Workshop Series:
Reusable Research Data Made Shiny

Ontario Dairy Research Centre | Zoom
February 21st - 24th, 2023

University of Guelph
Improve Life.

Compute Ontario

ADC

Ultimate question

Are the temperatures inside the barns milder than outside?

What do we need to know?

- Average temperatures during winter and summer months for each barn, inside and outside

barn	season	location	avg_temp
sp_needs	winter	inside	
sp_needs	winter	outside	
sp_needs	summer	inside	
sp_needs	summer	outside	
lactating	winter	inside	
lactating	winter	outside	
lactating	summer	inside	
lactating	summer	outside	


group_by()

group_by()

Group observations by common values

group_by(.data, ...)

.data	dataframe to transform
...	one or more column names to group

group_by()

Get the min, mean, and max temperatures per barn and location

```
env_data %>%
  na.omit() %>%
  summarize(min_temp = min(temp),
            avg_temp = mean(temp),
            max_temp = max(temp
```

```
# A tibble: 1 × 3
  min_temp avg_temp max_temp
     <dbl>    <dbl>    <dbl>
1      -24     12.2     39.2
```

group_by()

Get the min, mean, and max temperatures per barn and location

```
env_data %>%
  na.omit() %>%
  group_by(barn, location) %>%
  summarize(min_temp = min(temp),
            avg_temp = mean(temp),
            max_temp = max(temp
```

```
# A tibble: 4 x 5
# Groups:   barn [2]
  barn      location min_temp avg_temp max_temp
  <chr>     <chr>       <dbl>    <dbl>    <dbl>
1 lactating inside       1.34     13.8     31.3
2 lactating outside    -23.9      10.3     39.1
3 sp_needs  inside      -1.95     14.4     31.4
4 sp_needs  outside     -24        10.3     39.2
```

group_by()

```
sampled_env_data %>% na.omit() %>% summarize(min = min(temp), avg = mean(temp), max = max(temp))
```

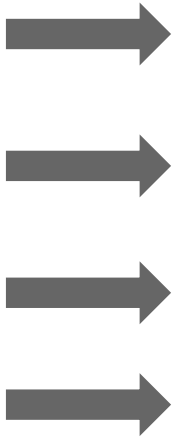
barn	location	rh	temp
lactating	inside	79	20.4
lactating	inside	85	19.9
lactating	outside	83	-2.5
lactating	outside	47	23.4
sp_needs	inside	83	12.0
sp_needs	inside	78	9.2
sp_needs	outside	73	-14.5
sp_needs	outside	58	15.7

min	avg	max
-14.5	10.4	23.4

group_by()

group_by() + summarize()

barn	location	rh	temp
lactating	inside	79	20.4
lactating	inside	85	19.9
lactating	outside	83	-2.5
lactating	outside	47	23.4
sp_needs	inside	83	12.0
sp_needs	inside	78	9.2
sp_needs	outside	73	-14.5
sp_needs	outside	58	15.7



min	avg	max
19.9	20.1	20.4
-2.5	10.4	23.4
9.2	10.6	12.0
-14.5	0.6	15.7

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

group_by()

```
sampled_env_data %>% group_by(barn, location) %>% na.omit() %>%
        summarize(min = min(temp),
                  avg = mean(temp),
                  max = max(temp))
```

barn	location	rh	temp
lactating	inside	79	20.4
lactating	inside	85	19.9
lactating	outside	83	-2.5
lactating	outside	47	23.4
sp_needs	inside	83	12.0
sp_needs	inside	78	9.2
sp_needs	outside	73	-14.5
sp_needs	outside	58	15.7

min	avg	max
19.9	20.1	20.4
-2.5	10.4	23.4
9.2	10.6	12.0
-14.5	0.6	15.7

barn	location	min	avg	max
lactating	inside	19.9	20.1	20.4
lactating	outside	-2.5	10.4	23.4
sp_needs	inside	9.2	10.6	12.0
sp_needs	outside	-14.5	0.6	15.7

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Your turn!

Use group_by(), filter(), and summarize() to show the lowest and highest relative humidity and temperature of the inside of each barn

Your turn!

Use group_by(), filter(), and summarize() to show the lowest and highest relative humidity and temperature of the inside of each barn

```
env_data %>%
  filter(location == "inside") %>%
  na.omit() %>%
  group_by(barn, location) %>%
  summarize(min_temp = min(temp),
            max_temp = max(temp),
            min_rh = min(rh),
            max_rh = max(rh))
```

```
# A tibble: 2 × 6
# Groups:   barn [2]
  barn      location min_temp max_temp min_rh max_rh
  <chr>     <chr>       <dbl>    <dbl>  <dbl>  <dbl>
1 lactating inside       1.34     31.3     24     90
2 sp_needs  inside      -1.95     31.4     29     91
```

Ultimate question

Are the temperatures inside the barns milder than outside?

What do we need to know?

- Average temperatures during winter and summer months for each barn, inside and outside

barn	season	location	avg_temp
sp_needs	winter	inside	
sp_needs	winter	outside	
sp_needs	summer	inside	
sp_needs	summer	outside	
lactating	winter	inside	
lactating	winter	outside	
lactating	summer	inside	
lactating	summer	outside	


mutate()

mutate()

Apply vectorized functions to columns to create new columns

mutate(.data, new_column = function(vector))

.data	dataframe to transform
new_column	New column created by function()
function(...)	Function used to transform a vector
vector	Vector to be transformed, can be a column from .data

mutate()

Create new columns

```
env_data %>%
  mutate(year = lubridate::year(date),
         month = lubridate::month(date),
         day = lubridate::day(date),
         barn = dplyr::if_else(barn == "sp_needs", "special_needs", barn))
```

```
# A tibble: 124,744 × 9
   date       time    barn          location    rh  temp  year month   day
   <date>     <time>  <chr>         <chr>    <dbl> <dbl> <dbl> <dbl> <int>
 1 2022-01-01 11'58" lactating     inside      74  7.74  2022     1     1
 2 2022-01-01 11'58" lactating     outside     87  2.5   2022     1     1
 3 2022-01-01 11'58" special_needs inside      78 10.1   2022     1     1
 4 2022-01-01 11'58" special_needs outside     87  2.5   2022     1     1
 5 2022-01-01 26'58" lactating     inside      74  8.31  2022     1     1
```

Your turn!

Using the functions from today, create the following table to answer our ultimate question:
Are the temperatures inside the barns milder than outside?

barn	season	location	avg_temp
sp_needs	winter	inside	
sp_needs	winter	outside	
sp_needs	summer	inside	
sp_needs	summer	outside	
lactating	winter	inside	
lactating	winter	outside	
lactating	summer	inside	
lactating	summer	outside	

Recap!

Extract variables with **select()**

Extract observations with **filter()**

Arrange/Sort observations with **arrange()**

Make table of summaries with **summarize**()

Make new variables with **mutate()**

Your turn!

Using the functions from today, create the following table to answer our ultimate question:

Are the temperatures inside the barns milder than outside?

```
env_data %>%
  na.omit() %>%
  mutate(season = if_else(date >= "2021-12-31" & date <= "2022-03-20",
                          true = "winter",
                          false = if_else(date >= "2022-06-21" & date <= "2022-09-23",
                                          true = "summer",
                                          false = "spring/fall"))) %>%
  filter(season %in% c("summer", "winter")) %>%
  group_by(barn, season, location) %>%
  summarize(avg_temp = mean(temp)) %>%
  arrange(desc(barn), desc(season))
```

Your turn!

Using the functions from today, create the following table to answer our ultimate question:
Are the temperatures inside the barns milder than outside?

```
# A tibble: 8 × 4
# Groups:   barn, season [4]
  barn      season location avg_temp
  <chr>     <chr>  <chr>       <dbl>
1 sp_needs  winter inside       7.87
2 sp_needs  winter outside     -5.90
3 sp_needs  summer inside      20.5
4 sp_needs  summer outside     21.9
5 lactating winter inside       7.62
6 lactating winter outside     -5.88
7 lactating summer inside      20.3
8 lactating summer outside     21.8
```

Your turn!

Using the functions from today, create the following table to answer our ultimate question:
Are the temperatures inside the barns milder than outside?

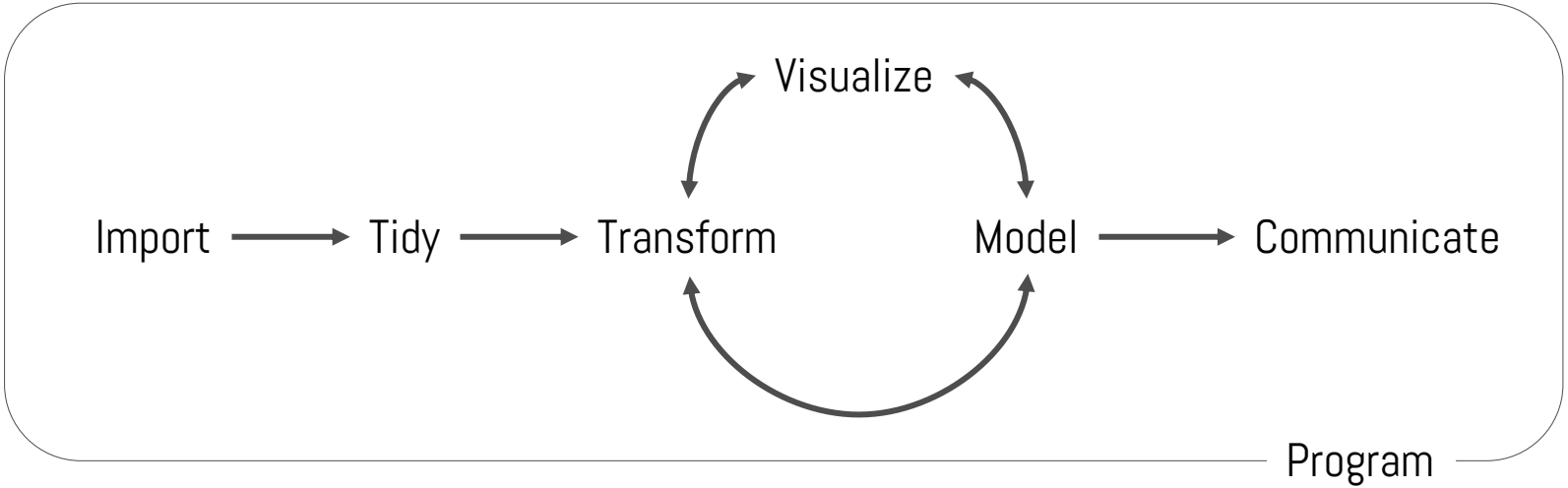
```
# A tibble: 8 × 4
# Groups:   barn, season [4]
  barn      season location avg_temp
  <chr>     <chr>  <chr>       <dbl>
1 sp_needs  winter inside       7.87
2 sp_needs  winter outside     -5.90
3 sp_needs  summer inside      20.5
4 sp_needs  summer outside     21.9
5 lactating winter inside       7.62
6 lactating winter outside     -5.88
7 lactating summer inside      20.3
8 lactating summer outside     21.8
```

Yes!*

*I'll leave it up to your curiosity to check the statistical significance ☺

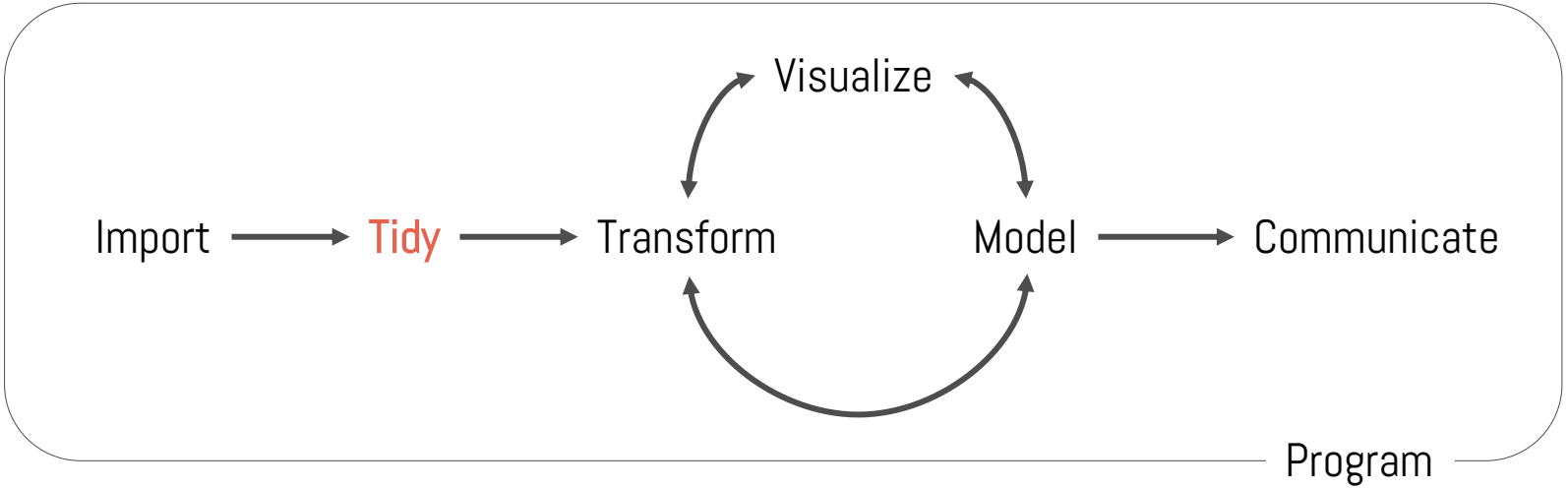
Tidy data

tidyverse



Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

tidyverse



Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Tidy data

Remember this?

```
# A tibble: 124,744 × 6
   date       time    barn      location    rh  temp
   <date>     <time>  <chr>     <chr>    <dbl> <dbl>
 1 2022-01-01 11'58" lactating inside       74  7.74
 2 2022-01-01 11'58" lactating outside      87  2.5
 3 2022-01-01 11'58" sp_needs  inside       78 10.1
 4 2022-01-01 11'58" sp_needs  outside      87  2.5
 5 2022-01-01 26'58" lactating inside       74  8.31
 6 2022-01-01 26'58" lactating outside      87  2.5
 7 2022-01-01 26'58" sp_needs  inside       77  9.95
 8 2022-01-01 26'58" sp_needs  outside      87  2.5
 9 2022-01-01 41'58" lactating inside       74  8.89
10 2022-01-01 41'58" lactating outside      87  2.5
```

Tidy data

It came from this:

```
# A tibble: 62,372 × 14
```

	date	time	barn	sensor_1	sensor_2	sensor_3	sensor_4	sensor_5	sensor_6	sensor_7	sensor_8	rh	outside_temp	outside_rh
	<date>	<time>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	2022-01-01	00:11:58	lactating	9.2	8.8	8.1	5.8	8.2	7.1	8.6	6.1	74	2.5	87
2	2022-01-01	00:26:58	lactating	9.8	9.2	8.7	6.2	8.7	8	9.1	6.8	74	2.5	87
3	2022-01-01	00:41:58	lactating	10.5	9.8	9.3	6.8	9.4	8.6	9.3	7.4	74	2.5	87
4	2022-01-01	00:56:58	lactating	10.1	9.3	8.7	5.7	8.8	7.4	9.2	7	74	2.6	87
5	2022-01-01	01:11:58	lactating	10	9.4	8.8	6.6	8.9	8.2	9.7	7.2	75	2.8	87
6	2022-01-01	01:26:58	lactating	9.2	8.6	9.1	6	8.9	7.4	9.4	7.1	74	2.9	87
7	2022-01-01	01:41:58	lactating	9.6	8.8	8.7	6.1	9.1	7.5	9.3	7.1	75	3	87
8	2022-01-01	01:56:58	lactating	10.1	9.3	9.1	6.8	9.1	7.8	9.1	7.1	75	3.1	87
9	2022-01-01	02:11:58	lactating	10.2	9.6	9.2	6.5	9.1	7.9	9.5	7.5	75	3	87
10	2022-01-01	02:26:58	lactating	10.2	9.5	8.9	6.7	9.2	7.7	8.9	7	75	3	87

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Tidy data

It came from this:

```
# A tibble: 62,372 × 14
```

	date	time	barn	sensor_1	sensor_2	sensor_3	sensor_4	sensor_5	sensor_6	sensor_7	sensor_8	rh	outside_temp	outside_rh
	<date>	<time>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	2022-01-01	00:11:58	lactating	9.2	8.8	8.1	5.8	8.2	7.1	8.6	6.1	74	2.5	87
2	2022-01-01	00:26:58	lactating	9.8	9.2	8.7	6.2	8.7	8	9.1	6.8	74	2.5	87
3	2022-01-01	00:41:58	lactating	10.5	9.8	9.3	6.8	9.4	8.6	9.3	7.4	74	2.5	87
4	2022-01-01	00:56:58	lactating	10.1	9.3	8.7	5.7	8.8	7.4	9.2	7	74	2.6	87
5	2022-01-01	01:11:58	lactating	10	9.4	8.8	6.6	8.9	8.2	9.7	7.2	75	2.8	87
6	2022-01-01	01:26:58	lactating	9.2	8.6	9.1	6	8.9	7.4	9.4	7.1	74	2.9	87
7	2022-01-01	01:41:58	lactating	9.6	8.8	8.7	6.1	9.1	7.5	9.3	7.1	75	3	87
8	2022-01-01	01:56:58	lactating	10.1	9.3	9.1	6.8	9.1	7.8	9.1	7.1	75	3.1	87
9	2022-01-01	02:11:58	lactating	10.2	9.6	9.2	6.5	9.1	7.9	9.5	7.5	75	3	87
10	2022-01-01	02:26:58	lactating	10.2	9.5	8.9	6.7	9.2	7.7	8.9	7	75	3	87

Are the temperatures inside the barns milder than outside?

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Tidy Data

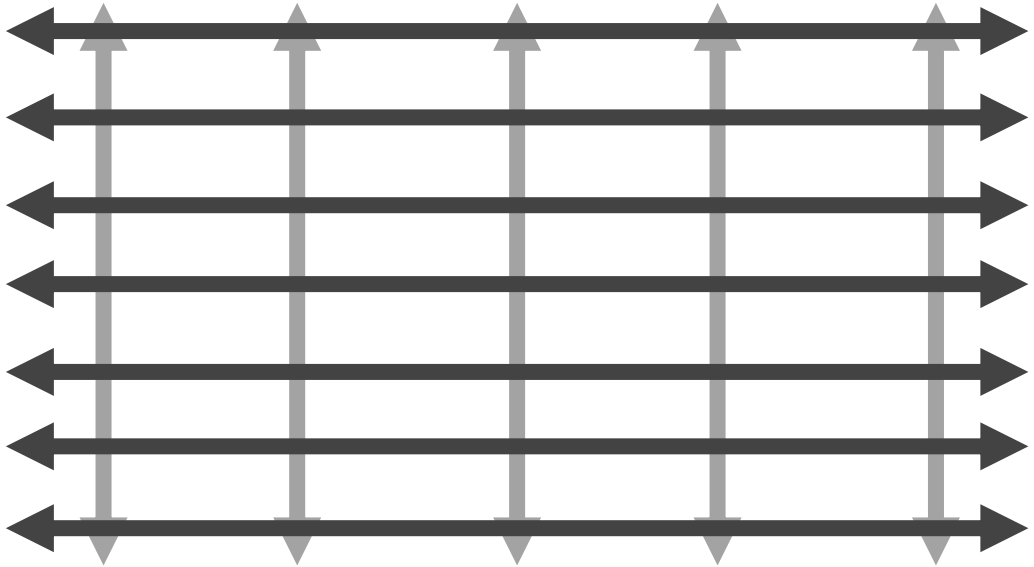
"Data comes in many formats, but R prefers just one: tidy data."

- Garrett Grolemund

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Tidy Data

Date	Report #	Sample ID	Comp 1	Comp 2



A dataset is **tidy** if:
Each variable is in its own column
Each observation is in its own row
Each value is in its own cell

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

tidyverse

An R package that serves as a shortcut for installing and loading components of the tidyverse.

```
install.packages("tidyverse")
```

Does the equivalent of

```
install.packages("ggplot2")
install.packages("tibble")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("dplyr")
install.packages("stringr")
install.packages("forcats")
install.packages("broom")
install.packages("dbplyr")
install.packages("haven")
install.packages("hms")
install.packages("httr")
...
```

tidyverse

An R package that serves as a shortcut for installing and loading components of the tidyverse.

```
install.packages("tidyverse")
```

Does the equivalent of

```
install.packages("ggplot2")
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install.packages("forcats")
install.packages("broom")
install.packages("dbplyr")
install.packages("haven")
install.packages("hms")
install.packages("httr")
...
```

```
library("tidyverse")
```

Does the equivalent of

```
library("ggplot2")
library("tibble")
library("tidyr")
library("readr")
library("purrr")
library("dplyr")
library("stringr")
library("forcats")
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

tidyr verbs

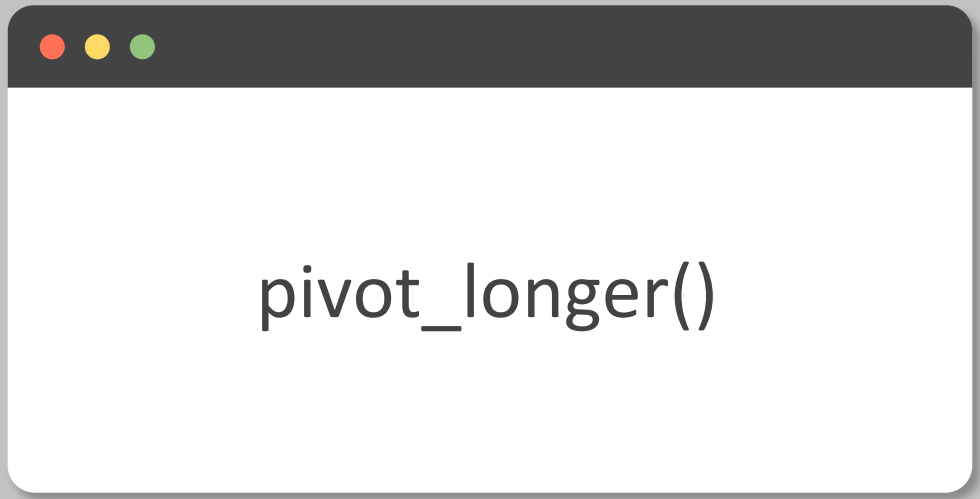
Move values into column names with **pivot_wider()**

Move column names into values with **pivot_longer()**

Split a column with **separate()**

Unite columns with **unite()**

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz


pivot_longer()

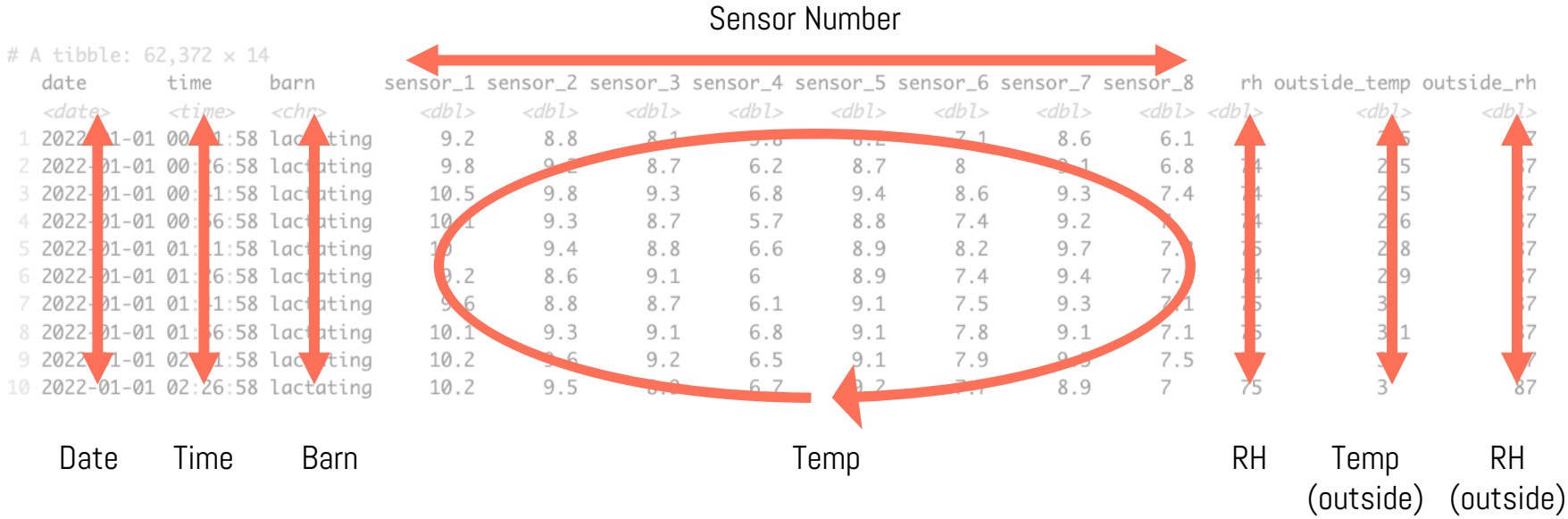
pivot_longer()

What are the variables here?

```
# A tibble: 62,372 × 14
   date       time     barn      sensor_1 sensor_2 sensor_3 sensor_4 sensor_5 sensor_6 sensor_7 sensor_8    rh outside_temp outside_rh
   <date>     <time>   <chr>        <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <dbl>        <dbl>      <dbl>
 1 2022-01-01 00:11:58 lactating      9.2      8.8      8.1      5.8      8.2      7.1      8.6      6.1    74          2.5         87
 2 2022-01-01 00:26:58 lactating      9.8      9.2      8.7      6.2      8.7      8        9.1      6.8    74          2.5         87
 3 2022-01-01 00:41:58 lactating     10.5      9.8      9.3      6.8      9.4      8.6      9.3      7.4    74          2.5         87
 4 2022-01-01 00:56:58 lactating     10.1      9.3      8.7      5.7      8.8      7.4      9.2      7      74          2.6         87
 5 2022-01-01 01:11:58 lactating     10        9.4      8.8      6.6      8.9      8.2      9.7      7.2    75          2.8         87
 6 2022-01-01 01:26:58 lactating      9.2      8.6      9.1      6        8.9      7.4      9.4      7.1    74          2.9         87
 7 2022-01-01 01:41:58 lactating      9.6      8.8      8.7      6.1      9.1      7.5      9.3      7.1    75          3           87
 8 2022-01-01 01:56:58 lactating     10.1      9.3      9.1      6.8      9.1      7.8      9.1      7.1    75          3.1         87
 9 2022-01-01 02:11:58 lactating     10.2      9.6      9.2      6.5      9.1      7.9      9.5      7.5    75          3           87
10 2022-01-01 02:26:58 lactating     10.2      9.5      8.9      6.7      9.2      7.7      8.9      7      75          3           87
```

pivot_longer()

What are the variables here?



Your turn!

On a sheet of paper, draw how the env_data dataset would look like if it had the same values grouped into only 8 columns: date, time, barn, sensor, temp, rh, outside_temp, outside_rh.

Your table should only show the first 8 lines.

Your turn!

```
# A tibble: 62,372 × 14
   date       time     barn      sensor_1 sensor_2 sensor_3 sensor_4 sensor_5 sensor_6 sensor_7 sensor_8    rh outside_temp outside_rh
   <date>     <time>   <chr>        <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <dbl>        <dbl>      <dbl>
 1 2022-01-01 00:11:58 lactating      9.2      8.8      8.1      5.8      8.2      7.1      8.6      6.1    74          2.5         87
 2 2022-01-01 00:26:58 lactating      9.8      9.2      8.7      6.2      8.7      8        9.1      6.8    74          2.5         87
 3 2022-01-01 00:41:58 lactating     10.5      9.8      9.3      6.8      9.4      8.6      9.3      7.4    74          2.5         87
 4 2022-01-01 00:56:58 lactating     10.1      9.3      8.7      5.7      8.8      7.4      9.2      7      74          2.6         87
 5 2022-01-01 01:11:58 lactating     10        9.4      8.8      6.6      8.9      8.2      9.7      7.2    75          2.8         87
 6 2022-01-01 01:26:58 lactating      9.2      8.6      9.1      6        8.9      7.4      9.4      7.1    74          2.9         87
 7 2022-01-01 01:41:58 lactating      9.6      8.8      8.7      6.1      9.1      7.5      9.3      7.1    75          3           87
 8 2022-01-01 01:56:58 lactating     10.1      9.3      9.1      6.8      9.1      7.8      9.1      7.1    75          3.1         87
 9 2022-01-01 02:11:58 lactating     10.2      9.6      9.2      6.5      9.1      7.9      9.5      7.5    75          3           87
10 2022-01-01 02:26:58 lactating     10.2      9.5      8.9      6.7      9.2      7.7      8.9      7      75          3           87

# A tibble: 498,976 × 8
   date       time   barn         rh outside_temp outside_rh sensor   temp
   <date>     <time> <chr>     <dbl>        <dbl>      <dbl> <chr>   <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 sensor_1  9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 sensor_2  8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 sensor_3  8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 sensor_4  5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 sensor_5  8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 sensor_6  7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 sensor_7  8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 sensor_8  6.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Your turn!

```
# A tibble: 62,372 × 14
   date       time     barn      sensor_1 sensor_2 sensor_3 sensor_4 sensor_5 sensor_6 sensor_7 sensor_8    rh outside_temp outside_rh
   <date>     <time>   <chr>        <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <dbl>        <dbl>      <dbl>
 1 2022-01-01 00:11:58 lactating      9.2      8.8      8.1      5.8      8.2      7.1      8.6      6.1    74          2.5         87
 2 2022-01-01 00:26:58 lactating      9.8      9.2      8.7      6.2      8.7      8        9.1      6.8    74          2.5         87
 3 2022-01-01 00:41:58 lactating     10.5      9.8      9.3      6.8      9.4      8.6      9.3      7.4    74          2.5         87
 4 2022-01-01 00:56:58 lactating     10.1      9.3      8.7      5.7      8.8      7.4      9.2      7      74          2.6         87
 5 2022-01-01 01:11:58 lactating     10        9.4      8.8      6.6      8.9      8.2      9.7      7.2    75          2.8         87
 6 2022-01-01 01:26:58 lactating      9.2      8.6      9.1      6        8.9      7.4      9.4      7.1    74          2.9         87
 7 2022-01-01 01:41:58 lactating      9.6      8.8      8.7      6.1      9.1      7.5      9.3      7.1    75          3           87
 8 2022-01-01 01:56:58 lactating     10.1      9.3      9.1      6.8      9.1      7.8      9.1      7.1    75          3.1         87
 9 2022-01-01 02:11:58 lactating     10.2      9.6      9.2      6.5      9.1      7.9      9.5      7.5    75          3           87
10 2022-01-01 02:26:58 lactating     10.2      9.5      8.9      6.7      9.2      7.7      8.9      7      75          3           87

# A tibble: 498,976 × 8
   date       time   barn         rh outside_temp outside_rh sensor   temp
   <date>     <time> <chr>     <dbl>        <dbl>      <dbl> <chr>   <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 sensor_1  9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 sensor_2  8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 sensor_3  8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 sensor_4  5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 sensor_5  8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 sensor_6  7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 sensor_7  8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 sensor_8  6.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Your turn!

```
# A tibble: 62,372 × 14
   date       time     barn      sensor_1 sensor_2 sensor_3 sensor_4 sensor_5 sensor_6 sensor_7 sensor_8    rh outside_temp outside_rh
   <date>     <time>   <chr>        <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <dbl>        <dbl>      <dbl>
 1 2022-01-01 00:11:58 lactating      9.2      8.8      8.1      5.8      8.2      7.1      8.6      6.1    74          2.5         87
 2 2022-01-01 00:26:58 lactating      9.8      9.2      8.7      6.2      8.7      8        9.1      6.8    74          2.5         87
 3 2022-01-01 00:41:58 lactating     10.5      9.8      9.3      6.8      9.4      8.6      9.3      7.4    74          2.5         87
 4 2022-01-01 00:56:58 lactating     10.1      9.3      8.7      5.7      8.8      7.4      9.2      7      74          2.6         87
 5 2022-01-01 01:11:58 lactating     10        9.4      8.8      6.6      8.9      8.2      9.7      7.2    75          2.8         87
 6 2022-01-01 01:26:58 lactating      9.2      8.6      9.1      6        8.9      7.4      9.4      7.1    74          2.9         87
 7 2022-01-01 01:41:58 lactating      9.6      8.8      8.7      6.1      9.1      7.5      9.3      7.1    75          3           87
 8 2022-01-01 01:56:58 lactating     10.1      9.3      9.1      6.8      9.1      7.8      9.1      7.1    75          3.1         87
 9 2022-01-01 02:11:58 lactating     10.2      9.6      9.2      6.5      9.1      7.9      9.5      7.5    75          3           87
10 2022-01-01 02:26:58 lactating     10.2      9.5      8.9      6.7      9.2      7.7      8.9      7      75          3           87
```

```
# A tibble: 498,976 × 8
   date       time     barn         rh outside_temp outside_rh sensor   temp
   <date>     <time>   <chr>     <dbl>        <dbl>      <dbl> <chr>   <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 sensor_1  9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 sensor_2  8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 sensor_3  8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 sensor_4  5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 sensor_5  8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 sensor_6  7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 sensor_7  8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 sensor_8  6.1
```

tidyr::pivot_longer()

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Your turn!

```
# A tibble: 62,372 × 14
```

	date	time	barn	sensor_1	sensor_2	sensor_3	sensor_4	sensor_5	sensor_6	sensor_7	sensor_8	rh	outside_temp	outside_rh
	<date>	<time>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	2022-01-01	00:11:58	lactating	9.2	8.8	8.1	5.8	8.2	7.1	8.6	6.1	74	2.5	87
2	2022-01-01	00:26:58	lactating	9.8	9.2	8.7	6.2	8.7	8	9.1	6.8	74	2.5	87
3	2022-01-01	00:41:58	lactating	10.5	9.8	9.3	6.8	9.4	8.6	9.3	7.4	74	2.5	87
4	2022-01-01	00:56:58	lactating	10.1	9.3	8.7	5.7	8.8	7.4	9.2	7	74	2.6	87
5	2022-01-01	01:11:58	lactating	10	9.4	8.8	6.6	8.9	8.2	9.7	7.2	75	2.8	87
6	2022-01-01	01:26:58	lactating	9.2	8.6	9.1	6	8.9	7.4	9.4	7.1	74	2.9	87
7	2022-01-01	01:41:58	lactating	9.6	8.8	8.7	6.1	9.1	7.5	9.3	7.1	75	3	87
8	2022-01-01	01:56:58	lactating	10.1	9.3	9.1	6.8	9.1	7.8	9.1	7.1	75	3.1	87
9	2022-01-01	02:11:58	lactating	10.2	9.6	9.2	6.5	9.1	7.9	9.5	7.5	75	3	87
10	2022-01-01	02:26:58	lactating	10.2	9.5	8.9	6.7	9.2	7.7	8.9	7	75	3	87

```
# A tibble: 498,976 × 8
```

	date	time	barn	rh	outside_temp	outside_rh	sensor	temp
	<date>	<time>	<chr>	<dbl>	<dbl>	<dbl>	<chr>	<dbl>
1	2022-01-01	11'58"	lactating	74	2.5	87	sensor_1	9.2
2	2022-01-01	11'58"	lactating	74	2.5	87	sensor_2	8.8
3	2022-01-01	11'58"	lactating	74	2.5	87	sensor_3	8.1
4	2022-01-01	11'58"	lactating	74	2.5	87	sensor_4	5.8
5	2022-01-01	11'58"	lactating	74	2.5	87	sensor_5	8.2
6	2022-01-01	11'58"	lactating	74	2.5	87	sensor_6	7.1
7	2022-01-01	11'58"	lactating	74	2.5	87	sensor_7	8.6
8	2022-01-01	11'58"	lactating	74	2.5	87	sensor_8	6.1

```
env_data_raw %>%
    pivot_longer(cols = ...,
                 values_to = "temp",
                 names_to = "sensor")
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Your turn!

```
# A tibble: 62,372 × 14
   date       time     barn     sensor_1 sensor_2 sensor_3 sensor_4 sensor_5 sensor_6 sensor_7 sensor_8    rh outside_temp outside_rh
   <date>     <time>   <chr>       <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <dbl>        <dbl>      <dbl>
 1 2022-01-01 00:11:58 lactating     9.2      8.8      8.1      5.8      8.2      7.1      8.6      6.1    74          2.5         87
 2 2022-01-01 00:26:58 lactating     9.8      9.2      8.7      6.2      8.7      8        9.1      6.8    74          2.5         87
 3 2022-01-01 00:41:58 lactating    10.5      9.8      9.3      6.8      9.4      8.6      9.3      7.4    74          2.5         87
 4 2022-01-01 00:56:58 lactating    10.1      9.3      8.7      5.7      8.8      7.4      9.2      7      74          2.6         87
 5 2022-01-01 01:11:58 lactating    10        9.4      8.8      6.6      8.9      8.2      9.7      7.2    75          2.8         87
 6 2022-01-01 01:26:58 lactating     9.2      8.6      9.1      6        8.9      7.4      9.4      7.1    74          2.9         87
 7 2022-01-01 01:41:58 lactating     9.6      8.8      8.7      6.1      9.1      7.5      9.3      7.1    75          3           87
 8 2022-01-01 01:56:58 lactating    10.1      9.3      9.1      6.8      9.1      7.8      9.1      7.1    75          3.1         87
 9 2022-01-01 02:11:58 lactating    10.2      9.6      9.2      6.5      9.1      7.9      9.5      7.5    75          3           87
10 2022-01-01 02:26:58 lactating    10.2      9.5      8.9      6.7      9.2      7.7      8.9      7      75          3           87

# A tibble: 498,976 × 8
   date       time   barn        rh outside_temp outside_rh sensor   temp
   <date>     <time> <chr>    <dbl>        <dbl>      <dbl> <chr>   <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 sensor_1  9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 sensor_2  8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 sensor_3  8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 sensor_4  5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 sensor_5  8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 sensor_6  7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 sensor_7  8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 sensor_8  6.1
```

```
env_data_raw %>%
    pivot_longer(cols = starts_with("sensor_"),
                 values_to = "temp",
                 names_to = "sensor")
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

pivot_longer()

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"),
               values_to = "temp",
               names_to = "sensor",
               names_prefix = "sensor_")
```

```
# A tibble: 498,976 × 8
   date       time    barn         rh outside_temp outside_rh sensor  temp
   <date>     <time>  <chr>     <dbl>        <dbl>      <dbl> <chr>  <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 1        9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 2        8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 3        8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 4        5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 5        8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 6        7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 7        8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 8        6.1
```

pivot_longer()

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"),
               values_to = "temp",
               names_to = "sensor",
               names_prefix = "sensor_")
```

```
# A tibble: 498,976 × 8
   date       time   barn         rh outside_temp outside_rh sensor  temp
   <date>     <time> <chr>     <dbl>        <dbl>      <dbl> <chr>  <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 1        9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 2        8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 3        8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 4        5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 5        8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 6        7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 7        8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 8        6.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

pivot_longer()

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"),
               values_to = "temp",
               names_to = "sensor",
               names_prefix = "sensor_")
```

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"),
               values_to = "temp",
               names_to = "sensor",
               names_prefix = "sensor_",
               names_transform = list(sensor = as.integer))
```

```
# A tibble: 498,976 × 8
   date       time     barn         rh outside_temp outside_rh sensor  temp
   <date>     <time>   <chr>     <dbl>        <dbl>      <dbl> <chr>  <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 1        9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 2        8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 3        8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 4        5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 5        8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 6        7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 7        8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 8        6.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

pivot_longer()

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"),
               values_to = "temp",
               names_to = "sensor",
               names_prefix = "sensor_")
```

```
# A tibble: 498,976 × 8
   date       time     barn        rh outside_temp outside_rh sensor  temp
   <date>     <time>   <chr>    <dbl>        <dbl>      <dbl> <chr>  <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87 1        9.2
 2 2022-01-01 11'58" lactating    74          2.5         87 2        8.8
 3 2022-01-01 11'58" lactating    74          2.5         87 3        8.1
 4 2022-01-01 11'58" lactating    74          2.5         87 4        5.8
 5 2022-01-01 11'58" lactating    74          2.5         87 5        8.2
 6 2022-01-01 11'58" lactating    74          2.5         87 6        7.1
 7 2022-01-01 11'58" lactating    74          2.5         87 7        8.6
 8 2022-01-01 11'58" lactating    74          2.5         87 8        6.1
```

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"),
               values_to = "temp",
               names_to = "sensor",
               names_prefix = "sensor_",
               names_transform = list(sensor = as.integer))
```

```
# A tibble: 498,976 × 8
   date       time     barn        rh outside_temp outside_rh sensor  temp
   <date>     <time>   <chr>    <dbl>        <dbl>      <dbl>  <int> <dbl>
 1 2022-01-01 11'58" lactating    74          2.5         87      1   9.2
 2 2022-01-01 11'58" lactating    74          2.5         87      2   8.8
 3 2022-01-01 11'58" lactating    74          2.5         87      3   8.1
 4 2022-01-01 11'58" lactating    74          2.5         87      4   5.8
 5 2022-01-01 11'58" lactating    74          2.5         87      5   8.2
 6 2022-01-01 11'58" lactating    74          2.5         87      6   7.1
 7 2022-01-01 11'58" lactating    74          2.5         87      7   8.6
 8 2022-01-01 11'58" lactating    74          2.5         87      8   6.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Your turn!

Using the tidyverbs from last session, summarize env_data_raw to show **date, time, barn, rh, outside_rh, and avg_temp** (the average temperature across all sensors per day, time and barn).

```
env_data_raw %>%
 pivot_longer(cols = starts_with("sensor_"),
              values_to = "temp",
              names_to = "sensor",
              names_prefix = "sensor_",
              names_transform = list(sensor = as.integer)) %>%
 ...
```

Your turn!

Using the tidyverbs from last session, summarize env_data_raw to show **date, time, barn, rh, outside_rh, and avg_temp** (the average temperature across all sensors per day, time and barn).

```
env_data_raw %>%
 pivot_longer(cols = starts_with("sensor_"),
              values_to = "temp",
              names_to = "sensor",
              names_prefix = "sensor_",
              names_transform = list(sensor = as.integer)) %>%
 group_by(date, time, barn, rh, outside_rh, outside_temp) %>%
 summarize(avg_temp = mean(temp))
```

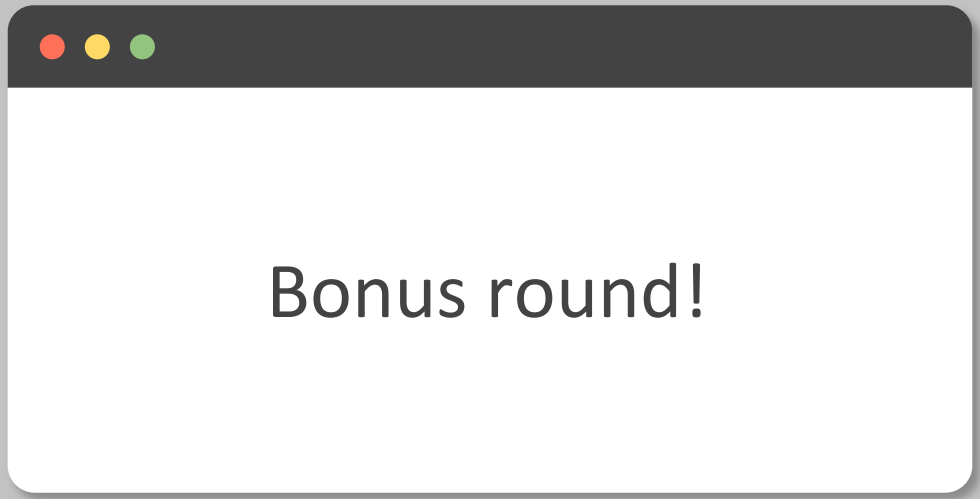
```
# A tibble: 62,372 × 6
# Groups:   date, time, barn, rh [62,372]
   date       time     barn         rh outside_rh avg_temp
   <date>     <time>   <chr>     <dbl>      <dbl>    <dbl>
 1 2022-01-01 00:11:58 lactating    74         87     7.74
 2 2022-01-01 00:11:58 sp_needs     78         87    10.1
 3 2022-01-01 00:26:58 lactating    74         87     8.31
 4 2022-01-01 00:26:58 sp_needs     77         87     9.95
 5 2022-01-01 00:41:58 lactating    74         87     8.89
 6 2022-01-01 00:41:58 sp_needs     77         87     9.98
 7 2022-01-01 00:56:58 lactating    74         87     8.28
 8 2022-01-01 00:56:58 sp_needs     78         87     9.94
 9 2022-01-01 01:11:58 lactating    75         87     8.6
10 2022-01-01 01:11:58 sp_needs     78         87     9.93
```

Your turn!

Using the tidyverbs from last session, summarize env_data_raw to show **date, time, barn, rh, outside_rh, and avg_temp** (the average temperature across all sensors per day, time and barn).

```
env_data_raw %>%
 pivot_longer(cols = starts_with("sensor_"),
              values_to = "temp",
              names_to = "sensor",
              names_prefix = "sensor_",
              names_transform = list(sensor = as.integer)) %>%
 group_by(date, time, barn, rh, outside_rh , outside_temp) %>%
 summarize(avg_temp = mean(temp))
```

```
# A tibble: 62,372 × 7
# Groups:   date, time, barn, rh, outside_rh [62,372]
   date       time     barn       rh outside_rh outside_temp avg_temp
   <date>     <time>   <chr>   <dbl>      <dbl>        <dbl>    <dbl>
 1 2022-01-01 00:11:58 lactating    74         87          2.5     7.74
 2 2022-01-01 00:11:58 sp_needs     78         87          2.5    10.1
 3 2022-01-01 00:26:58 lactating    74         87          2.5     8.31
 4 2022-01-01 00:26:58 sp_needs     77         87          2.5     9.95
 5 2022-01-01 00:41:58 lactating    74         87          2.5     8.89
 6 2022-01-01 00:41:58 sp_needs     77         87          2.5     9.98
 7 2022-01-01 00:56:58 lactating    74         87          2.6     8.28
 8 2022-01-01 00:56:58 sp_needs     78         87          2.6     9.94
```


Bonus round!

Bonus round!

Using pivot_longer(), create a table that shows **date**, **time**, **barn**, **location**, **sensor_type**, **value**, where:

1. **date, time,** and **barn** remains the same
2. **location** indicates if the sensor was inside or outside the barn
3. **sensor** indicates if the sensor was measuring either **rh** or **temp**,
4. **value** contains their respective measurements

```
# A tibble: 62,372 × 7
# Groups:   date, time, barn, rh, outside_rh [62,372]
   date       time     barn         rh outside_rh outside_temp avg_temp
   <date>     <time>   <chr>     <dbl>      <dbl>        <dbl>    <dbl>
 1 2022-01-01 00:11:58 lactating    74         87          2.5     7.74
 2 2022-01-01 00:11:58 sp_needs     78         87          2.5    10.1
 3 2022-01-01 00:26:58 lactating    74         87          2.5     8.31
 4 2022-01-01 00:26:58 sp_needs     77         87          2.5     9.95
 5 2022-01-01 00:41:58 lactating    74         87          2.5     8.89
 6 2022-01-01 00:41:58 sp_needs     77         87          2.5     9.98
 7 2022-01-01 00:56:58 lactating    74         87          2.6     8.28
 8 2022-01-01 00:56:58 sp_needs     78         87          2.6     9.94
```

```
# A tibble: 249,488 × 6
# Groups:   date, time, barn [62,372]
   date       time     barn      location sensor_type value
   <date>     <time>   <chr>     <chr>    <chr>       <dbl>
 1 2022-01-01 11'58" lactating inside    rh           74
 2 2022-01-01 11'58" lactating outside   rh           87
 3 2022-01-01 11'58" lactating outside   temp          2.5
 4 2022-01-01 11'58" lactating inside    temp          7.74
 5 2022-01-01 11'58" sp_needs  inside    rh           78
 6 2022-01-01 11'58" sp_needs  outside   rh           87
 7 2022-01-01 11'58" sp_needs  outside   temp          2.5
 8 2022-01-01 11'58" sp_needs  inside    temp         10.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Bonus round!

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"), values_to = "temp", names_to = "sensor", names_prefix = "sensor_",
               names_transform = list(sensor = as.integer)) %>%
  group_by(date, time, barn, rh, outside_rh, outside_temp) %>%
  summarize(avg_temp = mean(temp)) %>%
  rename(inside_rh = rh,
         inside_temp = avg_temp)
```

```
# A tibble: 62,372 × 7
# Groups:   date, time, barn, inside_rh, outside_rh [62,372]
   date       time     barn      inside_rh outside_rh outside_temp inside_temp
   <date>     <time>   <chr>         <dbl>      <dbl>        <dbl>       <dbl>
 1 2022-01-01 00:11:58 lactating        74         87          2.5        7.74
 2 2022-01-01 00:11:58 sp_needs         78         87          2.5       10.1
 3 2022-01-01 00:26:58 lactating        74         87          2.5        8.31
 4 2022-01-01 00:26:58 sp_needs         77         87          2.5        9.95
 5 2022-01-01 00:41:58 lactating        74         87          2.5        8.89
 6 2022-01-01 00:41:58 sp_needs         77         87          2.5        9.98
 7 2022-01-01 00:56:58 lactating        74         87          2.6        8.28
 8 2022-01-01 00:56:58 sp_needs         78         87          2.6        9.94
```

Bonus round!

```
env_data_raw %>%
  pivot_longer(cols = starts_with("sensor_"), values_to = "temp", names_to = "sensor", names_prefix = "sensor_",
               names_transform = list(sensor = as.integer)) %>%
  group_by(date, time, barn, rh, outside_rh, outside_temp) %>%
  summarize(avg_temp = mean(temp)) %>%
  rename(inside_rh = rh,
         inside_temp = avg_temp) %>%
  pivot_longer(contains("side"),
               names_to = c("location", "sensor_type"),
               names_sep = "_",
               values_to = "value")
```

```
# A tibble: 62,372 × 7
# Groups:   date, time, barn, inside_rh, outside_rh [62,372]
   date       time     barn      inside_rh outside_rh outside_temp inside_temp
   <date>     <time>   <chr>         <dbl>      <dbl>        <dbl>       <dbl>
 1 2022-01-01 00:11:58 lactating        74         87          2.5        7.74
 2 2022-01-01 00:11:58 sp_needs         78         87          2.5       10.1
 3 2022-01-01 00:26:58 lactating        74         87          2.5        8.31
 4 2022-01-01 00:26:58 sp_needs         77         87          2.5        9.95
 5 2022-01-01 00:41:58 lactating        74         87          2.5        8.89
 6 2022-01-01 00:41:58 sp_needs         77         87          2.5        9.98
 7 2022-01-01 00:56:58 lactating        74         87          2.6        8.28
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```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Bonus round!

```
env_data_raw %>%
 pivot_longer(cols = starts_with("sensor_"), values_to = "temp", names_to = "sensor", names_prefix = "sensor_",
              names_transform = list(sensor = as.integer)) %>%
 group_by(date, time, barn, rh, outside_rh, outside_temp) %>%
 summarize(avg_temp = mean(temp)) %>%
 rename(inside_rh = rh,
        inside_temp = avg_temp) %>%
 pivot_longer(contains("side"),
              names_to = c("location", "sensor_type"),
              names_sep = "_",
              values_to = "value")
```

```
# A tibble: 249,488 × 6
# Groups:   date, time, barn [62,372]
  date       time     barn      location sensor_type value
  <date>     <time>   <chr>     <chr>    <chr>       <dbl>
1 2022-01-01 11'58" lactating inside   rh          74
2 2022-01-01 11'58" lactating outside  rh          87
3 2022-01-01 11'58" lactating outside  temp         2.5
4 2022-01-01 11'58" lactating inside   temp         7.74
5 2022-01-01 11'58" sp_needs  inside   rh          78
6 2022-01-01 11'58" sp_needs  outside  rh          87
7 2022-01-01 11'58" sp_needs  outside  temp         2.5
8 2022-01-01 11'58" sp_needs  inside   temp        10.1
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Bonus round!

```
env_data_raw %>%
 pivot_longer(cols = starts_with("sensor_"), values_to = "temp", names_to = "sensor", names_prefix = "sensor_",
              names_transform = list(sensor = as.integer)) %>%
 group_by(date, time, barn, rh, outside_rh, outside_temp) %>%
 summarize(avg_temp = mean(temp)) %>%
 rename(inside_rh = rh,
        inside_temp = avg_temp) %>%
 pivot_longer(contains("side"),
              names_to = c("location", "sensor_type"),
              names_sep = "_",
              values_to = "value")
```

```
# A tibble: 249,488 × 6
# Groups:   date, time, barn [62,372]
  date       time     barn      location sensor_type value
  <date>     <time>   <chr>     <chr>    <chr>       <dbl>
1 2022-01-01 11'58" lactating inside    rh           74
2 2022-01-01 11'58" lactating outside   rh           87
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4 2022-01-01 11'58" lactating inside    temp          7.74
5 2022-01-01 11'58" sp_needs  inside    rh           78
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7 2022-01-01 11'58" sp_needs  outside   temp          2.5
8 2022-01-01 11'58" sp_needs  inside    temp         10.1
```
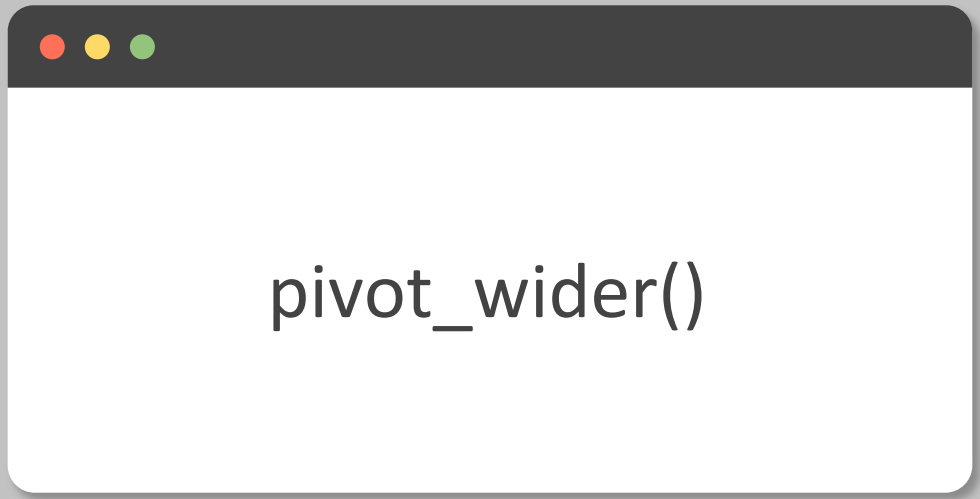

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz


pivot_wider()

pivot_wider()

"Shortens" data, decreasing the number of rows and increasing the number of columns. It's the opposite of pivot_longer().

```
data %>% pivot_wider(names_from = column1, values_from = column2)
```

data	dataframe to be transformed
column1	column to use for keys (values in it become new column names)
column2	column to use for values (becomes the values in the new columns)

Your turn!

Use pivot_wider() to continue reorganizing env_data_raw by transforming **sensor_type** and **value** into two columns (**rh** and **temp**) with their respective values

```
# A tibble: 124,744 × 6
# Groups:   date, time, barn [62,372]
   date       time   barn      location    rh   temp
   <date>     <time> <chr>     <chr>    <dbl> <dbl>
 1 2022-01-01 11'58" lactating inside       74  7.74
 2 2022-01-01 11'58" lactating outside      87  2.5
 3 2022-01-01 11'58" sp_needs  inside       78 10.1
 4 2022-01-01 11'58" sp_needs  outside      87  2.5
 5 2022-01-01 26'58" lactating inside       74  8.31
 6 2022-01-01 26'58" lactating outside      87  2.5
 7 2022-01-01 26'58" sp_needs  inside       77  9.95
 8 2022-01-01 26'58" sp_needs  outside      87  2.5
```

Your turn!

Use pivot_wider() to continue reorganizing env_data_raw by transforming **sensor_type** and **value** into two columns (**rh** and **temp**) with their respective values

```
env_data_raw %>%
 pivot_longer(cols = starts_with("sensor_"), values_to = "temp", names_to = "sensor", names_prefix = "sensor_",
              names_transform = list(sensor = as.integer)) %>%
 group_by(date, time, barn, rh, outside_rh, outside_temp) %>%
 summarize(avg_temp = mean(temp)) %>%
 rename(inside_rh = rh,
        inside_temp = avg_temp) %>%
 pivot_longer(contains("side"),
              names_to = c("location", "sensor_type"),
              names_sep = "_",
              values_to = "value") %>%
 pivot_wider(names_from = "sensor_type",
             values_from = "value")
```

```
# A tibble: 124,744 × 6
# Groups:   date, time, barn [62,372]
  date       time   barn      location    rh  temp
  <date>     <time> <chr>     <chr>    <dbl> <dbl>
1 2022-01-01 11'58" lactating inside       74  7.74
2 2022-01-01 11'58" lactating outside      87  2.5
3 2022-01-01 11'58" sp_needs  inside       78 10.1
4 2022-01-01 11'58" sp_needs  outside      87  2.5
5 2022-01-01 26'58" lactating inside       74  8.31
6 2022-01-01 26'58" lactating outside      87  2.5
7 2022-01-01 26'58" sp_needs  inside       77  9.95
8 2022-01-01 26'58" sp_needs  outside      87  2.5
```

Adapted from: https://tidy-ds.wjakethompson.com and https://r4ds.had.co.nz

Lunch