

http://127.0.0.1:7795 Open in Browser

~/Google Drive/Business Science/Learning Labs/2019-01-09-How_To_Learn_R/Shiny_App_Employee_Attrition_Predictor/R/application - Shiny

HR Analytics Employee Risk Department Risk Executive Report



Employee Number: 30

Attrition Risk: No
Predicted Risk: 20.84%
Departmental Risk Prediction: 5%

Job Role: Sales
Department: Sales
Education Field: Marketing

Feature Contributions to Attrition Risk:

Feature	Contribution	Risk Level
Years Since Last Promotion <= 4	Low Risk	
Monthly Income <= 5693	High Risk	

Employee Risk Assessment

Shiny In Production

Building Production-Quality Apps with Shiny

Attrition Risk Assessment Map

- Direction
- High Risk
- Low Risk
- Low Risk
- Low Risk
- Low Risk

Matt Dancho & David Curry

Learning Labs

university.business-science.io

Learning Lab Structure

- **Presentation**
(30 Minutes)
- **Q&A**
(15 Minutes)



university.business-science.io



Your Hosts!



Matt Dancho

Founder of Business Science, Matt designs and executes educational courses and workshops that deliver immediate value to organizations. His passion is up-leveling future data scientists coming from unconventional backgrounds.

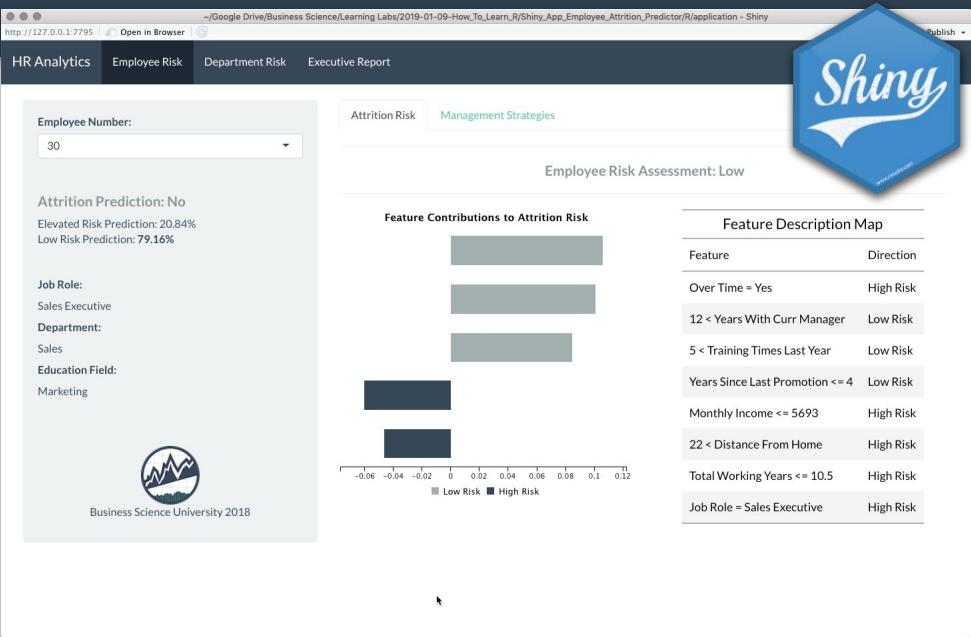


David Curry

Founder of Sure Optimize, David works with businesses to help improve website performance and SEO using data science. His passion is ethical Machine Learning initiatives.

Agenda: R In Production

- R in Production
 - Demo
 - New Tools
- Why Production?
- Workflow for Business Value
- Accelerated Learning Plan





in Production



What is Production?

Putting a data science product
**in the hands of decision
makers**

What is Shiny?

A web framework for building data
science products that **go into the
hands of decision makers**



Makes going from
concept to production fast

Demo Time!



File Edit Code View Plots Session Build Debug Profile Tools Window Help

~Google Drive/Business Science/Learning Labs/2019-01-09-How To Learn R_Fast/Shiny_App_Employee_Attrition_Predictor - RStudio

```
1 # 
2 # HR 301 Shiny Application
3 #
4 # libraries(shiny)
5 # library(shinythemes)
6 # library(DT)
7 # library(tidyverse)
8 # library(glue)
9 # library(lime)
10 # library(hilloorder)
11 # library(sheets)
12 # library(gt)
13 #
14 # source("employee_risk/rec_strategies.R")
15 # source("employee_risk/sheets_interactions.R")
16 # source("department_risk/department_summary.R")
17 pred <- readRDS("data/lime_prediction_results.RDS")
18 #
19 mgmt_note_fields <- c("obs", "mgmt.notes")
20 ui <- fluidPage(
21   headerPanel(
22     theme = shinytheme("flatly"),
23     "HR Analytics",
24     "Employee Risk",
25     "NoveltyLog"
26   ),
27   sidebarPanel(
28     selectInput("obs", "Employee Number:", choices = application_data$EmployeeNumber),
29     hr(),
30     selectInput("role", "Job Role:", choices = application_data$Role),
31     hr(),
32     selectInput("dept", "Department:", choices = application_data$Department),
33     hr(),
34     selectInput("edu", "Education Field:", choices = application_data$EducationField),
35     hr()
36   ),
37   mainPanel(
38     h3("Attrition Prediction: Yes"),
39     p("Elevated Risk Prediction: 47.08%"),
40     p("Low Risk Prediction: 52.92%"),
41     br(),
42     p("Job Role: Manager"),
43     p("Department: Human Resources"),
44     p("Education Field: Human Resources")
45   )
46 )
47 
```

Console Terminal Job ~Google Drive/Business Science/Learning Labs/2019-01-09-How To Learn R_Fast/Shiny_App_Employee_Attrition_Predictor

label: unnamed-chunk-2 (with options)

List of 1

\$ echo: log1 FALSE

Quitting from lines 17-22 (dept_report.Rmd)

Warning: Error in filter_(impl): Evaluation error: object 'Attrition' not found.

[No stack trace available]

Tue Jan 16 3:27 PM Matthew Dancho

Shiny_App_Employee_Attrition_Predictor

Environment History Connections QR

Staged Status Path

Icons R/icon R/application/icon R/application/data/icon R/application/department_risk/icon R/application/employee_risk/icon

http://127.0.0.1:6570 Open in Browser

HR Analytics Employee Risk Department Risk Executive Report

Employee Number: 891

Attrition Risk Management Strategies

Employee Risk Assessment: Low

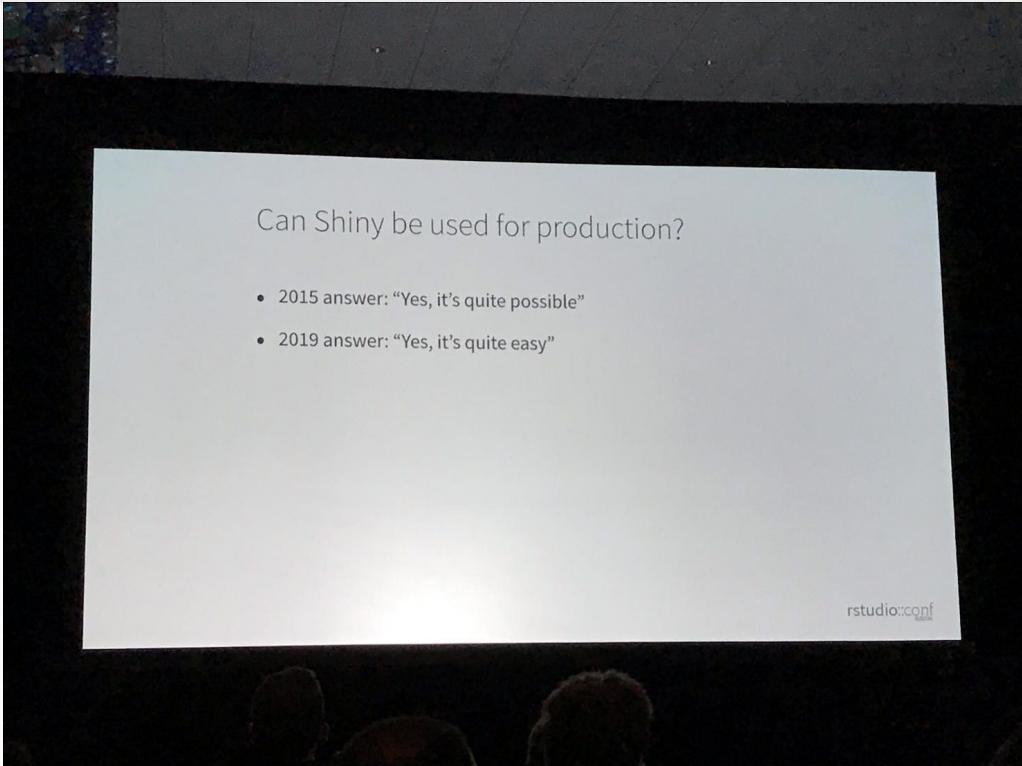
Feature Contributions to Attrition Risk

Feature	Direction
Over Time = No	Low Risk
Stock Option Level = 0	High Risk
28 < Years At Company	High Risk
6 < Num Companies Worked	High Risk
Job Satisfaction = Low	High Risk
Training Times Last Year <= 2	High Risk
Job Level = 3	High Risk
Work Life Balance = Better	Low Risk

Business Science University 2018

Shiny H₂O.ai

Can R Be Used In Production?



"Yes, it's quite easy."

-Joe Cheng, CTO RStudio
Keynote at Rstudio::conf 2019





New Tools

- shinytest
- shinyloadtest
- profvis



New tools for Shiny in production

- **RStudio Connect** – On-premises Shiny serving with push-button deployment
<https://www.rstudio.com/products/connect/>
- **shinytest** – Automated UI testing for Shiny
<https://rstudio.github.io/shinytest/>
- **shinyloadtest** – Load testing for Shiny
<https://rstudio.github.io/shinyloadtest/>
- **profvis** – Profiler for R (not new but still very important!)
<https://rstudio.github.io/profvis/>
- **Plot caching** – Dramatically speed up repeated plots
<http://shiny.rstudio.com/articles/plot-caching.html>
- **Async** – Last resort technique for dealing with slow operations
<https://rstudio.github.io/promises/>

rstudio::conf 2019

"We have new tools."

-Joe Cheng, CTO RStudio
Keynote at Rstudio::conf 2019

New Tools



shinytest

What has broken as your app has evolved?

<https://rstudio.github.io/shinytest/articles/shinytest.html>

Test event recorder

-
-
-

On exit, save tests as:

Open script in editor on exit

Run test script on exit

Recorded events

Event type	Name
------------	------

~[Dropbox/Projects/shinytest/inst/difflviewerapp - Shiny

Differences between expected (old) and current (new) test results for 081-widgets-gallery: mytest

Save and quit Quit

001.json 001.png

001.json 001.png

1 1 00 -1,9 +1,9 @@
2 2 {
3 3 "input": {
4 4 "action": 1,
5 5 "checkbox": true,
6 6 "checkboxGroup": ["1", "2", "3"],
7 7 "checkboxGroupOut": ["1", "3"],
8 8 "date": "2014-01-01",
9 9 "dates": ("2014-01-01", "2015-01-01"),
10 10 "file": null,
11 11 "num": 1,
12 12 00 -1,9 +1,9 @@
13 13 },
14 14 "output": {
15 15 "actionOut": "[1] \\\\neattr(, \"class\")\\\\n[1] \\\\\"integer\\\\\" \\\\nshinyActionButtonValue\\\\\"",
16 16 "checkboxOut": "[1] TRUE",
17 17 "checkboxGroupOut": "[1] \"1\" \\\\n\"3\"",
18 18 "checkboxGroupOut": "[1] \"1\" \\\\n\"3\"",
19 19 "dateOut": "[1] \"2014-01-01\"",
20 20 "datesOut": "[1] \"2014-01-01\" \\\\n\"2015-01-01\"",
21 21 "fileOut": "NULL",
22 22 "numOut": "[1] 1",
23 23 14 14 11 21 Difference Toggle Slider

Shiny Widgets Gallery

Action button Single checkbox Checkbox group

Action Action Action
Current state Current state Current state
Action Action Action

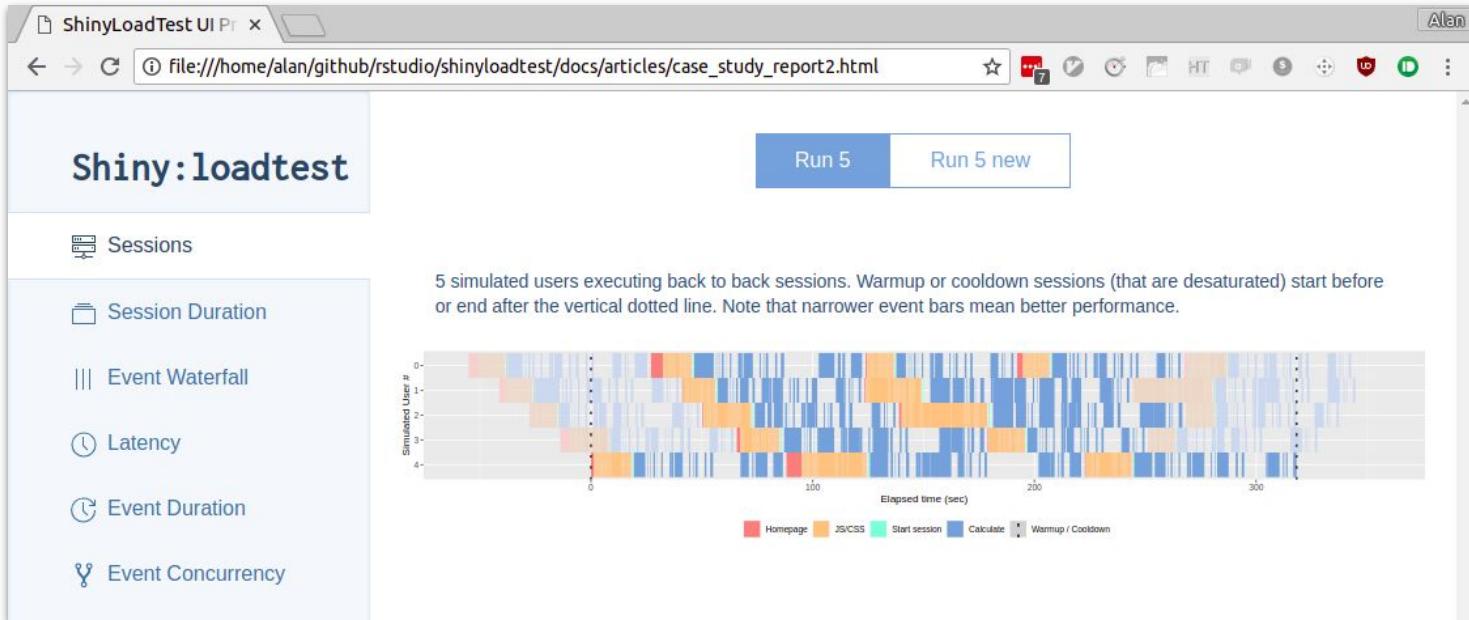




shinyloadtest

How well does your application scale?

<https://rstudio.github.io/shinyloadtest/>





profvis

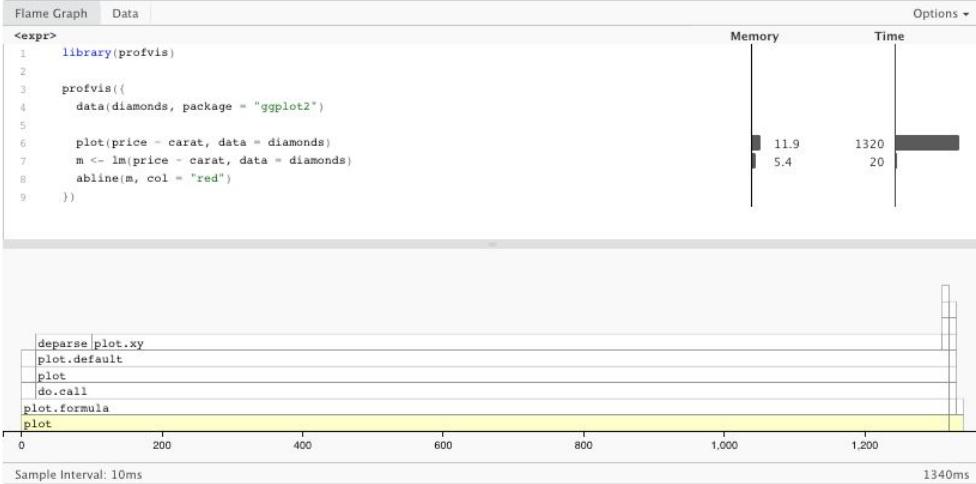
How efficient is your code?

<https://rstudio.github.io/profvis/>

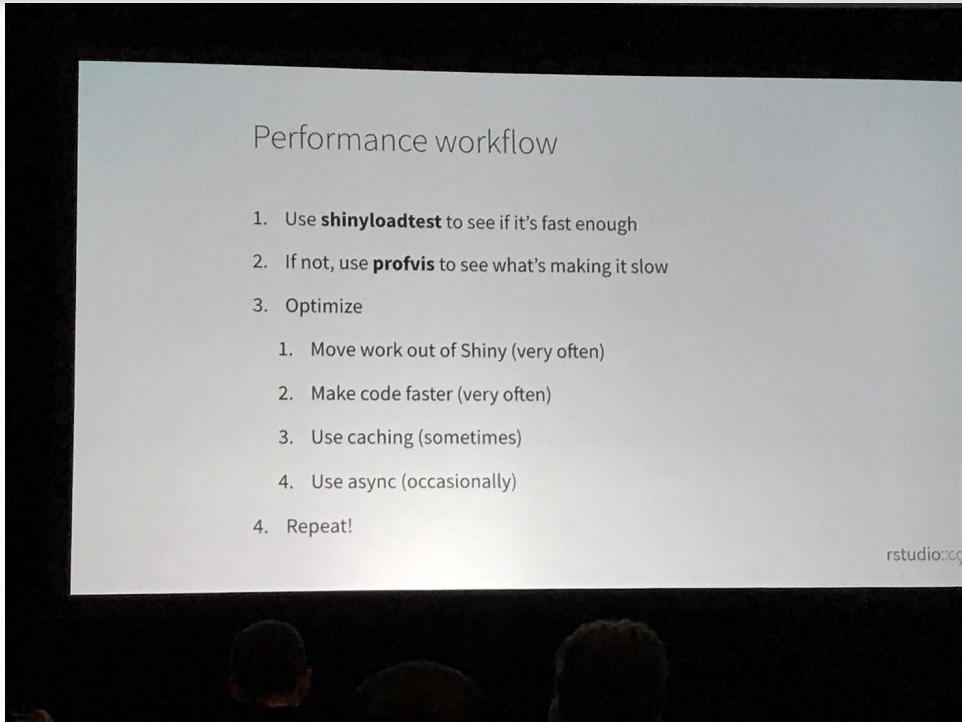
```
library(profvis)

profvis({
  data(diamonds, package = "ggplot2")

  plot(price ~ carat, data = diamonds)
  m <- lm(price ~ carat, data = diamonds)
  abline(m, col = "red")
})
```



Can R Be Used In Production?



"Recipe for performance."

-Joe Cheng, CTO RStudio
Keynote at Rstudio::conf 2019

Why Production?

\$5M

Per Year

How much you can save your organization by solving a
large business problem

Case Study: True Cost of Employee Churn



```
calculate_attrition_cost <- function(  
  
  # Employee  
  n           = 1,  
  salary      = 80000,  
  
  # Direct Costs  
  separation_cost = 500,  
  vacancy_cost   = 10000,  
  acquisition_cost = 4900,  
  placement_cost  = 3500,  
  
  # Productivity Costs  
  net_revenue_per_employee = 250000,  
  workdays_per_year        = 240,  
  workdays_position_open   = 40,  
  workdays_onboarding      = 60,  
  onboarding_efficiency    = 0.50  
  
) {  
  
  # Direct Costs  
  direct_cost <- sum(separation_cost, vacancy_cost, acquisition_cost, placement_cost)  
  
  # Lost Productivity Costs  
  productivity_cost <- net_revenue_per_employee / workdays_per_year *  
    (workdays_position_open + workdays_onboarding * onboarding_efficiency)  
  
  # Savings of Salary & Benefits (Cost Reduction)  
  salary_benefit_reduction <- salary / workdays_per_year * workdays_position_open  
  
  # Estimated Turnover Per Employee  
  cost_per_employee <- direct_cost + productivity_cost - salary_benefit_reduction  
  
  # Total Cost of Employee Turnover  
  total_cost <- n * cost_per_employee  
  
  return(total_cost)  
  
}
```

• SIMPLE CALCULATION

Direct costs

Lost Productivity

Savings (Salary & Benefits)

• \$78K COST / EMPLOYEE

• IF ORGANIZATION LOSES 200 HIGH PERFORMERS EACH YEAR...

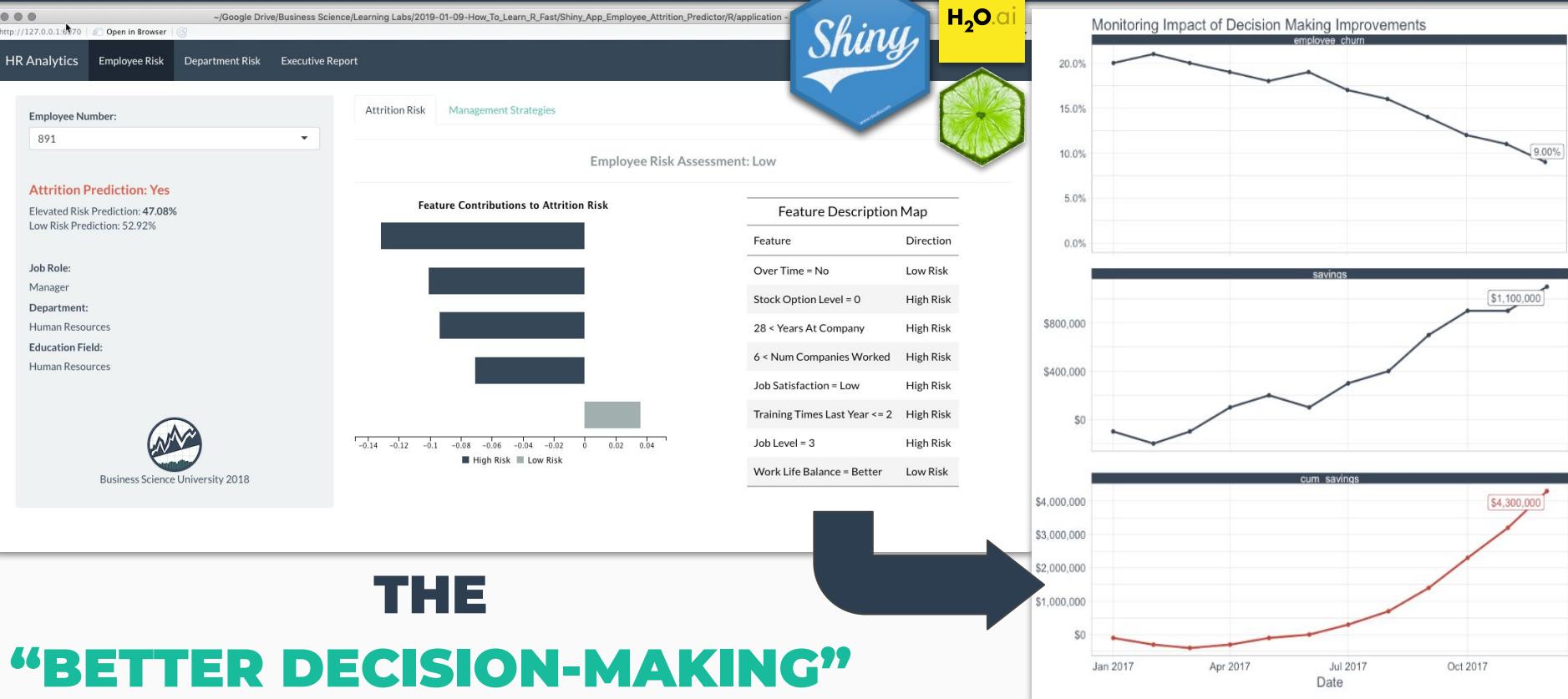
A young boy with blonde hair, wearing a grey herringbone vest over a pink long-sleeved shirt, stands against a dark background. He is holding an open book in front of him with both hands and has a wide-eyed, shocked expression on his face.

**\$15M / YEAR
PROBLEM**

You Only Generate
Business Value When
You Effect Decision

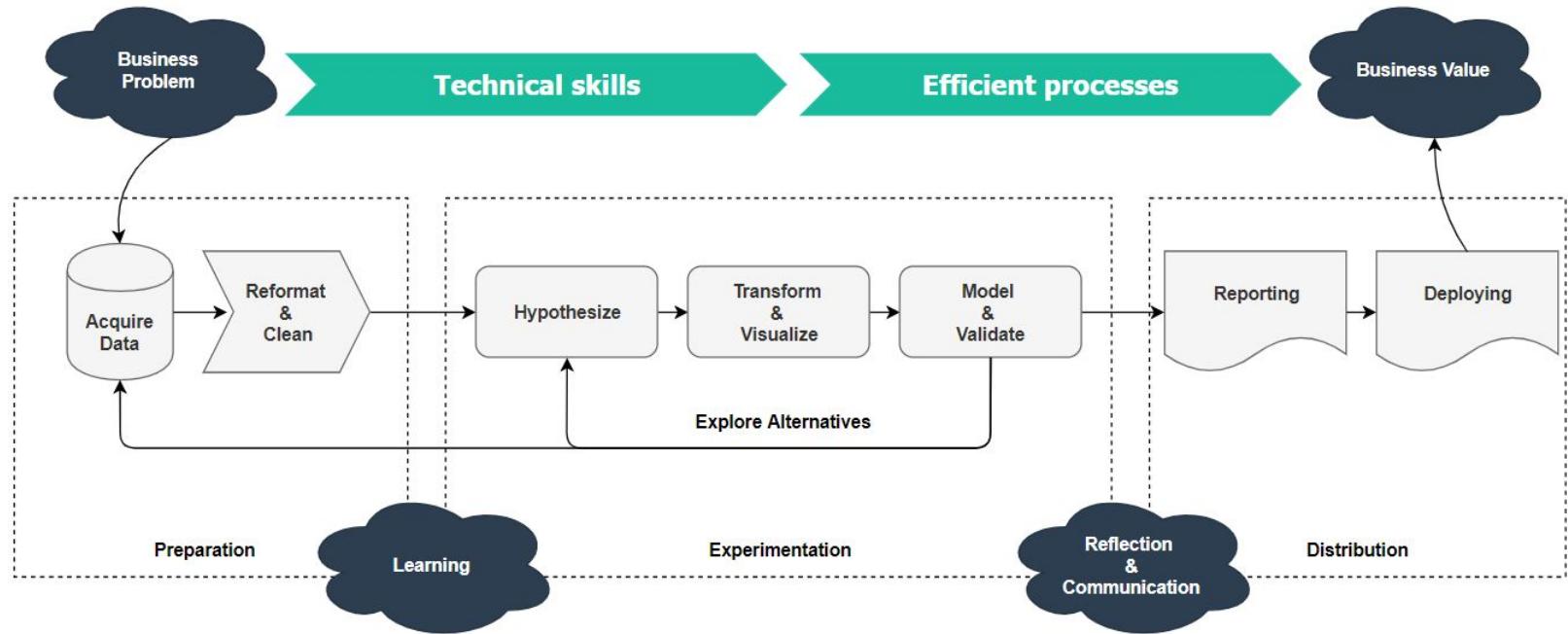


Cause & Effect

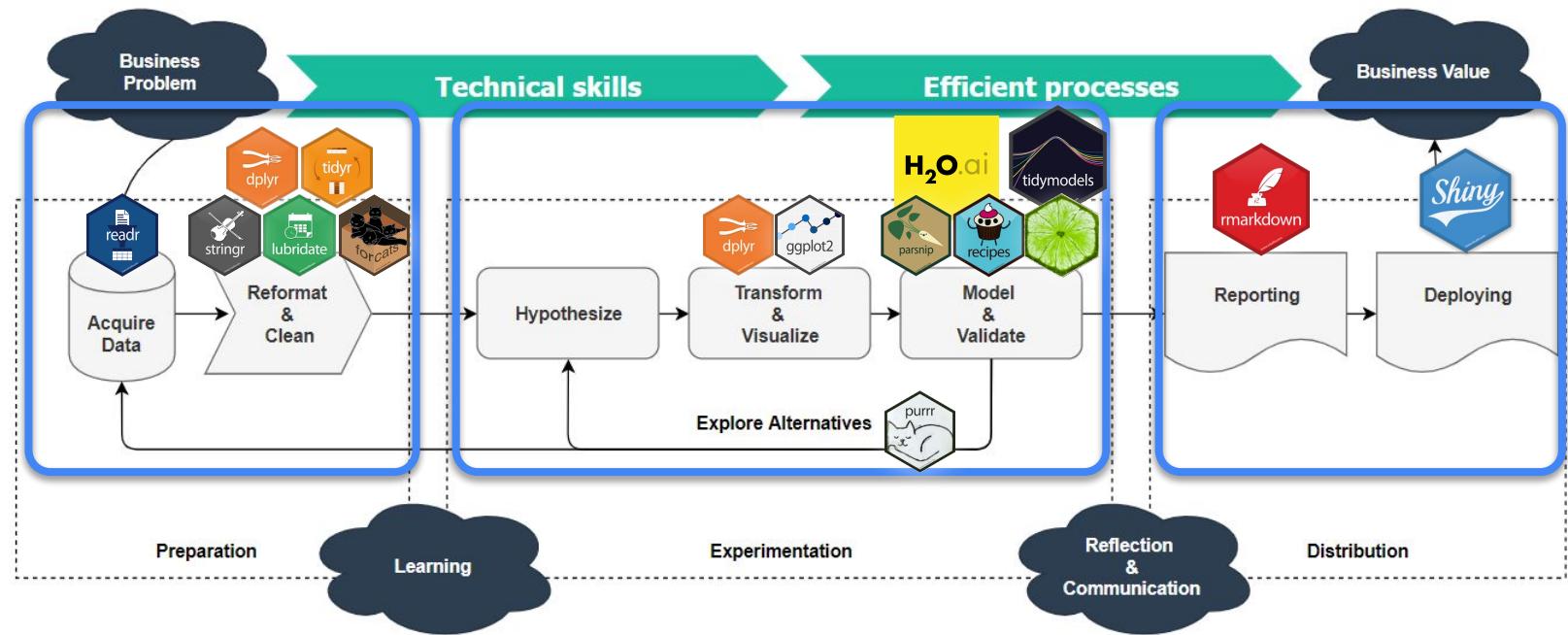


Workflow For Business Value

Data Science Workflow



Data Science Workflow



Apply Tools To Problem



Data Science Workflow



Data Science Toolchain



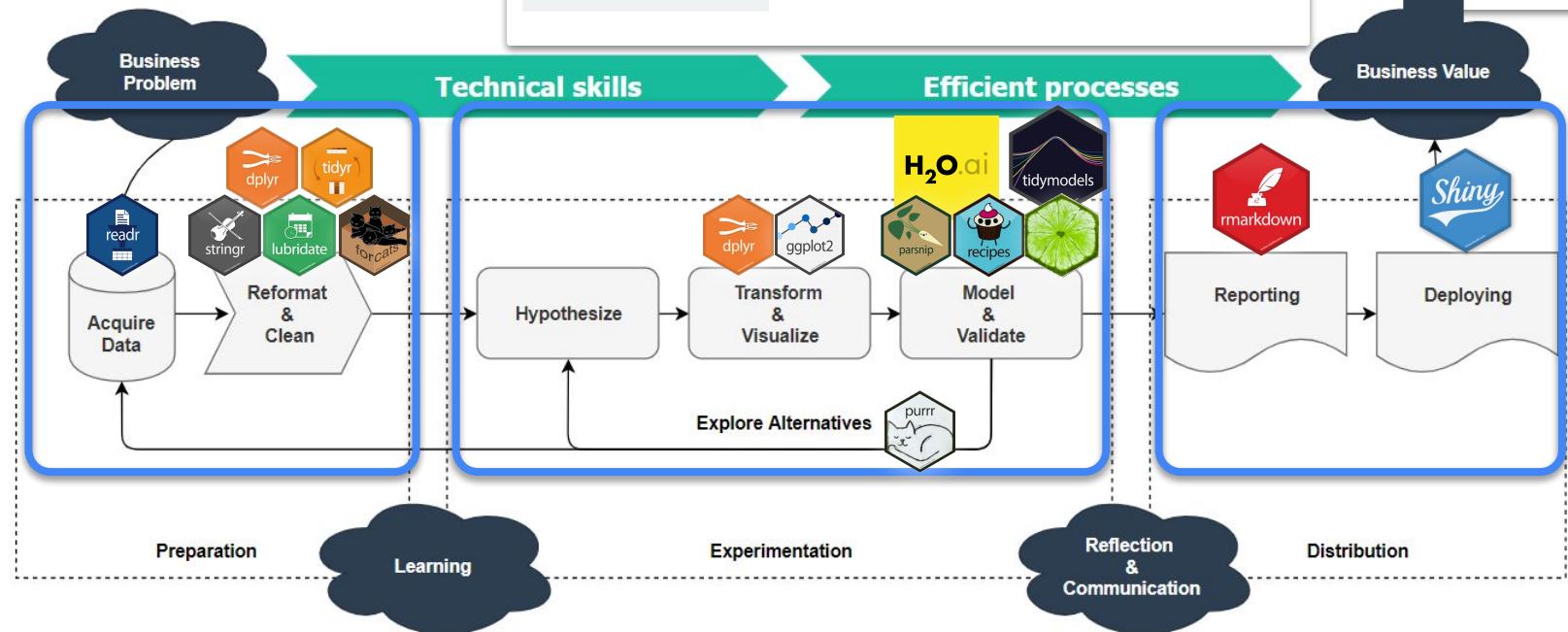
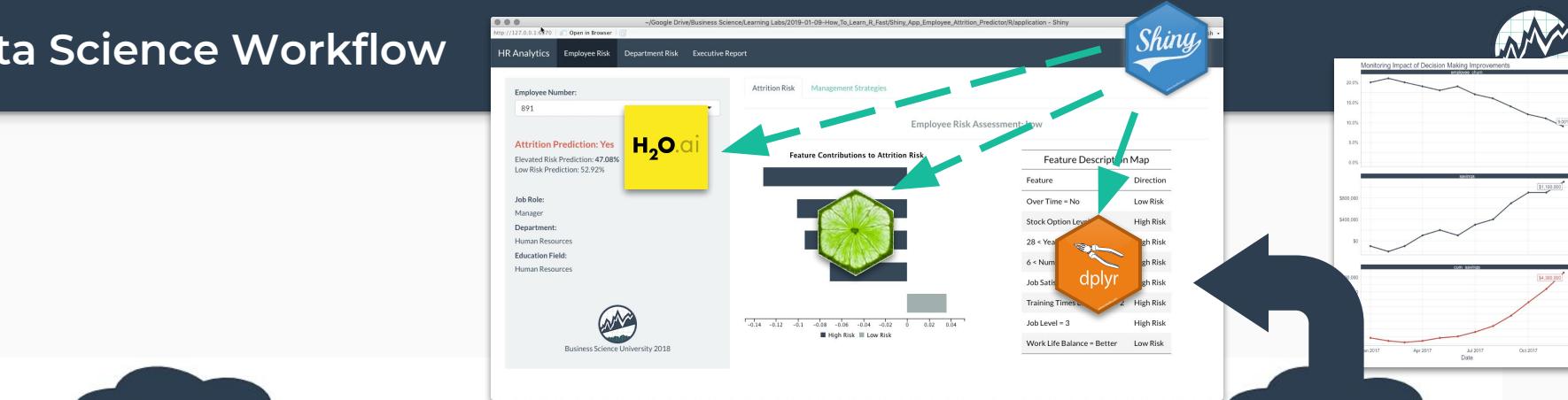
Building

- HTML
- CSS

Testing

- shinytest
- shinyloadtest
- profvis

Data Science Workflow



Case Study

For Generating Business Value



Data Science Workflow

```
# 1C. Measure The Drivers ----  
  
# Collect Information on Employee Attrition: On going  
  
# Develop KPI's: Industry KPIs: 8.8%  
  
dept_job_role_tbl %>%  
  
  count(Department, JobRole, Attrition) %>%  
  
  count_to_pct(Department, JobRole) %>%  
  
  assess_attrition(Attrition, attrition_value = "Yes", baseline_pct = 0.088) %>%  
  
  mutate(  
    cost_of_attrition = calculate_attrition_cost(n = n, salary = 80000)  
  )  
...  
)
```

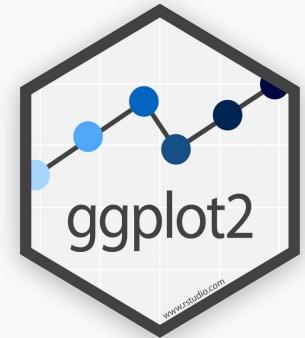
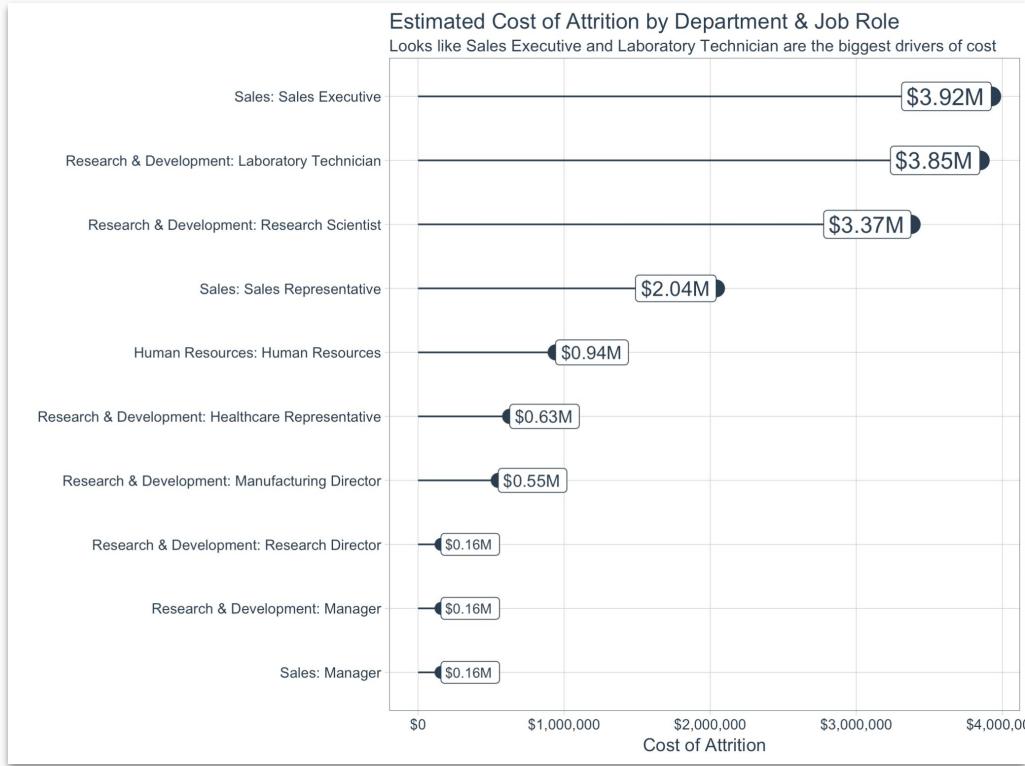
Department <chr>	JobRole <chr>	Attrition <chr>	n <int>	pct <dbl>	above_industry_avg <chr>	cost_of_attrition <dbl>
Sales	Sales Representative	Yes	26	0.40000000	Yes	2040566.7
Human Resources	Human Resources	Yes	12	0.30769231	Yes	941800.0
Research & Development	Laboratory Technician	Yes	49	0.21875000	Yes	3845683.3
Sales	Sales Executive	Yes	50	0.18315018	Yes	3924166.7
Research & Development	Research Scientist	Yes	43	0.16602317	Yes	3374783.3
Research & Development	Healthcare Representative	Yes	8	0.07619048	No	627866.7
Sales	Manager	Yes	2	0.06451613	No	156966.7
Research & Development	Manufacturing Director	Yes	7	0.05691057	No	549383.3
Research & Development	Manager	Yes	2	0.04166667	No	156966.7
Research & Development	Research Director	Yes	2	0.02739726	No	156966.7

1-10 of 10 rows



Size the Problem

Data Science Workflow



ggplot2

www.rstudio.com

Visualize Employee Churn Cost

Data Science Workflow



```
# 2. Modeling ----  
  
h2o.init()  
  
split_h2o <- h2o.splitFrame(as.h2o(train_tbl), ratios = c(0.85), seed = 1234)  
  
train_h2o <- split_h2o[[1]]  
valid_h2o <- split_h2o[[2]]  
test_h2o <- as.h2o(test_tbl)  
  
y <- "Attrition"  
x <- setdiff(names(train_h2o), y)  
  
automl_models_h2o <- h2o.automl(  
  x = x,  
  y = y,  
  training_frame = train_h2o,  
  validation_frame = valid_h2o,  
  leaderboard_frame = test_h2o,  
  max_runtime_secs = 30,  
  nfolds = 5  
)
```

H₂O.ai



Predict Employee Churn Risk

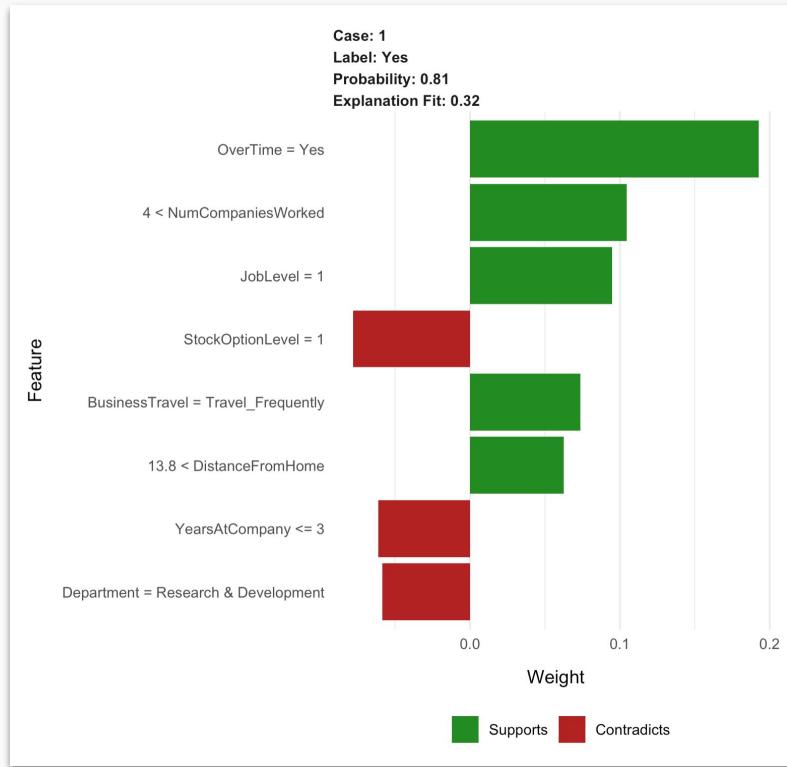


Data Science Workflow

```
explainer <- train_tbl %>%
  select(-Attrition) %>%
  lime(
    model              = automl_leader,
    bin_continuous     = TRUE,
    n_bins             = 4,
    quantile_bins      = TRUE
  )

explainer

explanation <- test_tbl %>%
  slice(5) %>%
  select(-Attrition) %>%
  lime::explain(
    explainer = explainer,
    n_labels   = 1,
    n_features = 8,
    n_permutations = 5000,
    kernel_width = 1
  )
```



Explain Features Employee Churn Risk

Data Science Workflow



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http://127.0.0.1:6700 | Open in Browser | C

HR Analytics Employee Risk Department Risk Executive Report

Employee Number: 891

Attrition Prediction: Yes
Elevated Risk Prediction: 47.08%
Low Risk Prediction: 52.92%

Job Role: Manager
Department: Human Resources
Education Field: Human Resources

H₂O.ai

Business Science University 2018

Attrition Risk Management Strategies

Employee Risk Assessment: Low

Feature Contributions to Attrition Risk

Feature Description Map

Feature	Direction
Over Time = No	Low Risk
Stock Option Level = 1	High Risk
28 < Years = No	High Risk
6 < Number of Children = No	High Risk
Job Satisfaction = High	High Risk
Training Times Last Year > 2	High Risk
Job Level = 3	High Risk
Work Life Balance = Better	Low Risk

Shiny

Data Science Workflow

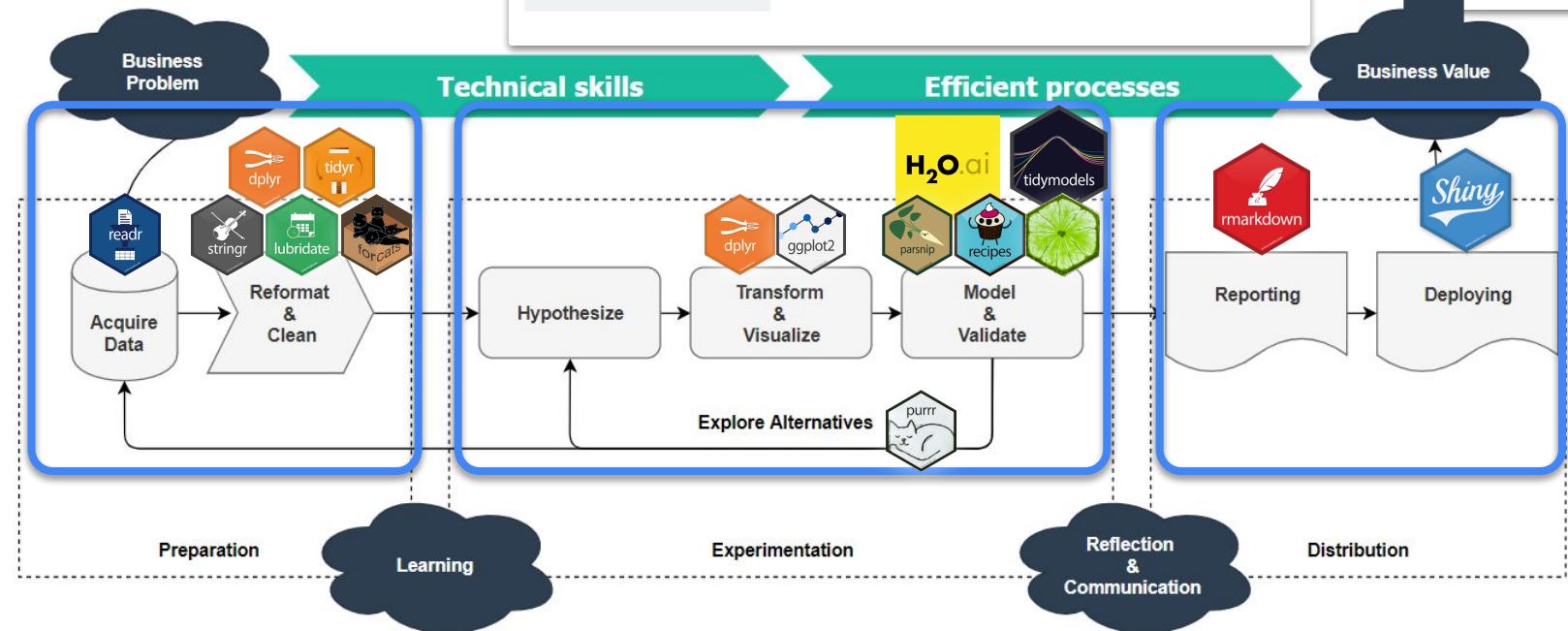
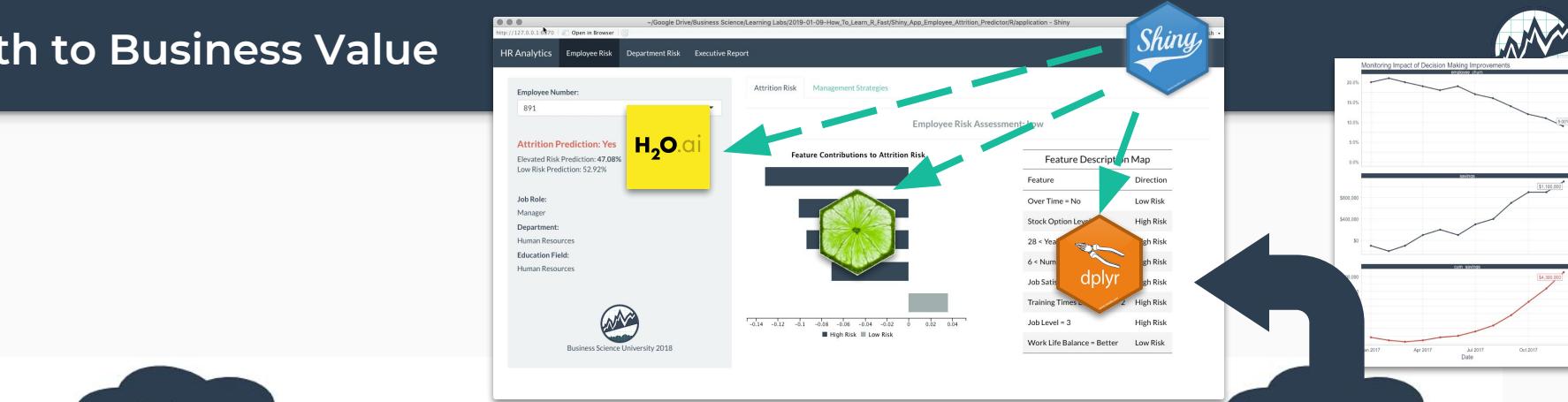
Better decisions benefits the organization financially



\$4.3M

Per Year Savings

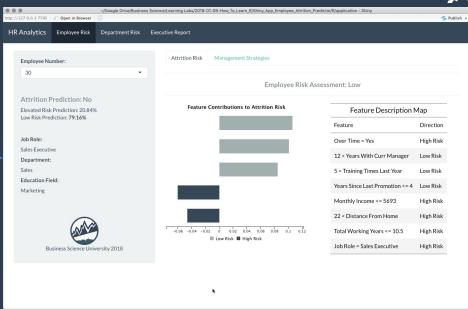
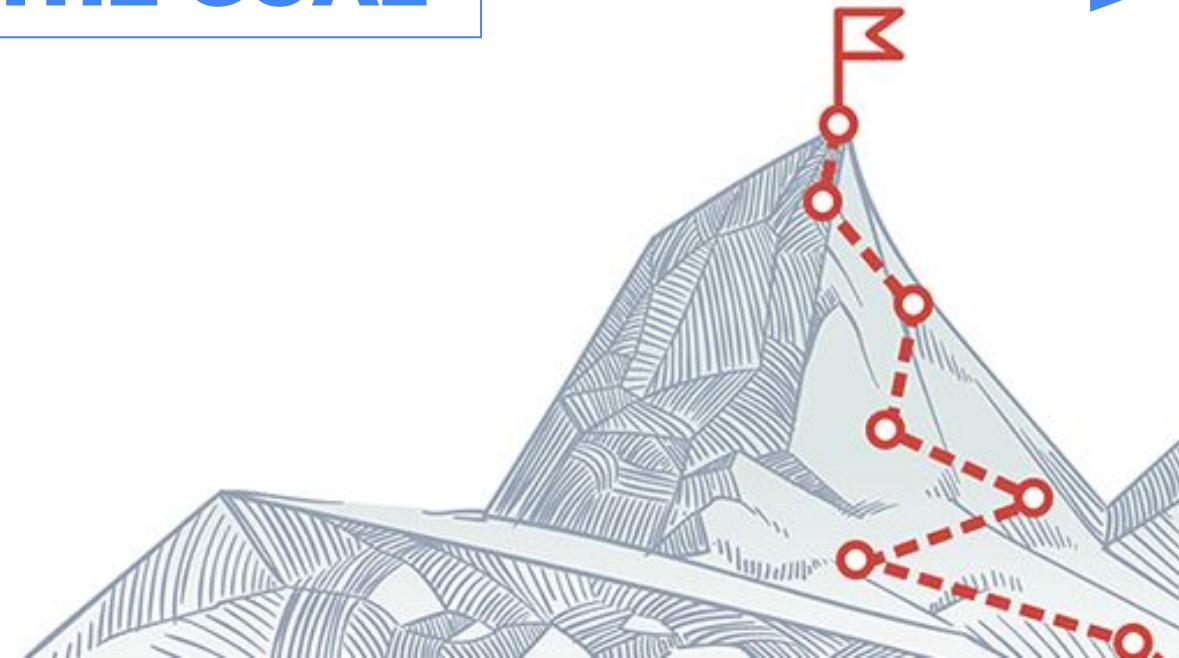
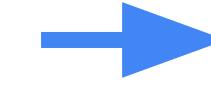
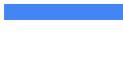
Path to Business Value



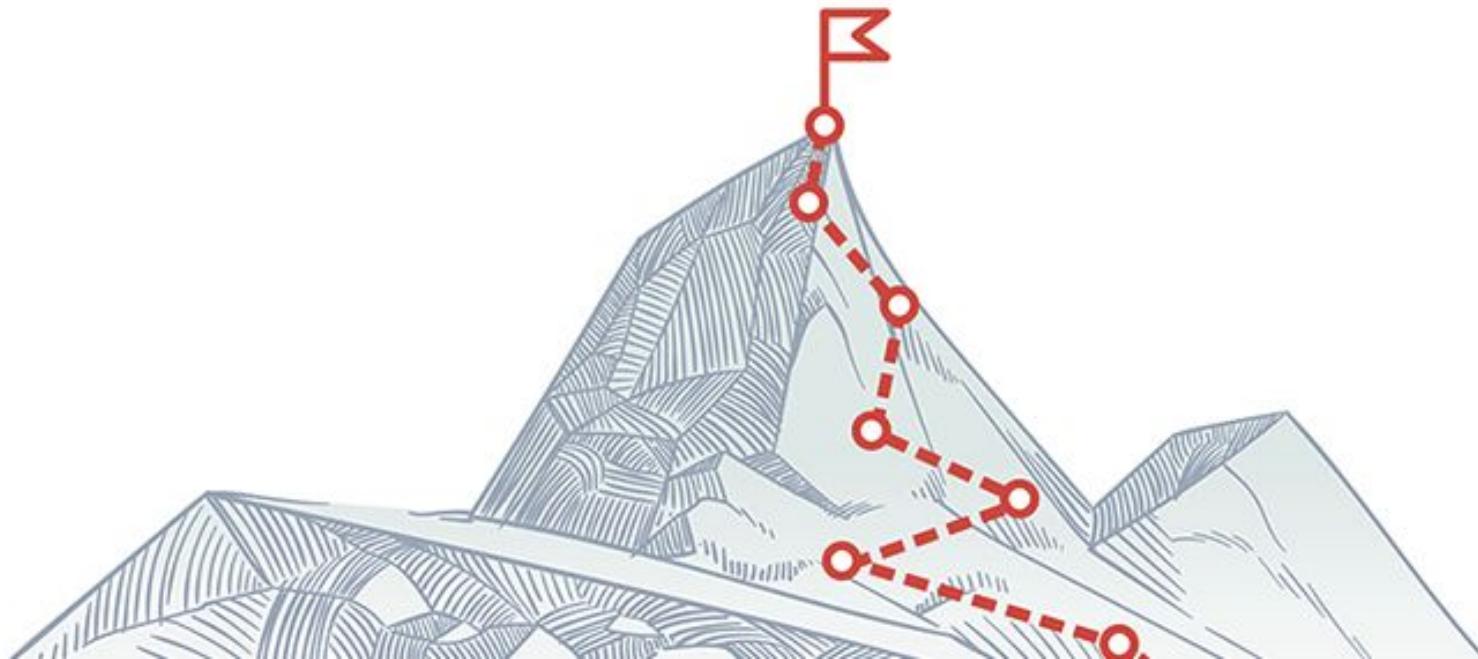
How to get to Production

Learning R is a Hill Climb

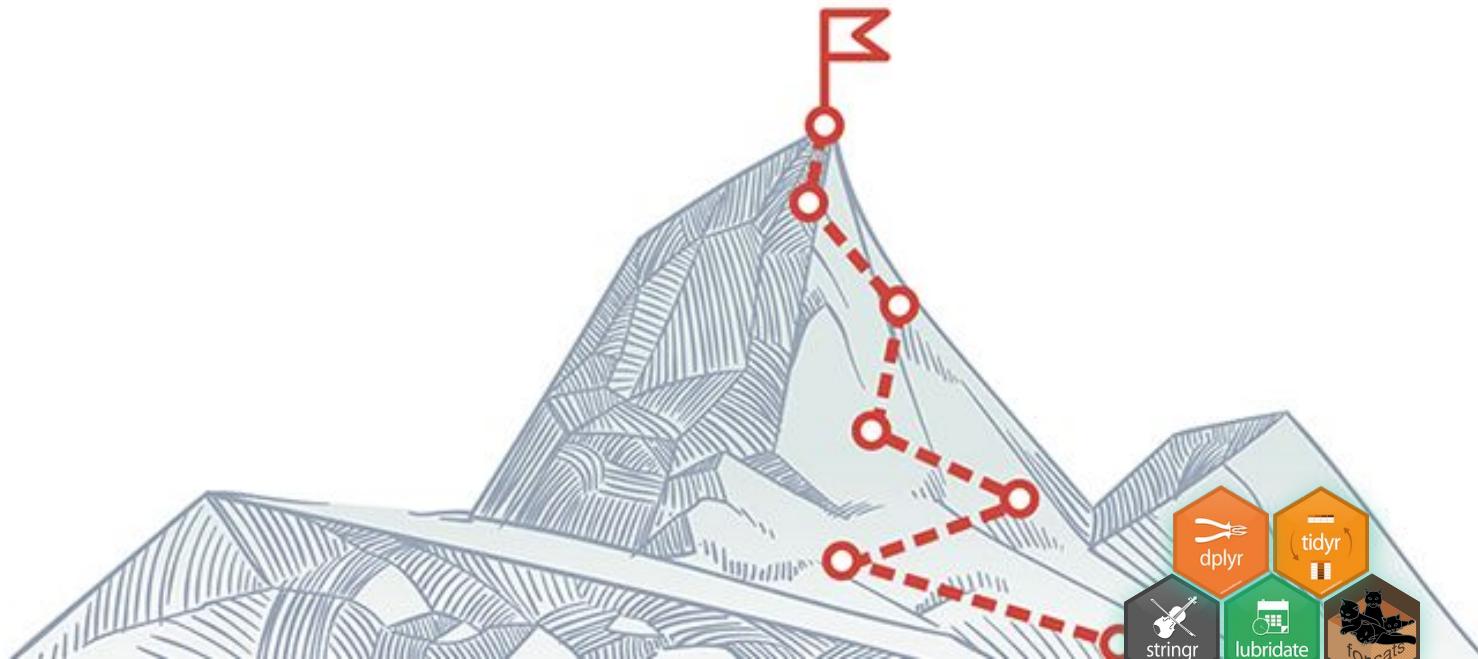
THE GOAL



Learning R is a Hill Climb

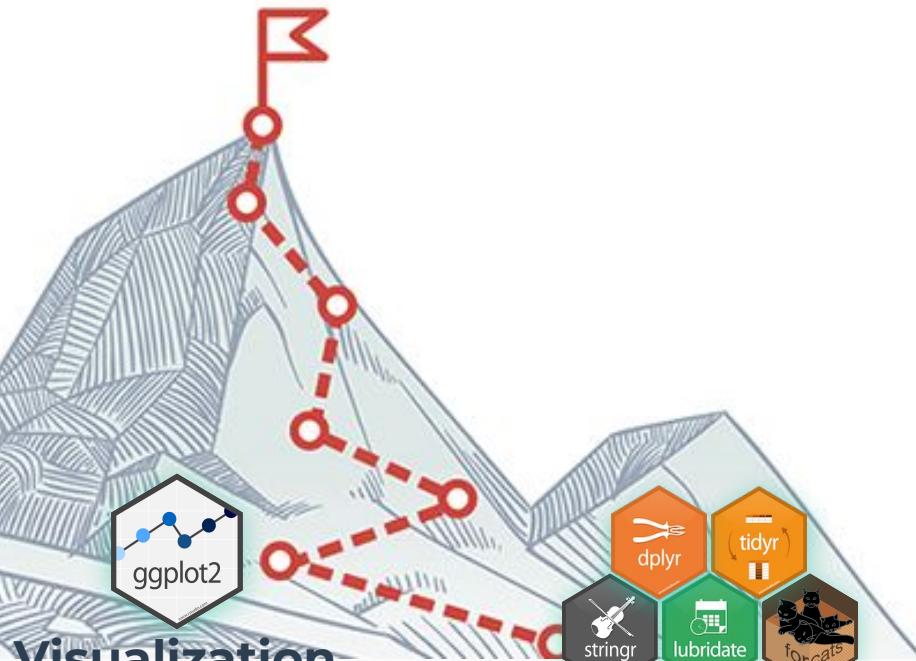
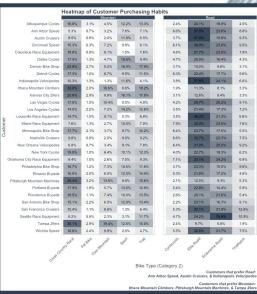
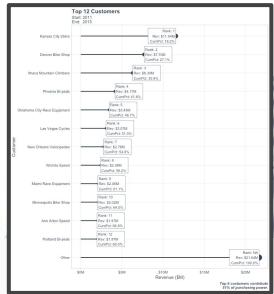


Learning R is a Hill Climb



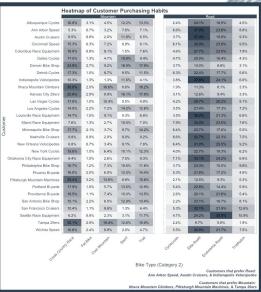
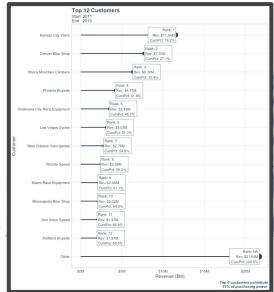
**Data Cleaning
& Manipulation**

Learning R is a Hill Climb



Data Cleaning
& Manipulation

Learning R is a Hill Climb



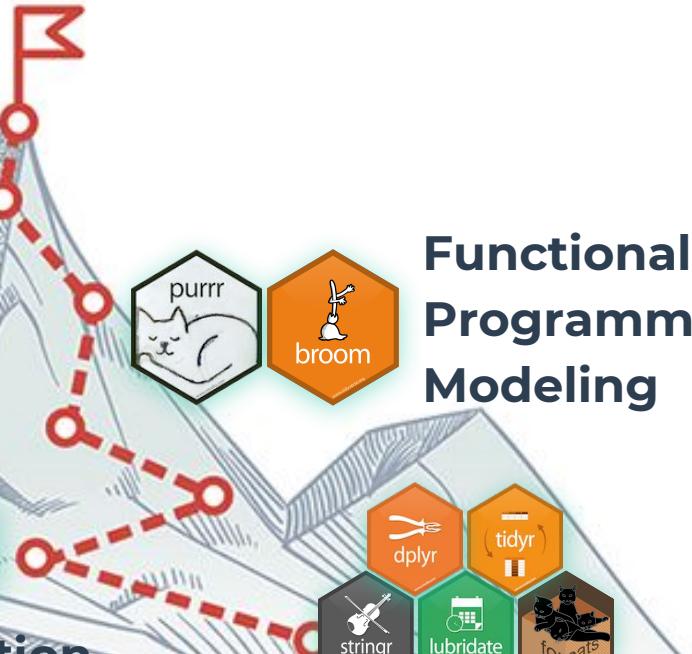
Visualization



Functional
Programming &
Modeling



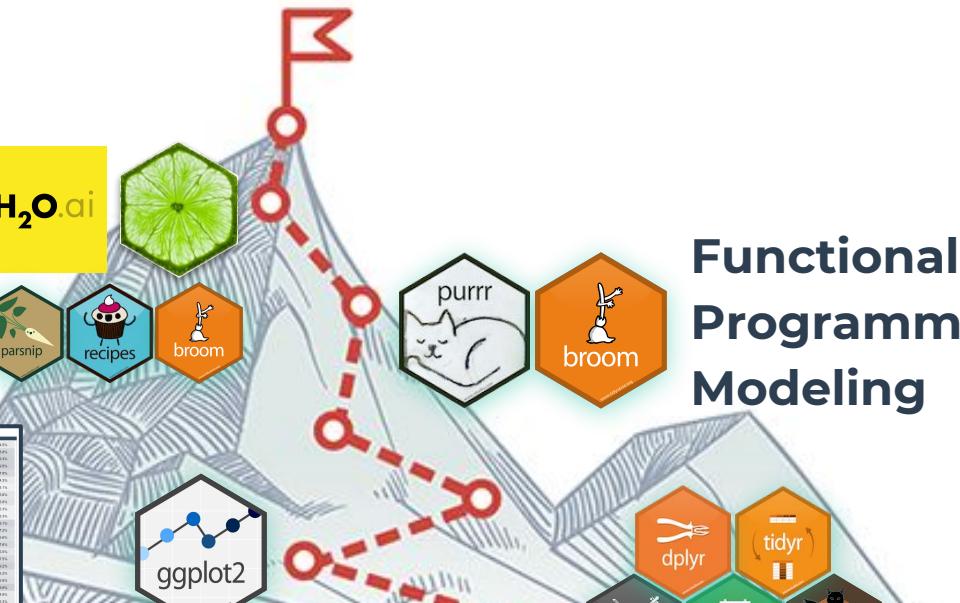
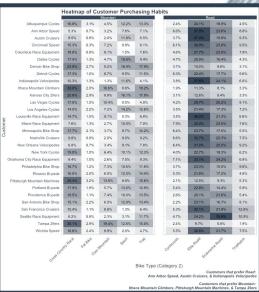
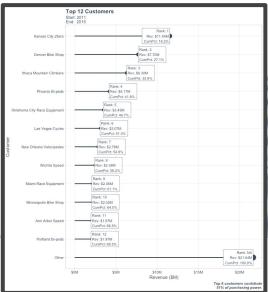
Data Cleaning
& Manipulation



Learning R is a Hill Climb



Advanced Data Science



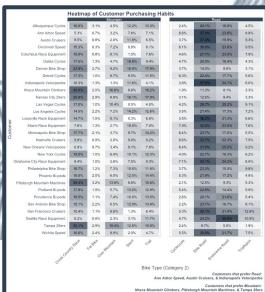
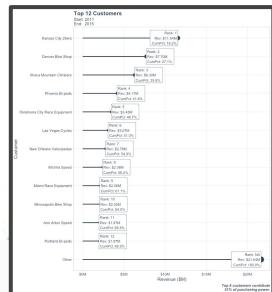
Visualization

Data Cleaning & Manipulation

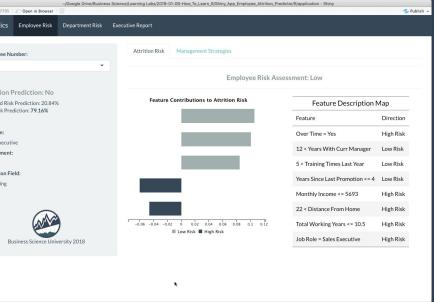
Learning R is a Hill Climb

THE GOAL

Advanced
Data Science



Visualization



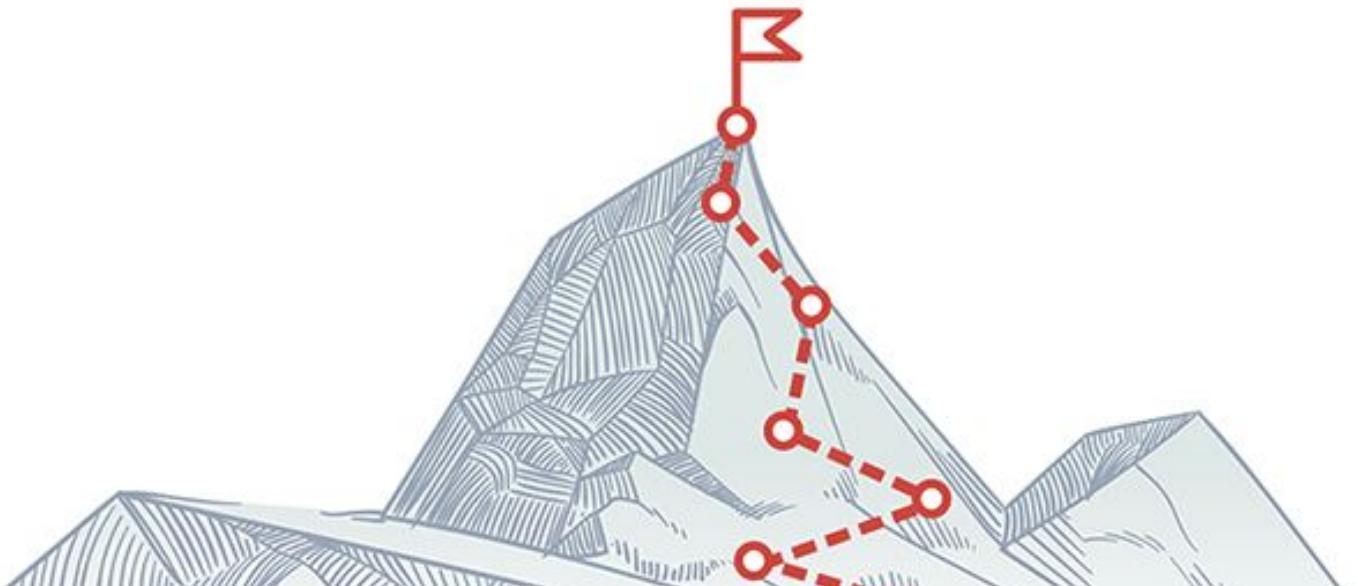
Functional
Programming &
Modeling



Data Cleaning
& Manipulation

Last Mile
is Challenging

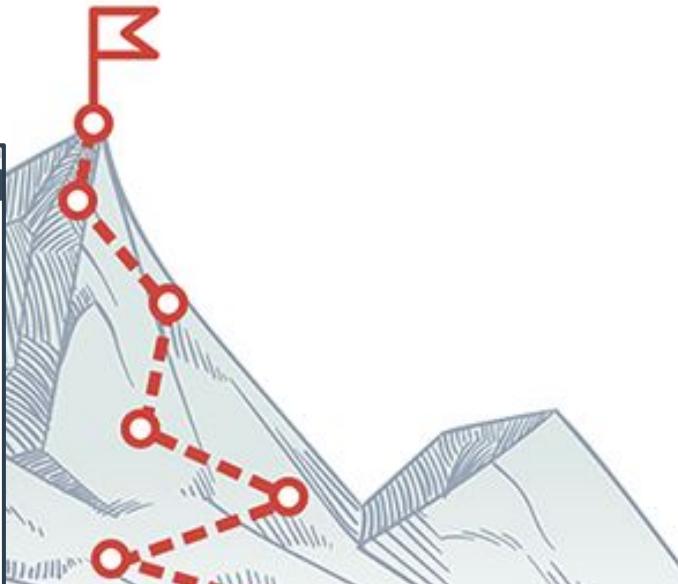
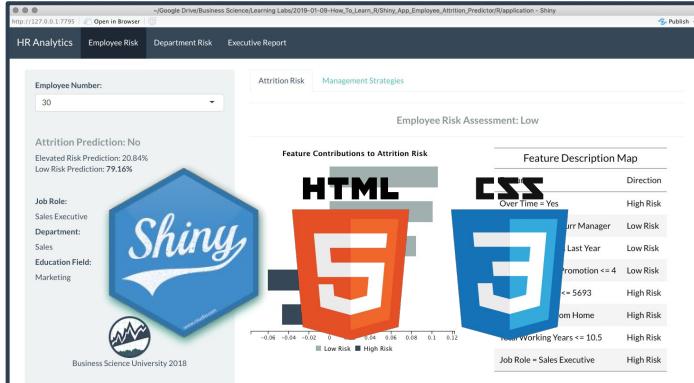
Last Mile is Challenging



Last Mile is Challenging



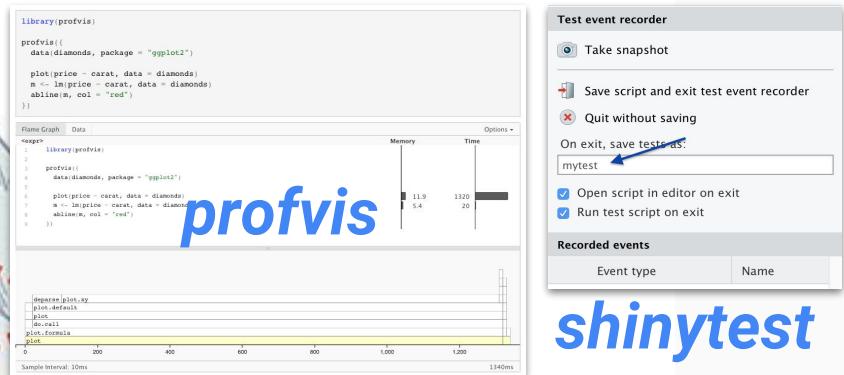
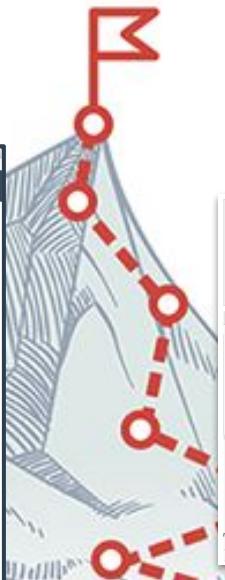
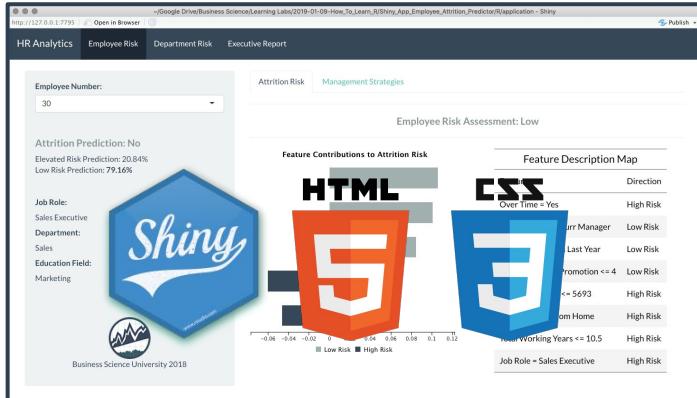
Build App



Last Mile is Challenging



Build App



Last Mile is Challenging



Production Quality



Build App

Employee Number: 30

Attrition Prediction: No
Elevated Risk Prediction: 20.84%
Low Risk Prediction: 79.16%

Job Role: Sales Executive
Department: Sales
Education Field: Marketing

Attrition Risk: Management Strategies

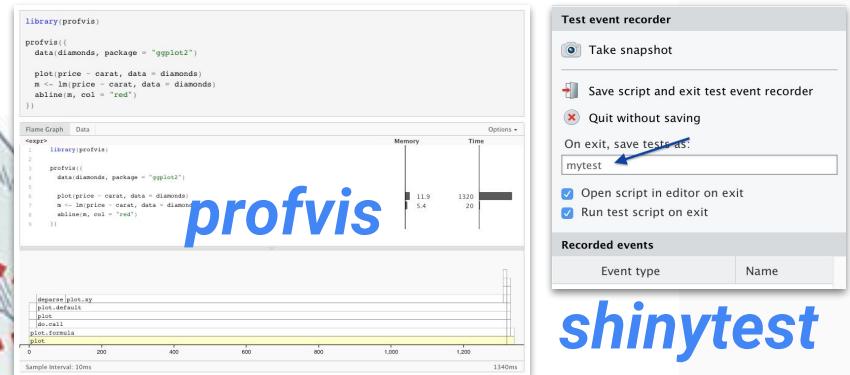
Employee Risk Assessment: Low

Feature Contributions to Attrition Risk

Feature	Direction
HTML	High Risk
CSS	Over-Time = Yes Manager
JS	Last Year Promotion <= 4 <= 5693 Work Home High Risk
Java	High Risk
Python	High Risk
Job Role = Sales Executive	High Risk

Feature Description Map

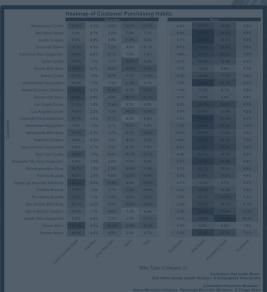
Business Science University 2018



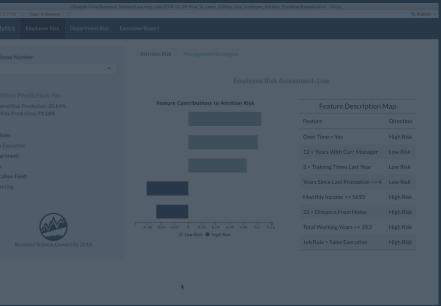
Learning R is a Hill Climb

Path To Top Can Be Accomplished FAST

Advanced Data Science



Visualization



Functional Programming & Modeling

Data Cleaning & Manipulation

The Plan

THE PLAN



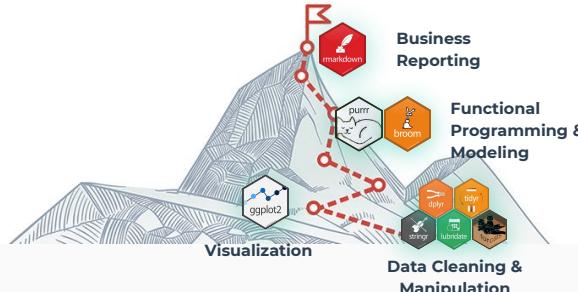
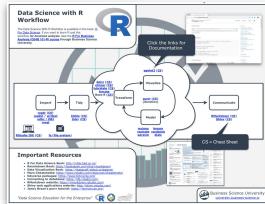
Business Analysis with R (DS4B 101-R)

Data Science For Business with R (DS4B 201-R)

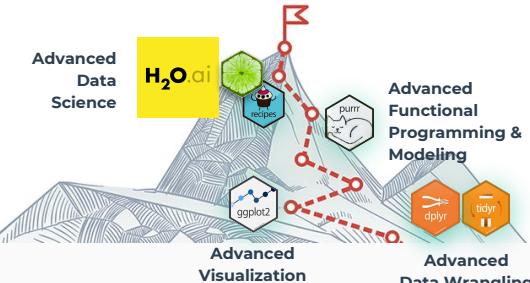
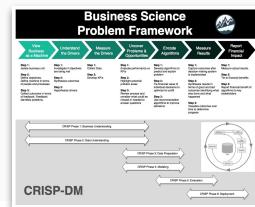
R Shiny Web Apps For Business (DS4B 301-R)

Project-Based Courses with Business Application

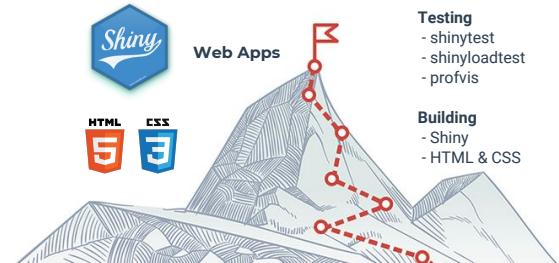
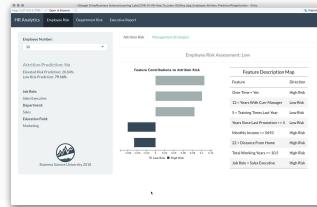
Data Science Foundations
7 Weeks



Machine Learning & Business Consulting
10 Weeks



Web Application Development
6 Weeks





THE RESULT



Business Analysis with R
(DS4B 101-R)
7 WEEKS

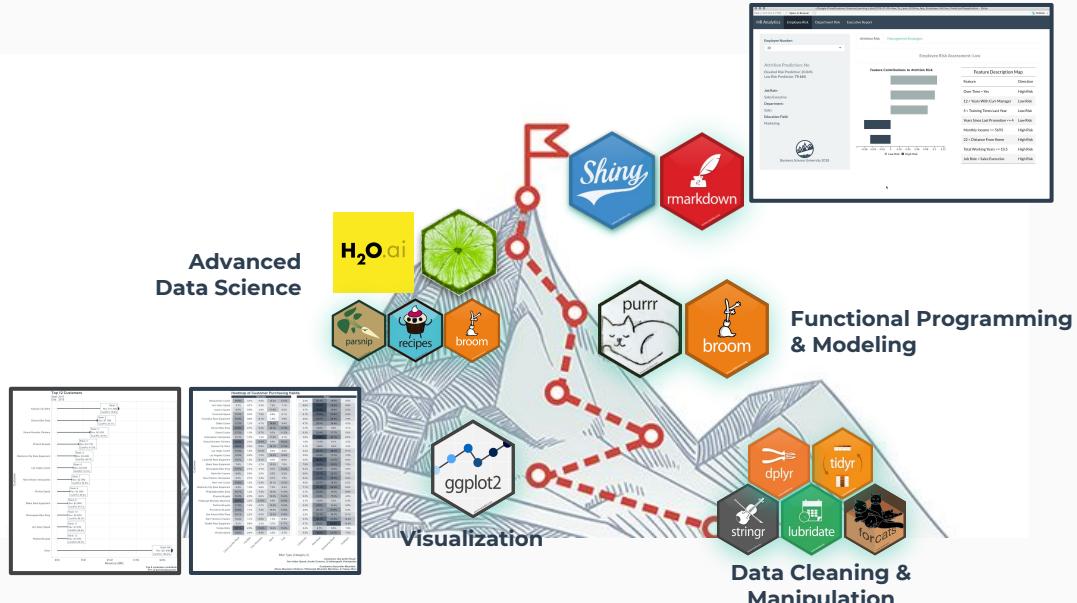


Data Science For Business with R
(DS4B 201-R)
10 WEEKS



R Shiny Web Apps For Business
(DS4B 301-R)
6 WEEKS

23 WEEKS!
(OR LESS)



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THE BONUS



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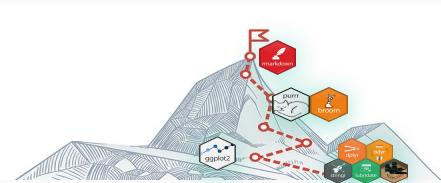
Business Analysis with R
(DS4B 101-R)

Data Science For Business with R
(DS4B 201-R)

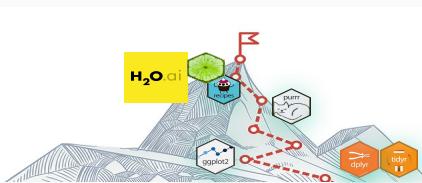
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Project-Based Courses with Business Application

Data Science Foundations
7 Weeks



Machine Learning &
Business Consulting
10 Weeks



Web Application Development
6 Weeks

