Batch loading data

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Week 4, Class 1

Agenda

- Discuss the midterm
    - Canvas quiz (10 points; please don't stress)
    - Take home (40 points)
- Review Lab 1
- `map_dfr` and batch–loading data
- Introduce list columns
    - This will mostly be an intro to Wednesday's lecture

Learning objectives

- Understand when `map_dfr` can and should be applied
- Better understand file paths, and how `{fs}` can help
- Be able to batch load data of a specific type within a mixed–type directory
- Use filenames to pull data

Midterm

Questions?

Let's look at the take-home portion

Review Lab 1

`map_dfr`

- If each iteration returns a data frame, you can use `map_dfr` to automatically bind all the data frames together.

Example

- Create a function that simulates data (please copy the code and follow along)

```
set.seed(8675309)
simulate <- function(n, mean = 0, sd = 1) {
    tibble(sample_id = seq_len(n),
           sample = rnorm(n, mean, sd))
}
simulate(10)
```

```
## # A tibble: 10 x 2
##    sample_id      sample
##        <int>       <dbl>
##  1         1 -0.9965824
##  2         2  0.7218241
##  3         3 -0.6172088
##  4         4  2.029392
##  5         5  1.065416
##  6         6  0.9872197
##  7         7  0.02745393
##  8         8  0.6728723
##  9         9  0.5720665
## 10        10  0.9036777
```

Two more quick examples

```
simulate(3, 100, 10)
```

```
## # A tibble: 3 x 2
##   sample_id    sample
##       <int>     <dbl>
## 1         1  84.50448
## 2         2 110.2264
## 3         3 101.5008
```

```
simulate(5, -10, 1.5)
```

```
## # A tibble: 5 x 2
##   sample_id     sample
##       <int>      <dbl>
## 1         1 -10.98995
## 2         2 -11.49188
## 3         3  -7.041312
## 4         4 -10.66270
## 5         5 -11.35096
```

Simulation

- Assume we want to vary the sample size from 10 to 150 by increments of 5
- `mean` stays constant at 100, `sd` is constant at 10

Try with `purrr::map`

02:00

```
library(tidyverse)
sims <- map(seq(10, 150, 5), simulate, 100, 10)
```

```
sims[1]
```

```
## [[1]]
## # A tibble: 10 x 2
##    sample_id    sample
##        <int>     <dbl>
##  1         1 103.7618
##  2         2 111.5353
##  3         3 115.7490
##  4         4 105.8853
##  5         5  93.84955
##  6         6  97.71089
##  7         7 100.6392
##  8         8  96.86526
##  9         9  97.51501
## 10        10  98.46205
```

```
sims[2]
```

```
## [[1]]
## # A tibble: 15 x 2
##    sample_id    sample
##        <int>     <dbl>
##  1         1  93.64743
##  2         2  99.96206
##  3         3 100.4562
##  4         4 106.8407
##  5         5  97.47957
##  6         6  98.48961
##  7         7  91.25069
##  8         8  80.23099
##  9         9 102.3766
## 10        10 100.3609
## 11        11 101.3490
## 12        12 101.1758
## 13        13  91.74411
## 14        14  78.64764
## 15        15 102.1421
```

Swap for `map_dfr`

Try it – what happens?

```
sims_df <- map_dfr(seq(10, 150, 5), simulate, 100, 10)
sims_df
```

```
## # A tibble: 2,320 x 2
##    sample_id    sample
##        <int>     <dbl>
##  1         1  85.64361
##  2         2 103.6789
##  3         3  94.71782
##  4         4 103.1350
##  5         5  99.78701
##  6         6 105.3462
##  7         7 100.0653
##  8         8  94.28314
##  9         9 108.8872
## 10        10 106.0850
## # … with 2,310 more rows
```

01:00

Notice a problem here

```
sims_df[1:15, ]
```

```
## # A tibble: 15 x 2
##    sample_id    sample
##        <int>     <dbl>
##  1         1  85.64361
##  2         2 103.6789
##  3         3  94.71782
##  4         4 103.1350
##  5         5  99.78701
##  6         6 105.3462
##  7         7 100.0653
##  8         8  94.28314
##  9         9 108.8872
## 10        10 106.0850
## 11         1  89.49968
## 12         2  86.99898
## 13         3  85.38054
## 14         4  99.10690
## 15         5 105.0088
```

.id argument

```
sims_df2 <- map_dfr(seq(10, 150, 5), simulate, 100, 10,
                    .id = "iteration")
sims_df2[1:14, ]
```

```
## # A tibble: 14 x 3
##    iteration sample_id    sample
##    <chr>         <int>     <dbl>
##  1 1                 1 112.1250
##  2 1                 2  88.07056
##  3 1                 3 108.3908
##  4 1                 4 100.8193
##  5 1                 5 102.1545
##  6 1                 6 113.5398
##  7 1                 7 101.4171
##  8 1                 8  99.33668
##  9 1                 9 100.2855
## 10 1                10  90.22043
## 11 2                 1  91.08882
## 12 2                 2 107.3664
## 13 2                 3 101.1745
## 14 2                 4  96.82053
```

> `.id`: Either a string or NULL. If a string, the output will contain a variable with that name, storing either the name (if .x is named) or the index (if .x is unnamed) of the input. If NULL, the default, no variable will be created.

– {purrr} documentation

setNames

```
sample_size <- seq(10, 150, 5)
sample_size
```

```
##  [1]  10  15  20  25  30  35  40  45  50  55  60  65  70  75  80  85  90
## [22] 115 120 125 130 135 140 145 150
```

```
sample_size <- setNames(sample_size,
                        english::english(seq(10, 150, 5)))
sample_size[1:15]
```

```
##          ten      fifteen       twenty  twenty-five       thirty  thirty
##           10           15           20           25           30
##        forty   forty-five        fifty   fifty-five        sixty   sixty
##           40           45           50           55           60
##      seventy seventy-five       eighty
##           70           75           80
```

Try again

```
sims_df3 <- map_dfr(sample_size, simulate, 100, 10,
                    .id = "n")
sims_df3[1:14, ]
```

```
## # A tibble: 14 x 3
##    n       sample_id    sample
##    <chr>       <int>     <dbl>
##  1 ten             1  98.94914
##  2 ten             2 101.6824
##  3 ten             3  88.16447
##  4 ten             4  90.13604
##  5 ten             5  85.53591
##  6 ten             6  90.69977
##  7 ten             7 105.8858
##  8 ten             8  89.12978
##  9 ten             9 114.4982
## 10 ten            10 111.6440
## 11 fifteen         1 103.2732
## 12 fifteen         2 106.8949
## 13 fifteen         3  88.83591
## 14 fifteen         4 105.5402
```

Another quick example

broom::tidy

- The {broom} package helps us extract model output in a tidy format

```
lm(tvhours ~ age, gss_cat) %>%
    broom::tidy()
```

```
## # A tibble: 2 x 5
##   term          estimate   std.error statistic       p.value
##   <chr>            <dbl>       <dbl>     <dbl>         <dbl>
## 1 (Intercept) 1.992391   0.06980966   28.54033 4.672161e-173
## 2 age         0.02095679 0.001387361  15.10551 4.689310e- 51
```

Fit separate models by year

Again – probs not best statistically

```
split(gss_cat, gss_cat$year) %>%
    map_dfr(~lm(tvhours ~ age, .x) %>%
              broom::tidy())
```

```
## # A tibble: 16 x 5
##    term          estimate   std.error statistic      p.value
##    <chr>            <dbl>       <dbl>     <dbl>        <dbl>
##  1 (Intercept) 2.080163   0.1709061   12.17138  7.995632e-33
##  2 age         0.01948584 0.003485199  5.591027 2.599011e- 8
##  3 (Intercept) 2.078999   0.2176829    9.550583 1.191266e-20
##  4 age         0.01963575 0.004400292  4.462375 9.137366e- 6
##  5 (Intercept) 1.767990   0.2464509    7.173804 1.531756e-12
##  6 age         0.02386070 0.005031548  4.742218 2.459650e- 6
##  7 (Intercept) 2.096054   0.1496431   14.00702  1.419772e-42
##  8 age         0.01781388 0.002977289  5.983256 2.589482e- 9
##  9 (Intercept) 1.855278   0.2156381    8.603668 2.167351e-17
## 10 age         0.02390720 0.004314567  5.541043 3.628675e- 8
## 11 (Intercept) 2.068914   0.2096397    9.868903 2.896085e-22
## 12 age         0.01989505 0.004086638  4.868317 1.251234e- 6
## 13 (Intercept) 1.878070   0.2258400    8.315932 2.280108e-16
## 14 age         0.02547794 0.004449295  5.726287 1.274840e- 8
## 15 (Intercept) 1.980095   0.1877544   10.54620  3.238043e-25
## 16 age         0.02049066 0.003611900  5.673098 1.650822e- 8
```

.id

In cases like the preceding, `.id` becomes invaluable

```
split(gss_cat, gss_cat$year) %>%
     map_dfr(~lm(tvhours ~ age, .x) %>%
               broom::tidy(),
             .id = "year")
```

```
## # A tibble: 16 x 6
##    year  term          estimate   std.error statistic      p.value
##    <chr> <chr>            <dbl>       <dbl>     <dbl>        <dbl>
##  1 2000  (Intercept) 2.080163   0.1709061   12.17138  7.995632e-33
##  2 2000  age         0.01948584 0.003485199  5.591027 2.599011e- 8
##  3 2002  (Intercept) 2.078999   0.2176829    9.550583 1.191266e-20
##  4 2002  age         0.01963575 0.004400292  4.462375 9.137366e- 6
##  5 2004  (Intercept) 1.767990   0.2464509    7.173804 1.531756e-12
##  6 2004  age         0.02386070 0.005031548  4.742218 2.459650e- 6
##  7 2006  (Intercept) 2.096054   0.1496431   14.00702  1.419772e-42
##  8 2006  age         0.01781388 0.002977289  5.983256 2.589482e- 9
##  9 2008  (Intercept) 1.855278   0.2156381    8.603668 2.167351e-17
## 10 2008  age         0.02390720 0.004314567  5.541043 3.628675e- 8
## 11 2010  (Intercept) 2.068914   0.2096397    9.868903 2.896085e-22
## 12 2010  age         0.01989505 0.004086638  4.868317 1.251234e- 6
## 13 2012  (Intercept) 1.878070   0.2258400    8.315932 2.280108e-16
## 14 2012  age         0.02547794 0.004449295  5.726287 1.274840e- 8
```

Batch–loading data

Please follow along

{fs}

- note – there are base equivalents. `{fs}` is just a a bit better across platforms and has better defaults.

Could we apply `map_dfr` here?

```
# install.packages("fs")
library(fs)
dir_ls(here::here("data"))
```

```
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
```

```
dir_ls(here::here("data", "pfiles_sim"))
```

```
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
```

Limit files

- We really only want the `.csv`
  - That happens to be the only thing that's in there but that's regularly not the case

```
dir_ls(here::here("data", "pfiles_sim"), glob = "*.csv")
```

```
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
```

Batch load

- Loop through the directories and `import` or `read_csv`

```
files <- dir_ls(
  here::here("data", "pfiles_sim"),
  glob = "*.csv"
)
batch <- map_dfr(files, read_csv)
batch
```

```
## # A tibble: 15,945 x 22
##    Entry   Theta Status Count RawScore    SE Infit Infit_Z  Outfit Outf
##    <dbl>   <dbl>  <dbl> <dbl>    <dbl> <dbl> <dbl>   <dbl>   <dbl>    <
##  1   123  1.2687      1    36       23 0.3713  0.93   -0.34 0.82       -
##  2    88  1.5541      1    36       25 0.3852  0.95   -0.37 0.81       -
##  3   105  3.2773      1    36       33 0.6187  0.9    -0.04 1.63000
##  4   153  4.4752      1    36       35 1.0234  0.93    0.23 0.35       -
##  5   437  2.6655      1    36       31 0.5008  0.92   -0.18 0.88       -
##  6   307  5.7137      0    36       36 1.8371  1       0    1
##  7   305  3.7326      1    36       34 0.7408  1.06    0.31 0.86
##  8    42  0.609       1    36       18 0.36    1.55    2.56 1.74
##  9    59 -2.623       1    36        3 1.0344  0.85    0.06 0.17       -
## 10   304  5.7137      0    36       36 1.8371  1       0    1
## # … with 15,935 more rows, and 11 more variables: PointMeasureCorr <dbl>
## #   ObservMatch <dbl>, ExpectMatch <dbl>, PointMeasureExpected <dbl>, RM
```

Problem

- We've lost a lot of info – no way to identify which file is which

Try to fix it!

02:00

Add id

```
batch2 <- map_dfr(files, read_csv, .id = "file")
batch2
```

```
## # A tibble: 15,945 x 23
## # … with 15,935 more rows, and 23 more variables: file <chr>, Entry <dbl
## #   Status <dbl>, Count <dbl>, RawScore <dbl>, SE <dbl>, Infit <dbl>, In
## #   Outfit <dbl>, Outfit_Z <dbl>, Displacement <dbl>, PointMeasureCorr <
## #   Weight <dbl>, ObservMatch <dbl>, ExpectMatch <dbl>, PointMeasureExpe
## #   RMSR <dbl>, WMLE <dbl>, testeventid <dbl>, ssid <dbl>, asmtprmrydsbl
## #   asmtscndrydsbltycd <dbl>
```

Note – the `file` column contains the full path, which is so long it makes no rows print

```
batch2 %>%
    count(file)
```

```
## # A tibble: 31 x 2
## # … with 21 more rows, and 2 more variables: file <chr>, n <int>
```

- Still not terrifically useful. What can we do?

Step 1

- Remove the `here::here` path from string

```
batch2 <- batch2 %>%
    mutate(
      file = str_replace_all(
        file,
        here::here("data", "pfiles_sim"),
        ""
      )
    )

batch2 %>%
  count(file)
```

```
## # A tibble: 31 x 2
##    file                              n
##    <chr>                         <int>
##  1 /g11ELApfiles18_sim.csv         453
##  2 /g11Mathpfiles18_sim.csv        460
##  3 /g11Rdgpfiles18_sim.csv         453
##  4 /g11Sciencepfiles18_sim.csv     438
##  5 /g11Wripfiles18_sim.csv         453
##  6 /g3ELApfiles18_sim.csv          540
##  7 /g3Mathpfiles18_sim.csv         536
```

Pull out pieces you need

- Regular expressions are most powerful here
    - We haven't talked about them much
- Try RegExplain

Pull grade

- Note – I'm not expecting you to just suddenly be able to do this. This is more for illustration. There's also other ways you could extract the same info

```
batch2 %>%
    mutate(
      grade = str_replace_all(
        file,
        "/g(\\d?\\d).+",
        "\\1"
    )
  ) %>%
    select(file, grade)
```

```
## # A tibble: 15,945 x 2
##    file                    grade
##    <chr>                   <chr>
##  1 /g11ELApfiles18_sim.csv 11
##  2 /g11ELApfiles18_sim.csv 11
##  3 /g11ELApfiles18_sim.csv 11
##  4 /g11ELApfiles18_sim.csv 11
##  5 /g11ELApfiles18_sim.csv 11
```

parse_number

- In this case `parse_number` also works – but note that it would not work to extract the year

```
batch2 %>%
mutate(grade = parse_number(file)) %>%
    select(file, grade)
```

```
## # A tibble: 15,945 x 2
##    file                    grade
##    <chr>                   <dbl>
##  1 /g11ELApfiles18_sim.csv    11
##  2 /g11ELApfiles18_sim.csv    11
##  3 /g11ELApfiles18_sim.csv    11
##  4 /g11ELApfiles18_sim.csv    11
##  5 /g11ELApfiles18_sim.csv    11
##  6 /g11ELApfiles18_sim.csv    11
##  7 /g11ELApfiles18_sim.csv    11
##  8 /g11ELApfiles18_sim.csv    11
##  9 /g11ELApfiles18_sim.csv    11
## 10 /g11ELApfiles18_sim.csv    11
## # … with 15,935 more rows
```

Extract year

- In this case `parse_number` also works – but note that it would not work to extract the year

```
batch2 %>%
    mutate(
      grade = str_replace_all(
        file, "/g(\\d?\\d).+", "\\1"
    ),
    year = str_replace_all(
      file, ".+files(\\d\\d)_sim.+", "\\1"
    )
  ) %>%
    select(file, grade, year)
```

```
## # A tibble: 15,945 x 3
##    file                    grade year
##    <chr>                   <chr> <chr>
##  1 /g11ELApfiles18_sim.csv 11    18
##  2 /g11ELApfiles18_sim.csv 11    18
##  3 /g11ELApfiles18_sim.csv 11    18
##  4 /g11ELApfiles18_sim.csv 11    18
##  5 /g11ELApfiles18_sim.csv 11    18
##  6 /g11ELApfiles18_sim.csv 11    18
```

Extract Content Area

```
batch2 %>%
    mutate(grade = str_replace_all(file,
                                   "/g(\\d?\\d).+",
                                   "\\1"),
           year = str_replace_all(file,
                                  ".+files(\\d\\d)_sim.+",
                                  "\\1"),
         content = str_replace_all(file,
                                   "/g\\d?\\d(.+)pfiles.+",
                                   "\\1")) %>%
    select(file, grade, year, content)
```

```
## # A tibble: 15,945 x 4
##    file                    grade year  content
##    <chr>                   <chr> <chr> <chr>
##  1 /g11ELApfiles18_sim.csv 11    18    ELA
##  2 /g11ELApfiles18_sim.csv 11    18    ELA
##  3 /g11ELApfiles18_sim.csv 11    18    ELA
##  4 /g11ELApfiles18_sim.csv 11    18    ELA
##  5 /g11ELApfiles18_sim.csv 11    18    ELA
##  6 /g11ELApfiles18_sim.csv 11    18    ELA
##  7 /g11ELApfiles18_sim.csv 11    18    ELA
##  8 /g11ELApfiles18_sim.csv 11    18    ELA
##  9 /g11ELApfiles18_sim.csv 11    18    ELA
## 10 /g11ELApfiles18_sim.csv 11    18    ELA
```

Double checks: grade

```
batch2 %>%
    mutate(grade = str_replace_all(file,
                                   "/g(\\d?\\d).+",
                                   "\\1"),
           year = str_replace_all(file,
                                  ".+files(\\d\\d)_sim.+",
                                  "\\1"),
           content = str_replace_all(file,
                                     "/g\\d?\\d(.+)pfiles.+",
                                     "\\1")) %>%
    select(file, grade, year, content) %>%
    count(grade)
```

```
## # A tibble: 7 x 2
##   grade     n
##   <chr> <int>
## 1 11     2257
## 2 3      2156
## 3 4      2341
## 4 5      2632
## 5 6      2216
## 6 7      1962
## 7 8      2381
```

Double checks: year

```
batch2 %>%
    mutate(grade = str_replace_all(file,
                                   "/g(\\d?\\d).+",
                                   "\\1"),
           year = str_replace_all(file,
                                  ".+files(\\d\\d)_sim.+",
                                  "\\1"),
           content = str_replace_all(file,
                                     "/g\\d?\\d(.+)pfiles.+",
                                     "\\1")) %>%
    select(file, grade, year, content) %>%
    count(year)
```

```
## # A tibble: 1 x 2
##   year      n
##   <chr> <int>
## 1 18    15945
```

Double checks: content

```
batch2 %>%
    mutate(grade = str_replace_all(file,
                                   "/g(\\d?\\d).+",
                                   "\\1"),
           year = str_replace_all(file,
                                  ".+files(\\d\\d)_sim.+",
                                  "\\1"),
           content = str_replace_all(file,
                                     "/g\\d?\\d(.+)pfiles.+",
                                     "\\1")) %>%
    select(file, grade, year, content) %>%
    count(content)
```

```
## # A tibble: 5 x 2
##   content     n
##   <chr>   <int>
## 1 ELA      3627
## 2 Math     3629
## 3 Rdg      3627
## 4 Science  1435
## 5 Wri      3627
```

Finalize

```
d <- batch2 %>%
    mutate(grade = str_replace_all(file, "/g(\\d?\\d).+", "\\1")
           grade = as.integer(grade),
           year = str_replace_all(file, ".+files(\\d\\d)_sim.+",
           year = as.integer(grade),
           content = str_replace_all(file, "/g\\d?\\d(.+)pfiles.
    select(-file) %>%
    select(ssid, grade, year, content, testeventid, asmtprmrydsb
           asmtscndrydsbltycd, Entry:WMLE)
```

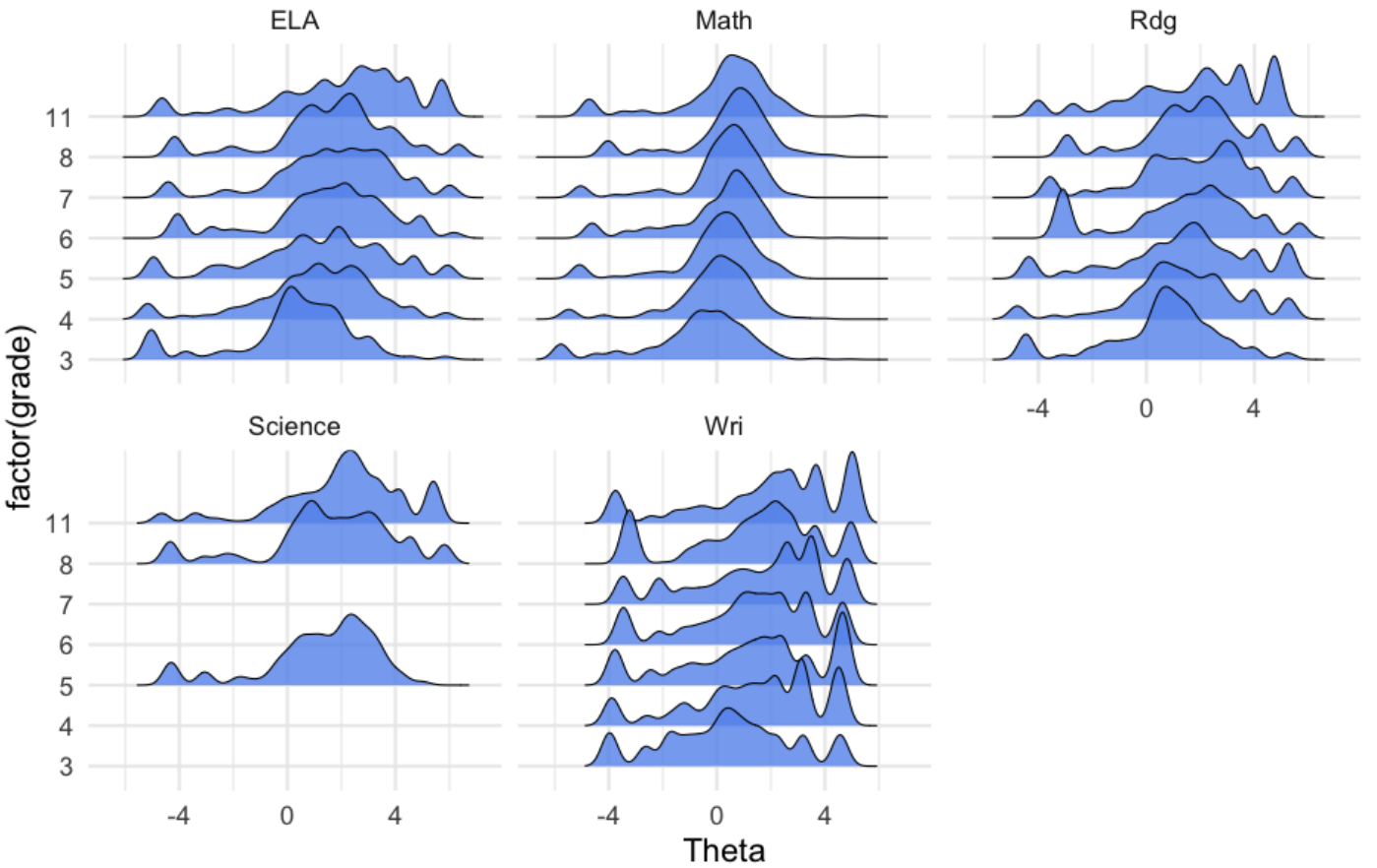
Final product

- In this case, we basically have a tidy data frame already!
- We've reduced our problem from 31 files to a single file

```
d
```

```
## # A tibble: 15,945 x 25
##        ssid grade  year content testeventid asmtprmrydsbltycd asmtscndry
##       <dbl> <int> <int> <chr>         <dbl>               <dbl>
##  1  9466908    11    11 ELA          148933                   0
##  2  7683685    11    11 ELA          147875                  10
##  3  9025693    11    11 ELA          143699                  40
##  4 10099824    11    11 ELA          143962                  82
##  5 18886078    11    11 ELA          150680                  10
##  6 10606750    11    11 ELA          144583                  80
##  7 10541306    11    11 ELA          145204                  50
##  8  7632967    11    11 ELA          148926                  10
##  9  7661118    11    11 ELA          148893                  50
## 10 10547177    11    11 ELA          144583                  82
## # … with 15,935 more rows, and 17 more variables: Theta <dbl>, Status <c
## #   Count <dbl>, RawScore <dbl>, SE <dbl>, Infit <dbl>, Infit_Z <dbl>, O
## #   Outfit_Z <dbl>, Displacement <dbl>, PointMeasureCorr <dbl>, Weight <
## #   ObservMatch <dbl>, ExpectMatch <dbl>, PointMeasureExpected <dbl>, RM
## #   WMLE <dbl>
```

Quick look at distributions



Summary stats

```
d %>%
    group_by(grade, content, asmtprmrydsbltycd) %>%
    summarize(mean = mean(Theta)) %>%
    pivot_wider(names_from = content,
                values_from = mean)
```

```
## # A tibble: 77 x 7
## # Groups:   grade [7]
##    grade asmtprmrydsbltycd         ELA        Math         Rdg         Wri
##    <int>             <dbl>       <dbl>       <dbl>       <dbl>       <dbl>
##  1     3                 0 -0.073610   -1.21055     1.010455   1.612308
##  2     3                10  0.3700416  -0.8182091   0.5184354  0.3206475
##  3     3                20 -0.06335000 -1.251400    1.52       -0.5775
##  4     3                40 -1.877683   -3.56365    -1.761667  -0.7514286
##  5     3                50  0.9462857  -0.09186957  0.9791176  1.191481
##  6     3                60  0.8407750   1.040375    2.181111   1.067
##  7     3                70 -1.104049   -1.517955   -0.8454839 -1.005625
##  8     3                74  0.996       0.02083750  0.6        1.2925
##  9     3                80 -0.144304   -0.5325596   0.6791667  0.2686301
## 10     3                82  0.3708244  -1.080988    0.5676650  0.3440741
## # … with 67 more rows
```

Backing up a bit

- What if we wanted only math files?

```
dir_ls(here::here("data", "pfiles_sim"), regexp = "Math")
```

```
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
```

Only Grade 5

You try

```
dir_ls(here::here("data", "pfiles_sim"), regexp = "g5")
```

```
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
## /Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/data/p
```

Base equivalents

```
list.files(here::here("data", "pfiles_sim"))
```

```
##  [1] "g11ELApfiles18_sim.csv"      "g11Mathpfiles18_sim.csv"
##  [3] "g11Rdgpfiles18_sim.csv"      "g11Sciencepfiles18_sim.csv"
##  [5] "g11Wripfiles18_sim.csv"      "g3ELApfiles18_sim.csv"
##  [7] "g3Mathpfiles18_sim.csv"      "g3Rdgpfiles18_sim.csv"
##  [9] "g3Wripfiles18_sim.csv"       "g4ELApfiles18_sim.csv"
## [11] "g4Mathpfiles18_sim.csv"      "g4Rdgpfiles18_sim.csv"
## [13] "g4Wripfiles18_sim.csv"       "g5ELApfiles18_sim.csv"
## [15] "g5Mathpfiles18_sim.csv"      "g5Rdgpfiles18_sim.csv"
## [17] "g5Sciencepfiles18_sim.csv"   "g5Wripfiles18_sim.csv"
## [19] "g6ELApfiles18_sim.csv"       "g6Mathpfiles18_sim.csv"
## [21] "g6Rdgpfiles18_sim.csv"       "g6Wripfiles18_sim.csv"
## [23] "g7ELApfiles18_sim.csv"       "g7Mathpfiles18_sim.csv"
## [25] "g7Rdgpfiles18_sim.csv"       "g7Wripfiles18_sim.csv"
## [27] "g8ELApfiles18_sim.csv"       "g8Mathpfiles18_sim.csv"
## [29] "g8Rdgpfiles18_sim.csv"       "g8Sciencepfiles18_sim.csv"
## [31] "g8Wripfiles18_sim.csv"
```

Full path

```
list.files(here::here("data", "pfiles_sim"), full.names = TRUE)
```

```
##  [1] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [2] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [3] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [4] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [5] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [6] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [7] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [8] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [9] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [10] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [11] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [12] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [13] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [14] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [15] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [16] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [17] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [18] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [19] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [20] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [21] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [22] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [23] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [24] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
```

Only csvs

```
list.files(here::here("data", "pfiles_sim"),
           full.names = TRUE,
           pattern = "*.csv")
```

```
##  [1] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [2] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [3] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [4] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [5] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [6] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [7] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [8] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
##  [9] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [10] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [11] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [12] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [13] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [14] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [15] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [16] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [17] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [18] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [19] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [20] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [21] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
## [22] "/Users/daniel/Teaching/data_sci_specialization/2020-21/c3-fp-2021/
```

Why not use base?

- We could, but {fs} plays a little nicer with {purrr}

```
files <- list.files(
  here::here("data", "pfiles_sim"),
  pattern = "*.csv"
)
batch3 <- map_dfr(files, read_csv, .id = "file")
```

```
## Error: 'g11ELApfiles18_sim.csv' does not exist in current working direct
```

- Need to return full names

```
files
```

```
##  [1] "g11ELApfiles18_sim.csv"     "g11Mathpfiles18_sim.csv"
##  [3] "g11Rdgpfiles18_sim.csv"     "g11Sciencepfiles18_sim.csv"
##  [5] "g11Wripfiles18_sim.csv"     "g3ELApfiles18_sim.csv"
##  [7] "g3Mathpfiles18_sim.csv"     "g3Rdgpfiles18_sim.csv"
##  [9] "g3Wripfiles18_sim.csv"      "g4ELApfiles18_sim.csv"
## [11] "g4Mathpfiles18_sim.csv"     "g4Rdgpfiles18_sim.csv"
## [13] "g4Wripfiles18_sim.csv"      "g5ELApfiles18_sim.csv"
## [15] "g5Mathpfiles18_sim.csv"     "g5Rdgpfiles18_sim.csv"
```

Try again

```
files <- list.files(here::here("data", "pfiles_sim"),
                    pattern = "*.csv",
                    full.names = TRUE)
batch3 <- map_dfr(files, read_csv, .id = "file")
batch3
```

```
## # A tibble: 15,945 x 23
##    file  Entry   Theta Status Count RawScore     SE Infit Infit_Z  Outfi
##    <chr> <dbl>   <dbl>  <dbl> <dbl>    <dbl>  <dbl> <dbl>   <dbl>   <dbl
##  1 1       123  1.2687      1    36       23 0.3713  0.93   -0.34 0.82
##  2 1        88  1.5541      1    36       25 0.3852  0.95   -0.37 0.81
##  3 1       105  3.2773      1    36       33 0.6187  0.9    -0.04 1.6300
##  4 1       153  4.4752      1    36       35 1.0234  0.93    0.23 0.35
##  5 1       437  2.6655      1    36       31 0.5008  0.92   -0.18 0.88
##  6 1       307  5.7137      0    36       36 1.8371  1       0    1
##  7 1       305  3.7326      1    36       34 0.7408  1.06    0.31 0.86
##  8 1        42  0.609       1    36       18 0.36    1.55    2.56 1.74
##  9 1        59 -2.623       1    36        3 1.0344  0.85    0.06 0.17
## 10 1       304  5.7137      0    36       36 1.8371  1       0    1
## # … with 15,935 more rows, and 12 more variables: Displacement <dbl>,
## #   PointMeasureCorr <dbl>, Weight <dbl>, ObservMatch <dbl>, ExpectMatch
## #   PointMeasureExpected <dbl>, RMSR <dbl>, WMLE <dbl>, testeventid <dbl
## #   asmtprmrydsbltycd <dbl>, asmtscndrydsbltycd <dbl>
```

indexes

- The prior example gave us indexes, rather than the file path. Why?

No names

```
names(files)
```

```
## NULL
```

- We **need** the file path! An index isn't nearly as useful.

Base method that works

```
files <- list.files(here::here("data", "pfiles_sim"),
                    pattern = "*.csv",
                    full.names = TRUE)
files <- setNames(files, files)

batch4 <- map_dfr(files, read_csv, .id = "file")
batch4
```

```
## # A tibble: 15,945 x 23
## # … with 15,935 more rows, and 23 more variables: file <chr>, Entry <dbl
## #   Status <dbl>, Count <dbl>, RawScore <dbl>, SE <dbl>, Infit <dbl>, In
## #   Outfit <dbl>, Outfit_Z <dbl>, Displacement <dbl>, PointMeasureCorr <
## #   Weight <dbl>, ObservMatch <dbl>, ExpectMatch <dbl>, PointMeasureExpe
## #   RMSR <dbl>, WMLE <dbl>, testeventid <dbl>, ssid <dbl>, asmtprmrydsbl
## #   asmtscndrydsbltycd <dbl>
```

My recommendation

- If you're working interactively, no reason not to use `{fs}`
- If you are building functions that take generic paths, might be worth considering skipping the dependency

Note

I am **not** saying skip it, but rather that you should **consider** whether it is really needed or not.

List columns

Comparing models

Let's say we wanted to fit/compare a set of models for each content area

1. `lm(Theta ~ asmtprmrydsbltycd)`
2. `lm(Theta ~ asmtprmrydsbltycd + asmtscndrydsbltycd)`
3. `lm(Theta ~ asmtprmrydsbltycd + asmtscndrydsbltycd + asmtprmrydsbltycd:asmtscndrydsbltycd)`

Split the data

The base method we've been using...

```
splt_content <- split(d, d$content)
str(splt_content)
```

```
## List of 5
##  $ ELA    : tibble[,25] [3,627 × 25] (S3: tbl_df/tbl/data.frame)
##   ..$ ssid                : num [1:3627] 9466908 7683685 9025693 1009982
##   ..$ grade               : int [1:3627] 11 11 11 11 11 11 11 11 11 11 .
##   ..$ year                : int [1:3627] 11 11 11 11 11 11 11 11 11 11 .
##   ..$ content             : chr [1:3627] "ELA" "ELA" "ELA" "ELA" ...
##   ..$ testeventid         : num [1:3627] 148933 147875 143699 143962 150
##   ..$ asmtprmrydsbltycd   : num [1:3627] 0 10 40 82 10 80 50 10 50 82 ..
##   ..$ asmtscndrydsbltycd  : num [1:3627] 0 0 20 0 0 80 0 0 0 0 ...
##   ..$ Entry               : num [1:3627] 123 88 105 153 437 307 305 42 5
##   ..$ Theta               : num [1:3627] 1.27 1.55 3.28 4.48 2.67 ...
##   ..$ Status              : num [1:3627] 1 1 1 1 1 0 1 1 1 0 ...
##   ..$ Count               : num [1:3627] 36 36 36 36 36 36 36 36 36 36 .
##   ..$ RawScore            : num [1:3627] 23 25 33 35 31 36 34 18 3 36 ..
##   ..$ SE                  : num [1:3627] 0.371 0.385 0.619 1.023 0.501 .
##   ..$ Infit               : num [1:3627] 0.93 0.95 0.9 0.93 0.92 1 1.06
##   ..$ Infit_Z             : num [1:3627] -0.34 -0.37 -0.04 0.23 -0.18 0
##   ..$ Outfit              : num [1:3627] 0.82 0.81 1.63 0.35 0.88 1 0.86
##   ..$ Outfit_Z            : num [1:3627] -0.62 -0.56 1.03 -0.16 -0.12 0
##   ..$ Displacement        : num [1:3627] 0.0018 0.0019 0.0022 0.0023 0.0
```

We could use this method

```
m1 <- map(
  splt_content,
  ~lm(Theta ~ asmtprmrydsbltycd, data = .x)
)
m2 <- map(
  splt_content,
  ~lm(Theta ~ asmtprmrydsbltycd + asmtscndrydsbltycd,
      data = .x)
)
m3 <- map(
  splt_content,
  ~lm(Theta ~ asmtprmrydsbltycd * asmtscndrydsbltycd,
      data = .x)
)
```

- We could then go through and conduct tests to see which model had better fit indices, etc.

Alternative

- Create a data frame with a list column

```
d %>%
    nest(-content)
```

```
## # A tibble: 5 x 2
##   content data
##   <chr>   <list>
## 1 ELA     <tibble[,24] [3,627 × 24]>
## 2 Math    <tibble[,24] [3,629 × 24]>
## 3 Rdg     <tibble[,24] [3,627 × 24]>
## 4 Science <tibble[,24] [1,435 × 24]>
## 5 Wri     <tibble[,24] [3,627 × 24]>
```

Add model list column

```
mods <- d %>%
    nest(-content) %>%
    mutate(
      m1 = map(
        data,
        ~lm(Theta ~ asmtprmrydsbltycd,data = .x)
    ),
      m2 = map(
        data,
        ~lm(Theta ~ asmtprmrydsbltycd + asmtscndrydsbltycd,
            data = .x)
    ),
      m3 = map(
        data, ~lm(Theta ~ asmtprmrydsbltycd * asmtscndrydsbltycd
                  data = .x)
    )
  )
```

```
mods
```

```
## # A tibble: 5 x 5
##   content data                          m1     m2     m3
##   <chr>   <list>                        <list> <list> <list>
## 1 ELA     <tibble[,24] [3,627 × 24]> <lm>   <lm>   <lm>
## 2 Math    <tibble[,24] [3,629 × 24]> <lm>   <lm>   <lm>
## 3 Rdg     <tibble[,24] [3,627 × 24]> <lm>   <lm>   <lm>
## 4 Science <tibble[,24] [1,435 × 24]> <lm>   <lm>   <lm>
## 5 Wri     <tibble[,24] [3,627 × 24]> <lm>   <lm>   <lm>
```

Part of the benefit

It's a normal data frame!

```
mods %>%
    pivot_longer(
      m1:m3,
      names_to = "model",
      values_to = "output"
  )
```

```
## # A tibble: 15 x 4
##    content data                        model output
##    <chr>   <list>                      <chr> <list>
##  1 ELA     <tibble[,24] [3,627 × 24]> m1    <lm>
##  2 ELA     <tibble[,24] [3,627 × 24]> m2    <lm>
##  3 ELA     <tibble[,24] [3,627 × 24]> m3    <lm>
##  4 Math    <tibble[,24] [3,629 × 24]> m1    <lm>
##  5 Math    <tibble[,24] [3,629 × 24]> m2    <lm>
##  6 Math    <tibble[,24] [3,629 × 24]> m3    <lm>
##  7 Rdg     <tibble[,24] [3,627 × 24]> m1    <lm>
##  8 Rdg     <tibble[,24] [3,627 × 24]> m2    <lm>
##  9 Rdg     <tibble[,24] [3,627 × 24]> m3    <lm>
## 10 Science <tibble[,24] [1,435 × 24]> m1    <lm>
## 11 Science <tibble[,24] [1,435 × 24]> m2    <lm>
## 12 Science <tibble[,24] [1,435 × 24]> m3    <lm>
```

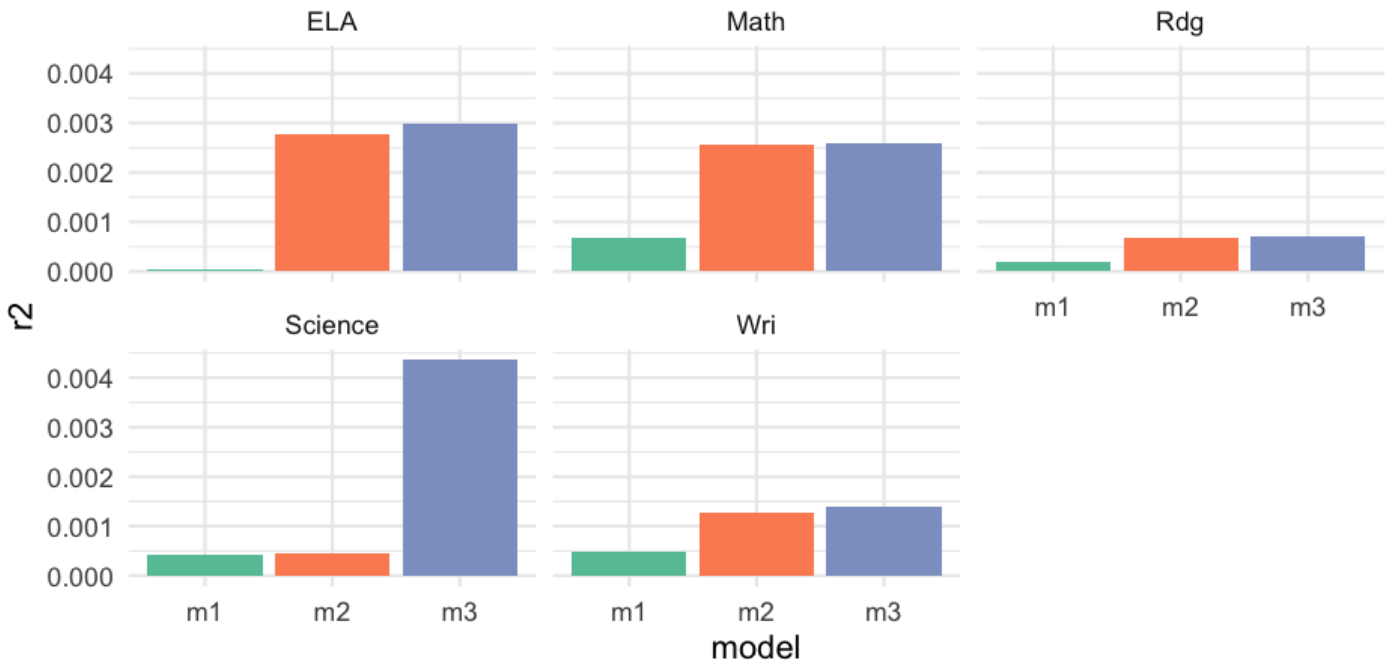
Extract all R^2

```
r2 <- mods %>%
    pivot_longer(
      m1:m3,
      names_to = "model",
      values_to = "output"
  ) %>%
    mutate(r2 = map_dbl(output, ~summary(.x)$r.squared))
r2
```

```
## # A tibble: 15 x 5
##    content data                        model output           r2
##    <chr>   <list>                      <chr> <list>        <dbl>
##  1 ELA     <tibble[,24] [3,627 × 24]> m1    <lm>   0.00002742625
##  2 ELA     <tibble[,24] [3,627 × 24]> m2    <lm>   0.002784211
##  3 ELA     <tibble[,24] [3,627 × 24]> m3    <lm>   0.002994548
##  4 Math    <tibble[,24] [3,629 × 24]> m1    <lm>   0.0006718361
##  5 Math    <tibble[,24] [3,629 × 24]> m2    <lm>   0.002575408
##  6 Math    <tibble[,24] [3,629 × 24]> m3    <lm>   0.002586228
##  7 Rdg     <tibble[,24] [3,627 × 24]> m1    <lm>   0.0001925962
##  8 Rdg     <tibble[,24] [3,627 × 24]> m2    <lm>   0.0006773540
##  9 Rdg     <tibble[,24] [3,627 × 24]> m3    <lm>   0.0007050212
## 10 Science <tibble[,24] [1,435 × 24]> m1    <lm>   0.0004085780
## 11 Science <tibble[,24] [1,435 × 24]> m2    <lm>   0.0004520424
## 12 Science <tibble[,24] [1,435 × 24]> m3    <lm>   0.004354060
## 13 Wri     <tibble[,24] [3,627 × 24]> m1    <lm>   0.0004902093
```

Plot

```
ggplot(r2, aes(model, r2)) +
    geom_col(aes(fill = model)) +
    facet_wrap(~content) +
    guides(fill = "none") +
    scale_fill_brewer(palette = "Set2")
```



Summary

- Batch processing is **really** powerful
- Much of the tools we've learned in the past can be applied once we get the data in a more workable format
- List columns are also **really** nice for organization and using our data frame toolkit

Next time

- We'll talk more about list columns
- We'll also talk more about the new `rowwise()` and `nest_by()` functions