

Data Manipulation with the Tidyverse

December 5, 2019 (9AM-12PM)

Galter Health Sciences Library

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https://github.com/katieselevans/nuit_tidyverse

Workshop Resources

The screenshot shows a GitHub repository page for 'katieselevans/nuit_tidyverse'. The repository is described as a 'Tidyverse workshop for Northwestern Data Science and Programming Workshops Summer 2019'. It contains 19 commits, 1 branch, 0 packages, 0 releases, and 1 contributor. The repository includes files like 'workshop update 20191204', 'initial update - dplyr', 'workshop update 20191204', 'update readme', 'workshop update 20191204', and 'workshop update 20191204'. A large green arrow points to the 'workshop update 20191204' file. The page also features a section titled 'Data Manipulation with the Tidyverse' with a sub-section 'What is the Tidyverse?' and a bulleted list of its characteristics.

katieselevans / nuit_tidyverse

Tidyverse workshop for Northwestern Data Science and Programming Workshops Summer 2019

19 commits 1 branch 0 packages 0 releases 1 contributor

Branch: master New pull request Find file Clone or download

katieselevans update readme

Latest commit f8ae0b7 1 minute ago

July2019 workshop update 20191204 3 minutes ago

handouts initial update - dplyr 5 months ago

scripts workshop update 20191204 3 minutes ago

README.md update readme 1 minute ago

slides.key workshop update 20191204 3 minutes ago

slides.pdf workshop update 20191204 3 minutes ago

README.md

Data Manipulation with the Tidyverse

Tidyverse workshop for Northwestern Data Science and Programming Workshops Fall 2019

Instructor: Katie Evans

What is the Tidyverse?

- Collection of packages for data manipulation, exploration, and visualization that share a common syntax
- Intended to make data scientists more productive by guiding them through workflows
- Allows for connections between tools

https://github.com/katieselevans/nuit_tidyverse

What is the Tidyverse?

- Collection of packages for data manipulation, exploration, and visualization that share a common syntax
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Messy vs. clean data

“Happy families are all alike; every unhappy family is unhappy in its own way.” — Leo Tolstoy

“Tidy datasets are all alike, but every messy dataset is messy in its own way.” — Hadley Wickham

Messy vs. clean data

The diagram illustrates a data table with various annotations:

- color:** An arrow points to the first row, which has a light orange background for the header cells.
- merged cells:** An arrow points to the header row, specifically to the "Replicate1", "Replicate2", "Replicate3", and "Replicate4" columns which are merged.
- multiple column titles:** An arrow points to the second row, where each column contains three different titles stacked vertically.

	Replicate1			Replicate2			Replicate3			Replicate4		
PLATE1	day0	day2	day2/day0	day0	day2	day2/day0	day0	day2	day2/day0	day0	day2	day2/day0
BRC20067	229	2	0.873362445414	138	0	0	234	0	0	136	0	0
DL238	285	183	64.21052631578	334	161	48.203592814371	179	71	39.664804469273	224	110	49.1071428571429
A3	166	0	0	104	0	0	231	0	0	251	0	0
A6_R1	57	0	0	62	0	0	60	0	0	75	0	0
A6_R2	150	0	0	256	6	2.34375	265	4	1.5094339622641	236	0	0
B2	187	2	1.069518716577	165	1	0.606060606060606	183	0	0	171	4	2.33918128654971
B3	179	12	6.703910614525	202	26	12.871287128712	251	22	8.7649402390438	243	26	10.6995884773663
B6	128	15	11.71875	113	9	7.9646017699115	220	10	4.545454545454545	214	14	6.54205607476636
B8	268	0	0	155	0	0	164	1	0.6097560975609	175	0	0
B9	93	2	2.150537634408	118	2	1.6949152542372	132	0	0	111	2	1.8018018018018
B10	188	2	1.063829787234	379	2	0.5277044854881	225	0	0			
C6	169	0	0	129	1	0.7751937984496	130	0	0	115	1	0.869565217391304

Q: Clean or messy?

Messy vs. clean data

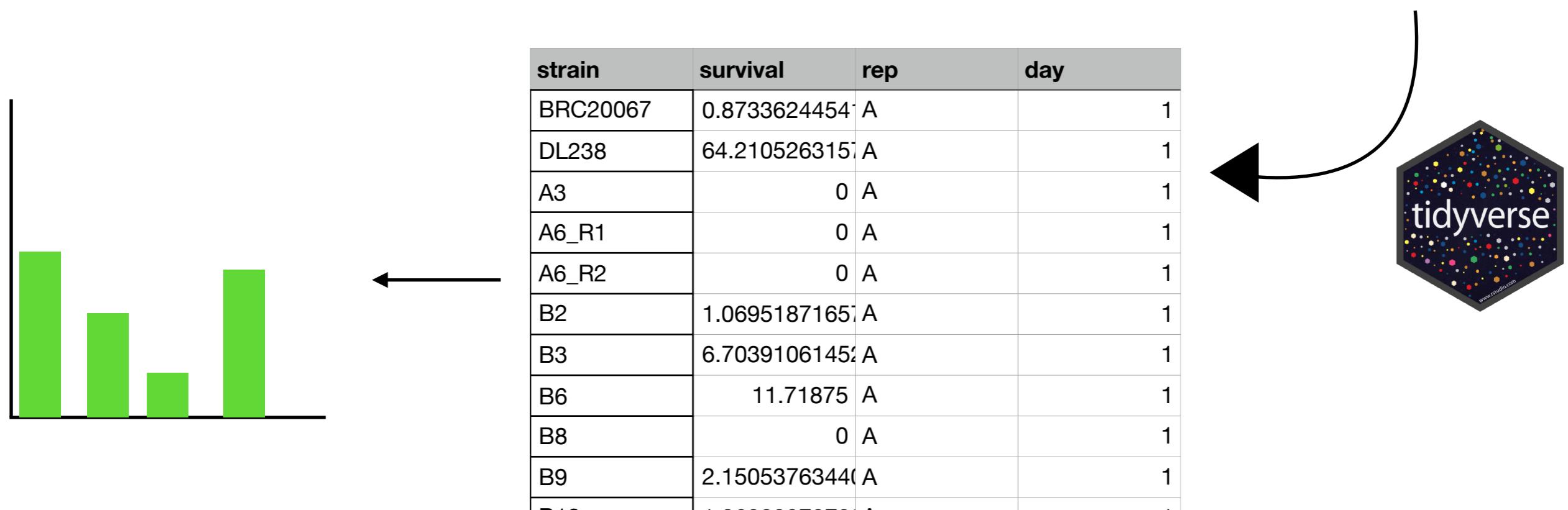
strain	survival	rep	day
BR20067	0.873362445	A	1
DL238	64.2105263	B	1
A3	0	A	1
A6_R1	0	A	1
A6_R2	0	A	1
B2	1.069518716	A	1
B3	6.703910614	A	1
B6	11.71875	A	1
B8	0	A	1
B9	2.150537634	A	1
B10	1.063829787	A	1
C6	0	A	1
BR20067	0	B	1
DL238	48.203592814	B	1
A3	0	B	1
A6_R1	0	B	1
A6_R2	2.34375	B	1
B2	0.606060606	B	1
B3	12.871287123	B	1
B6	7.9646017699	B	1
B8	0	B	1

Rules for tidy data

- Each **variable** must have its own **column**
- Each **observation** must have its own **row**
- Each **value** must have its own **cell**

Messy vs. clean data

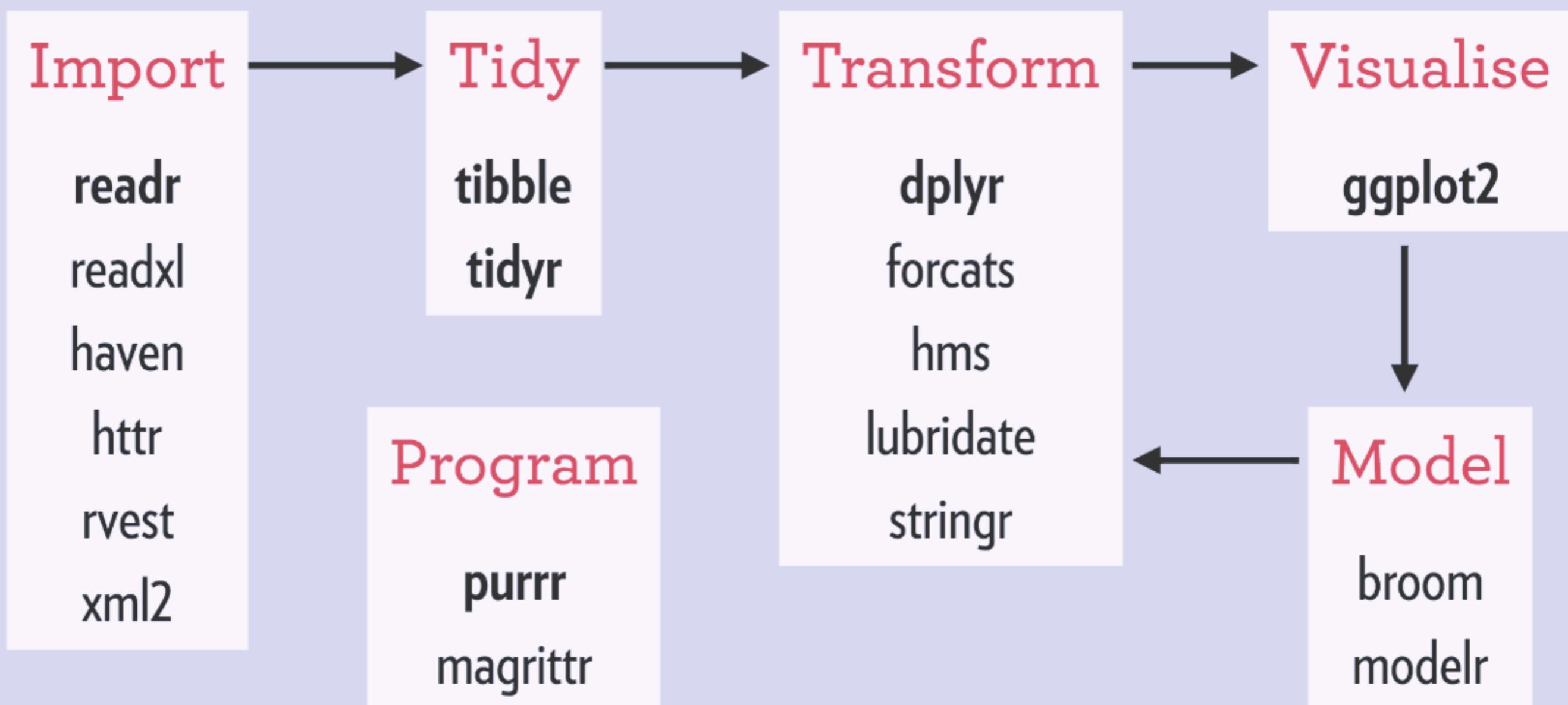
PLATE1	Replicate1			Replicate2			Replicate3			Replicate4		
	day0	day2	day2/day0	day0	day2	day2/day0	day0	day2	day2/day0	day0	day2	day2/day0
BRC20067	229	2	0.873362445414	138	0	0	234	0	0	136	0	0
DL238	285	183	64.21052631578	334	161	48.203592814371	179	71	39.664804469273	224	110	49.1071428571429
A3	166	0	0	104	0	0	231	0	0	251	0	0
A6_R1	57	0	0	62	0	0	60	0	0	75	0	0
A6_R2	150	0	0	256	6	2.34375	265	4	1.5094339622641	236	0	0
B2	187	2	1.069518716577	165	1	0.6060606060606	183	0	0	171	4	2.33918128654971
B3	179	12	6.703910614525	202	26	12.871287128712	251	22	8.7649402390438	243	26	10.6995884773663
B6	128	15	11.71875	113	9	7.9646017699115	220	10	4.5454545454545	214	14	6.54205607476636
B8	268	0	0	155	0	0	164	1	0.6097560975609	175	0	0
B9	93	2	2.150537634408	118	2	1.6949152542372	132	0	0	111	2	1.8018018018018
B10	188	2	1.063829787234	379	2	0.52770448548811	225	0	0			
C6	169	0	0	129	1	0.7751937984496	130	0	0	115	1	0.869565217391304



Tidyverse resources

- <https://www.tidyverse.org>
- <https://www.rstudio.com/resources/cheatsheets>
- <https://cran.r-project.org/web/packages/dplyr/vignettes/dplyr.html>
- <https://cran.r-project.org/web/packages/tidyr/vignettes/tidy-data.html>
- <https://cran.r-project.org/web/packages/readr/vignettes/readr.html>

Packages in Tidyverse



Thinking like a computer

1. Figure out what you want to do
2. Describe those tasks words
3. Describe those tasks in code

Starwars dataset



library(tidyverse)
data(starwars)
View(starwars)

variables

	name	height	mass	hair_color	skin_color	eye_color	birth_year	gender	homeworld	species	films	vehicles	starships
1	Luke Skywalker	172	77.0	blond	fair	blue	19.0	male	Tatooine	Human	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	c("Snowspeeder", "Imperial Speeder Bike")	c("X-wing", "Imperial shuttle")
	C-3PO	167	75.0	NA	gold	yellow	112.0	NA	Tatooine	Droid	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
	R2-D2	96	32.0	NA	white, blue	red	33.0	NA	Naboo	Droid	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
	Darth Vader	202	136.0	none	white	yellow	41.9	male	Tatooine	Human	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	character(0)	TIE Advanced x1
	Leia Organa	150	49.0	brown	light	brown	19.0	female	Alderaan	Human	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	Imperial Speeder Bike	character(0)
	Owen Lars	178	120.0	brown, grey	light	blue	52.0	male	Tatooine	Human	c("Attack of the Clones", "Revenge of the Sith", "A New...	character(0)	character(0)
	Beru Whitesun Lars	165	75.0	brown	light	blue	47.0	female	Tatooine	Human	c("Attack of the Clones", "Revenge of the Sith", "A New...	character(0)	character(0)
	R5-D4	97	32.0	NA	white, red	red	NA	NA	Tatooine	Droid	A New Hope	character(0)	character(0)
	Biggs Darklighter	183	84.0	black	light	brown	24.0	male	Tatooine	Human	A New Hope	character(0)	X-wing
10	Obi-Wan Kenobi	182	77.0	auburn, white	fair	blue-gray	57.0	male	Stewjon	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	Tribubble bongo	c("Jedi starfighter", "Trade Federation cruiser", "Naboo...
11	Anakin Skywalker	188	84.0	blond	fair	blue	41.9	male	Tatooine	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	c("Zephyr-G swoop bike", "XJ-6 airspeeder")	c("Trade Federation cruiser", "Jedi Interceptor", "Naboo...
12	Wilhuff Tarkin	180	NA	auburn, grey	fair	blue	64.0	male	Eriadu	Human	c("Revenge of the Sith", "A New Hope")	character(0)	character(0)
13	Chewbacca	228	112.0	brown	unknown	blue	200.0	male	Kashyyyk	Wookiee	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	AT-ST	c("Millennium Falcon", "Imperial shuttle")
14	Han Solo	180	80.0	brown	fair	brown	29.0	male	Corellia	Human	c("Return of the Jedi", "The Empire Strikes Back", "A N...	character(0)	c("Millennium Falcon", "Imperial shuttle")
15	Greedo	173	74.0	NA	green	black	44.0	male	Rodia	Rodian	A New Hope	character(0)	character(0)
16	Jabba Desilijic Tiure	175	1358.0	NA	green-tan, brown	orange	600.0	hermaphrodite	Nal Hutta	Hutt	c("The Phantom Menace", "Return of the Jedi", "A New ...	character(0)	character(0)
17	Wedge Antilles	170	77.0	brown	fair	hazel	21.0	male	Corellia	Human	c("Return of the Jedi", "The Empire Strikes Back", "A N...	Snowspeeder	X-wing
18	Jek Tono Porkins	180	110.0	brown	fair	blue	NA	male	Bestine IV	Human	A New Hope	character(0)	X-wing
19	Yoda	66	17.0	white	green	brown	896.0	male	NA	Yoda's species	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
20	Palpatine	170	75.0	grey	pale	yellow	82.0	male	Naboo	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
21	Boba Fett	183	78.2	black	fair	brown	31.5	male	Kamino	Human	c("Attack of the Clones", "Return of the Jedi", "The Em...	character(0)	Slave 1
22	IG-88	200	140.0	none	metal	red	15.0	none	NA	Droid	The Empire Strikes Back	character(0)	character(0)
23	Bossk	190	113.0	none	green	red	53.0	male	Trandosha	Trandoshan	The Empire Strikes Back	character(0)	character(0)
24	Lando Calrissian	177	79.0	black	dark	brown	31.0	male	Socorro	Human	c("Return of the Jedi", "The Empire Strikes Back")	character(0)	Millennium Falcon

observations

values

Introduction: dplyr

- Collection of functions as **verbs** to easily describe what you want to do with your data

Functions:

- `filter()` to keep rows based on values
- `select()` to keep columns based on names
- `mutate()` to add new (or change existing) columns
- `group_by()` to group rows by columns
- `summarize()` to condense multiple columns
- `arrange()` to reorder the rows
- `rename()` to give columns new names
- `xxx_join()` to combine data frames
- `bind_rows()` or `bind_cols()` to combine dataframes
- `pull()` to return a column as a vector



Introduction: dplyr

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dplyr::filter()

`dplyr::filter()` to keep rows based on values

dplyr::filter()

dplyr::filter(dataframe, condition(s))

starwars

only humans

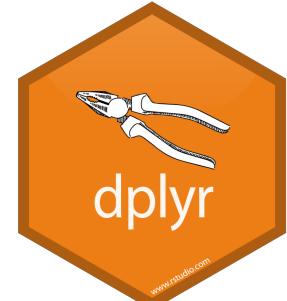
1. Figure out what you want to do

2. Describe your goal in words

Filter the starwars dataframe to only include humans

3. Describe your goal in code

dplyr::filter(starwars, ?)



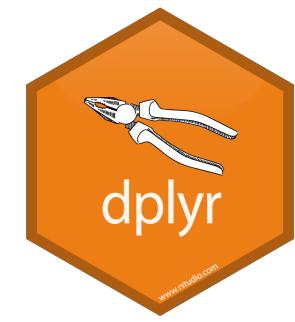
dplyr::filter() to keep rows based on values

dplyr::filter()

	name	height	mass	hair_color	skin_color	eye_color	birth_year	gender	homeworld	species	films	vehicles	starships
1	Luke Skywalker	172	77.0	blond	fair	blue	19.0	male	Tatooine	Human	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	c("Snowspeeder", "Imperial Speeder Bike")	c("X-wing", "Imperial shuttle")
2	C-3PO	167	75.0	NA	gold	yellow	112.0	NA	Tatooine	Droid	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
3	R2-D2	96	32.0	NA	white, blue	red	33.0	NA	Naboo	Droid	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
4	Darth Vader	202	136.0	none	white	yellow	41.9	male	Tatooine	Human	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	character(0)	TIE Advanced x1
5	Leia Organa	150	49.0	brown	light	brown	19.0	female	Alderaan	Human	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	Imperial Speeder Bike	character(0)
6	Owen Lars	178	120.0	brown, grey	light	blue	52.0	male	Tatooine	Human	c("Attack of the Clones", "Revenge of the Sith", "A New...	character(0)	character(0)
7	Beru Whitesun Lars	165	75.0	brown	light	blue	47.0	female	Tatooine	Human	c("Attack of the Clones", "Revenge of the Sith", "A New...	character(0)	character(0)
8	R5-D4	97	32.0	NA	white, red	red	NA	NA	Tatooine	Droid	A New Hope	character(0)	character(0)
9	Biggs Darklighter	183	84.0	black	light	brown	24.0	male	Tatooine	Human	A New Hope	character(0)	X-wing
10	Obi-Wan Kenobi	182	77.0	auburn, white	fair	blue-gray	57.0	male	Stewjon	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	Tribubble bongo	c("Jedi starfighter", "Trade Federation cruiser", "Naboo...
11	Anakin Skywalker	188	84.0	blond	fair	blue	41.9	male	Tatooine	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	c("Zephyr-G swoop bike", "XJ-6 airspeeder")	c("Trade Federation cruiser", "Jedi Interceptor", "Naboo...
12	Wilhuff Tarkin	180	NA	auburn, grey	fair	blue	64.0	male	Eriadu	Human	c("Revenge of the Sith", "A New Hope")	character(0)	character(0)
13	Chewbacca	228	112.0	brown	unknown	blue	200.0	male	Kashyyyk	Wookiee	c("Revenge of the Sith", "Return of the Jedi", "The Emp...	AT-ST	c("Millennium Falcon", "Imperial shuttle")
14	Han Solo	180	80.0	brown	fair	brown	29.0	male	Corellia	Human	c("Return of the Jedi", "The Empire Strikes Back", "A N...	character(0)	c("Millennium Falcon", "Imperial shuttle")
15	Greedo	173	74.0	NA	green	black	44.0	male	Rodia	Rodian	A New Hope	character(0)	character(0)
16	Jabba Desilijic Tiure	175	1358.0	NA	green-tan, brown	orange	600.0	hermaphrodite	Nal Hutta	Hutt	c("The Phantom Menace", "Return of the Jedi", "A New ...	character(0)	character(0)
17	Wedge Antilles	170	77.0	brown	fair	hazel	21.0	male	Corellia	Human	c("Return of the Jedi", "The Empire Strikes Back", "A N...	Snowspeeder	X-wing
18	Jek Tono Porkins	180	110.0	brown	fair	blue	NA	male	Bestine IV	Human	A New Hope	character(0)	X-wing
19	Yoda	66	17.0	white	green	brown	896.0	male	NA	Yoda's species	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
20	Palpatine	170	75.0	grey	pale	yellow	82.0	male	Naboo	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
21	Boba Fett	183	78.2	black	fair	brown	31.5	male	Kamino	Human	c("Attack of the Clones", "Return of the Jedi", "The Em...	character(0)	Slave 1
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23	Bossk	190	113.0	none	green	red	53.0	male	Trandosha	Trandoshan	The Empire Strikes Back	character(0)	character(0)
24	Lando Calrissian	177	79.0	black	dark	brown	31.0	male	Socorro	Human	c("Return of the Jedi", "The Empire Strikes Back")	character(0)	Millennium Falcon

species == "Human"

dplyr::filter() to keep rows based on values



dplyr::filter()

dplyr::filter(dataframe, condition(s))

starwars

only humans

1. Figure out what you want to do

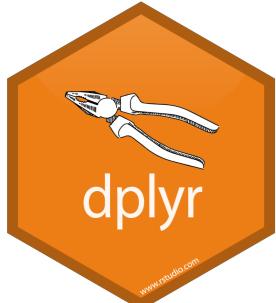
2. Describe your goal in words

Filter the starwars dataframe to only include humans

3. Describe your goal in code

```
dplyr::filter(starwars, species == "Human")
```

dplyr::filter() to keep rows based on values

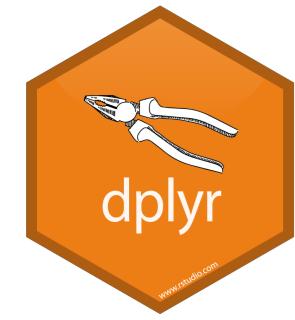


dplyr::filter()

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7	Obi-Wan Kenobi	182	77.0	auburn, white	fair	blue-gray	57.0	male	Stewjon	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	Tribubble bongo	c("Jedi starfighter", "Trade Federation cruiser", "Naboo...
8	Anakin Skywalker	188	84.0	blond	fair	blue	41.9	male	Tatooine	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	c("Zephyr-G swoop bike", "XJ-6 airspeeder")	c("Trade Federation cruiser", "Jedi Interceptor", "Naboo...
9	Wilhuff Tarkin	180	NA	auburn, grey	fair	blue	64.0	male	Eriadu	Human	c("Revenge of the Sith", "A New Hope")	character(0)	character(0)
10	Han Solo	180	80.0	brown	fair	brown	29.0	male	Corellia	Human	c("Return of the Jedi", "The Empire Strikes Back", "A N...	character(0)	c("Millennium Falcon", "Imperial shuttle")
11	Wedge Antilles	170	77.0	brown	fair	hazel	21.0	male	Corellia	Human	c("Return of the Jedi", "The Empire Strikes Back", "A N...	Snowspeeder	X-wing
12	Jek Tono Porkins	180	110.0	brown	fair	blue	NA	male	Bestine IV	Human	A New Hope	character(0)	X-wing
13	Palpatine	170	75.0	grey	pale	yellow	82.0	male	Naboo	Human	c("Attack of the Clones", "The Phantom Menace", "Rev...	character(0)	character(0)
14	Boba Fett	183	78.2	black	fair	brown	31.5	male	Kamino	Human	c("Attack of the Clones", "Return of the Jedi", "The Em...	character(0)	Slave 1
15	Lando Calrissian	177	79.0	black	dark	brown	31.0	male	Socorro	Human	c("Return of the Jedi", "The Empire Strikes Back")	character(0)	Millennium Falcon
16	Lobot	175	79.0	none	light	blue	37.0	male	Bespin	Human	The Empire Strikes Back	character(0)	character(0)
17	Mon Mothma	150	NA	auburn	fair	blue	48.0	female	Chandrilia	Human	Return of the Jedi	character(0)	character(0)
18	Arvel Crynyd	NA	NA	brown	fair	brown	NA	male	NA	Human	Return of the Jedi	character(0)	A-wing
19	Qui-Gon Jinn	193	89.0	brown	fair	blue	92.0	male	NA	Human	The Phantom Menace	Tribubble bongo	character(0)
20	Finis Valorum	170	NA	blond	fair	blue	91.0	male	Coruscant	Human	The Phantom Menace	character(0)	character(0)
21	Shmi Skywalker	163	NA	black	fair	brown	72.0	female	Tatooine	Human	c("Attack of the Clones", "The Phantom Menace")	character(0)	character(0)

`dplyr::filter(starwars, species == "Human")`

dplyr::filter() to keep rows based on values



dplyr::filter()

```
dplyr::filter(dataframe, condition(s))
```



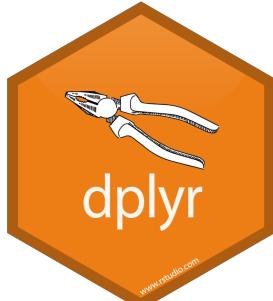
You can also filter based on multiple conditions

Filter the starwars dataframe to include only male humans.

```
dplyr::filter(starwars, species == "Human", gender == "male")
```

Filter the starwars dataframe to include humans and droids.

```
dplyr::filter(starwars, species %in% c("Human", "Droid"))
```



dplyr::filter() to keep rows based on values

dplyr::filter()

```
dplyr::filter(dataframe, condition(s))
```

Filter starwars to include only people with height less than 100.

```
dplyr::filter(starwars, height < 100)
```

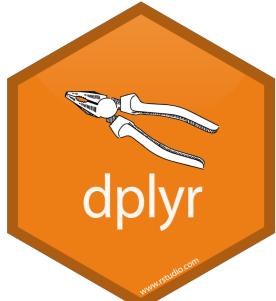
Keep all non-humans

```
dplyr::filter(starwars, species != "Human")
```

Remove characters with no known species

```
dplyr::filter(starwars, !is.na(species))
```

dplyr::filter() to keep rows based on values





pipe (%>%)

takes output of left side and makes it input of right side

Piping in Tidyverse

Filter the starwars dataframe to include only male humans.

Without pipes

```
dplyr::filter(starwars, species == "Human", gender == "male")
```

With pipes

```
starwars %>%  
  dplyr::filter(species == "Human") %>%  
  dplyr::filter(gender == "male")
```

1. start with the starwars dataframe

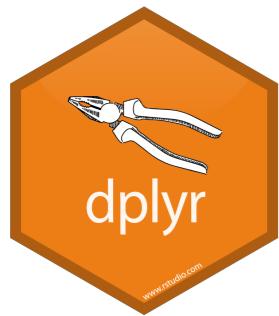
2. filter to keep only humans

3. filter to keep only males

**Can be useful to combine several Tidyverse
“verbs” to one block of code**

takes output of left side and makes it input of right side





dplyr::select()

`dplyr::select()` to keep columns based on names

dplyr::select()

```
dplyr::select(dataframe, columns_to_keep)
```

starwars

name, species, films

Select only name, species, and films variables from the starwars dataframe

```
dplyr::select(starwars, name, species, films)
```

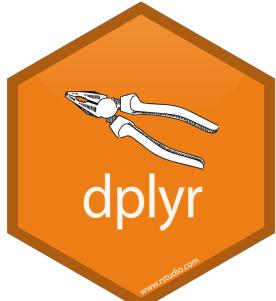


Deselect a column with -column_name

Select all columns except the gender

```
dplyr::select(starwars, -gender)
```

dplyr::select() to keep columns based on names



dplyr::select()

```
dplyr::select(dataframe, columns_to_keep)
```



Select a range of columns with column1:column2

Select columns name, height, mass, hair color, and skin color

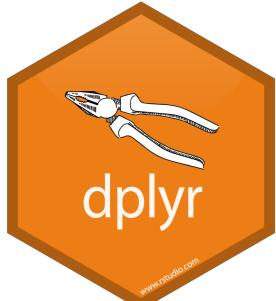
```
dplyr::select(starwars, name:skin_color)
```

Select all columns except hair color, skin color, and eye color

```
dplyr::select(starwars, -hair_color, -skin_color, -eye_color)
```

```
dplyr::select(starwars, -(hair_color:eye_color))
```

dplyr::select() to keep columns based on names



dplyr::select()

```
dplyr::select(dataframe, columns_to_keep)
```



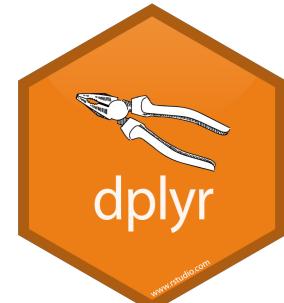
Reorder columns with select too!

Select columns name, height, mass, hair color, and skin color

```
dplyr::select(starwars, name:skin_color)
```

Select columns name, mass, skin color, hair color, and height (in order)

```
dplyr::select(starwars, name, mass, skin_color, hair_color, height)
```



dplyr::select() to keep columns based on names

dplyr::select()

```
dplyr::select(dataframe, new_name = old_name)
```



You can also use `select()` to rename columns

Rename the “name” column to “character” and the “mass” column to “weight” using `select()`

```
renamed <- starwars %>%  
  dplyr::select(character = name, weight = mass)
```

character	weight
Luke Skywalker	77.0
C-3PO	75.0
R2-D2	32.0
Darth Vader	136.0
Leia Organa	49.0
Owen Lars	120.0

dplyr::select() to keep columns based on names



Combine filter and select

```
dplyr::filter (dataframe, condition(s))
```

```
dplyr::select (dataframe, columns_to_keep)
```

Challenge OYO:

[**Keep:** height greater than 100 &
Keep: humans &
Remove: brown hair color &
Remove: vehicles &
Keep: name, homeworld, height, species, hair color]



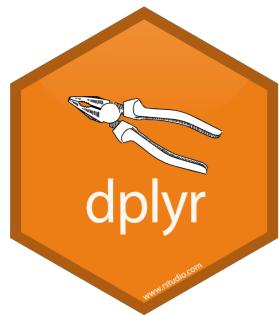
dplyr::filter () to keep rows based on values
dplyr::select () to keep columns based on names



Combine filter and select

	name	homeworld	height	species	hair_color
1	Luke Skywalker	Tatooine	172	Human	blond
2	Darth Vader	Tatooine	202	Human	none
3	Owen Lars	Tatooine	178	Human	brown, grey
4	Biggs Darklighter	Tatooine	183	Human	black
5	Obi-Wan Kenobi	Stewjon	182	Human	auburn, white
6	Anakin Skywalker	Tatooine	188	Human	blond
7	Wilhuff Tarkin	Eriadu	180	Human	auburn, grey
8	Palpatine	Naboo	170	Human	grey
9	Boba Fett	Kamino	183	Human	black
10	Lando Calrissian	Socorro	177	Human	black
11	Lobot	Bespin	175	Human	none
12	Mon Mothma	Chandrila	150	Human	auburn
13	Finis Valorum	Coruscant	170	Human	blond
14	Shmi Skywalker	Tatooine	163	Human	black
15	Mace Windu	Haruun Kal	188	Human	none
16	Gregar Typho	Naboo	185	Human	black
17	Dooku	Coruscant	102	Human	white

```
starwars %>%
  dplyr::filter(height > 100) %>%
  dplyr::filter(species == "Human") %>%
  dplyr::filter(hair_color != "brown") %>%
  dplyr::select(-vehicles) %>%
  dplyr::select(name, homeworld, height, species, hair_color)
```



dplyr::mutate()

`dplyr::mutate()` to add new (or change existing) columns

dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

1. Figure out what you want to do

calculate BMI of all starwars characters

2. Describe your goal in words

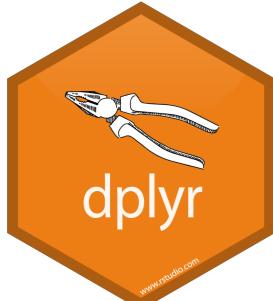
cm

$$\text{BMI} = \text{weight (kg)} / [\text{height (m)}]^2$$

	name	height	mass	hair_color	skin_color	eye_color
1	Luke Skywalker	172	77.0	blond	fair	blue
2	C-3PO	167	75.0	NA	gold	yellow
3	R2-D2	96	32.0	NA	white, blue	red
4	Darth Vader	202	136.0	none	white	yellow

?starwars

dplyr::mutate() to add new (or change existing) columns



dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

1. Figure out what you want to do

calculate BMI of all starwars characters

2. Describe your goal in words

$$\text{BMI} = \text{weight (kg)} / [\text{height (m)}]^2$$

First: convert height in cm to height in meters

Second: calculate BMI as new column



dplyr::mutate() to add new (or change existing) columns

dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

starwars

height_m

height / 100

2. Describe your goal in words

$$\text{BMI} = \text{weight} \text{ (kg)} / [\text{height} \text{ (m)}]^2$$

First: convert height in cm to height in meters

Second: calculate BMI as new column

3. Describe your goal in code

```
new_starwars <- dplyr::mutate(starwars, height_m = height / 100)
```



dplyr::mutate() to add new (or change existing) columns

dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

new_starwars

bmi

mass / height_m^2

2. Describe your goal in words

$$\text{BMI} = \text{weight} \text{ (kg)} / [\text{height} \text{ (m)}]^2$$

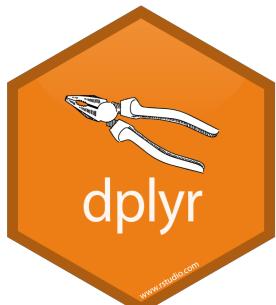
First: convert height in cm to height in meters

Second: calculate BMI as new column

3. Describe your goal in code

```
new_starwars <- starwars %>%  
  dplyr::mutate(height_m = height / 100) %>%  
dplyr::mutate(bmi = mass / height_m^2)
```

dplyr::mutate() to add new (or change existing) columns



dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

Select only name, height, mass, height_m, and bmi and view dataframe

```
new_starwars <- new_starwars %>%  
  dplyr::select(name, height, mass, height_m, bmi)
```

```
View(new_starwars)
```

name	height	mass	height_m	bmi
Luke Skywalker	172	77.0	1.72	26.02758
C-3PO	167	75.0	1.67	26.89232
R2-D2	96	32.0	0.96	34.72222
Darth Vader	202	136.0	2.02	33.33007
Leia Organa	150	49.0	1.50	21.77778
Owen Lars	178	120.0	1.78	37.87401
Beru Whitesun Lars	165	75.0	1.65	27.54821
R5-D4	97	32.0	0.97	34.00999
Biggs Darklighter	183	84.0	1.83	25.08286

dplyr::mutate() to add new (or change existing) columns



dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

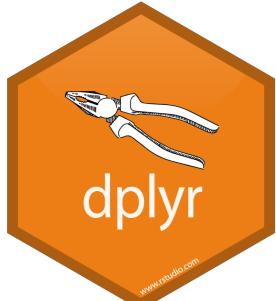
★ We can change existing columns if we use the same name

```
new_starwars <- starwars %>%  
  dplyr::mutate(height = height / 100) %>%  
  dplyr::mutate(bmi = mass / height^2)
```

```
View(new_starwars)
```

name	height	mass	bmi
Luke Skywalker	1.72	77.0	26.02758
C-3PO	1.67	75.0	26.89232
R2-D2	0.96	32.0	34.72222
Darth Vader	2.02	136.0	33.33007
Leia Organa	1.50	49.0	21.77778
Owen Lars	1.78	120.0	37.87401

dplyr::mutate() to add new (or change existing) columns



dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

Make a new column to find the average height (in meters)

```
starwars %>%
```

```
  dplyr::m
```

```
  dplyr::m
```

```
?mean
```

Arithmetic Mean

Description

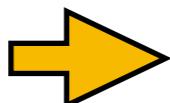
Generic function for the (trimmed) arithmetic mean.

Usage

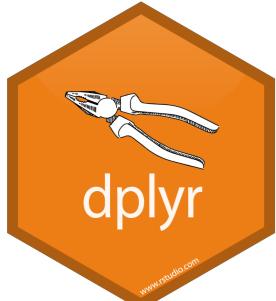
```
mean(x, ...)  
## Default S3 method:  
mean(x, trim = 0, na.rm = FALSE, ...)
```

Arguments

- x An R object. Currently there are methods for numeric/logical vectors and [date](#), [date-time](#) and [time interval](#) objects. Complex vectors are allowed for trim = 0, only.
- trim the fraction (0 to 0.5) of observations to be trimmed from each end of x before the mean is computed. Values of trim outside that range are taken as the nearest endpoint.
- na.rm a logical value indicating whether NA values should be stripped before the computation proceeds.
- ... further arguments passed to or from other methods.



dplyr::mutate() to add new (or change existing) columns



dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

Make a new column to find the average height (in meters)

```
starwars %>%
```

```
  dplyr::mutate(height = height / 100) %>%
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE))
```

name	height	mass	avg_height
Luke Skywalker	172	77.0	1.74358
C-3PO	167	75.0	1.74358
R2-D2	96	32.0	1.74358
Darth Vader	202	136.0	1.74358
Leia Organa	150	49.0	1.74358
Owen Lars	178	120.0	1.74358
Beru Whitesun Lars	165	75.0	1.74358
R5-D4	97	32.0	1.74358



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dplyr::mutate() to add new (or change existing) columns

dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

Standardize the heights of the starwars characters (height / avg_height)

```
starwars %>%  
  dplyr::mutate(height = height / 100) %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE)) %>%  
  dplyr::mutate(std_height = height / avg_height)
```

name	height	mass	avg_height	std_height
Luke Skywalker	1.72	77.0	1.74358	0.9864760
C-3PO	1.67	75.0	1.74358	0.9577993
R2-D2	0.96	32.0	1.74358	0.5505912
Darth Vader	2.02	136.0	1.74358	1.1585357
Leia Organa	1.50	49.0	1.74358	0.8602988
Owen Lars	1.78	120.0	1.74358	1.0208879
Beru Whitesun Lars	1.65	75.0	1.74358	0.9463287
R5-D4	0.97	32.0	1.74358	0.5563266
Biggs Darklighter	1.83	84.0	1.74358	1.0495645
Obi-Wan Kenobi	1.82	77.0	1.74358	1.0438292

dplyr::mutate() to add new (or change existing) columns



dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

Make a new column to see if each character is above or below the average height

hint: try using ifelse(condition, if_true_do_this, if_false_do_this)

```
test <- starwars %>%  
  dplyr::mutate(height = height / 100) %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE)) %>%  
  dplyr::mutate(std_height = height / avg_height) %>%  
  dplyr::select(name, height, mass, avg_height, std_height) %>%  
dplyr::mutate(relative_height =  
    ifelse(std_height > 1, "above", "below")) %>%  
dplyr::filter(relative_height == "below")
```

Bonus: make a new dataframe that only keeps characters with heights BELOW average



dplyr::mutate() to add new (or change existing) columns

dplyr::mutate()

```
dplyr::mutate(dataframe, new_column = expression)
```

Make a new column to see if each character is above or below the average height

hint: try using ifelse(condition, if_true_do_this, if_false_do_this)

```
test <- starwars %>%  
  dplyr::mutate(height = height / 100) %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE)) %>%  
  dplyr::mutate(std_height = height / avg_height) %>%  
  dplyr::select(name, height, mass, avg_height, std_height) %>%  
dplyr::mutate(relative_height =  
    ifelse(std_height > 1, "above", "below")) %>%  
dplyr::filter(std_height < 1)
```

Bonus: make a new dataframe that only keeps characters with heights BELOW average



dplyr::mutate() to add new (or change existing) columns

dplyr::mutate()

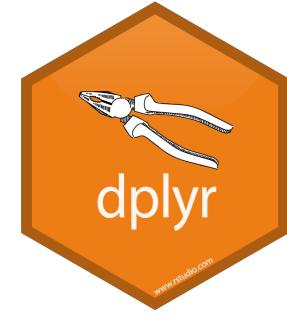
```
dplyr::mutate(dataframe, new_column = expression)
```

Make a new column to see if each character is above or below the average height

hint: try using ifelse(condition, if_true_do_this, if_false_do_this)

```
test <- starwars %>%  
  dplyr::mutate(height = height / 100) %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE)) %>%  
  dplyr::mutate(std_height = height / avg_height) %>%  
  dplyr::select(name, height, mass, avg_height, std_height) %>%  
dplyr::mutate(relative_height =  
    ifelse(std_height > 1, "above", "below")) %>%  
dplyr::filter(height < avg_height)
```

Bonus: make a new dataframe that only keeps characters with heights BELOW average



dplyr::mutate() to add new (or change existing) columns



dplyr::group_by()

`dplyr::group_by()` to group rows by columns

dplyr::group_by()

```
dplyr::group_by(dataframe, column_to_group_by)
```



- Doesn't change how the data looks, changes how the data interacts with other dplyr verbs

Group starwars dataframe by gender

```
grouped_starwars <- starwars %>%  
  dplyr::group_by(gender)
```

```
View(starwars)  
View(grouped_starwars)
```



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dplyr::group_by() to group rows by columns

dplyr::group_by()

dplyr::group_by(dataframe, column_to_group_by)

ungrouped

	name	height	mass	hair_color	skin_color	eye_color	birth_year	gender
1	Luke Skywalker	172	77.0	blond	fair	blue	19.0	male
2	C-3PO	167	75.0	NA	gold	yellow	112.0	NA
3	R2-D2	96	32.0	NA	white, blue	red	33.0	NA
4	Darth Vader	202	136.0	none	white	yellow	41.9	male
5	Leia Organa	150	49.0	brown	light	brown	19.0	female
6	Owen Lars	178	120.0	brown, grey	light	blue	52.0	male
7	Beru Whitesun Lars	165	75.0	brown	light	blue	47.0	female
8	R5-D4	97	32.0	NA	white, red	red	NA	NA
9	Biggs Darklighter	183	84.0	black	light	brown	24.0	male
10	Obi-Wan Kenobi	182	77.0	auburn, white	fair	blue-gray	57.0	male
11	Anakin Skywalker	188	84.0	blond	fair	blue	41.9	male
12	Wilhuff Tarkin	180	NA	auburn, grey	fair	blue	64.0	male
13	Chewbacca	228	112.0	brown	unknown	blue	200.0	male
14	Han Solo	180	80.0	brown	fair	brown	29.0	male
15	Greedo	173	74.0	NA	green	black	44.0	male
16	Jabba Desilijic Tiure	175	1358.0	NA	green-tan, brown	orange	600.0	hermaphrodite
17	Wedge Antilles	170	77.0	brown	fair	hazel	21.0	male
18	Jek Tono Porkins	180	110.0	brown	fair	blue	NA	male
19	Yoda	66	17.0	white	green	brown	896.0	male
20	Palpatine	170	75.0	grey	pale	yellow	82.0	male
21	Boba Fett	183	78.2	black	fair	brown	31.5	male
22	IG-88	200	140.0	none	metal	red	15.0	none
23	Bossk	190	113.0	none	green	red	53.0	male
24	Lando Calrissian	177	79.0	black	dark	brown	31.0	male

grouped by gender

	name	height	mass	hair_color	skin_color	eye_color	birth_year	gender
1	Luke Skywalker	172	77.0	blond	fair	blue	19.0	male
2	C-3PO	167	75.0	NA	gold	yellow	112.0	NA
3	R2-D2	96	32.0	NA	white, blue	red	33.0	NA
4	Darth Vader	202	136.0	none	white	yellow	41.9	male
5	Leia Organa	150	49.0	brown	light	brown	19.0	female
6	Owen Lars	178	120.0	brown, grey	light	blue	52.0	male
7	Beru Whitesun Lars	165	75.0	brown	light	blue	47.0	female
8	R5-D4	97	32.0	NA	white, red	red	NA	NA
9	Biggs Darklighter	183	84.0	black	light	brown	24.0	male
10	Obi-Wan Kenobi	182	77.0	auburn, white	fair	blue-gray	57.0	male
11	Anakin Skywalker	188	84.0	blond	fair	blue	41.9	male
12	Wilhuff Tarkin	180	NA	auburn, grey	fair	blue	64.0	male
13	Chewbacca	228	112.0	brown	unknown	blue	200.0	male
14	Han Solo	180	80.0	brown	fair	brown	29.0	male
15	Greedo	173	74.0	NA	green	black	44.0	male
16	Jabba Desilijic Tiure	175	1358.0	NA	green-tan, brown	orange	600.0	hermaphrodite
17	Wedge Antilles	170	77.0	brown	fair	hazel	21.0	male
18	Jek Tono Porkins	180	110.0	brown	fair	blue	NA	male
19	Yoda	66	17.0	white	green	brown	896.0	male
20	Palpatine	170	75.0	grey	pale	yellow	82.0	male
21	Boba Fett	183	78.2	black	fair	brown	31.5	male
22	IG-88	200	140.0	none	metal	red	15.0	none
23	Bossk	190	113.0	none	green	red	53.0	male
24	Lando Calrissian	177	79.0	black	dark	brown	31.0	male

dplyr::group_by() to group rows by columns



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dplyr::group_by()

```
dplyr::group_by(dataframe, column_to_group_by)
```



- Doesn't change how the data looks, changes how the data interacts with other dplyr verbs

Group starwars dataframe by gender

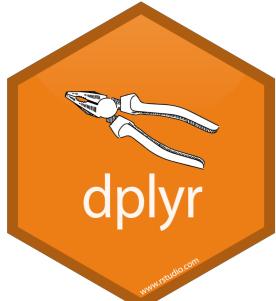
```
grouped_starwars <- starwars %>%  
  dplyr::group_by(gender)
```

Calculate average height **PER GENDER**

hint: group by gender FIRST

```
grouped_starwars <- starwars %>%  
  dplyr::group_by(gender) %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE))
```

dplyr::group_by() to group rows by columns



dplyr::group_by()

```
dplyr::group_by(dataframe, column_to_group_by)
```

Calculate average height **PER GENDER**

name	gender	height	avg_height
Luke Skywalker	male	1.72	1.792373
C-3PO	NA	1.67	1.200000
R2-D2	NA	0.96	1.200000
Darth Vader	male	2.02	1.792373
Leia Organa	female	1.50	1.654706
Owen Lars	male	1.78	1.792373
Beru Whitesun lars	female	1.65	1.654706
R5-D4	NA	0.97	1.200000
Biggs Darklighter	male	1.83	1.792373
Obi-Wan Kenobi	male	1.82	1.792373
Anakin Skywalker	male	1.88	1.792373
Wilhuff Tarkin	male	1.80	1.792373
Chewbacca	male	2.28	1.792373
Han Solo	male	1.80	1.792373

Calculate average height

name	gender	height	avg_height
Luke Skywalker	male	1.72	1.74358
C-3PO	NA	1.67	1.74358
R2-D2	NA	0.96	1.74358
Darth Vader	male	2.02	1.74358
Leia Organa	female	1.50	1.74358
Owen Lars	male	1.78	1.74358
Beru Whitesun lars	female	1.65	1.74358
R5-D4	NA	0.97	1.74358
Biggs Darklighter	male	1.83	1.74358
Obi-Wan Kenobi	male	1.82	1.74358
Anakin Skywalker	male	1.88	1.74358
Wilhuff Tarkin	male	1.80	1.74358
Chewbacca	male	2.28	1.74358
Han Solo	male	1.80	1.74358

dplyr::group_by() to group rows by columns



dplyr::group_by()

```
dplyr::group_by(dataframe, column_to_group_by)
```



dplyr::ungroup() removes all groups

Ungroup your grouped dataframe and re-calculate average height

```
ungrouped_starwars <- grouped_starwars %>%  
  dplyr::ungroup() %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE))
```



dplyr::group_by() to group rows by columns

dplyr::group_by()

```
dplyr::group_by(dataframe, column_to_group_by)
```



You can also group by multiple columns

Calculate the average height per gender AND eye color

```
grouped_starwars <- starwars %>%  
  dplyr::group_by(gender, eye_color) %>%  
  dplyr::mutate(avg_height = mean(height, na.rm = TRUE))
```



dplyr::group_by() to group rows by columns

Review: dplyr

Functions:

`dplyr::filter()` to keep rows based on values

`dplyr::select()` to keep columns based on names

`dplyr::mutate()` to add new (or change existing) columns

`dplyr::group_by()` to group rows by columns

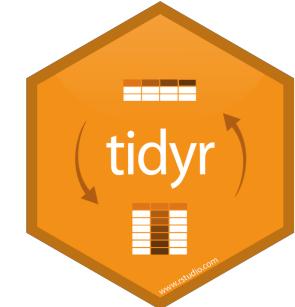


Introduction: **tidyr**

- Collection of functions as **verbs** to easily “tidy” your data

Functions:

- `gather()` to collapse multiple columns
- `spread()` to expand one column to multiple
- `unite()` to combine multiple columns into one
- `separate()` to split one column into two
- `separate_rows()` to split one cell into several rows
- `drop_na()` to remove rows with NA values

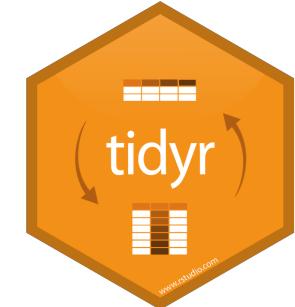


Introduction: **tidyr**

- Collection of functions as **verbs** to easily “tidy” your data

Functions:

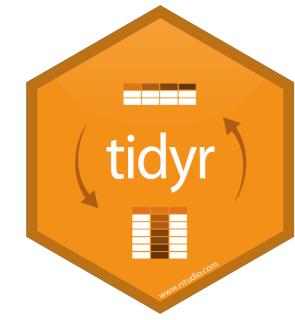
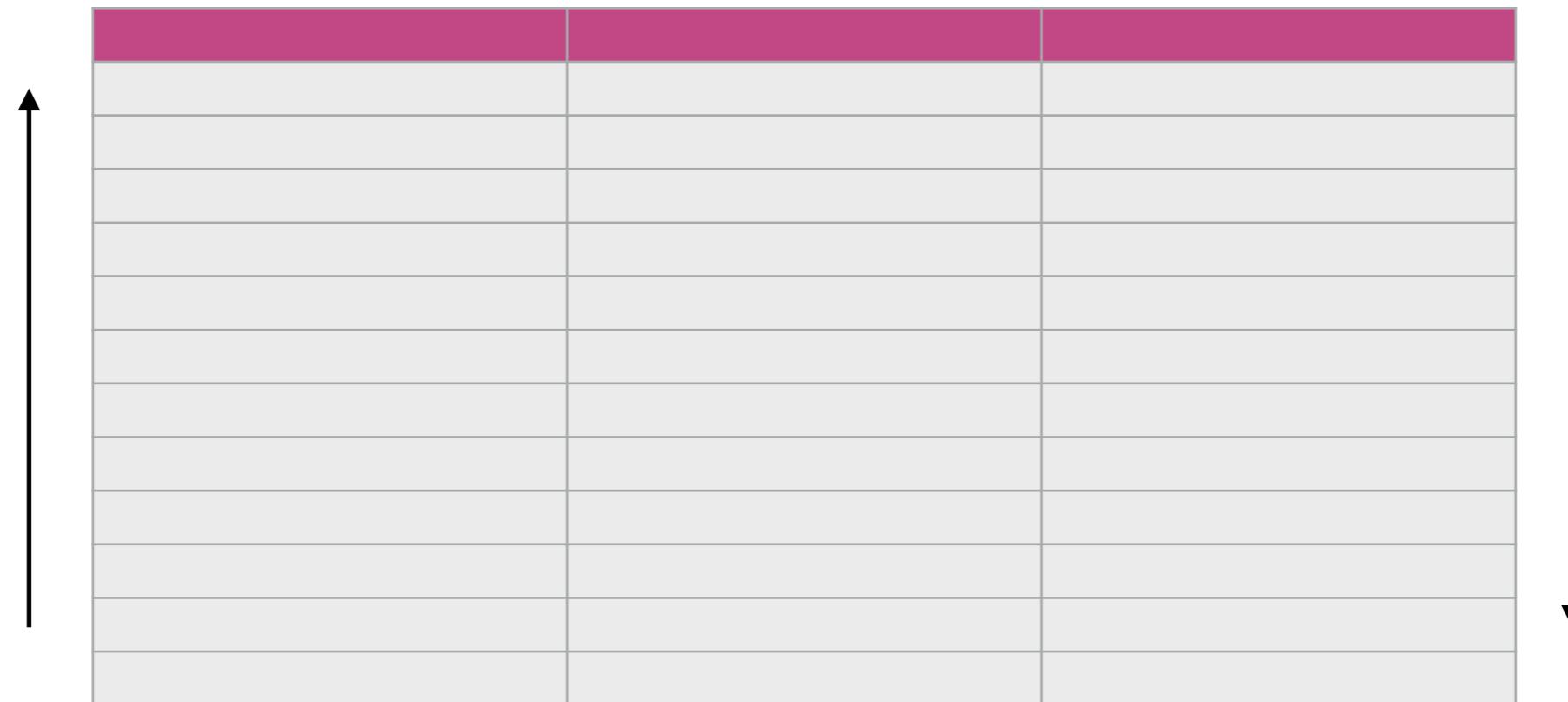
- **gather () to collapse multiple columns**
- **spread () to expand one column to multiple**
- **unite () to combine multiple columns into one**
- **separate () to split one column into two**
- **separate_rows () to split one cell into several rows**
- **drop_na () to remove rows with NA values**



Wide vs. Long data



Long



Wide vs. Long data

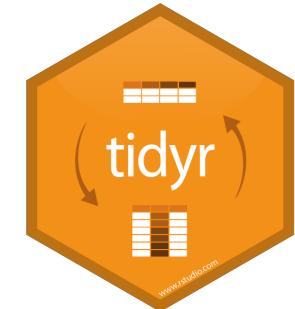
Wide

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

Long

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75

Which is better?



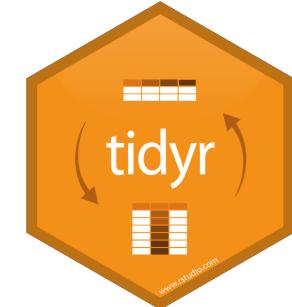
Wide vs. Long data

Wide

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
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Long

name	midterm	score
samantha	midterm_1	72
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kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75



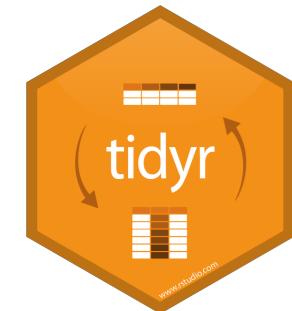
Q1: Find the average of each student's midterms

Wide vs. Long data

← Wide →

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

```
df %>%
  dplyr::mutate(average = mean(midterm_1, midterm_2, midterm_3))
```



Q1: Find the average of each student's midterms

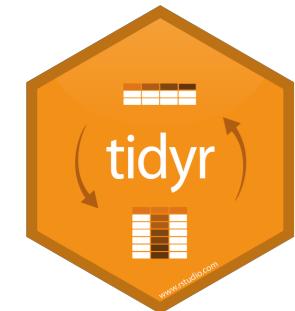
Wide vs. Long data

← **Wide** →

name	midterm_1	midterm_2	midterm_3	average
samantha	72	80	81	77.6
taylor	91	92	90	91
kelsey	83	74	90	82.3
ramona	65	71	75	70.3

```
df %>%
  dplyr::mutate(average = mean(midterm_1, midterm_2, midterm_3))
```

Imagine you have 100 midterms to average... this would be difficult to script



Q1: Find the average of each student's midterms

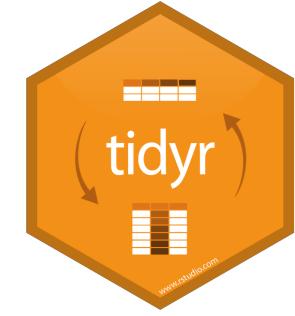
Wide vs. Long data

```
df %>%
  dplyr::group_by(name) %>%
  dplyr::mutate(average = mean(score))
```

Long

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75

Q1: Find the average of each student's midterms



Wide vs. Long data

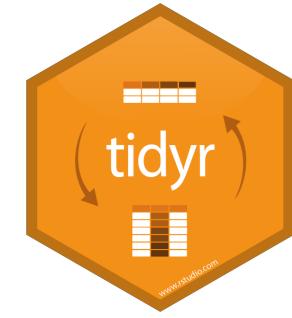
```
df %>%
  dplyr::group_by(name) %>%
  dplyr::mutate(average = mean(score))
```

The script won't change no matter how many midterms you have to score!

Long

name	midterm	score	average
samantha	midterm_1	72	77.6
samantha	midterm_2	80	77.6
samantha	midterm_3	81	77.6
taylor	midterm_1	91	91
taylor	midterm_2	92	91
taylor	midterm_3	90	91
kelsey	midterm_1	83	82.3
kelsey	midterm_2	74	82.3
kelsey	midterm_3	90	82.3
ramona	midterm_1	65	70.3
ramona	midterm_2	71	70.3
ramona	midterm_3	75	70.3

Q1: Find the average of each student's midterms



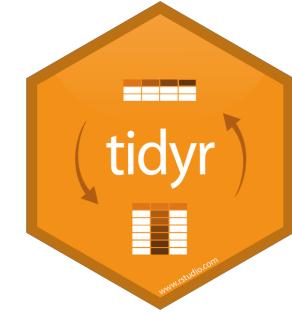
Wide vs. Long data

Wide

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

Long

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75



Q2: Plot each student's score by midterm

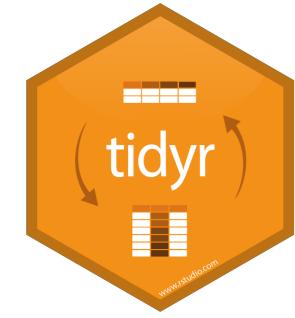
Wide vs. Long data

```
df %>%
  ggplot2::ggplot(.) +
  ggplot2::aes(x = name, y = score, fill = midterm) +
  ggplot2::geom_bar(stat = "identity", position = "dodge")
```

Long

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75

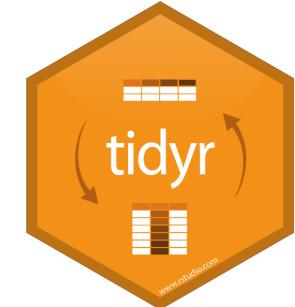
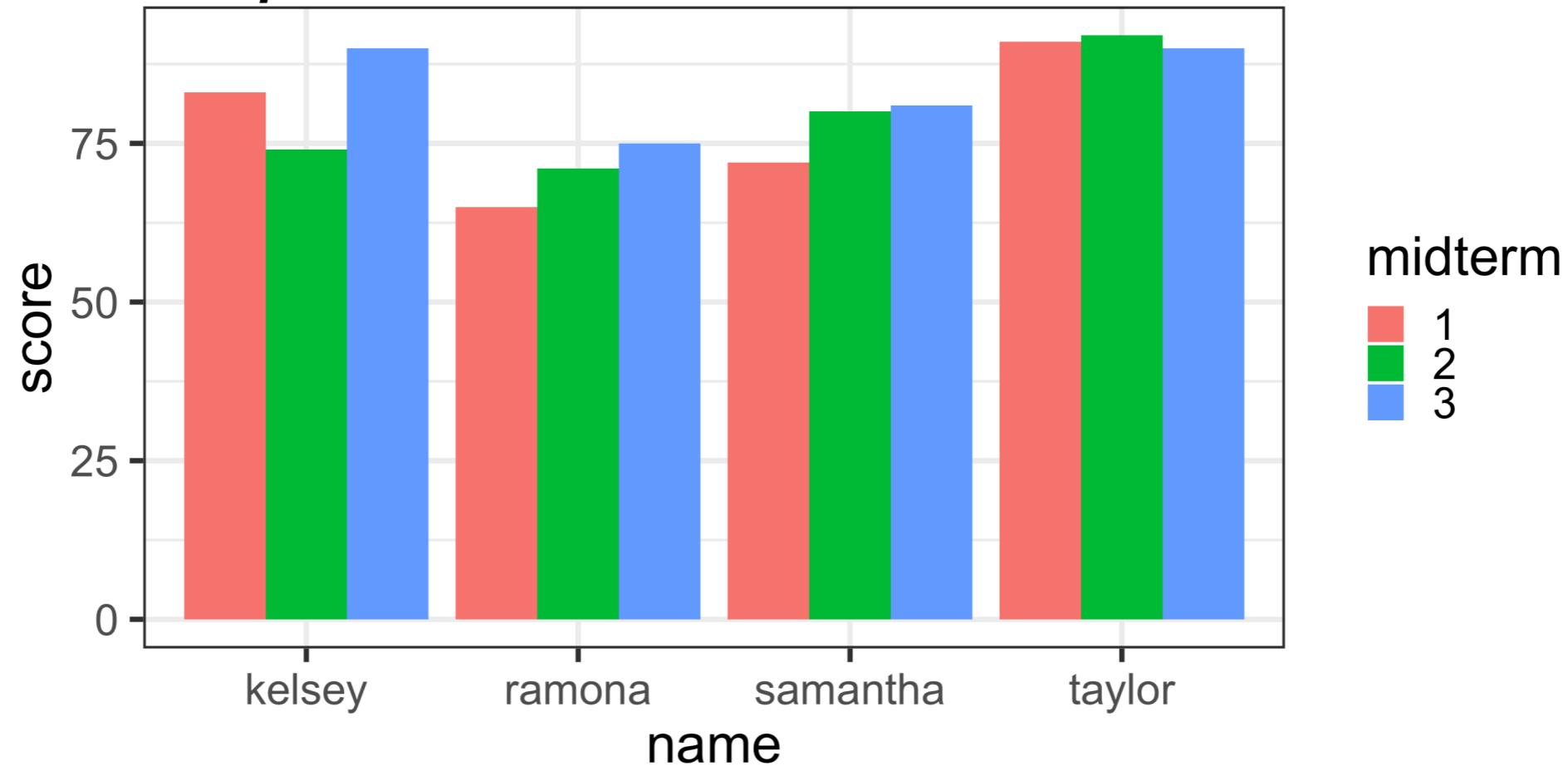
Q2: Plot each student's score by midterm



Wide vs. Long data

```
df %>%
  ggplot2::ggplot(.) +
  ggplot2::aes(x = name, y = score, fill = midterm) +
  ggplot2::geom_bar(stat = "identity", position = "dodge")
```

*** this plot would be difficult with wide format...**



Q2: Plot each student's score by midterm

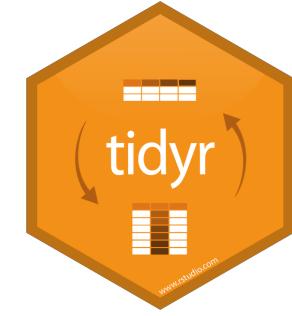
Wide vs. Long data

Wide

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

Long

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
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taylor	midterm_1	91
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kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75



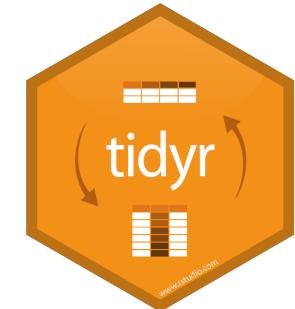
Q3: Find the ratio between midterm 1 and 2

Wide vs. Long data

Wide

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

```
df %>%
  dplyr::mutate(ratio = midterm_1 / midterm_2)
```



Q3: Find the ratio between midterm 1 and 2

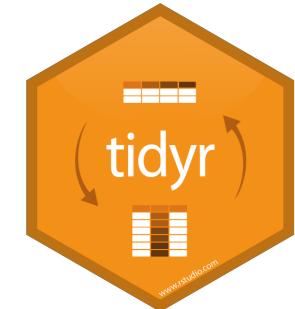
Wide vs. Long data

← **Wide** →

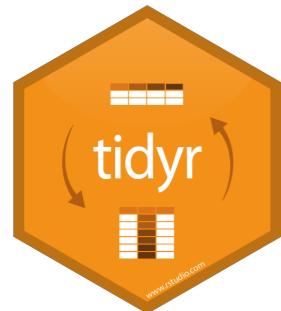
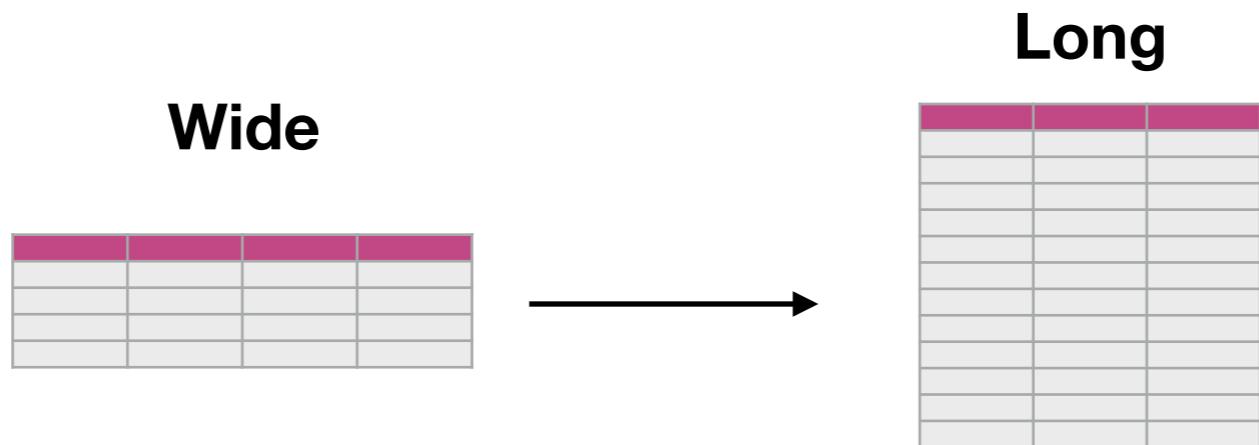
name	midterm_1	midterm_2	midterm_3	ratio
samantha	72	80	81	0.9
taylor	91	92	90	0.989
kelsey	83	74	90	1.12
ramona	65	71	75	0.915

```
df %>%
  dplyr::mutate(ratio = midterm_1 / midterm_2)
```

This would be more difficult to do with the long data...



Q3: Find the ratio between midterm 1 and 2

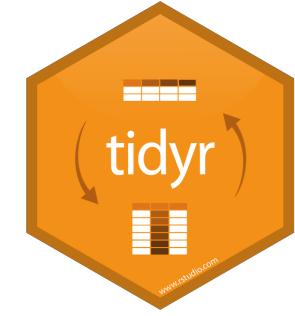


`tidyverse::gather()`

`tidyverse::gather()` to collapse multiple columns

tidyr::gather ()

```
tidyr::gather (dataframe, key, value, columns_to_include)
```



tidyr::gather () to collapse multiple columns

tidyverse::gather()

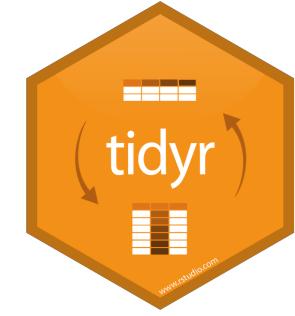
tidyverse::gather(dataframe, key, value, columns_to_include)

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75



tidyverse::gather() to collapse multiple columns



tidyverse::gather()

```
tidyverse::gather(dataframe, key, value, columns_to_include)
```

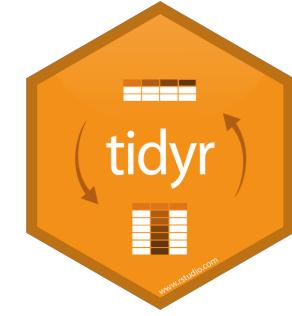
name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90

```
long_df <- tidyverse::gather(wide_df, midterm, score,  
midterm_1:midterm_3)
```

kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75

tidyverse::gather() to collapse multiple columns



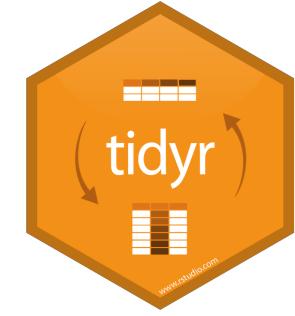
tidyverse::gather()

```
tidyverse::gather(dataframe, key, value, columns_to_include)
```

**Convert the starwars dataframe from wide to long, containing three columns:
*name, characteristic, value***

name	characteristic	value
Luke Skywalker	height	172
C-3PO	height	167
R2-D2	height	96
Darth Vader	height	202
Leia Organa	height	150
Owen Lars	height	178
Beru Whitesun Lars	height	165
R5-D4	height	97
Biggs Darklighter	height	183
Obi-Wan Kenobi	height	182
Anakin Skywalker	height	188
Wilhuff Tarkin	height	180

tidyverse::gather() to collapse multiple columns



tidyr::gather()

```
tidyr::gather(dataframe, key, value, columns_to_include)
```

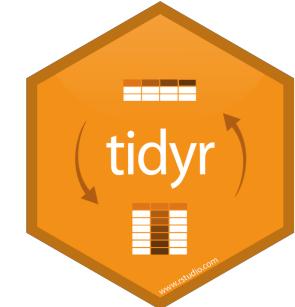
**Convert the starwars dataframe from wide to long, containing three columns:
*name, characteristic, value***

```
gathered <- starwars %>%  
  tidyr::gather(characteristic, value, height:starships)
```



You can also select which columns NOT to include instead

```
gathered <- starwars %>%  
  tidyr::gather(characteristic, value, -name)
```



tidyr::gather() to collapse multiple columns

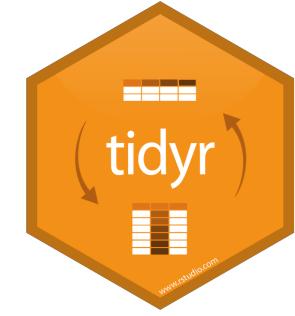
tidyr::gather()

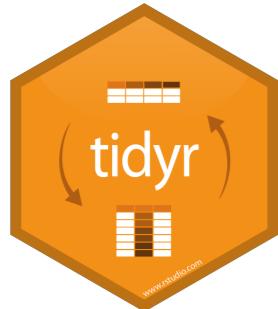
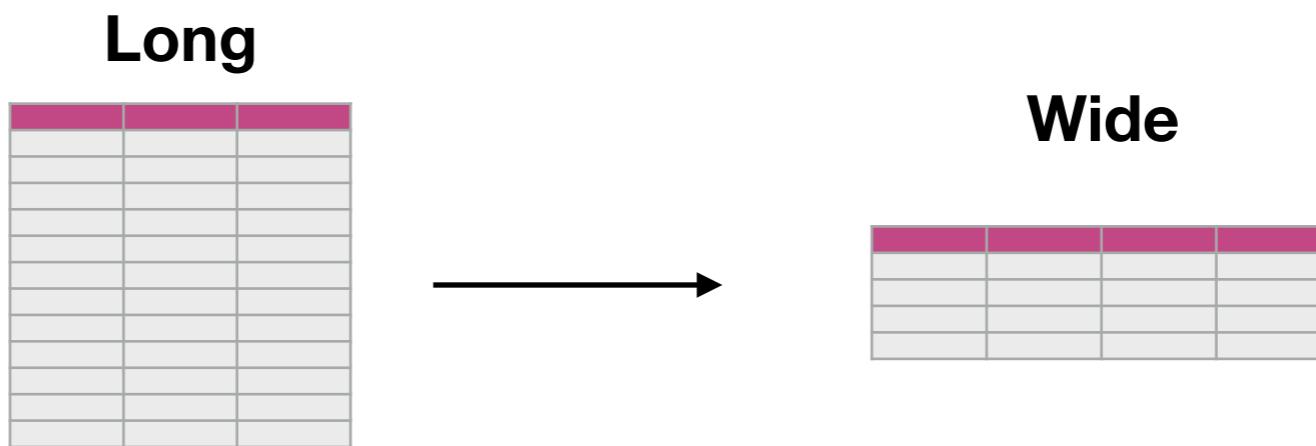
```
tidyr::gather(dataframe, key, value, columns_to_include)
```

Gather height, mass, eye color, skin color, and gender

```
gathered <- starwars %>%  
  tidyr::gather(characteristic, value, height, mass,  
                 eye_color, skin_color, gender)
```

tidyr::gather() to collapse multiple columns



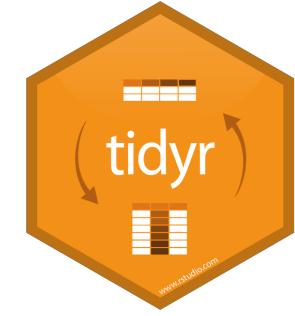


tidy়r::spread()

`tidyverse::spread()` to expand one column to multiple

tidyr::spread()

```
tidyr::spread(dataframe, key, value)
```



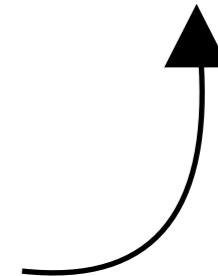
`tidyr::spread()` to expand one column to multiple

tidyverse::spread()

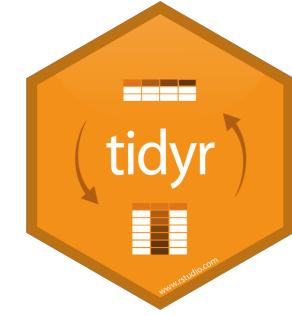
tidyverse::spread(dataframe, key, value)

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75



tidyverse::spread() to expand one column to multiple

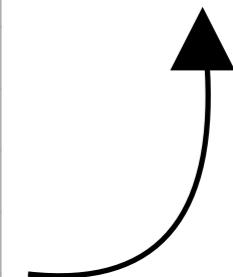


tidyverse::spread()

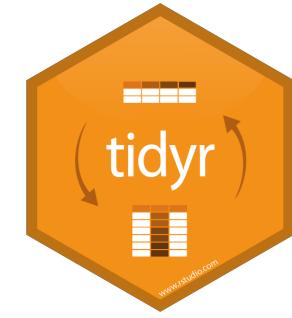
tidyverse::spread(dataframe, key, value)

name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90
kelsey	midterm_1	83
kelsey	midterm_2	74
kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75



tidyverse::spread() to expand one column to multiple



tidyverse::spread()

tidyverse::spread(dataframe, key, value)

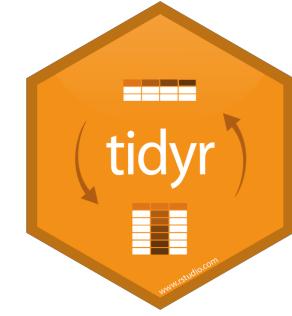
name	midterm_1	midterm_2	midterm_3
samantha	72	80	81
taylor	91	92	90
kelsey	83	74	90
ramona	65	71	75

name	midterm	score
samantha	midterm_1	72
samantha	midterm_2	80
samantha	midterm_3	81
taylor	midterm_1	91
taylor	midterm_2	92
taylor	midterm_3	90

wide_df <- tidyverse::spread(long_df, midterm, score)

kelsey	midterm_3	90
ramona	midterm_1	65
ramona	midterm_2	71
ramona	midterm_3	75

tidyverse::spread() to expand one column to multiple



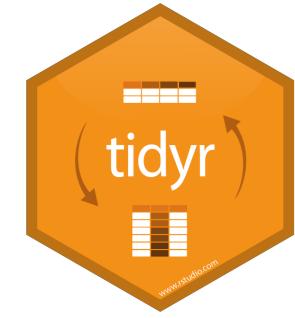
tidyr::spread()

```
tidyr::spread(dataframe, key, value)
```

Un-gather (spread) the starwars data frame

```
ungathered <- gathered %>%  
  tidyr::spread(characteristic, value)
```

tidyr::spread() to expand one column to multiple



tidy়r::spread()

name = key

tidy়r::spread(dataframe, key, value)

GOAL:

Ackbar	Adi Gallia	Anakin Skywalker	Arvel Crynyd	Ayla Secura	Bail Prestor Organa	Barriss Offee	BB8	Ben Quadinaros	Beru Whitesun Lars	Bib Fortuna	Biggs Darklighter	Boba Fett	Bossk	C-3PO	Captain Phasma	Chewbacca
orange	blue	blue	brown	hazel	brown	blue	black	orange	blue	pink	brown	brown	red	yellow	unknown	blue

eye_color = value

1. Select columns to keep

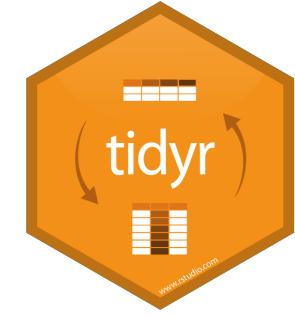
name, eye_color

2. Spread data frame

What is the key? What is the value?

```
eyes <- starwars %>%
  dplyr::select(name, eye_color) %>%
  tidy়r::spread(name, eye_color)
```

tidy়r::spread() to expand one column to multiple



tidyr::spread()

name = key

tidyr::spread(dataframe, key, value)

GOAL:

Ackbar	Adi Gallia	Anakin Skywalker	Arvel Crynyd	Ayla Secura	Bail Prestor Organa	Barriss Offee	BB8	Ben Quadinaros	Beru Whitesun Lars	Bib Fortuna	Biggs Darklighter	Boba Fett	Bossk	C-3PO	Captain Phasma	Chewbacca
orange	blue	blue	brown	hazel	brown	blue	black	orange	blue	pink	brown	brown	red	yellow	unknown	blue

eye_color = value

~~1. Select columns to keep~~

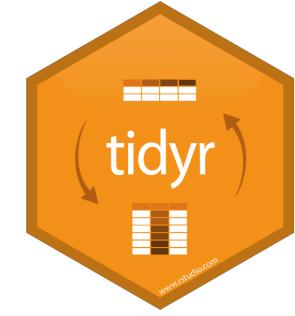
~~name, eye_color~~

2. Spread data frame

What is the key? What is the value?

```
eyes <- starwars %>%
  dplyr::select(name, eye_color) %>%
  tidyr::spread(name, eye_color)
```

tidyr::spread() to expand one column to multiple



tidy়::spread()

tidy়::spread(dataframe, key, value)

vehicles	starships	Ackbar	Adi Gallia	Anakin Skywalker	Arvel Crynyd	Ayla Secura	Bail Prestor Organa	Barris Offee	BB8	Ben Quadinaros	Beru Whitesun lars	Bib Fortuna	B	C
c("Snowspeeder", "Imperial Speeder Bike")	c("X-wing", "Imperial shuttle")	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	TIE Advanced x1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Imperial Speeder Bike	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	blue	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	X-wing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tribubble bongo	c("Jedi starfighter", "Trade Federation cruiser", "Naboo...")	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
c("Zephyr-G swoop bike", "XJ-6 airspeeder")	c("Trade Federation cruiser", "Jedi Interceptor", "Nabo...")	NA	NA	blue	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
AT-ST	c("Millennium Falcon", "Imperial shuttle")	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	c("Millennium Falcon", "Imperial shuttle")	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Snowspeeder	X-wing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	X-wing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	Slave 1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	Millennium Falcon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	orange	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	A-wing	NA	NA	NA	brown	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	Millennium Falcon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tribubble bongo	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

tidy়::spread() to expand one column to multiple

tidy়::spread()

tidy়::spread(dataframe, key, value)

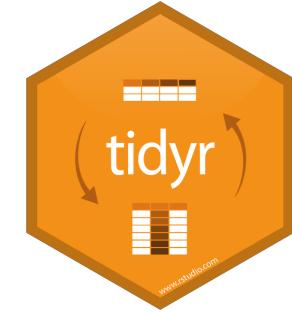
vehicles	starships	Ackbar	Adi Gallia	Anakin Skywalker	Arvel Crynyd	Ayla Secura	Bail Prestor Organa	Barris Offee	BB8	Ben Quadinaros	Beru Whitesun lars	Bib Fortuna	B
c("Snowspeeder", "Imperial Speeder Bike")	c("X-wing", "Imperial shuttle")	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
character(0)	TIE Advanced x1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Imperial Speeder Bike	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	blue	NA
character(0)	character(0)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
character(0)	X-wing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tribubble bongo	c("Jedi starfighter", "Trade Federation cruiser", "Naboo...")	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c("Zephyr-G swoop bike", "XJ-6 airspeeder")	c("Trade Federation cruiser", "Jedi Interceptor", "Nabo...")	NA	NA	blue	NA	NA	NA	NA	NA	NA	NA	NA	NA



Can fill empty values with fill = "xxx"

```
eyes <- starwars %>%
  dplyr::select(name, eye_color) %>%
  tidy়::spread(name, eye_color, fill = 0)
```

tidy়::spread() to expand one column to multiple

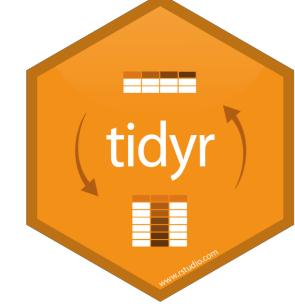


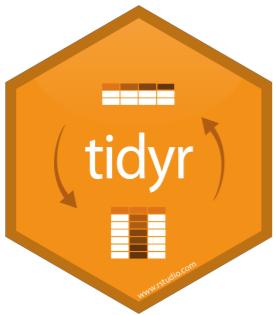
tidy়r::spread()

tidy়r::spread(dataframe, key, value)

ehicles	starships	Ackbar	Adi Gallia	Anakin Skywalker	Arvel Crynyd	Ayla Secura	Bail Prestor Organa	Barris Offee	BB8	Ben Quadinaros	Beru Whitesun lars	Bib Fortuna	E
c("Snowspeeder", "Imperial Speeder Bike")	c("X-wing", "Imperial shuttle")	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	TIE Advanced x1	0	0	0	0	0	0	0	0	0	0	0	0
Imperial Speeder Bike	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	blue	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	X-wing	0	0	0	0	0	0	0	0	0	0	0	0
Tribubble bongo	c("Jedi starfighter", "Trade Federation cruiser", "Naboo...")	0	0	0	0	0	0	0	0	0	0	0	0
c("Zephyr-G swoop bike", "XJ-6 airspeeder")	c("Trade Federation cruiser", "Jedi Interceptor", "Nabo...")	0	0	blue	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
AT-ST	c("Millennium Falcon", "Imperial shuttle")	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	c("Millennium Falcon", "Imperial shuttle")	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
Snowspeeder	X-wing	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	X-wing	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	Slave 1	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	Millennium Falcon	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	orange	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	A-wing	0	0	0	brown	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	Millennium Falcon	0	0	0	0	0	0	0	0	0	0	0	0
Tribubble bongo	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0
character(0)	character(0)	0	0	0	0	0	0	0	0	0	0	0	0

tidy়r::spread() to expand one column to multiple





tidyverse::unite()

`tidyverse::unite()` to combine multiple columns into one

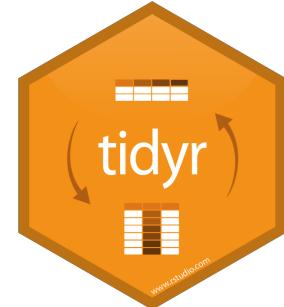
tidyverse::unite()

```
tidyverse::unite(dataframe, old_columns, col = new_column, sep = separator)
```

Combine name and homeworld into one column named character
(e.g. *Luke Skywalker, Tatooine*)

```
united <- starwars %>%
  tidyverse::unite(name, homeworld, col = "character", sep = ", ")
```

character	height	mass	hair_color	skin_color	eye_color	birth_year
Luke Skywalker, Tatooine	172	77.0	blond	fair	blue	19.0
C-3PO, Tatooine	167	75.0	NA	gold	yellow	112.0
R2-D2, Naboo	96	32.0	NA	white, blue	red	33.0
Darth Vader, Tatooine	202	136.0	none	white	yellow	41.9
Leia Organa, Alderaan	150	49.0	brown	light	brown	19.0
Owen Lars, Tatooine	178	120.0	brown, grey	light	blue	52.0
Beru Whitesun lars, Tatooine	165	75.0	brown	light	blue	47.0



tidyverse::unite() to combine multiple columns into one

tidyverse::unite()

```
tidyverse::unite(dataframe, old_columns, col = new_column, sep = separator)
```

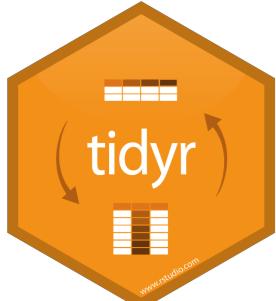
**Combine name, homeworld, and species into one column named character
(e.g. Luke Skywalker, Tatooine, Human)**

```
united <- starwars %>%
  tidyverse::unite(name, homeworld, species,
                  col = "character", sep = ", ")
```



Keep the original columns with argument `remove = FALSE`

```
united <- starwars %>%
  tidyverse::unite(name, homeworld, species,
                  col = "character", sep = ", ", remove = FALSE)
```



`tidyverse::unite()` to combine multiple columns into one

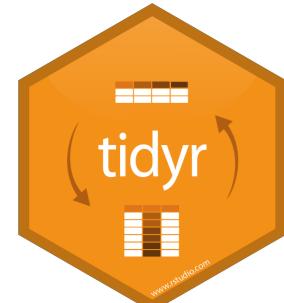
tidyverse::unite()

```
tidyverse::unite(dataframe, old_columns, col = new_column, sep = separator)
```



Keep the original columns with argument `remove = FALSE`

character	name	height	mass	hair_color	skin_color	eye_color	birth_year	gender	homeworld
Luke Skywalker, Tatooine	Luke Skywalker	172	77.0	blond	fair	blue	19.0	male	Tatooine
C-3PO, Tatooine	C-3PO	167	75.0	NA	gold	yellow	112.0	NA	Tatooine
R2-D2, Naboo	R2-D2	96	32.0	NA	white, blue	red	33.0	NA	Naboo
Darth Vader, Tatooine	Darth Vader	202	136.0	none	white	yellow	41.9	male	Tatooine
Leia Organa, Alderaan	Leia Organa	150	49.0	brown	light	brown	19.0	female	Alderaan
Owen Lars, Tatooine	Owen Lars	178	120.0	brown, grey	light	blue	52.0	male	Tatooine
Beru Whitesun Lars, Tatooine	Beru Whitesun Lars	165	75.0	brown	light	blue	47.0	female	Tatooine
R5-D4, Tatooine	R5-D4	97	32.0	NA	white, red	red	NA	NA	Tatooine
Biggs Darklighter, Tatooine	Biggs Darklighter	183	84.0	black	light	brown	24.0	male	Tatooine



tidyverse::unite() to combine multiple columns into one

tidyverse::unite()

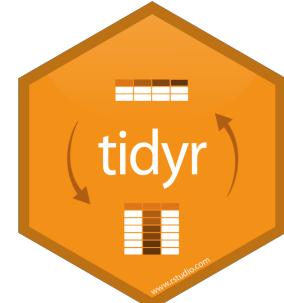
```
tidyverse::unite(dataframe, old_columns, col = new_column, sep = separator)
```

Combine name, homeworld, and species into one column named character
(e.g. Luke Skywalker, Tatooine (Human))

Hint: This might take multiple steps...

Hint: `paste("My name is", "Katie", sep = " ")` = “My name is Katie”

```
united <- starwars %>%
  tidyverse::unite(name, homeworld, col = "character", sep = ", ") %>%
  dplyr::mutate(species = paste("(", species, ")", sep = "")) %>%
  tidyverse::unite(character, species, col = "character", sep = " ")
```



`tidyverse::unite()` to combine multiple columns into one

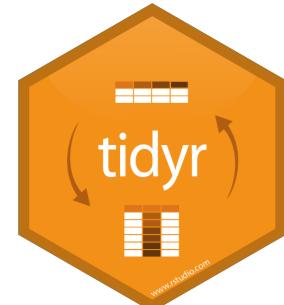
tidyverse::unite()

```
tidyverse::unite(dataframe, old_columns, col = new_column, sep = separator)
```

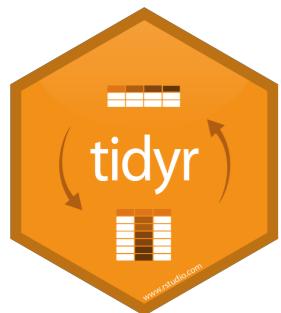


Keep the original columns with argument `remove = FALSE`

character	name	height	mass	hair_color	skin_color	eye_color	birth_year	gender	homeworld
Luke Skywalker, Tatooine	Luke Skywalker	172	77.0	blond	fair	blue	19.0	male	Tatooine
C-3PO, Tatooine	C-3PO	167	75.0	NA	gold	yellow	112.0	NA	Tatooine
R2-D2, Naboo	R2-D2	96	32.0	NA	white, blue	red	33.0	NA	Naboo
Darth Vader, Tatooine	Darth Vader	202	136.0	none	white	yellow	41.9	male	Tatooine
Leia Organa, Alderaan	Leia Organa	150	49.0	brown	light	brown	19.0	female	Alderaan
Owen Lars, Tatooine	Owen Lars	178	120.0	brown, grey	light	blue	52.0	male	Tatooine
Beru Whitesun Lars, Tatooine	Beru Whitesun Lars	165	75.0	brown	light	blue	47.0	female	Tatooine
R5-D4, Tatooine	R5-D4	97	32.0	NA	white, red	red	NA	NA	Tatooine
Biggs Darklighter, Tatooine	Biggs Darklighter	183	84.0	black	light	brown	24.0	male	Tatooine



tidyverse::unite() to combine multiple columns into one



tidyverse::separate()

`tidyverse::separate()` to split one column into two

tidyr::separate()

```
tidyr::separate(dataframe, old_column, into = c(new_columns), sep = separator)
```

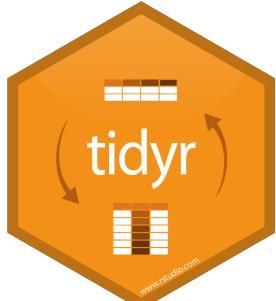
Separate the ‘character’ column back into name and homeworld

```
separated <- united %>%
  tidyr::separate(character, into = c("name", "homeworld"), sep = ",")
```



Keep the original columns with argument `remove = FALSE`

```
separated <- united %>%
  tidyr::separate(character, into = c("name", "homeworld"),
  sep = ",", remove = FALSE)
```



tidyr::separate() to split one column into two

tidyverse::separate()

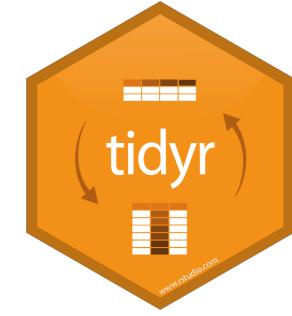
```
tidyverse::separate(dataframe, old_column, into = c(new_columns), sep = separator)
```

Separate characters into first and last names

```
names <- starwars %>%  
  tidyverse::separate(name, into = c("first_name", "last_name"), sep = " ")
```

first_name	last_name	height	mass	hair_color	skin_color	eye_color	birth_year	gender	homeworld	species
Luke	Skywalker	172	77.0	blond	fair	blue	19.0	male	Tatooine	Human
C-3PO	NA	167	75.0	NA	gold	yellow	112.0	NA	Tatooine	Droid
R2-D2	NA	96	32.0	NA	white, blue	red	33.0	NA	Naboo	Droid
Darth	Vader	202	136.0	none	white	yellow	41.9	male	Tatooine	Human
Leia	Organa	150	49.0	brown	light	brown	19.0	female	Alderaan	Human
Owen	Lars	178	120.0	brown, grey	light	blue	52.0	male	Tatooine	Human
Beru	Whitesun	165	75.0	brown	light	blue	47.0	female	Tatooine	Human
R5-D4	NA	97	32.0	NA	white, red	red	NA	NA	Tatooine	Droid

tidyverse::separate() to split one column into two



Review: `tidyr`

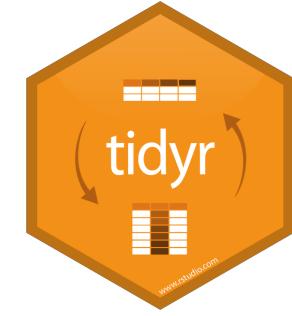
Functions:

`tidyr::gather()` to collapse multiple columns

`tidyr::spread()` to expand one column to multiple

`tidyr::unite()` to combine multiple columns into one

`tidyr::separate()` to split one column into two



dplyr/tidyr practice!

Select all characters and their homeworld in the film “Return of the Jedi”

name	homeworld
Luke Skywalker	Tatooine
C-3PO	Tatooine

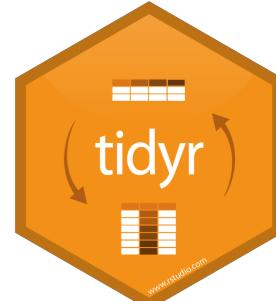
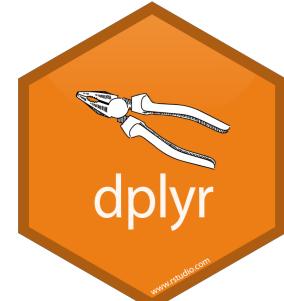
Hint: try using grepl() or stringr::str_detect()

GOAL:

CODE:

```
practice1 <- starwars %>%
  dplyr::filter(grepl("Return of the Jedi", films)) %>%
  dplyr::select(name, homeworld)
```

R2-D2	Naboo
Darth Vader	Tatooine
Leia Organa	Yavin 4
Obi-Wan Kenobi	Tatooine
Chewbacca	Kashyyyk
Han Solo	Kessel
Jabba the Hutt	Koonda
Wedge Antilles	Endor
Yoda	Kyberus
Palpatine	Coruscant
Boba Fett	Kamino
Lando Calrissian	Socorro
Ackbar	Mon Cala
Mon Mothma	Chandrila
Arvel Crynyd	NA
Wicket Systri Warrick	Endor
Nien Nunb	Sullust
Bib Fortuna	Ryloth



dplyr/tidyr practice!

Select all characters and their homeworld in the film “Return of the Jedi”

name	homeworld
Luke Skywalker	Tatooine
C-3PO	Tatooine

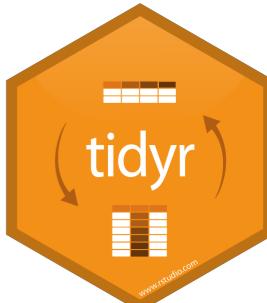
Hint: try using grepl() or stringr::str_detect()

GOAL:

CODE:

```
practice1 <- starwars %>%
  dplyr::filter(stringr::str_detect(films,
                                     "Return of the Jedi")) %>%
  dplyr::select(name, homeworld)
```

R2-D2	Corellia
Darth Vader	Tatooine
Leia Organa	Yavin 4
Obi-Wan Kenobi	Tatooine
Chewbacca	Kashyyyk
Han Solo	Kessel
Jabba the Hutt	Cloud City
Wedge Antilles	Endor
Yoda	Kyberus
Palpatine	Mustafar
Boba Fett	Kamino
Lando Calrissian	Socorro
Ackbar	Mon Cala
Mon Mothma	Chandrila
Arvel Crynyd	NA
Wicket Systri Warrick	Endor
Nien Nunb	Sullust
Bib Fortuna	Ryloth



dplyr/tidyr practice!

**Calculate the birth year of each character given the column
‘birth_year’ is actually age in 2019...**

name	age	birth_year
Luke Skywalker	19.0	2000.0
C-3PO	112.0	1907.0
R2-D2	33.0	1986.0
Darth Vader	41.9	1977.1
Leia Organa	19.0	2000.0

Owen Lars
Beru Whitesun Lars
Biggs Darklighter
Obi-Wan Kenobi
Anakin Skywalker
Wilhuff Tarkin
Chewbacca
Han Solo

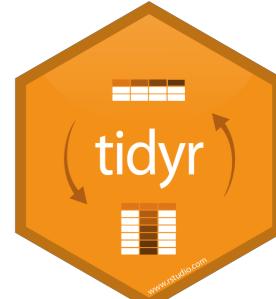
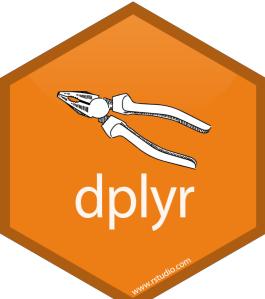
Greedo	44.0	1975.0
Jabba Desilijic Tiure	600.0	1419.0
Wedge Antilles	21.0	1998.0
Yoda	896.0	1123.0
Palpatine	82.0	1937.0
Boba Fett	31.5	1987.5
IG-88	15.0	2004.0

Hint: rename “birth_year” as “age” first then calculate “birth_year”

GOAL:

CODE:

```
practice2 <- starwars %>%
  dplyr::select(name, age = birth_year) %>%
  dplyr::mutate(birth_year = 2019 - age) %>%
  dplyr::filter(!is.na(age))
```



dplyr/tidyr practice!

Calculate the number of characters with each hair color combination

name	hair_color	number
Luke Skywalker	blond	3
C-3PO	NA	5
R2-D2	NA	5
Darth Vader	none	37
Leia Organa	brown	18
Owen Lars	brown, grey	1
Beru Whitesun lars	brown	18
R5-D4	NA	
Biggs Darklighter	black	
Obi-Wan Kenobi	auburn, white	
Anakin Skywalker	blond	
Wilhuff Tarkin	auburn, grey	
Chewbacca	brown	
Han Solo	brown	
Greedo	NA	
Jabba Desilijic Tiure	NA	5
Wedge Antilles	brown	18
Jek Tono Porkins	brown	18

Note: “brown, grey” is different than
“brown” or “grey”

GOAL:

Hint: the function n() counts the number of observations in a group

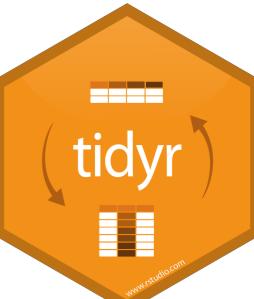
CODE:

```
practice3 <- starwars %>%
  dplyr::select(name, hair_color) %>%
  dplyr::group_by(hair_color) %>%
  dplyr::mutate(number = n())
```



dplyr

www.rstudio.com



tidyR

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dplyr/tidyr practice!

Combine hair, eye, and skin color as one “color” column (separated by “&”)

name	color (hair & eye & skin)
Luke Skywalker	blond & blue & fair
Darth Vader	none & yellow & white
Leia Organa	brown & brown & light
Owen Lars	brown, grey & blue & light
Beru Whitesun Lars	brown & blue & light

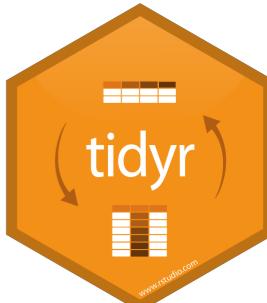
GOAL:

First remove anyone with “NA” in any of these columns

CODE:

```
practice4 <- starwars %>%
  dplyr::select(name, hair_color, eye_color, skin_color) %>%
  dplyr::filter(!is.na(hair_color),
                !is.na(eye_color),
                !is.na(skin_color)) %>%
  tidyr::unite(hair_color, eye_color, skin_color,
               col = "color (hair & eye & skin)", sep = " & ")
```

IG-88	none & red & metal
Bossk	none & red & green



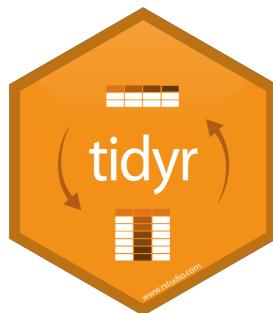
dplyr/tidyr practice!

GOAL:

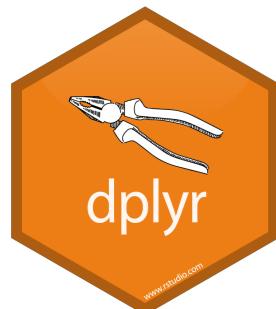
variable	Beru Whitesun lars	Cordé	Dormé	Jocasta Nu	Leia Organa	Mon Mothma	Padmé Amidala	Rey	Shmi Skywalker
birth_year	47	NA	NA	NA	19	48	46	NA	72
eye_color	blue	brown	brown	blue	brown	blue	brown	hazel	brown
gender	female	female	female	female	female	female	female	female	female
hair_color	brown	brown	brown	white	brown	auburn	brown	brown	black
height	165	157	165	167	150	150	165	NA	163
homeworld	Tatooine	Naboo	Naboo	Coruscant	Alderaan	Chandrila	Naboo	NA	Tatooine
mass	75	NA	NA	NA	49	NA	45	NA	NA
skin_color	light	light	light	fair	light	fair	light	light	fair
species	Human	Human	Human	Human	Human	Human	Human	Human	Human

CODE:

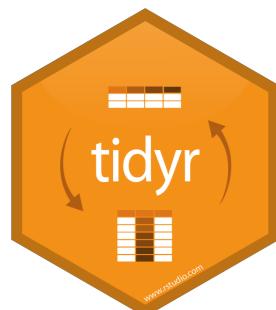
```
practice5 <- starwars %>%
  dplyr::select(name:species) %>%
  dplyr::filter(species == "Human",
                gender == "female") %>%
  tidyr::gather(variable, value, -name) %>%
  tidyr::spread(name, value)
```



Overview of Tidyverse



The **dplyr** package is the most useful package in R for data manipulation. One of the greatest advantages of the package is that you can use the pipe function (`%>%`) to combine different functions.



The **tidyr** package complements dplyr perfectly. It boosts the power of dplyr for data manipulation and pre-processing

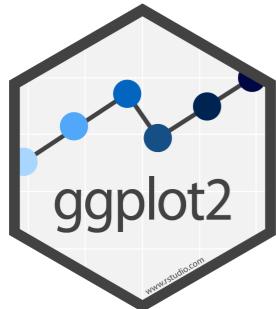


The **readr** package is used to import and export data as tibbles in R.



The **stringr** package is used for strings. It provides a cohesive set of functions designed to make working with strings as easy as possible.

Other Tidyverse packages



Data scientists universally love using **ggplot2** to produce their charts and visualizations!



The **lubridate** package is the best way to deal with dates and times in R! From converting strings to dates to calculating hours between two time points.



The **purrr** package in R provides a complete toolkit for enhancing R's functional programming. We can use the functions provided by purrr to avoid many loops with just one line of code.



The **forcats** package is dedicated to dealing with categorical variables or factors.



The **broom** package takes the messy output of built-in functions in R and turns them into tidy dataframes