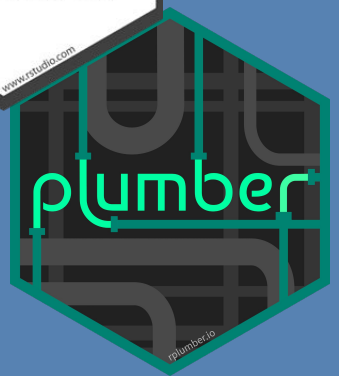

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Building RESTful APIs in R with **plumber**

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APIs: you're probably not using them and why you probably should

thanks to: **Josiah Parry**

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Changing Data Science Landscape

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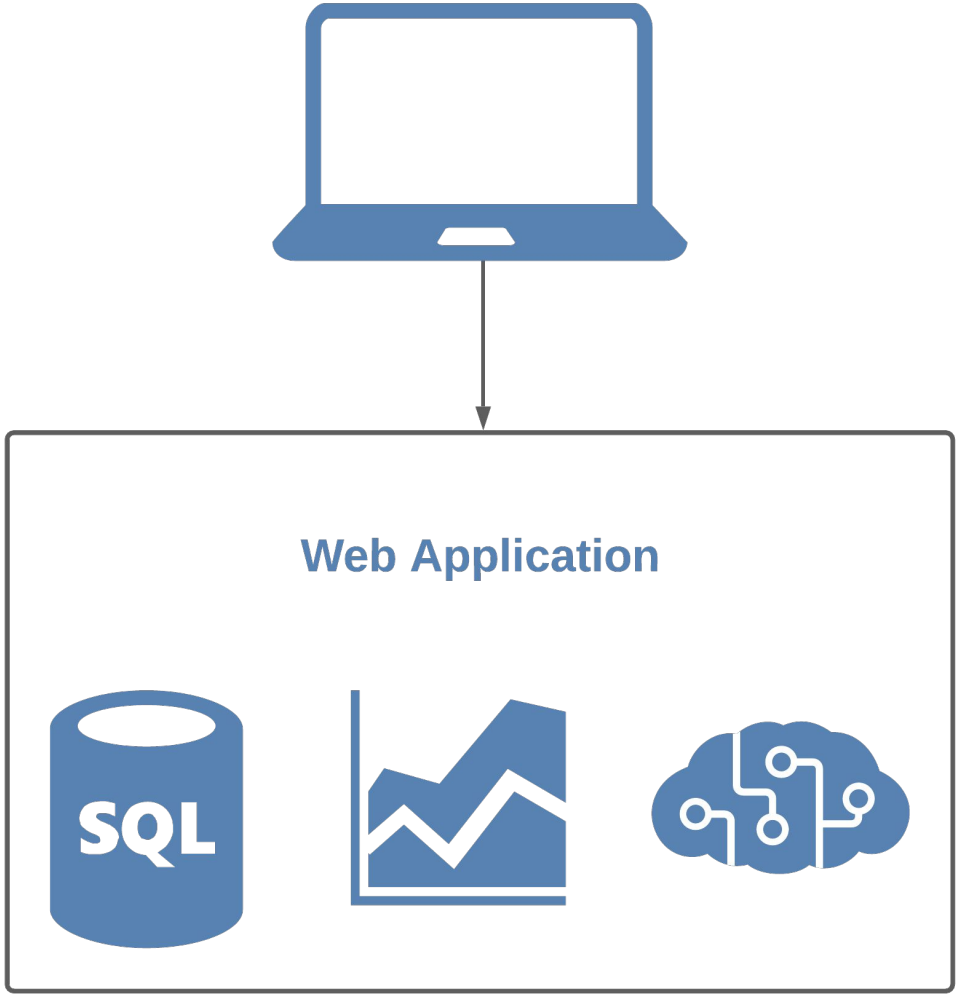
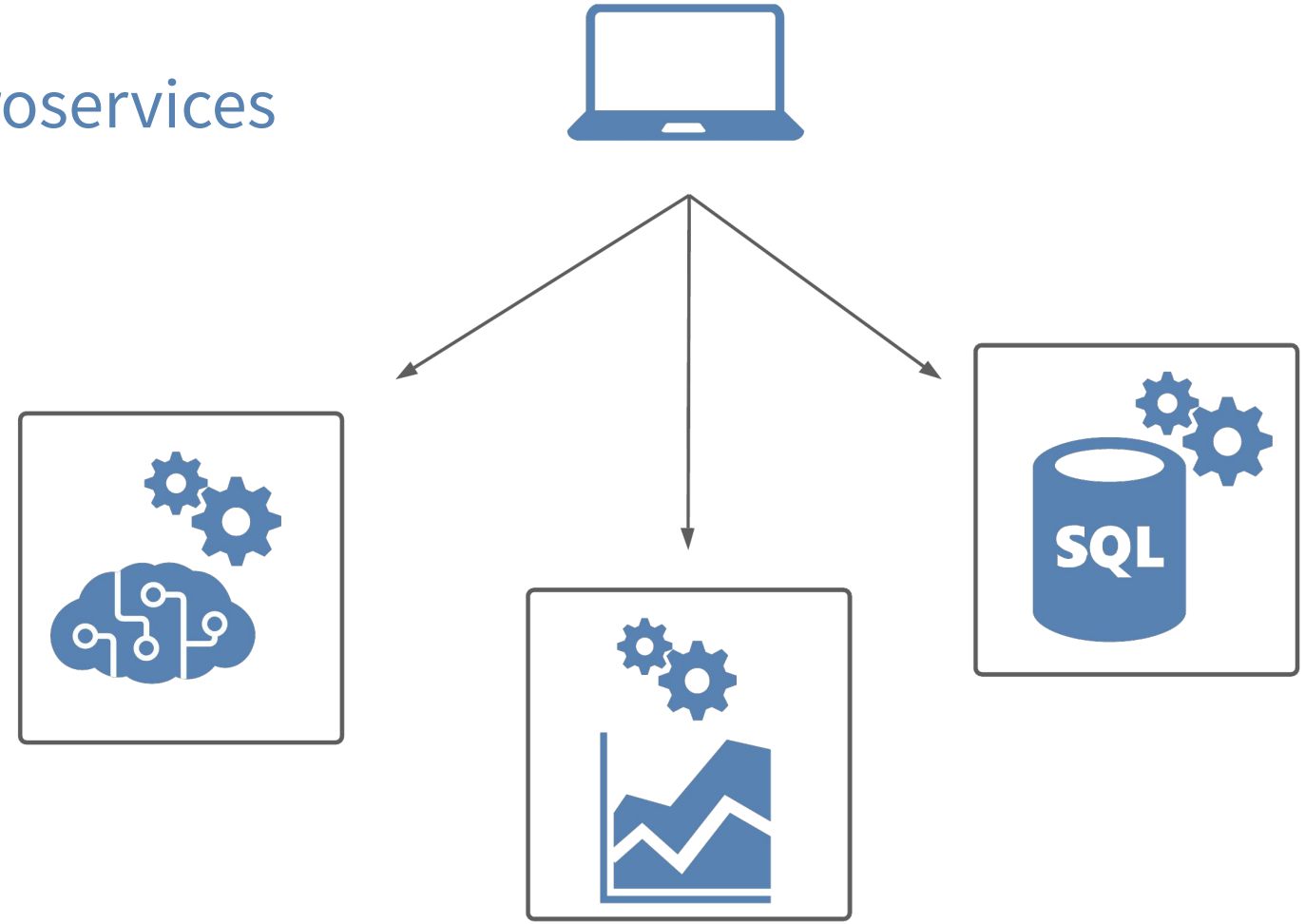
Data Science in 2021

- Part of production applications
- Beyond ad hoc reports, visualizations, and dashboards
- Need to equip data scientists with production tools
- Dependence on IT
- To succeed, we need to embrace DevOps
- How? Microservices

Monolith



Microservices



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“Gather together those things that change for the same reason, and separate those things that change for different reasons.”

- Robert C. Martin

the single responsibility principle

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Okay, but how?

APIs, that's how.

TL;DR - APIs

- Application Programming Interfaces
- Machines talking to machines
- RESTful APIs use HTTP
- Think of HTTP as a universal language

Conceptualizing APIs

- Think of an API like a function
- Functions have *arguments* and do something
- APIs have *parameters* and do something
- `function(argument = value)`
- `http://hostname:8888/api_endpoint/?parameter=value`

Why an API?

Data Science Tool Box

- PDF reports
- PowerPoint presentations
- Spreadsheets
- Interactive Dashboards
- *Etc.*
- Limited to end user consumption

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Data Science Tool Box

- PDF reports
- PowerPoint presentations
- Spreadsheets
- Interactive Dashboards
- *Etc.*
- **~ APIs ~**

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APIs as a Maturity Process

- The one off analysis
- The *what ifs*?
  - Parameterized Rmd
  - Shiny Dashboard
- Need programmatic access
  - Function
  - API

Organizational

- Smaller pieces are easier to manage (less code!)
- Component Monitoring
- Infrastructure for recycled code
  - Less technical debt!
- Better change management
  - Upgrade one service at a time without bringing down whole application

Collaborative

- Easier tool hand off
  - No need to translate work
  - Not blocked by communication
- Empower teams to use preferred tool chain
- Concerned about API requests not software language
- Programmatic use of services by other teams

Signs you might be ready to create an API

- Redundant code (copying and pasting/reusing)
- Other teams want your code
- *Other teams may not know your language*
- *You want to integrate different software into one toolchain*

How do you build an API?

API Frameworks

- R - plumber
- Python - Flask, Fast API
- JavaScript - Node.js & Express.js

Parts of an API

- Host (fixed)
  - `http://api.hostname.io/`
- Endpoint
  - Resource location (think of as a function)
  - `http://api.hostname.io` **`/end-point`**
- Parameters (optional)
  - Address varying parts of a request
  - `http://api.hostname.io/end-point/` **`?param`**`=value`
- Headers & body (optional) (not in URL)
  - Associated (meta)data

API Requests

- Each API endpoint has a different **method**
- **GET**
  - Used to *retrieve* data. Parameters only. No body.
  - Everything is in the URL.
  - Don’t send sensitive data!
- POST
  - Used for *sending* data (files or text). More secure.
  - Creating or modifying something.
- Other methods:
  - PUT
  - DELETE (yikes!)
  - HEAD
  - …

Example: Global Crop Yields

- TidyTuesday Week 36, 2020
- Goal:
    - Fetch crop yields for a given crop, year, and country
- Ad hoc analysis
- Parameterized Rmd
- Function
- Plumber API

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Example: ad hoc analysis

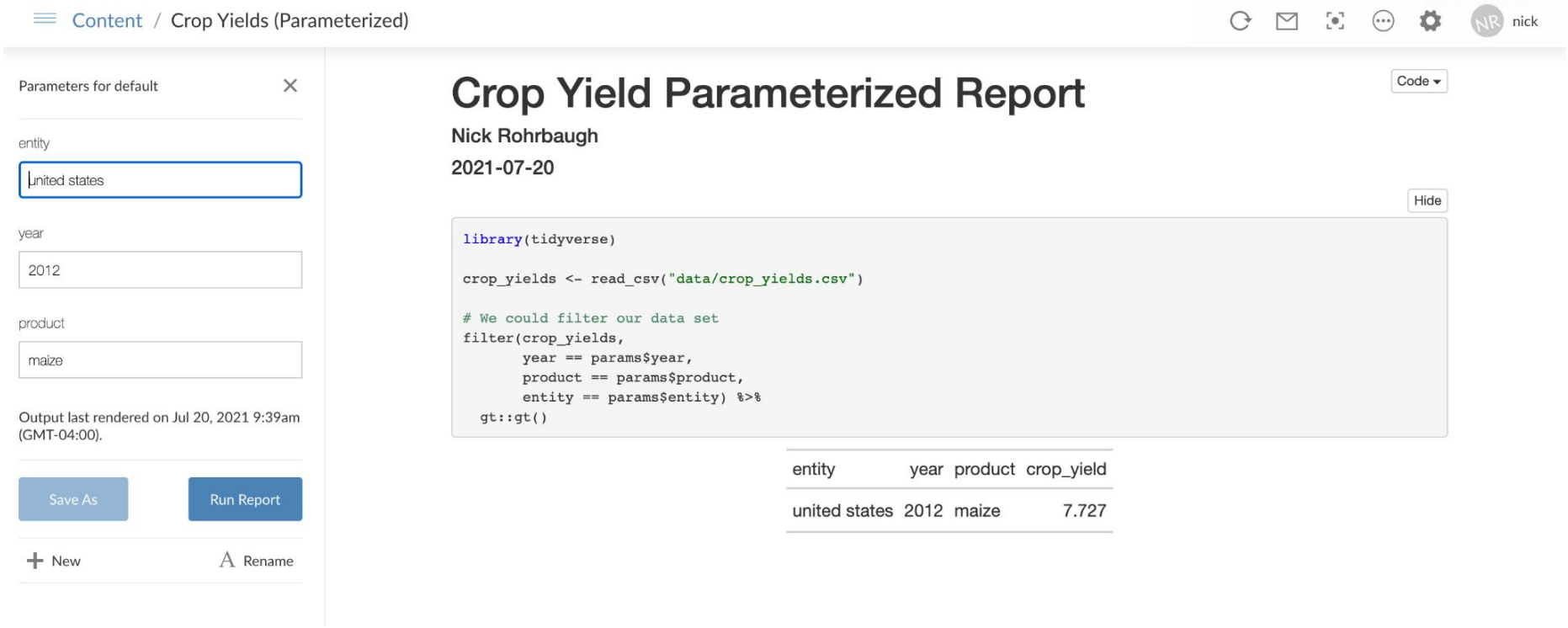
```
library(tidyverse)

crop_yields <- read_csv("data/crop_yields.csv")

# We could filter our data set
filter(crop_yields,
       year == 2018,
       product == "maize",
       entity == "cuba")
```

```
## # A tibble: 1 x 4
##   entity  year product crop_yield
##   <chr>  <dbl> <chr>        <dbl>
## 1 cuba    2018 maize         2.39
```

Parameterized Rmd



Update params link

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Making it functional

- Functions are code shortcuts!
- Functions are a special kind of object
- Arguments are placeholders
- Whatever is printed last is returned

```
my_fun <- function(arg) {
 # do something with the argument
 arg
}

my_fun("Hello!")
## [1] "Hello!"
```

What is changing?

- Things that change should be arguments

```
filter(crop_yields,
       year == 2018,
       product == "maize",
       entity == "cuba")
```

- Making the skeleton

```
filter_yields <- function(.year, .product, .entity) {
    # This is where our filtering will go!
}
```

- Using a `.` to avoid confusion in the `filter()`

Example: making it functional

```
filter_yields <- function(.year, .product, .entity) {

 filter(crop_yields,
      year == .year,
      product == .product,
      entity == .entity)
}

filter_yields(2012, "potatoes", "guatemala")
```

```
## # A tibble: 1 x 4
##    entity     year product  crop_yield
##    <chr>     <dbl> <chr>         <dbl>
## 1 guatemala  2012 potatoes       25.0
```

You've basically made an API already


host
RSC content path
endpoint
https://colorado.rstudio.com/rsc/crop-yield-api/crop-yield
?.year=1978&.product=cassava&.entity=congo
parameters

The API

```
library(plumber)
library(tidyverse)

crop_yields <- read_csv("data/crop_yields.csv")

#* @apiTitle Crop Yields API
#* Return crop yields for a given product, year, and entity.
#* @param .year The year of interest (1961 - 2018)
#* @param .product The crop of interest. One of wheat, rice, maize, soybeans,
potatoes, beans, peas, cassava, barley, cocoa beans, or bananas.
#* @param .entity The country of interest.
#* @get /crop-yield

function(.year, .product, .entity) {
 filter(crop_yields,
        year == .year,
        product == .product,
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```

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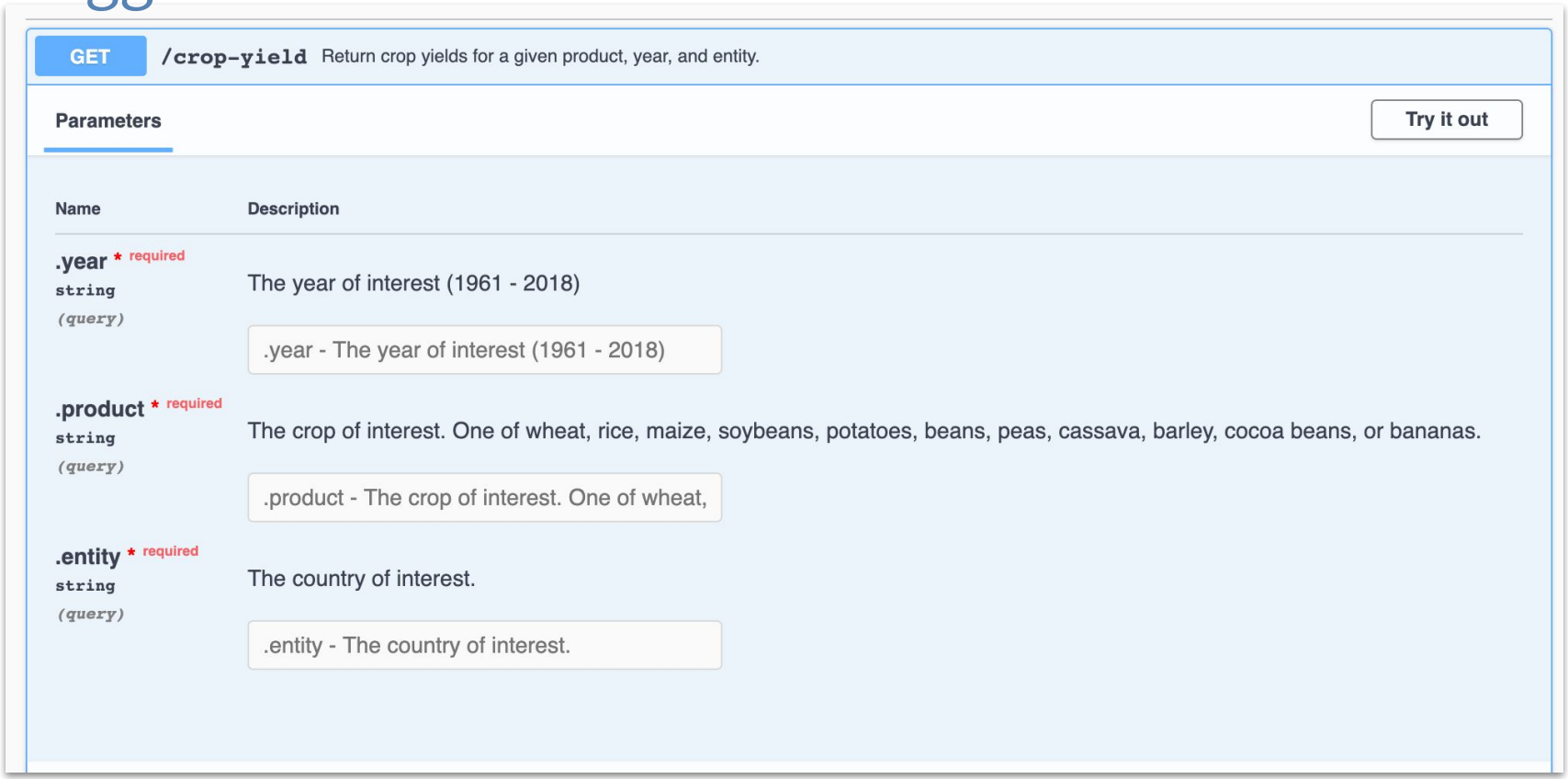
The Swagger Interface

Swagger



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Calling the API from R
{httr}

API Call Steps:

- This pattern is the same for all languages
- Generate the query URL
- Make the request
- Parse the response

Creating the URL

1. Specify the base URL
2. Create named list with parameters and values
3. Use `modify_url()` to fill in parameters

```
b_url <- "https://colorado.rstudio.com/rsc/crop-yield-api/crop-yield"

params <- list(.year = 1975, .product = "beans", .entity = "germany")

query_url <- modify_url(url = b_url, query = params)
```

```
"https://colorado.rstudio.com/rsc/crop-yield-api/crop-yield?.year=1975&.product=beans&.entity=germany"
```

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Send the request

- Use the appropriate method
  - e.g. `GET()`, `POST()`, `PUT()`

```
res <- GET(query_url)
```

```
## Response
```

[https://colorado.rstudio.com/rsc/crop-yield-api/crop-yield?.year=1975&.product=beans&.entity=germany]

```
##   Date: 2020-11-08 20:34
##   Status: 200
##   Content-Type: application/json
##   Size: 72 B
```

Parse the request

```
resp_raw <- content(res, as = "text")
```

```
"[{\"entity\":\"germany\",\"year\":1975,\"product\":\"beans\",\"crop_yiel
d\":2.8749}]"
```

```
 jsonlite::fromJSON(resp_raw)
```

```
##     entity year product crop_yield
## 1 germany 1975   beans     2.8749
```

Recap

Recap

- APIs: computers talking to computers
- RESTful APIs use HTTP
- HTTP is language agnostic
- Add APIs to your DS toolbox
- Reduce communication barriers
- Enable programmatic use of tools

More resources

- More API examples: https://solutions.rstudio.com/r/rest-apis/
- Logging and plumber APIs: https://solutions.rstudio.com/r/rest-apis/plumber-logging/
- Model management with R / RStudio Team: https://solutions.rstudio.com/data-science-admin/model-management/
- T-Mobile's loadtest package for load testing APIs from R: https://github.com/tmobile/loadtest

Thank you!

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