

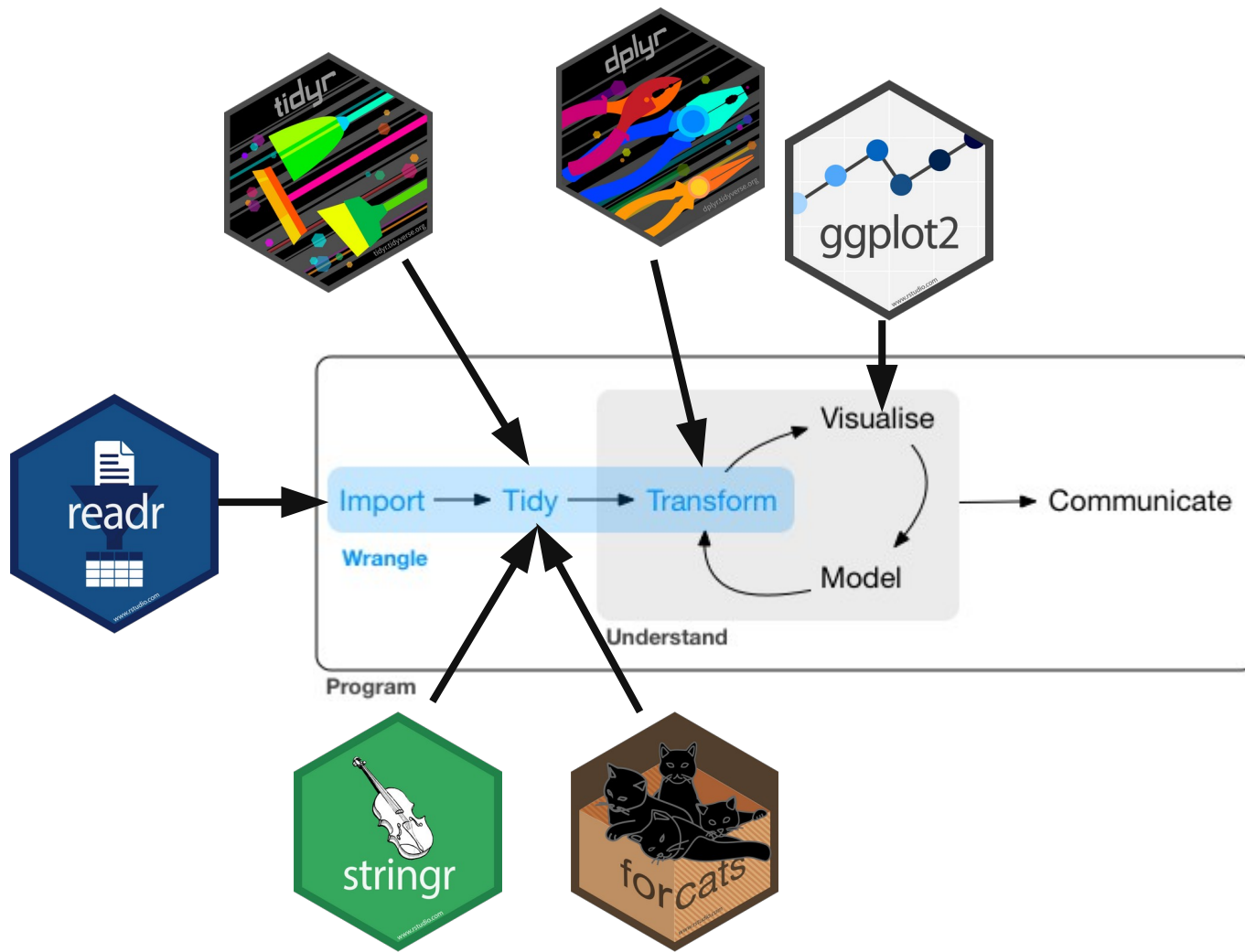
GG606

(More) Tidying data, data forms & formats

Homework

Homework

- Combine `nycflights13::flights` & `nycflights13::weather`
 - Identify primary keys
 - Put R-Script and figure in discord



Relational Data

- Mutating joins: new variables to one data frame from matching obs in another
- Filtering joins: filter observations from one data frame based on whether or not they match an obs in another
- Set operations, treat obs as if they were set elements

PostgreSQL



nycflights13

- Compare airlines, airports, planes, weather

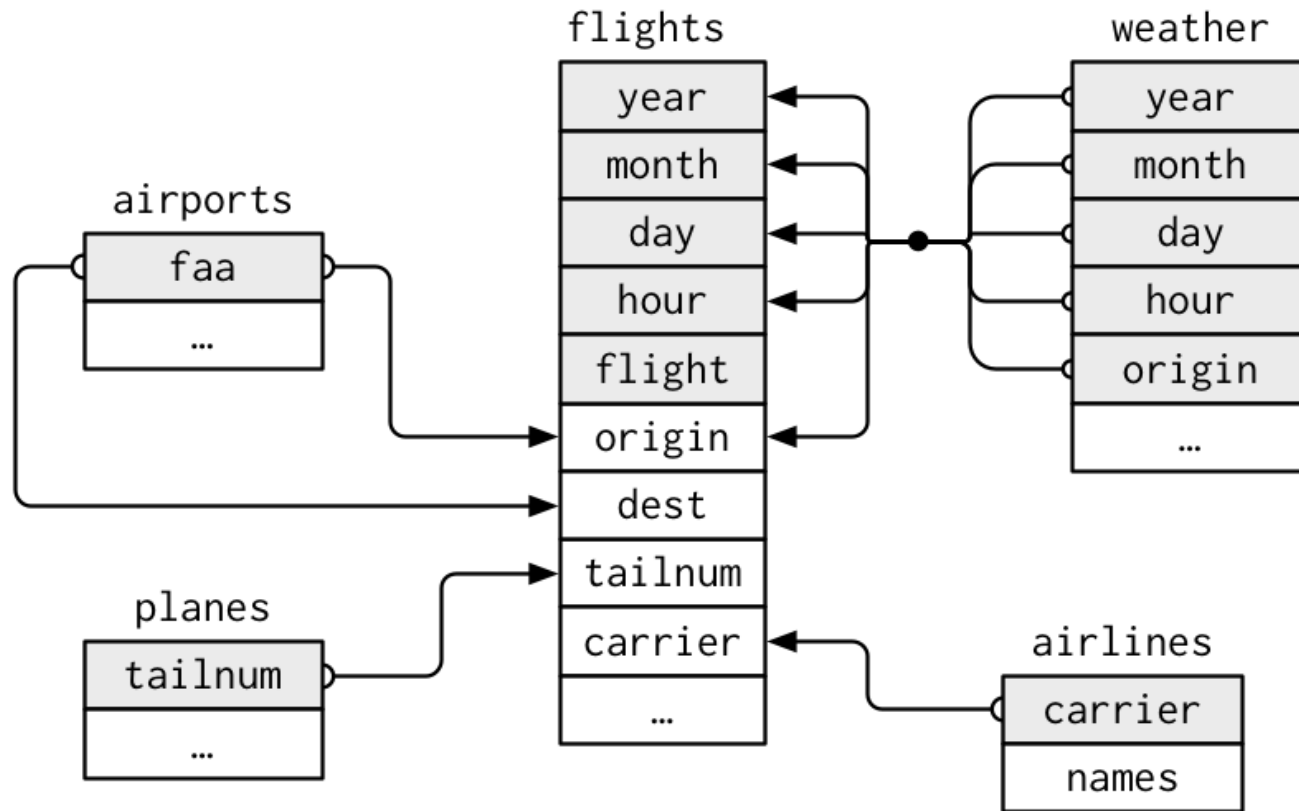
```
airlines
#> # A tibble: 16 x 2
#>   carrier name
#>   <chr>   <chr>
#> 1 9E      Endeavor Air Inc.
#> 2 AA      American Airlines Inc.
#> 3 AS      Alaska Airlines Inc.
#> 4 B6      JetBlue Airways
#> 5 DL      Delta Air Lines Inc.
#> 6 EV      ExpressJet Airlines Inc.
#> # ... with 10 more rows

airports
#> # A tibble: 1,458 x 8
#>   faa   name          lat lon alt
#>   <chr> <chr>         <dbl> <dbl> <dbl>
#> 1 04G   Lansdowne Airport  41.1 -80.6 1044
#> 2 06A   Moton Field Municipal Airp... 32.5 -85.7 264
#> 3 06C   Schaumburg Regional        42.0 -88.1 801
#> 4 06N   Randall Airport        41.4 -74.4 523
#> 5 09J   Jekyll Isl
#> 6 0A9   Elizabetht
#> # ... with 1,452 more rows
```

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

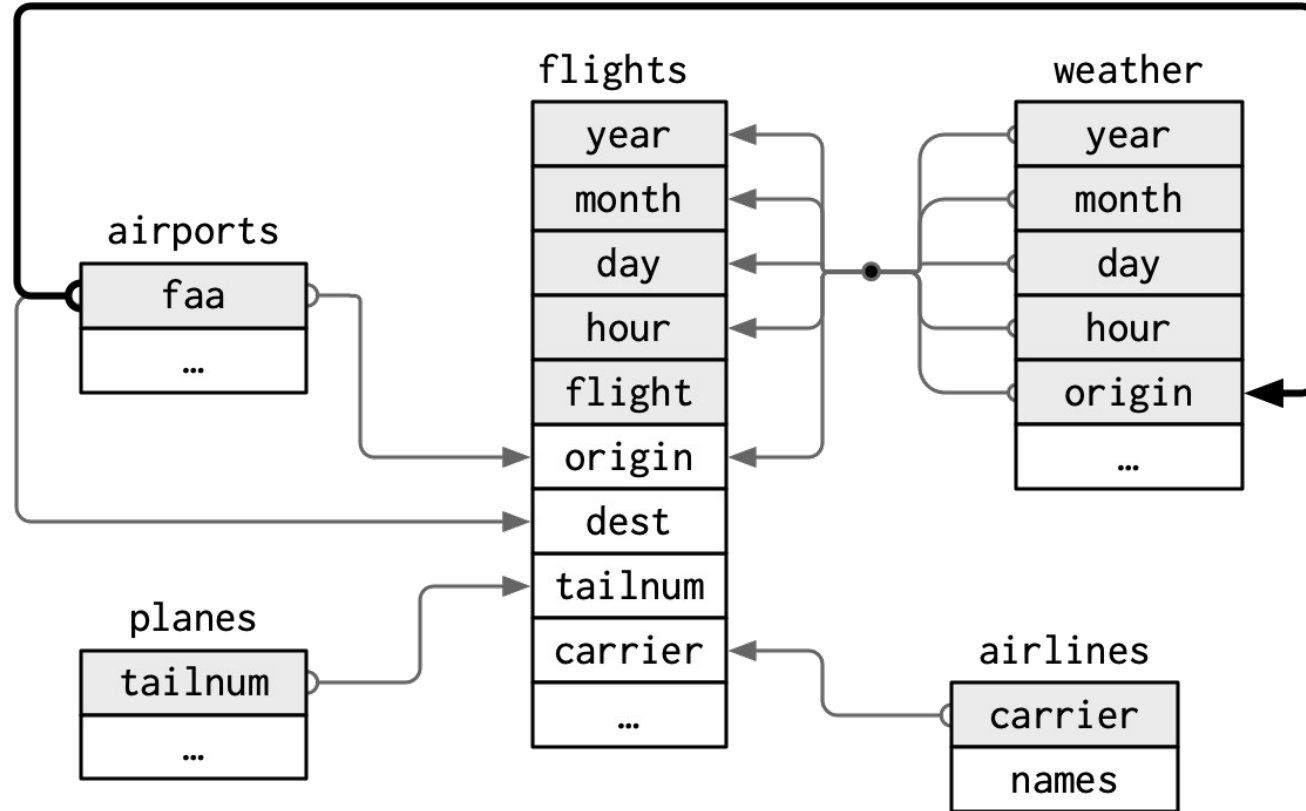
weather
#> # A tibble: 26,115 x 15
#>   origin year month   day hour temp
#>   <chr>   <int> <int> <int> <int> <dbl>
#> 1 EWR    2013     1     1     1 39.0
#> 2 EWR    2013     1     1     2 39.0
#> 3 EWR    2013     1     1     3 39.0
#> 4 EWR    2013     1     1     4 39.9
#> 5 EWR    2013     1     1     5 39.0
#> 6 EWR    2013     1     1     6 37.9
#> # ... with 26,109 more rows, and 4 more
#> #   visib <dbl>, time_hour <dtm>
```

nycflights13



walk through; airports to weather?

nycflights13



walk through; airports to weather?

Keys

- Primary: uniquely identifies obs in own table
- Foreign: uniquely identifies obs in other table

Keys

- Primary: uniquely identifies obs in own table
- Foreign: uniquely identifies obs in other table
- `planes %>% count(tailnum) %>%
 filter(n > 1)`
- `flights %>% count(tailnum) %>%
 filter(n > 1)`

Keys

- Primary: uniquely identifies obs in own table
- Foreign: uniquely identifies obs in other table
- Surrogate: added primary key, like row number

Keys

- Surrogate: added primary key, like row number
- `flights %>%
 count(year, month, day, flight) %>%
 filter(n > 1)`
- `flights %>%
 count(year, month, day, tailnum) %>%
 filter(n > 1)`

Add Surrogate Key

- Add `row_number()` as column `flight_id`
- What verb to add new column?

Add Surrogate Key

- Add `row_number()` as column `flight_id`
- ```
flights %>%
 arrange(year, month, day,
 sched_dep_time, carrier, flight) %>%
 mutate(flight_id = row_number()) %>%
 glimpse()
```

# Mutate Join

- Add airline carrier name to flights
- ```
flights2 ← flights %>%  
  select(year:day, hour, origin, dest,  
         tailnum, carrier)
```
-

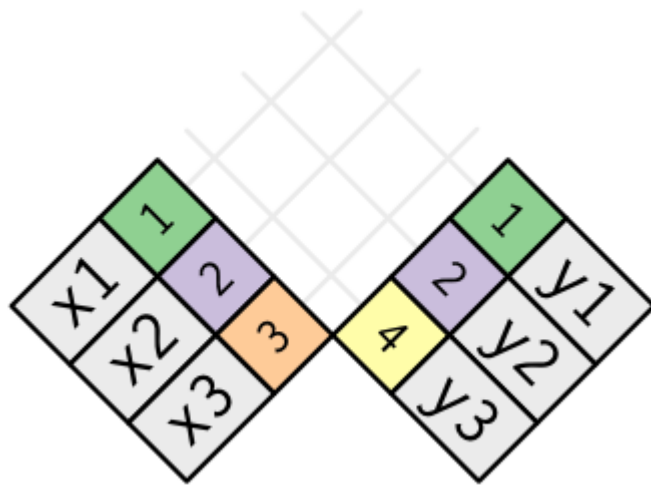
Mutate Join

- Add airline carrier name to flights
- `flights2 ← flights %>%
 select(year:day, hour, origin, dest,
 tailnum, carrier)`
- `flights2 %>%
 select(-origin, -dest) %>%
 left_join(airlines, by = "carrier")`

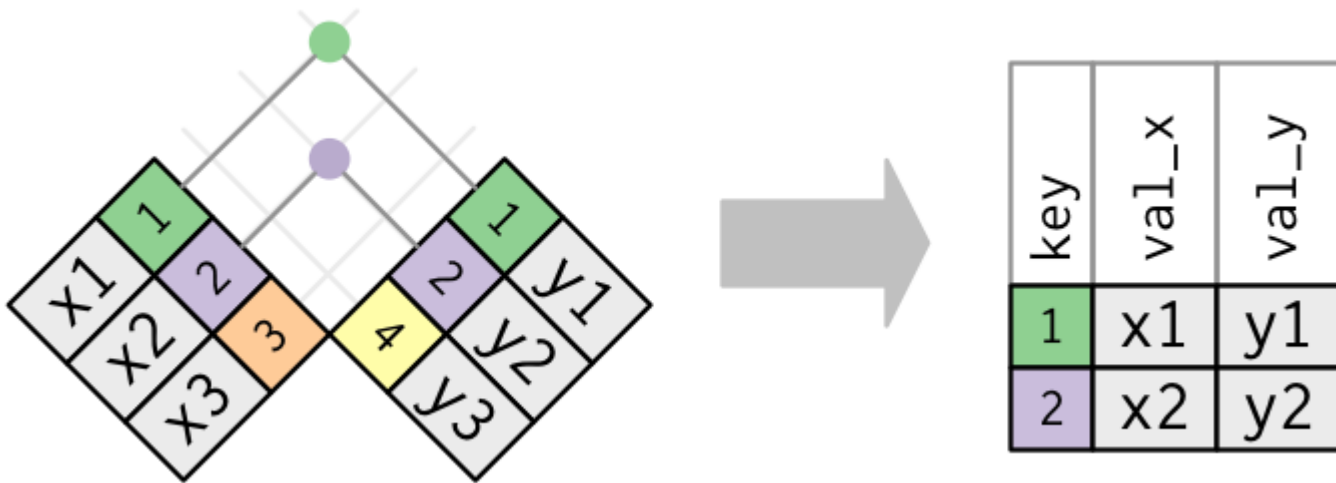
?left_join()

?mutate-joins

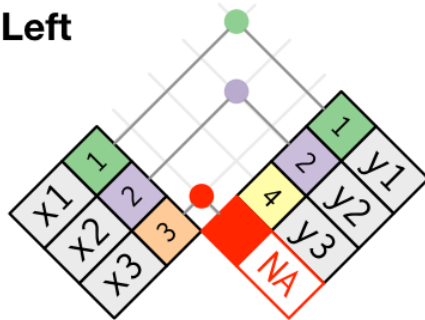
x		y	
1	x1	1	y1
2	x2	2	y2
3	x3	4	y3



?inner_join

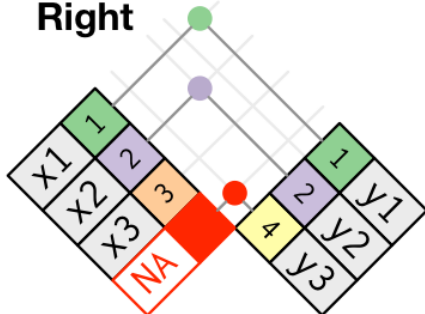


Left



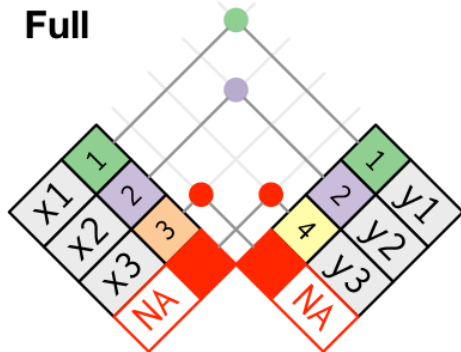
key	val_x	val_y
1	x1	y1
2	x2	y2
3	x3	NA

Right



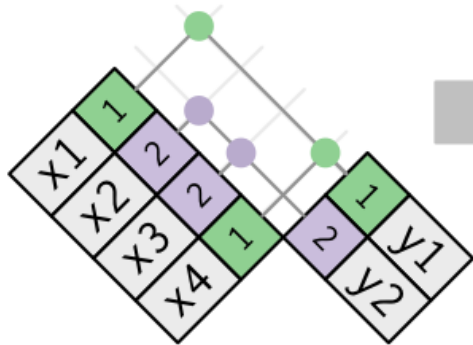
key	val_x	val_y
1	x1	y1
2	x2	y2
4	NA	y3

Full

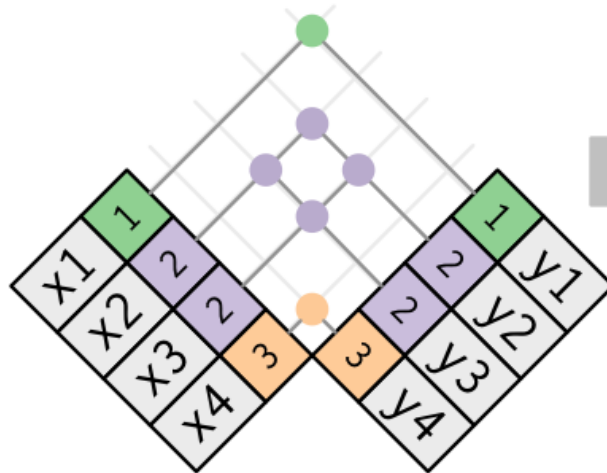


key	val_x	val_y
1	x1	y1
2	x2	y2
3	x3	NA
4	NA	y3

Duplicates



val_x	key	val_y
x1	1	y1
x2	2	y2
x3	2	y2
x4	1	y1



key	val_x	val_y
1	x1	y1
2	x2	y2
2	x2	y3
2	x3	y2
2	x3	y3
3	x4	y4

Might indicate an error/problem

Join by

- Compare
- `flights2 %>%
 left_join(weather)`
- `flights2 %>%
 left_join(planes, by = "tailnum")`

```
flights2 %>%  
  left_join(weather)  
#> Joining, by = c("year", "month", "day", "hour", "origin")  
#> # A tibble: 336,776 x 18  
#>   year month   day hour origin dest tailnum carrier temp  
#>   <int> <int> <int> <dbl> <chr> <chr> <chr>   <chr>   <dbl>  
#> 1  2013     1     1     5 EWR   IAH   N14228   UA      39.0  
#> 2  2013     1     1     5 LGA   IAH   N24211   UA      39.9
```

```
flights2 %>%  
  left_join(planes, by = "tailnum")  
#> # A tibble: 336,776 x 16  
#>   year.x month   day hour origin dest tailnum carrier year.y  
#>   <int> <int> <int> <dbl> <chr> <chr> <chr>   <chr>   <int>  
#> 1  2013     1     1     5 EWR   IAH   N14228   UA      1999  
#> 2  2013     1     1     5 LGA   IAH   N24211   UA      1998
```

SQL is the inspiration for dplyr's conventions, so the translation is straightforward:

dplyr	SQL
<code>inner_join(x, y, by = "z")</code>	<code>SELECT * FROM x INNER JOIN y USING (z)</code>
<code>left_join(x, y, by = "z")</code>	<code>SELECT * FROM x LEFT OUTER JOIN y USING (z)</code>
<code>right_join(x, y, by = "z")</code>	<code>SELECT * FROM x RIGHT OUTER JOIN y USING (z)</code>
<code>full_join(x, y, by = "z")</code>	<code>SELECT * FROM x FULL OUTER JOIN y USING (z)</code>

Note that "INNER" and "OUTER" are optional, and often omitted.

PostgreSQL



Filter Join

- Works on obs not on variables
- `semi_join()` return all rows from x with a match in y
- `anti_join()` return all rows from x without a match in y

Filter Join (vs Filter)

- Get top 10 destinations
- `top_dest ← flights %>%
 count(dest, sort = TRUE) %>%
 head(10)`
- `dest` columns is key

```
top_dest <- flights %>%  
  count(dest, sort = TRUE) %>%  
  head(10)  
top_dest  
#> # A tibble: 10 x 2  
#>   dest      n  
#>   <chr> <int>  
#> 1 ORD    17283  
#> 2 ATL    17215  
#> 3 LAX    16174  
#> 4 BOS    15508  
#> 5 MCO    14082  
#> 6 CLT    14064  
#> # ... with 4 more rows
```


Filter Join (vs Filter)

- Two ways:
- `flights %>%
 filter(dest %in% top_dest$dest)`
- `flights %>%
 semi_join(top_dest)`



Strings

- Cover basics
- regexps (regular expressions) are powerful
- Tips, gotchas
- Assembling labels
- Things that update/results

Strings

- "This is a string" vs “This is a string”
- Generally use ""
- `string1 ← "This is a string"`
- `string2 ← 'If I want to include a "quote" inside a string, I use single quotes'`

```
> string1
[1] "This is a string"
> string2
[1] "If I want to include a \"quote\" inside
a string, I use single quotes"
```

Special

- \ is special
- 'escape' some characters like \' and \"
- \n (newline) and \t (tab) useful

Single quotes need to be escaped by backslash in single-quoted strings, and double quotes in double-quoted strings.

<code>'\n'</code>	newline
<code>'\r'</code>	carriage return
<code>'\t'</code>	tab
<code>'\b'</code>	backspace
<code>'\a'</code>	alert (bell)
<code>'\f'</code>	form feed
<code>'\v'</code>	vertical tab
<code>'\\'</code>	backslash <code>'\'</code>
<code>'\''</code>	ASCII apostrophe <code>''</code>
<code>'\"'</code>	ASCII quotation mark <code>"</code>
<code>'`'</code>	ASCII grave accent (backtick) <code>`'</code>
<code>'\nnn'</code>	character with given octal code (1, 2 or 3 digits)
<code>'\xnn'</code>	character with given hex code (1 or 2 hex digits)
<code>'\unnnn'</code>	Unicode character with given code (1-4 hex digits)
<code>'\Unnnnnnnn'</code>	Unicode character with given code (1-8 hex digits)

?Quotes

Stringr functions

- Most begin with `str_`
- (Many base R string functions are fragile)
- `str_c("x", "y", "z")`
`c("x", "y", "z")`



Stringr functions

- `x ← c("Apple", "Banana", "Pear")`
- `str_sub(x, 1, 3)`
- `str_sub(x, -3, -1)`
- Similar to `left()` and `right()` in Excel?

Stringr functions

- `x ← c("Apple", "Banana", "Pear")`
- `str_to_lower(x)`
- `str_to_sentence(x)`
- `str_to_title(x)`
- `str_to_upper(x)`

Stringr locales

- `str_to_upper(c("i", "ı"))`
- `str_to_upper(c("i", "ı"), locale = "tr")`

```
# Turkish has two i's: with and without a dot, and it
# has a different rule for capitalising them:
str_to_upper(c("i", "ı"))
#> [1] "I" "I"
str_to_upper(c("i", "ı"), locale = "tr")
#> [1] "İ" "I"
```

Unicode U+0131 is ı (Latin small letter dotless i)

Stringr locales

- `y ← c("apple", "eggplant", "banana")`
- `str_sort(y, locale = "en")`
- `str_sort(y, locale = "haw")`

```
str_sort(x, locale = "en") # English  
#> [1] "apple"      "banana"     "eggplant"
```

```
str_sort(x, locale = "haw") # Hawaiian  
#> [1] "apple"      "eggplant"   "banana"
```

Strings

- Frustrating but powerful
- Good strings make good factors
- Excellent resource:
<https://r4ds.hadley.nz/strings.html>

