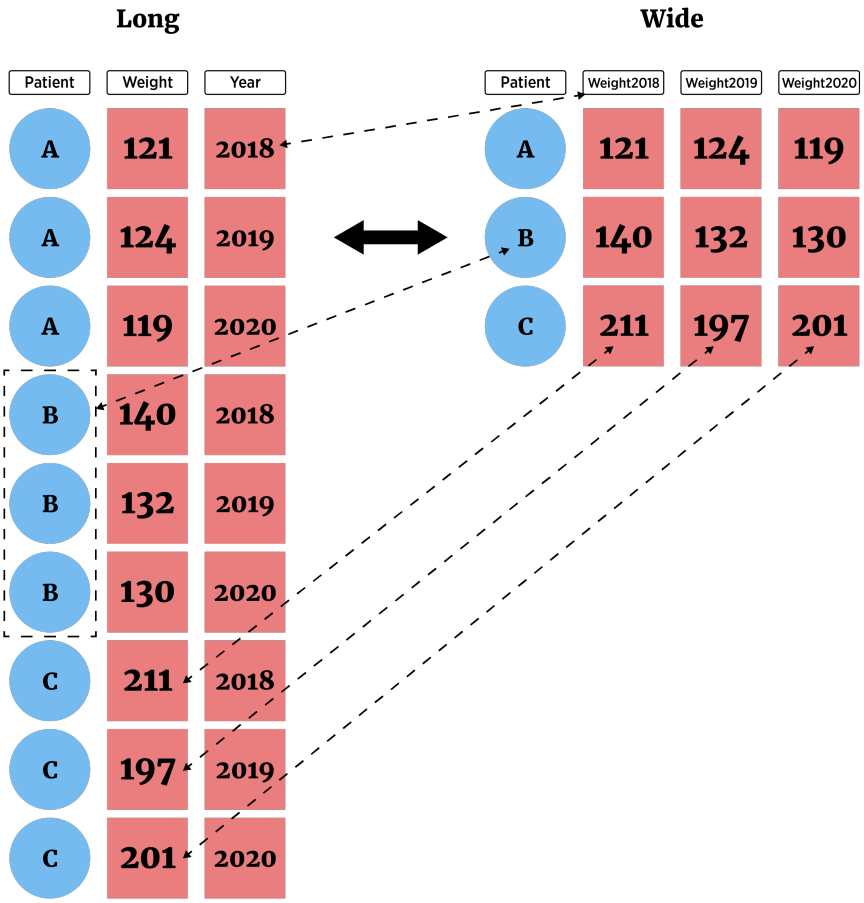
Manipulating Data with `tidyr`

We now have a good handle on common actions we want to take on our data frames. However, we've been treating our data as though it is already in **long format** where each row consists of one observation and each column one variable.

This isn't always the case! Sometimes we have **wide format** data where we may have more than one observation in a given row.



You might see wide data if you deal with pivot tables in excel. It is often a nicer way to *display* data, but almost all of the plotting, summarizing, and modeling we do in statistics expects data to be in long form. Luckily, the `tidyr` package gives us nice functionality for switching between these two forms!

`tidyr` Package

This pacakge allows us to easily manipulate data via

- `pivot_longer()` - lengthens data by increasing the number of rows and decreasing the number of columns
    - Most important as analysis methods often prefer this form
- `pivot_wider()` - widens data by increasing the number of columns and decreasing the number of rows

We'll also look at a couple other functions from `tidyr` that can be useful

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pivot_longer()

Consider the data set called `cityTemps.txt` available via the URL below.

```
library(readr)
```

```
Warning: package 'readr' was built under R version 4.1.3
```

```
temps_data <- read_table(file = "https://www4.stat.ncsu.edu/~online/datasets
```

```
-- Column specification --------------------------------------------------------
cols(
  city = col_character(),
  sun = col_double(),
  mon = col_double(),
  tue = col_double(),
  wed = col_double(),
  thr = col_double(),
  fri = col_double(),
  sat = col_double()
)
```

```
temps_data
```

```
# A tibble: 6 x 8
  city        sun   mon   tue   wed   thr   fri   sat
  <chr>     <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1 atlanta      81    87    83    79    88    91    94
2 baltimore    73    75    70    78    73    75    79
3 charlotte    82    80    75    82    83    88    93
4 denver       72    71    67    68    72    71    58
5 ellington    51    42    47    52    55    56    59
6 frankfort    70    70    72    70    74    74    79
```

This data is in wide format as more than one observation on a city is in each row.

- Switch to 'Long' form with `pivot_longer()`. Checking the help, the major arguments are:
    - `cols` = columns to pivot to longer format (`cols = 2:8`)
    - `names_to` = new name(s) for columns created (`names_to = "day"`)
    - `values_to` = new name(s) for data values (`values_to = "temp"`)

```
library(tidyr)
```

```
Warning: package 'tidyr' was built under R version 4.1.3
```

```
temps_data |>
  pivot_longer(cols = 2:8,
```

```
                names_to = "day",
                values_to = "temp")
```

```
# A tibble: 42 x 3
   city      day    temp
   <chr>     <chr> <dbl>
 1 atlanta   sun      81
 2 atlanta   mon      87
 3 atlanta   tue      83
 4 atlanta   wed      79
 5 atlanta   thr      88
 6 atlanta   fri      91
 7 atlanta   sat      94
 8 baltimore sun      73
 9 baltimore mon      75
10 baltimore tue      70
# i 32 more rows
```

That's better! Now each row has one observation in it. Recall we had a lot of functionality for selecting columns within the `tidyverse`. That holds here as well!

```
temps_data |>
  pivot_longer(cols = sun:sat,
                names_to = "day",
                values_to = "temp")
```

```
# A tibble: 42 x 3
   city      day    temp
   <chr>     <chr> <dbl>
 1 atlanta   sun      81
 2 atlanta   mon      87
 3 atlanta   tue      83
 4 atlanta   wed      79
 5 atlanta   thr      88
 6 atlanta   fri      91
 7 atlanta   sat      94
 8 baltimore sun      73
 9 baltimore mon      75
10 baltimore tue      70
# i 32 more rows
```

`pivot_wider()`

Occasionally we'll want to make our data wider for display purposes. We can make this switch to 'Wide' form with `pivot_wider()`. There are two major arguments we must specify:

- `names_from` = column(s) to get the names used in the output columns
- `values_from` = column(s) to get the cell values from

Let's consider our batting data set from the `dplyr` notes.

```
library(dplyr)
```

```
Warning: package 'dplyr' was built under R version 4.1.3


Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
library(Lahman)
```

```
Warning: package 'Lahman' was built under R version 4.1.3
```

```
batting_tbl <- as_tibble(Batting)
batting_tbl
```

```
# A tibble: 108,789 x 22
   playerID  yearID stint teamID lgID      G    AB     R     H   X2B   X3B
HR
   <chr>      <int> <int> <fct>  <fct> <int> <int> <int> <int> <int> <int>
<int>
 1 abercda01   1871     1 TRO    NA        1     4     0     0     0     0
0
 2 addybo01    1871     1 RC1    NA       25   118    30    32     6     0
0
 3 allisar01   1871     1 CL1    NA       29   137    28    40     4     5
0
 4 allisdo01   1871     1 WS3    NA       27   133    28    44    10     2
2
 5 ansonca01   1871     1 RC1    NA       25   120    29    39    11     3
0
 6 armstbo01   1871     1 FW1    NA       12    49     9    11     2     1
0
 7 barkeal01   1871     1 RC1    NA        1     4     0     1     0     0
0
 8 barnero01   1871     1 BS1    NA       31   157    66    63    10     9
0
 9 barrebi01   1871     1 FW1    NA        1     5     1     1     1     0
0
10 barrofr01   1871     1 BS1    NA       18    86    13    13     2     1
0
# i 108,779 more rows
# i 10 more variables: RBI <int>, SB <int>, CS <int>, BB <int>, SO <int>,
#   IBB <int>, HBP <int>, SH <int>, SF <int>, GIDP <int>
```

We may want to get just the data for one team (say the Pirates) and display each players number of hits across the years 2018 to 2020.

- Let's subset the data to get just the pirates (`teamID == "PIT"`)

- Then we'll select only their hits and year columns (`playerID`, `H` and `yearID`)
- Then we need to pivot that data set wider so that we have the year across the top (`names_from`), the players as the rows, and the entries as the hits (`values_from`)

```
batting_tbl |>
  filter(yearID %in% 2018:2020, teamID == "PIT") |>
  select(playerID, yearID, H) |>
  pivot_wider(names_from = yearID, values_from = "H")
```

```
# A tibble: 96 x 4
   playerID  `2018` `2019` `2020`
   <chr>      <int>  <int>  <int>
 1 anderta01      0     NA     NA
 2 archech01      2      4     NA
 3 belljo02     131    146     44
 4 bostich01      0     NA     NA
 5 braulst01      3     14      0
 6 burdini01      0      0      0
 7 cervefr01     86     21     NA
 8 crickky01      0      0      0
 9 diazel01      72     73     NA
10 dickeco01    151     40     NA
# i 86 more rows
```

Great! You can see that missing values are filled in for those that didn't play in a given year. Let's subset this to remove any rows with missing values (so we only get players that played for the pirates in all three years).

The `tidyr` function `drop_na()` does this exact thing for us!

```
batting_tbl |>
  filter(yearID %in% 2018:2020, teamID == "PIT") |>
  select(playerID, yearID, H) |>
  pivot_wider(names_from = yearID, values_from = "H") |>
  drop_na()
```

```
# A tibble: 17 x 4
   playerID  `2018` `2019` `2020`
   <chr>      <int>  <int>  <int>
 1 belljo02     131    146     44
 2 braulst01      3     14      0
 3 burdini01      0      0      0
 4 crickky01      0      0      0
 5 felizmi01      0      0      0
 6 fraziad01     88    154     48
 7 holmecl01      0      0      0
 8 kelake01       0      0      0
 9 moranco01    115    129     44
10 musgrjo01      5      8      0
11 neverdo01      0      0      0
12 newmake01     19    152     35
13 osunajo01     24     69     16
14 polangr01    117     37     24
```

```
14 polangr01    117     37     24
15 rodriri05      0      0      0
16 stallja01      8     50     31
17 willitr01      5      6      0
```

Let's also remove those with 0 hits:

```
batting_tbl |>
  filter(yearID %in% 2018:2020, teamID == "PIT", H > 0) |>
  select(playerID, yearID, H) |>
  pivot_wider(names_from = yearID, values_from = "H") |>
  drop_na()
```

```
# A tibble: 7 x 4
  playerID  `2018` `2019` `2020`
  <chr>      <int>  <int>  <int>
1 belljo02     131    146     44
2 fraziad01     88    154     48
3 moranco01    115    129     44
4 newmake01     19    152     35
5 osunajo01     24     69     16
6 polangr01    117     37     24
7 stallja01      8     50     31
```

Would be better with actual player names (we'll learn about how to combine this data set with another one that has their actual names soon!)

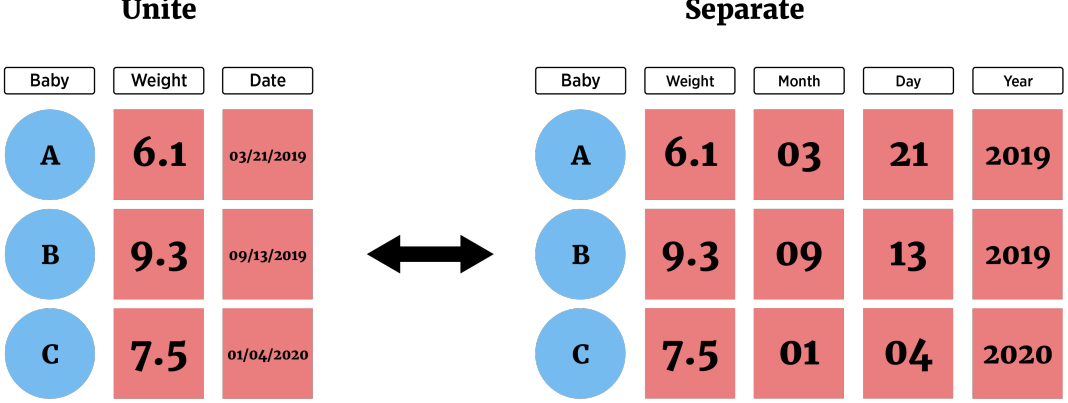
```
batting_tbl |>
  filter(yearID %in% 2018:2020, teamID == "PIT", H > 0) |>
  select(playerID, yearID, H) |>
  pivot_wider(names_from = yearID, values_from = "H") |>
  drop_na() |>
  dplyr::inner_join(select(People, playerID, nameFirst, nameLast)) |>
  select(nameFirst, nameLast, everything())
```

```
Joining with `by = join_by(playerID)`

# A tibble: 7 x 6
  nameFirst nameLast  playerID  `2018` `2019` `2020`
  <chr>     <chr>     <chr>      <int>  <int>  <int>
1 Josh      Bell      belljo02     131    146     44
2 Adam      Frazier   fraziad01     88    154     48
3 Colin     Moran     moranco01    115    129     44
4 Kevin     Newman    newmake01     19    152     35
5 Jose      Osuna     osunajo01     24     69     16
6 Gregory   Polanco   polangr01    117     37     24
7 Jacob     Stallings stallja01      8     50     31
```

Column Manipulations with `tidyr`

- Separate a column using `separate_wider_delim()` (a few other variants exist as well)
- Combine two columns with `unite()`



- Consider data set on air pollution in Chicago

```
chicago_data <- read_csv("https://www4.stat.ncsu.edu/~online/datasets/Chicag
```

```
Rows: 1461 Columns: 11
-- Column specification
--------------------------------------------------------
Delimiter: ","
chr (3): city, date, season
dbl (8): X, death, temp, dewpoint, pm10, o3, time, year

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this
message.
```

```
chicago_data
```

```
# A tibble: 1,461 x 11
       X city  date      death  temp dewpoint  pm10    o3  time season
year
   <dbl> <chr> <chr>     <dbl> <dbl>    <dbl> <dbl> <dbl> <dbl> <chr>
<dbl>
 1  3654 chic  1/1/1997    137  36      37.5  13.1   5.66  3654 winter
1997
 2  3655 chic  1/2/1997    123  45      47.2  41.9   5.53  3655 winter
1997
 3  3656 chic  1/3/1997    127  40      38    27.0   6.29  3656 winter
1997
 4  3657 chic  1/4/1997    146  51.5    45.5  25.1   7.54  3657 winter
1997
 5  3658 chic  1/5/1997    102  27      11.2  15.3  20.8   3658 winter
1997
 6  3659 chic  1/6/1997    127  17       5.75  9.36 14.9   3659 winter
1997
 7  3660 chic  1/7/1997    116  16       7    20.2  11.9   3660 winter
1997
 8  3661 chic  1/8/1997    118  19      17.8  33.1   8.68  3661 winter
1997
 9  3662 chic  1/9/1997    148  26      24    12.1  13.4   3662 winter
1997
10  3663 chic  1/10/1997   121  16       5.38 24.8  10.4   3663 winter
1997
```

```
# i 1,451 more rows
```

- Although we saw that we should treat date variables as `date` objects (say from `lubridate`), we could manually separate out the dates we see here. We can notice that the month comes first followed by a `/`, then the day, a `/`, and the year.
    - We can split on the delimiter `/`
    - The arguments to give `separate_wider_delim()` are:
        - `cols` = the columns we want
        - `delim` = the delimiter
        - `names` = new names for the split variables
        - `cols_remove` - binary, whether to remove the original column or not

```
chicago_data |>
  separate_wider_delim(cols = date,
                       delim = "/",
                       names = c("Month", "Day", "Year"),
                       cols_remove = FALSE)
```

```
# A tibble: 1,461 x 14
      X city  Month Day   Year  date     death  temp dewpoint  pm10    o3
time
   <dbl> <chr> <chr> <chr> <chr> <chr>    <dbl> <dbl>    <dbl> <dbl> <dbl>
<dbl>
 1  3654 chic  1     1     1997  1/1/1997   137  36      37.5  13.1   5.66
3654
 2  3655 chic  1     2     1997  1/2/1997   123  45      47.2  41.9   5.53
3655
 3  3656 chic  1     3     1997  1/3/1997   127  40      38    27.0   6.29
3656
 4  3657 chic  1     4     1997  1/4/1997   146  51.5    45.5  25.1   7.54
3657
 5  3658 chic  1     5     1997  1/5/1997   102  27      11.2  15.3  20.8
3658
 6  3659 chic  1     6     1997  1/6/1997   127  17       5.75  9.36 14.9
3659
 7  3660 chic  1     7     1997  1/7/1997   116  16       7    20.2  11.9
3660
 8  3661 chic  1     8     1997  1/8/1997   118  19      17.8  33.1   8.68
3661
 9  3662 chic  1     9     1997  1/9/1997   148  26      24    12.1  13.4
3662
10  3663 chic  1     10    1997  1/10/19~   121  16       5.38 24.8  10.4
3663
# i 1,451 more rows
# i 2 more variables: season <chr>, year <dbl>
```

Nice! These are character strings so we might want to turn them into numbers but, again, we'd really want to use `date` type data for these anyway.

- `unite()` allows us to combine two columns into one

- Perhaps we want a new column with the date and the season together (for display purposes)
- We just pass `unite()` the name of the new column (`col =`), the columns we want to combine, and the separator to use (`sep =`)

```
chicago_data |>
  unite(col = "season_date", season, date, sep = ": ") |>
  select(season_date, everything())
```

```
# A tibble: 1,461 x 10
   season_date           X city  death  temp dewpoint  pm10    o3  time
year
   <chr>             <dbl> <chr> <dbl> <dbl>    <dbl> <dbl> <dbl> <dbl>
<dbl>
 1 winter: 1/1/1997   3654 chic    137  36      37.5  13.1   5.66  3654
1997
 2 winter: 1/2/1997   3655 chic    123  45      47.2  41.9   5.53  3655
1997
 3 winter: 1/3/1997   3656 chic    127  40      38    27.0   6.29  3656
1997
 4 winter: 1/4/1997   3657 chic    146  51.5    45.5  25.1   7.54  3657
1997
 5 winter: 1/5/1997   3658 chic    102  27      11.2  15.3  20.8   3658
1997
 6 winter: 1/6/1997   3659 chic    127  17       5.75  9.36 14.9   3659
1997
 7 winter: 1/7/1997   3660 chic    116  16       7    20.2  11.9   3660
1997
 8 winter: 1/8/1997   3661 chic    118  19      17.8  33.1   8.68  3661
1997
 9 winter: 1/9/1997   3662 chic    148  26      24    12.1  13.4   3662
1997
10 winter: 1/10/1997  3663 chic    121  16       5.38 24.8  10.4   3663
1997
# i 1,451 more rows
```

Recap!

- `pivot_wider()` & `pivot_longer()` great for reshaping data
- `unite()` & `separate_wider_*()` nice for dealing with columns
- `tidyr` Cheat Sheet