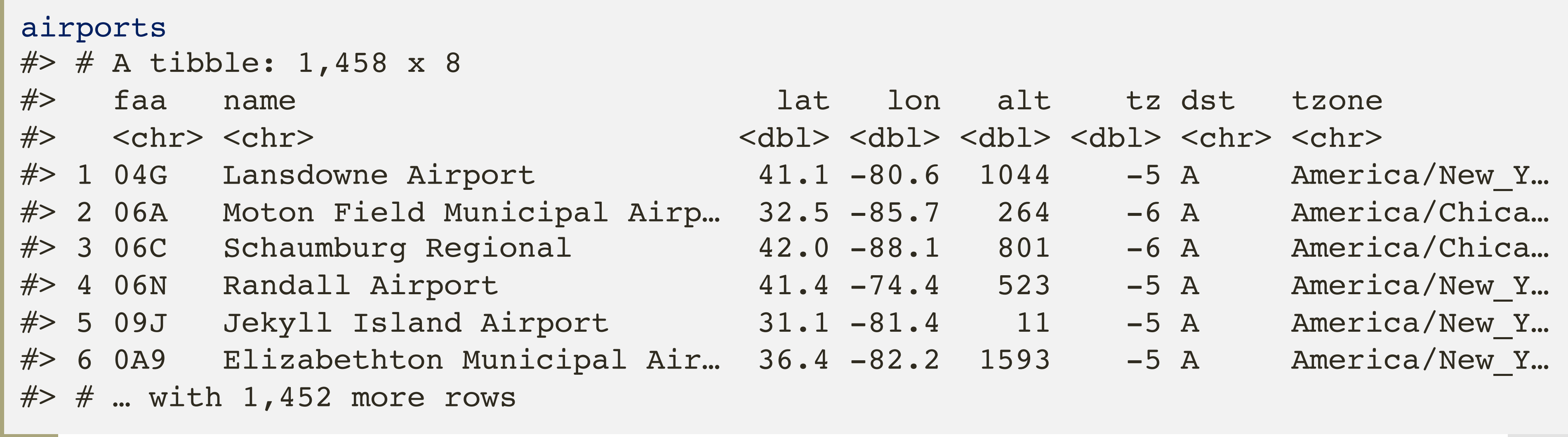


```
flights
#> # A tibble: 336,776 x 19
#>    year month   day dep_time sched_dep_time dep_delay arr_time sched_arr_time
#>   <int> <int> <int>    <int>          <int>     <dbl>    <int>          <int>
#> 1  2013     1     1      517            515         2      830            819
#> 2  2013     1     1      533            529         4      850            830
#> 3  2013     1     1      542            540         2      923            850
#> 4  2013     1     1      544            545        -1     1004           1022
#> 5  2013     1     1      554            600        -6      812            837
#> 6  2013     1     1      554            558        -4      740            728
#> # … with 336,770 more rows, and 11 more variables: arr_delay <dbl>,
#> #   carrier <chr>, flight <int>, tailnum <chr>, origin <chr>, dest <chr>,
#> #   air_time <dbl>, distance <dbl>, hour <dbl>, minute <dbl>, time_hour <dttm>
```

Multiple Tables

`nycflights13` Data

- `flights`, `airports`, `airlines`, `planes`, `weather`



```
airports
#> # A tibble: 1,458 x 8
#>   faa   name                            lat   lon   alt    tz dst   tzone
#>   <chr> <chr>                         <dbl> <dbl> <dbl> <dbl> <chr> <chr>
#> 1 04G   Lansdowne Airport              41.1 -80.6  1044    -5 A     America/New_Y…
#> 2 06A   Moton Field Municipal Airp…    32.5 -85.7   264    -6 A     America/Chica…
#> 3 06C   Schaumburg Regional            42.0 -88.1   801    -6 A     America/Chica…
#> 4 06N   Randall Airport                41.4 -74.4   523    -5 A     America/New_Y…
#> 5 09J   Jekyll Island Airport          31.1 -81.4    11    -5 A     America/New_Y…
#> 6 0A9   Elizabethton Municipal Air…    36.4 -82.2  1593    -5 A     America/New_Y…
#> # … with 1,452 more rows
```

Multiple Tables

nycflights13 Data

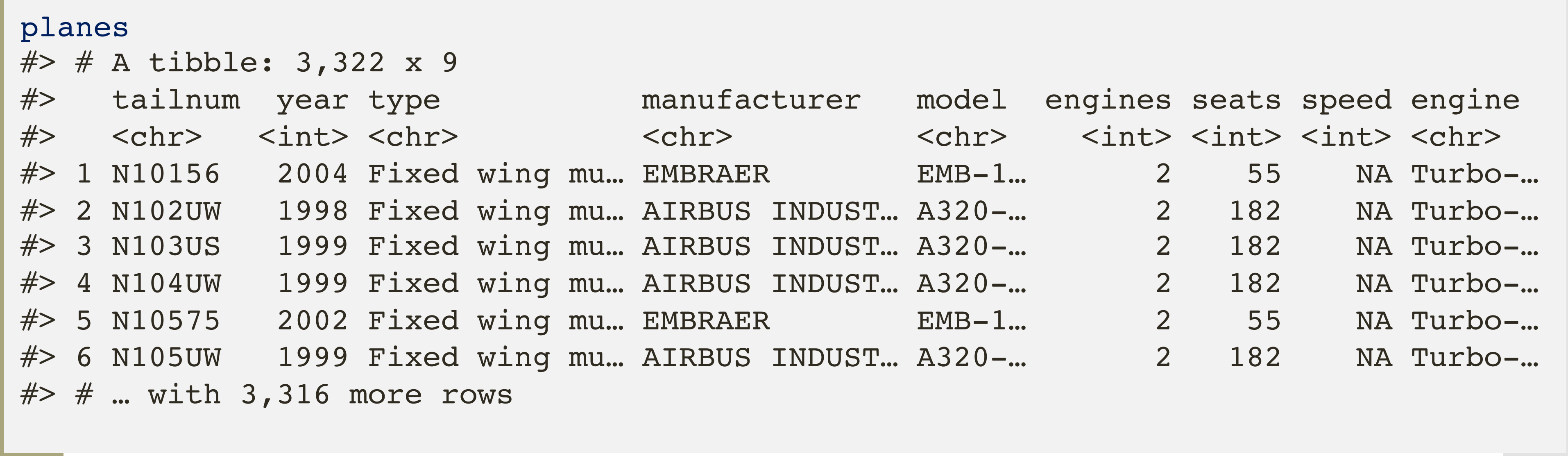
- flights, airports, airlines, planes, weather

```
airlines
#> # A tibble: 16 x 2
#>   carrier name
#>   <chr>   <chr>
#> 1 9E      Endeavor Air Inc.
#> 2 AA      American Airlines Inc.
#> 3 AS      Alaska Airlines Inc.
#> 4 B6      JetBlue Airways
#> 5 DL      Delta Air Lines Inc.
#> 6 EV      ExpressJet Airlines Inc.
#> # … with 10 more rows
```

Multiple Tables

nycflights13 Data

- flights, airports, airlines, planes, weather

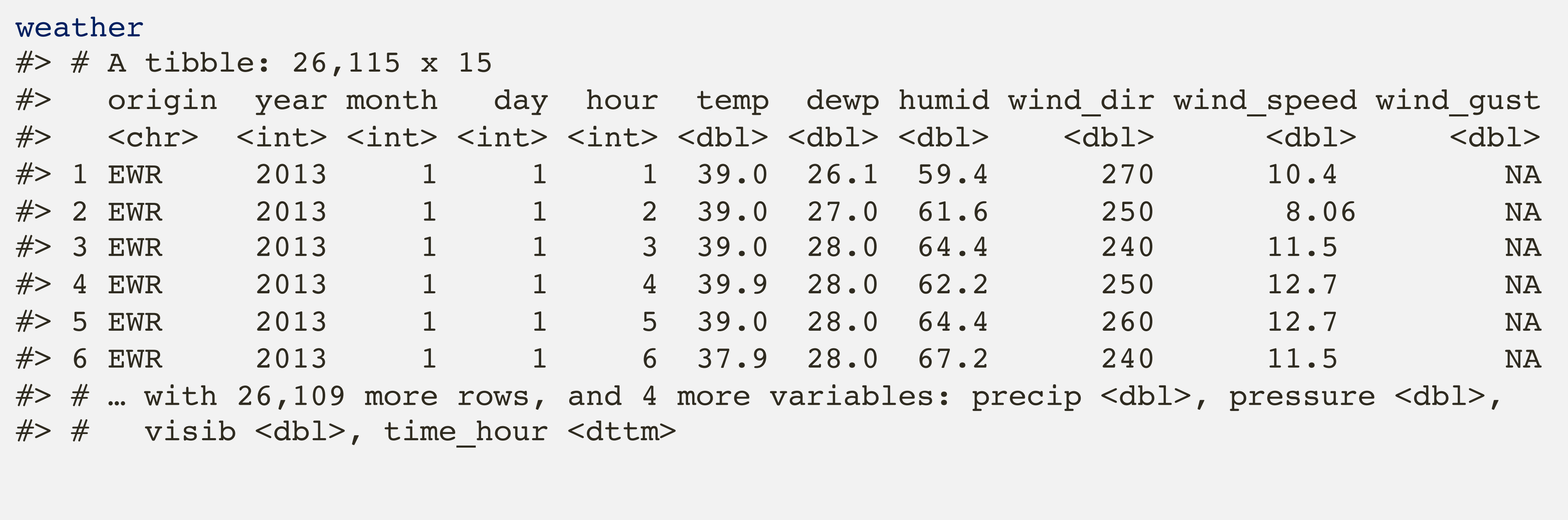


```
planes
#> # A tibble: 3,322 x 9
#>   tailnum  year type              manufacturer   model   engines seats speed engine
#>   <chr>   <int> <chr>             <chr>          <chr>     <int> <int> <int> <chr>
#> 1 N10156   2004 Fixed wing mu… EMBRAER        EMB-1…        2    55    NA Turbo-…
#> 2 N102UW   1998 Fixed wing mu… AIRBUS INDUST… A320-…        2   182    NA Turbo-…
#> 3 N103US   1999 Fixed wing mu… AIRBUS INDUST… A320-…        2   182    NA Turbo-…
#> 4 N104UW   1999 Fixed wing mu… AIRBUS INDUST… A320-…        2   182    NA Turbo-…
#> 5 N10575   2002 Fixed wing mu… EMBRAER        EMB-1…        2    55    NA Turbo-…
#> 6 N105UW   1999 Fixed wing mu… AIRBUS INDUST… A320-…        2   182    NA Turbo-…
#> # … with 3,316 more rows
```

Multiple Tables

nycflights13 Data

- flights, airports, airlines, planes, weather



```
weather
#> # A tibble: 26,115 x 15
#>   origin  year month   day  hour  temp  dewp humid wind_dir wind_speed wind_gust
#>   <chr>  <int> <int> <int> <int> <dbl> <dbl> <dbl>    <dbl>      <dbl>     <dbl>
#> 1 EWR     2013     1     1     1  39.0  26.1  59.4      270      10.4         NA
#> 2 EWR     2013     1     1     2  39.0  27.0  61.6      250       8.06        NA
#> 3 EWR     2013     1     1     3  39.0  28.0  64.4      240      11.5         NA
#> 4 EWR     2013     1     1     4  39.9  28.0  62.2      250      12.7         NA
#> 5 EWR     2013     1     1     5  39.0  28.0  64.4      260      12.7         NA
#> 6 EWR     2013     1     1     6  37.9  28.0  67.2      240      11.5         NA
#> # … with 26,109 more rows, and 4 more variables: precip <dbl>, pressure <dbl>,
#> #   visib <dbl>, time_hour <dttm>
```

Multiple Tables

nycflights13 Data

flights
year
month
day
dep_time
sched_dep_time
dep_delay
arr_time
sched_arr_time
arr_delay
carrier
flight
talinum
origin
dest
air_time
distance
hour
minute
time_hour

airports
faa
name
lat
lon
alt
tz
dst
tzone

airlines
carrier
name

planes
tailnum
year
type
manufacturer
model
engines
seats
speed
engine

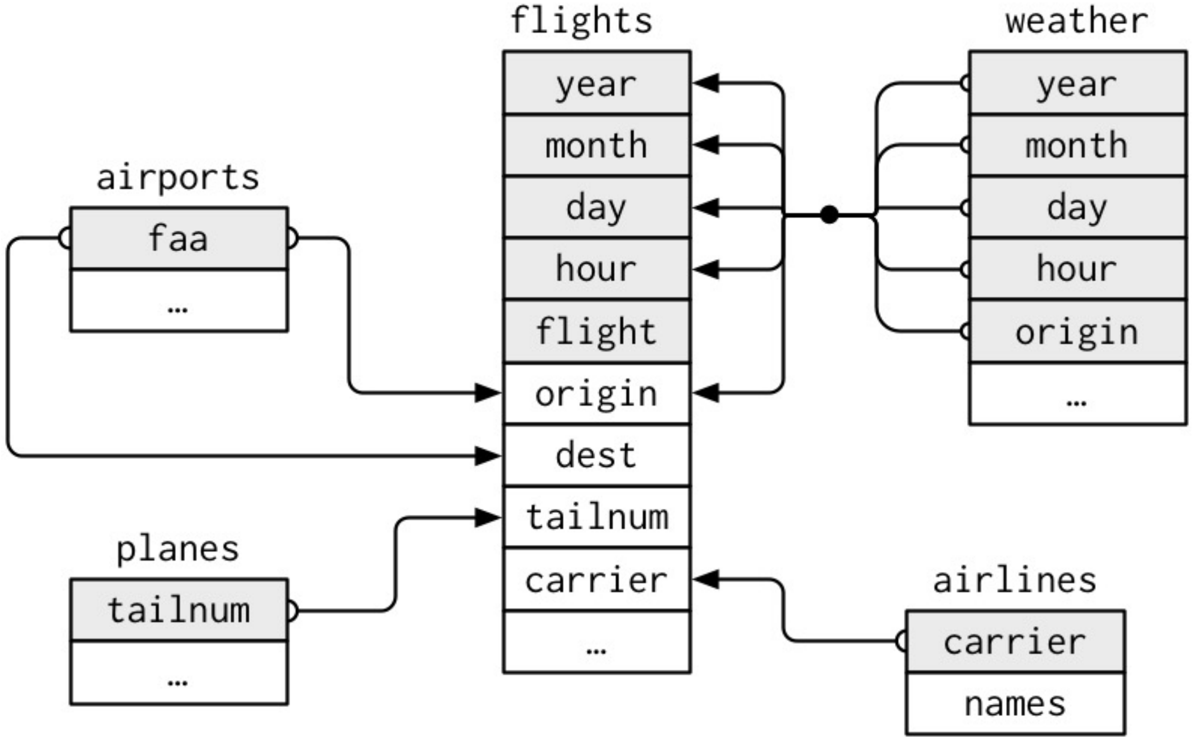
weather
origin
year
month
day
hour
temp
dewp
humid
wind_dir
wind_speed
wind_gust
precip
pressure
visib
time_hour

Work with the person next to you to find which columns are shared between these different tables

Draw in the connections on the Jamboard here: nycflights13 Data Diagram

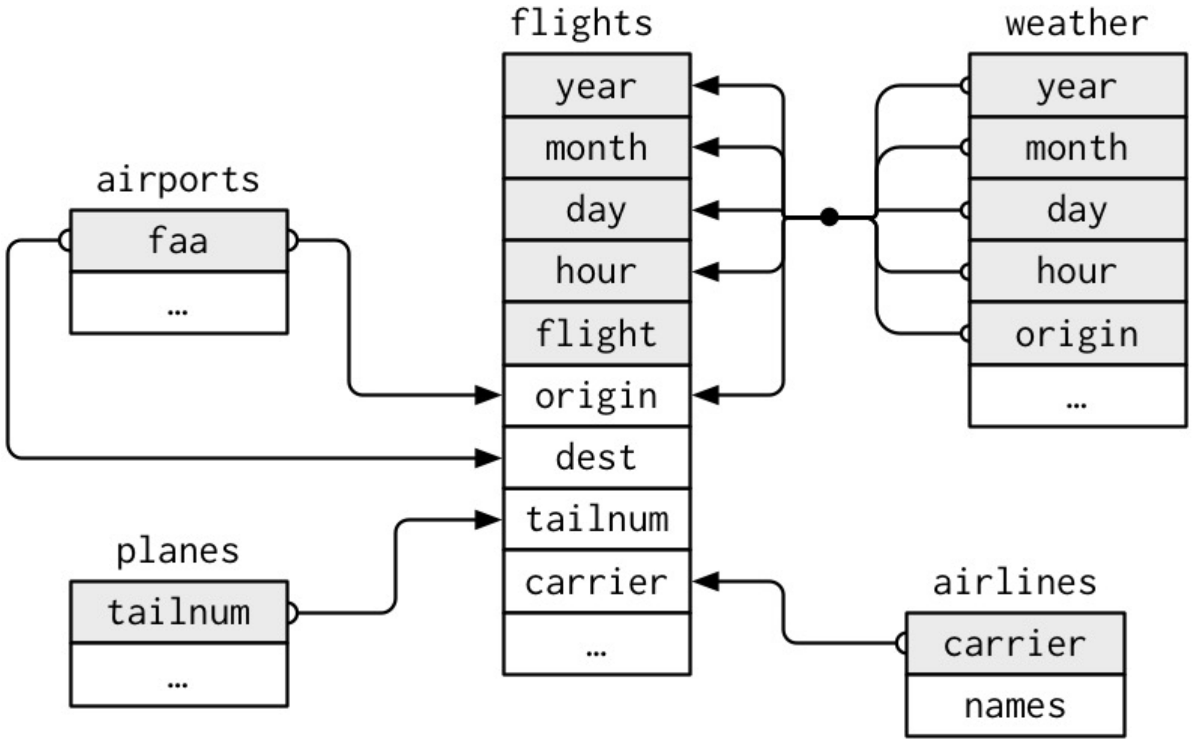
Multiple Tables

nycflights13 Data



Multiple Tables

nycflights13 Data



- We use shared columns to `join` (i.e. connect / merge) tables
- Ex. We could `join` the `planes` and `flights` tables on `talinum`, their shared column

Joins

Joins

- **Join** is the word for connecting or merging two data tables
- We join tables on shared columns, which we call the **key**
- Ex.

Table_X

ID	DataX
1	x1
2	x2
3	x3

Table_Y

ID	DataY
1	y1
2	y2
4	y3

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1	y1
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Joins

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- We join tables on shared columns, which we call the **key**
- Ex.

Table_X

ID	DataX
1	x1
2	x2
3	x3

Table_Y

ID	DataY
1	y1
2	y2
4	y3

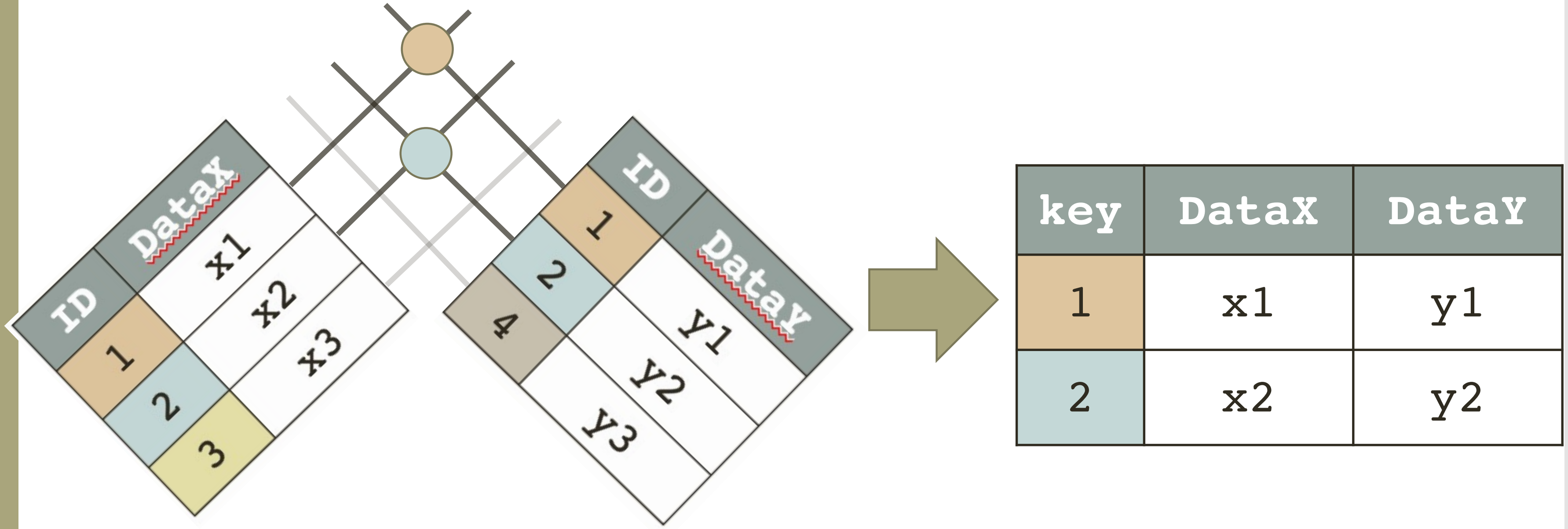
- Different types of joins handle this situation differently

Joins

inner_join()

- Resulting table has only rows in both tables

```
Table_X %>%
  inner_join(Table_Y, by = “ID”)
```



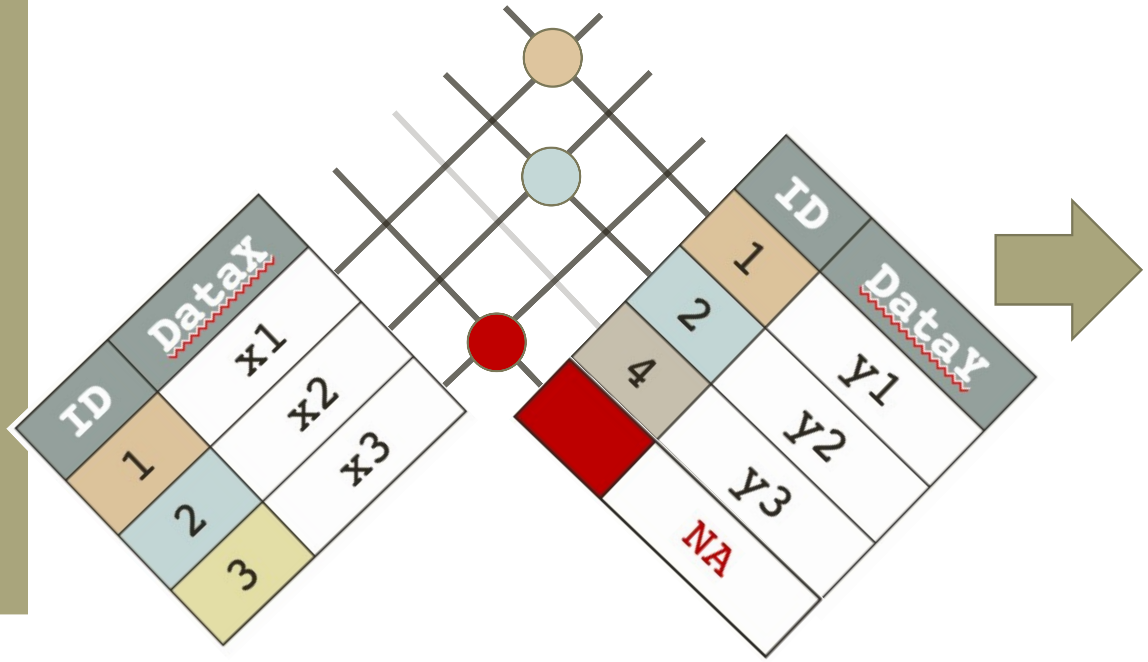
key	DataX	DataY
1	x1	y1
2	x2	y2

Joins

`left_join()`

- Resulting table has all rows in left table

```
Table_X %>%
  left_join(Table_Y, by = “ID”)
```



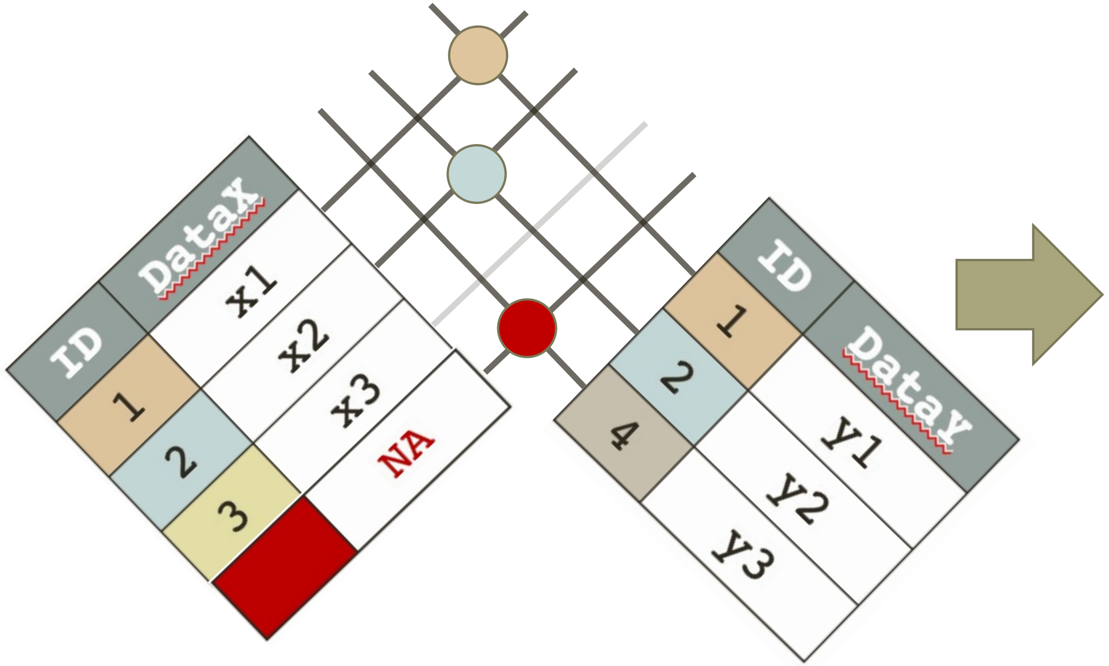
key	DataX	DataY
1	x1	y1
2	x2	y2
3	x3	NA

Joins

`right_join()`

- Resulting table has all rows in right table

```
Table_X %>%
  right_join(Table_Y, by = “ID”)
```



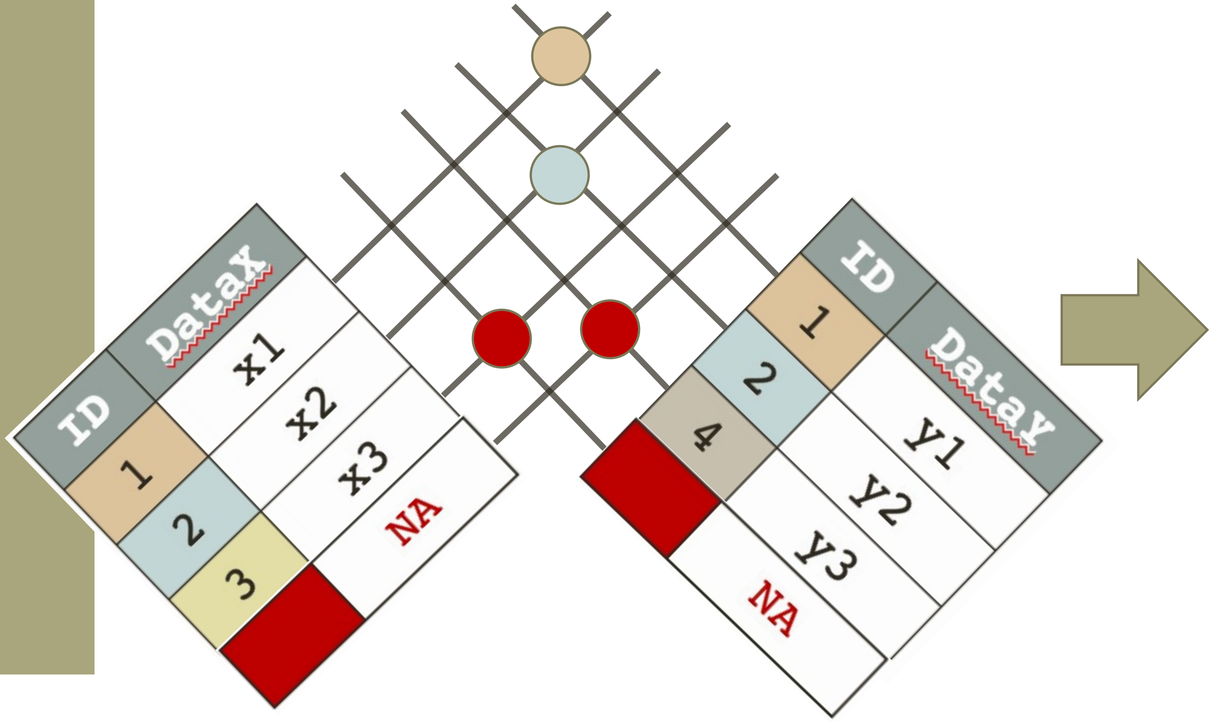
key	DataX	DataY
1	x1	y1
2	x2	y2
4	NA	y3

Joins

full_join()

- Resulting table has all rows in both tables

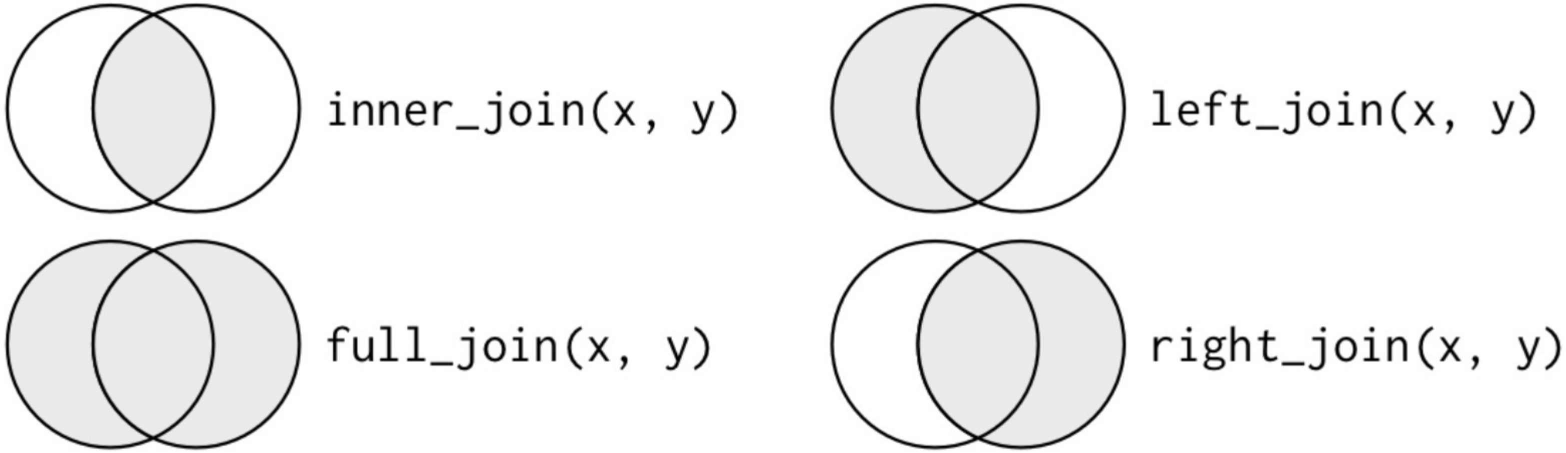
```
Table_X %>%
  full_join(Table_Y, by = “ID”)
```



key	DataX	DataY
1	x1	y1
2	x2	y2
3	x3	NA
4	NA	y3

Joins

Another way to visualize joins


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