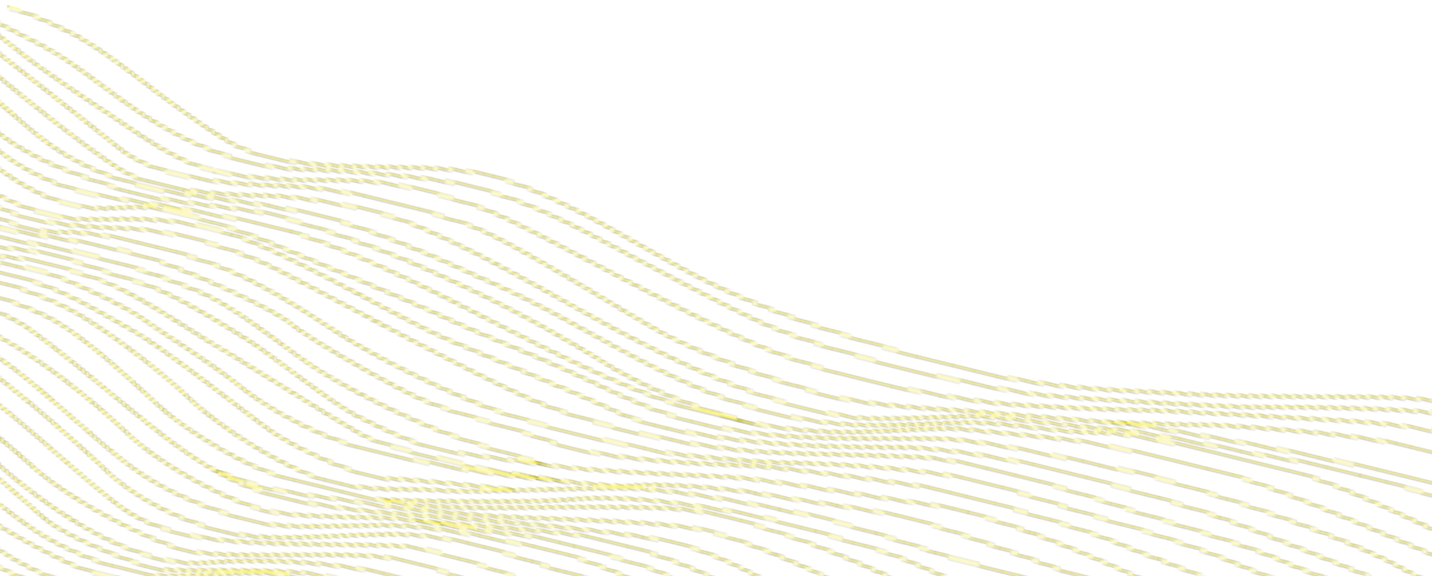
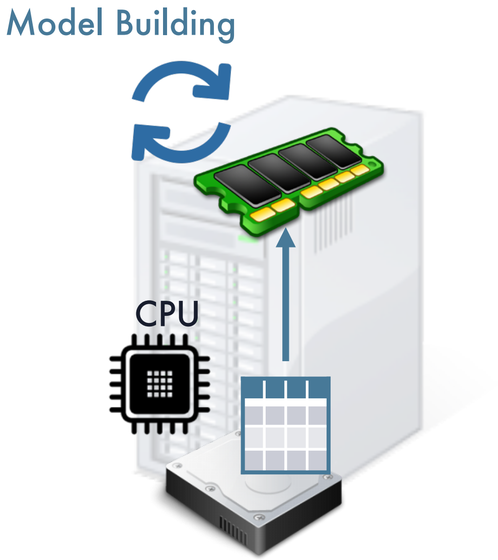
Architecture & Client API Overview Session



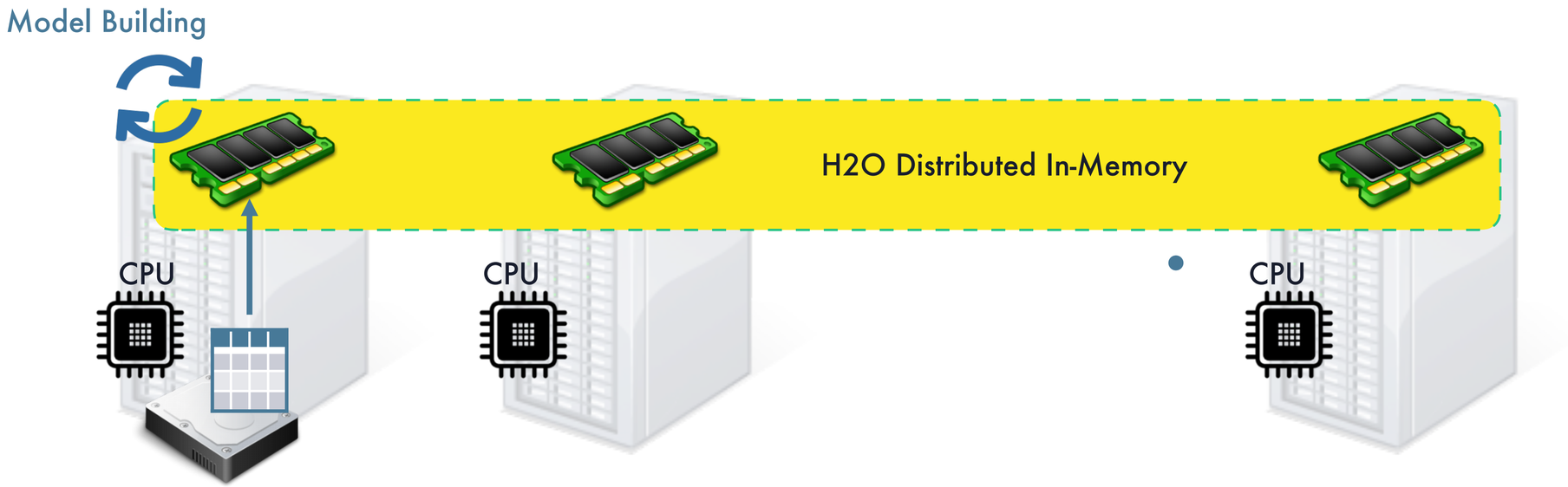
H2O Core

- Laptop
- Virtual Machine
- Container

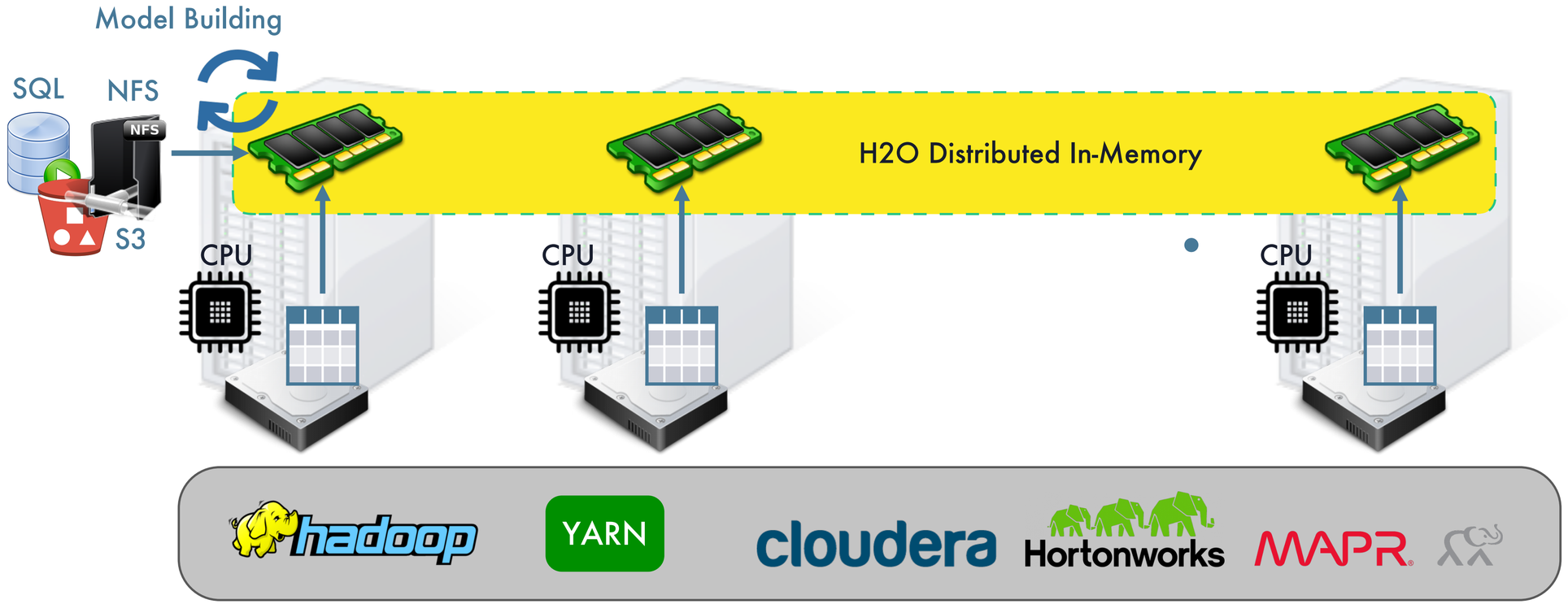
H2O Core



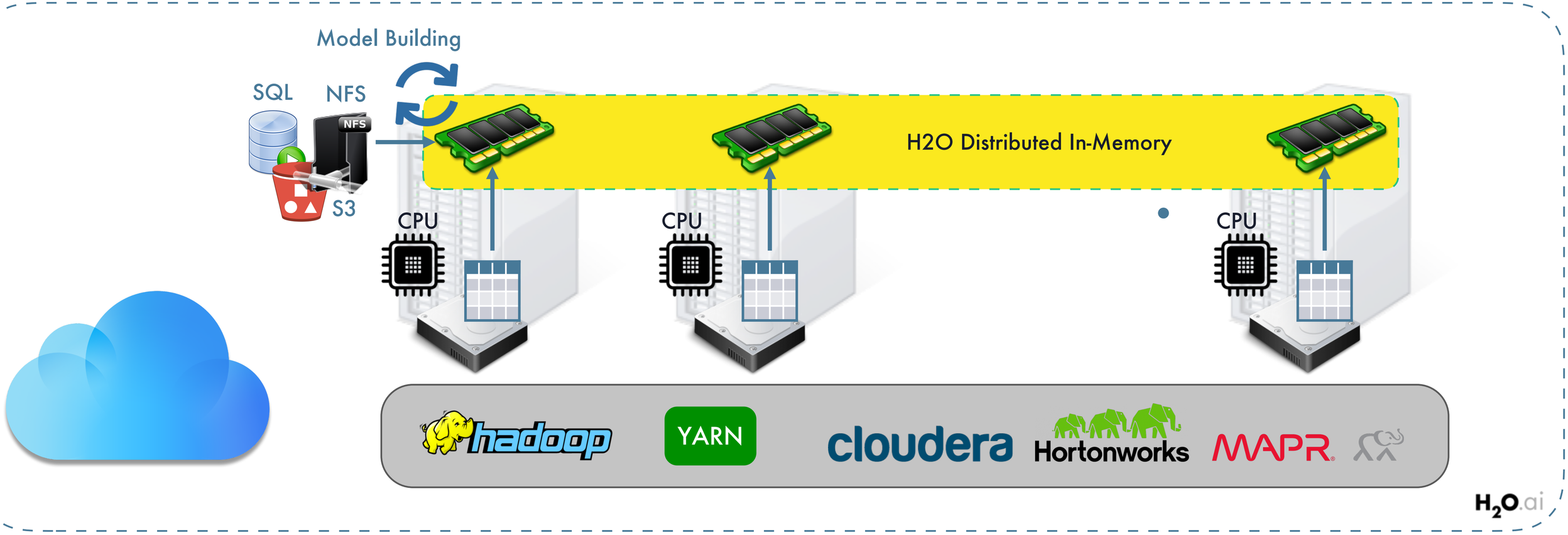
H2O Core



H2O Core with Other Data Sources

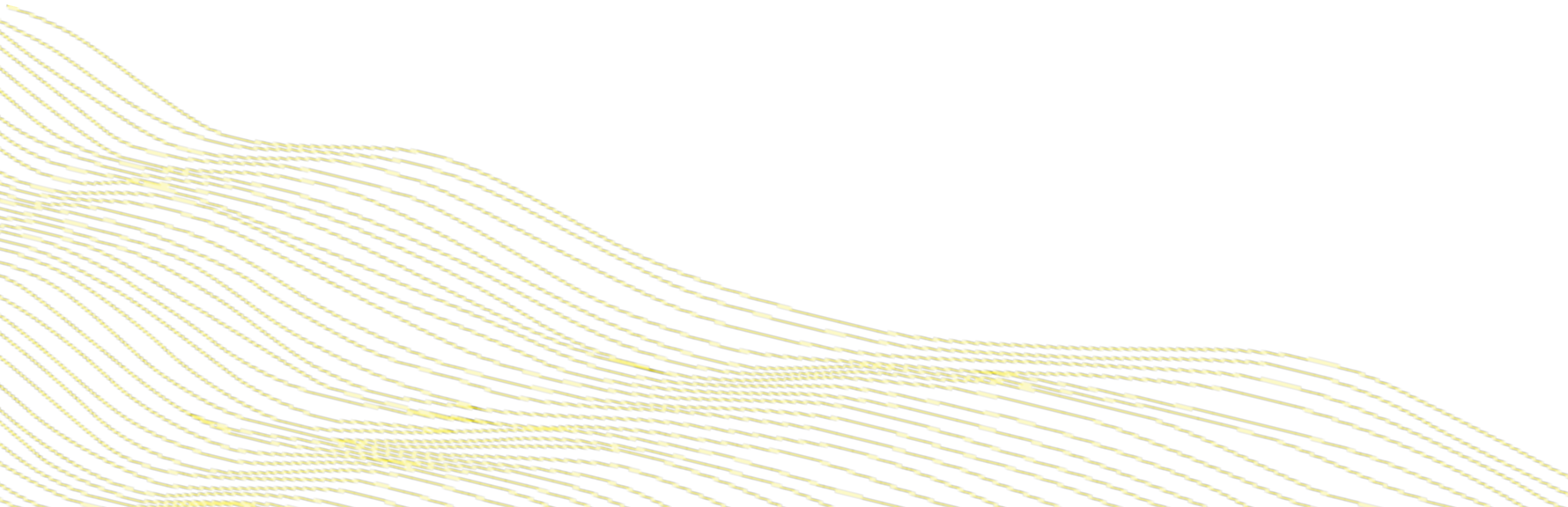


H2O Cluster on the Cloud



The API Overview

Client ⟷ *Cluster Communication*



First: The Client

Standard R Interface

RStudio Interface

RStudio

Go to file/function | Addins | Project: (None)

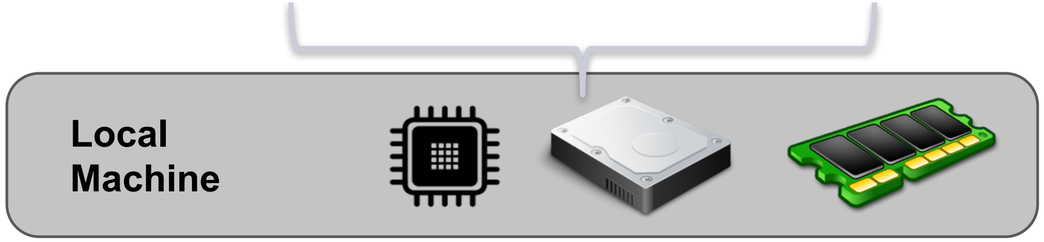
Source

Console ~/

```
> library("h2o")
> h2o.init(ip ="localhost", port =54321)

H2O is not running yet, starting it now...

Note:  In case of errors look at the following log files:
    /var/folders/k_/kpp1czqs3957vq2pr5qngck00000gn/T//Rtmpb16WSZ/h2o_laurend_started_from_r.out
    /var/folders/k_/kpp1czqs3957vq2pr5qngck00000gn/T//Rtmpb16WSZ/h2o_laurend_started_from_r.err

java version "1.8.0_73"
Java(TM) SE Runtime Environment (build 1.8.0_73-b02)
Java HotSpot(TM) 64-Bit Server VM (build 25.73-b02, mixed mode)

Starting H2O JVM and connecting: ... Connection successful!

R is connected to the H2O cluster:
    H2O cluster uptime:         1 seconds 943 milliseconds
    H2O cluster version:        3.10.5.1
    H2O cluster version age:    2 months and 29 days
    H2O cluster name:           H2O_started_from_R_laurend_jxt477
    H2O cluster total nodes:    1
    H2O cluster total memory:   3.56 GB
    H2O cluster total cores:    8
    H2O cluster allowed cores:  8
    H2O cluster healthy:        TRUE
    H2O Connection ip:          localhost
    H2O Connection port:        54321
    H2O Connection proxy:       NA
    H2O Internal Security:      FALSE
    R Version:                  R version 3.3.1 (2016-06-21)

>
```

Terminal Interface

```
Last login: Thu Sep  7 16:38:47 on ttys000
12:01:23 ~ R

R version 3.3.1 (2016-06-21) -- "Bug in Your Hair"
Copyright (C) 2016 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin13.4.0 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Previously saved workspace restored]

>
```



H2O.ai

Second: The Script

R Script

R Script using H2O Package

RStudio

Untitled1*

Source on Save | Run | Source

```
1  library("h2o")
2  h2o.init(ip ="localhost", port =54321)
3  # import the cars dataset:
4  # this dataset is used to classify whether or not a car is economical based on
5  # the car's displacement, power, weight, and acceleration, and the year it was made
6  cars <- h2o.importFile("https://s3.amazonaws.com/h2o-public-test-data/smalldata/junit/cars_20mpg.csv")
7
8  # convert response column to a factor
9  cars["economy_20mpg"] <- as.factor(cars["economy_20mpg"])
10
11 # set the predictor names and the response column name
12 predictors <- c("displacement","power","weight","acceleration","year")
13 response <- "economy_20mpg"
14
15 # split into train and validation
16 cars.splits <- h2o.splitFrame(data = cars, ratios = .8)
17 train <- cars.splits[[1]]
18 valid <- cars.splits[[2]]
19
20 # try using the `family` parameter:
21 car_glm <- h2o.glm(x = predictors, y = response, family = 'binomial', training_frame = train,
22                    validation_frame = valid)
23
24 # print the auc for your validation data
25 print(h2o.auc(car_glm, valid = TRUE))
```

25:38 (Top Level) R Script

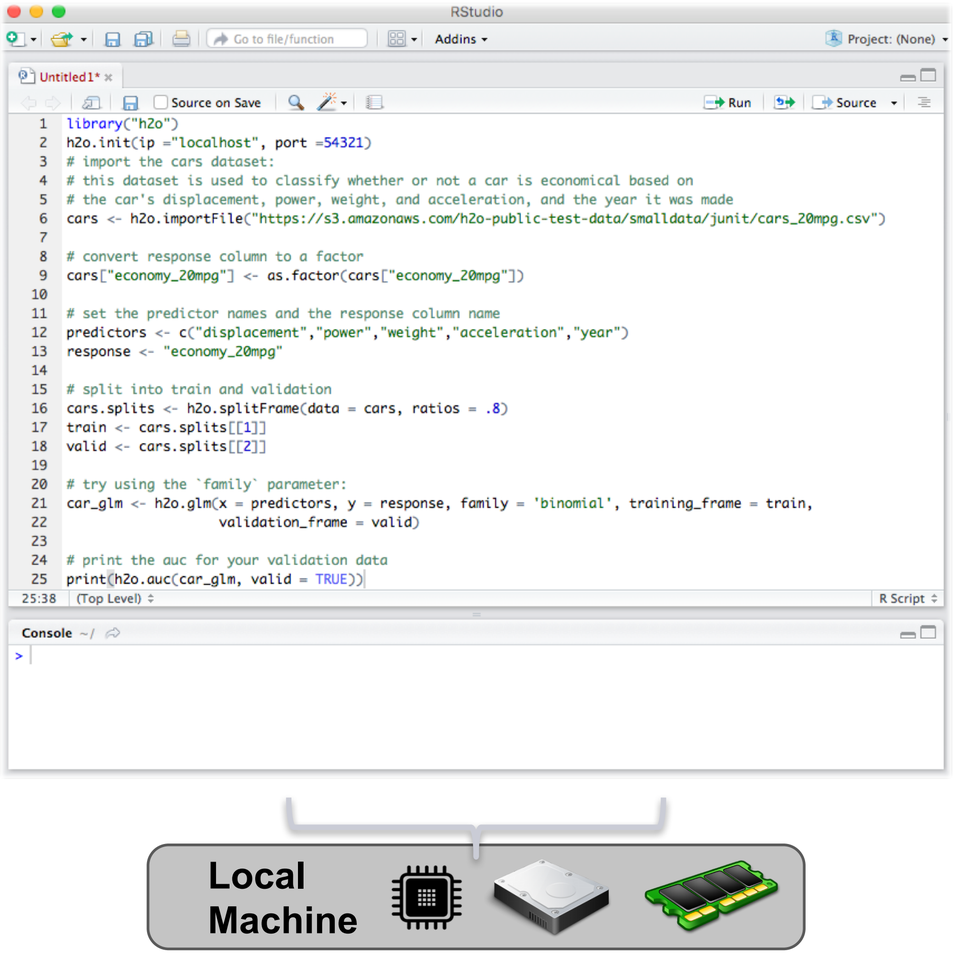
Console ~/

```
>
```

Third: A Command

R Commands

Importing Big Data with R Script



`h2o.importFile(…)`

H2O.ai

Fourth: Communicate

h2o.importFile(…)
requests file import

RStudio

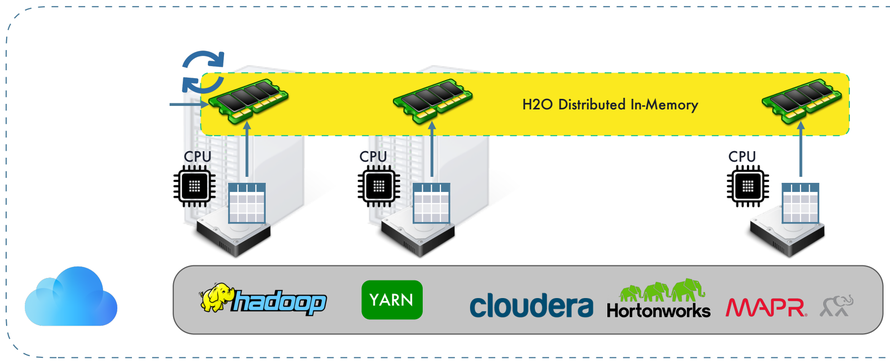
```
# import the cars dataset:
# this dataset is used to classify whether or not a car is economical based on
# the car's displacement, power, weight, and acceleration, and the year it was made
cars <- h2o.importFile("https://s3.amazonaws.com/h2o-public-test-data/smalldata/junit/cars_20mpg.csv")

# convert response column to a factor
cars["economy_20mpg"] <- as.factor(cars["economy_20mpg"])

# set the predictor names and the response column name
predictors <- c("displacement","power","weight","acceleration","year")
response <- "economy_20mpg"

# split into train and validation
cars.splits <- h2o.splitFrame(data = cars, ratios = .8)
train <- cars.splits[[1]]
valid <- cars.splits[[2]]

# try using the `family` parameter:
car_glm <- h2o.glm(x = predictors, y = response, family = 'binomial', training_frame = train,
                   validation_frame = valid)

# print the auc for your validation data
print(h2o.auc(car_glm, valid = TRUE))
```

Console

REST/ JSON

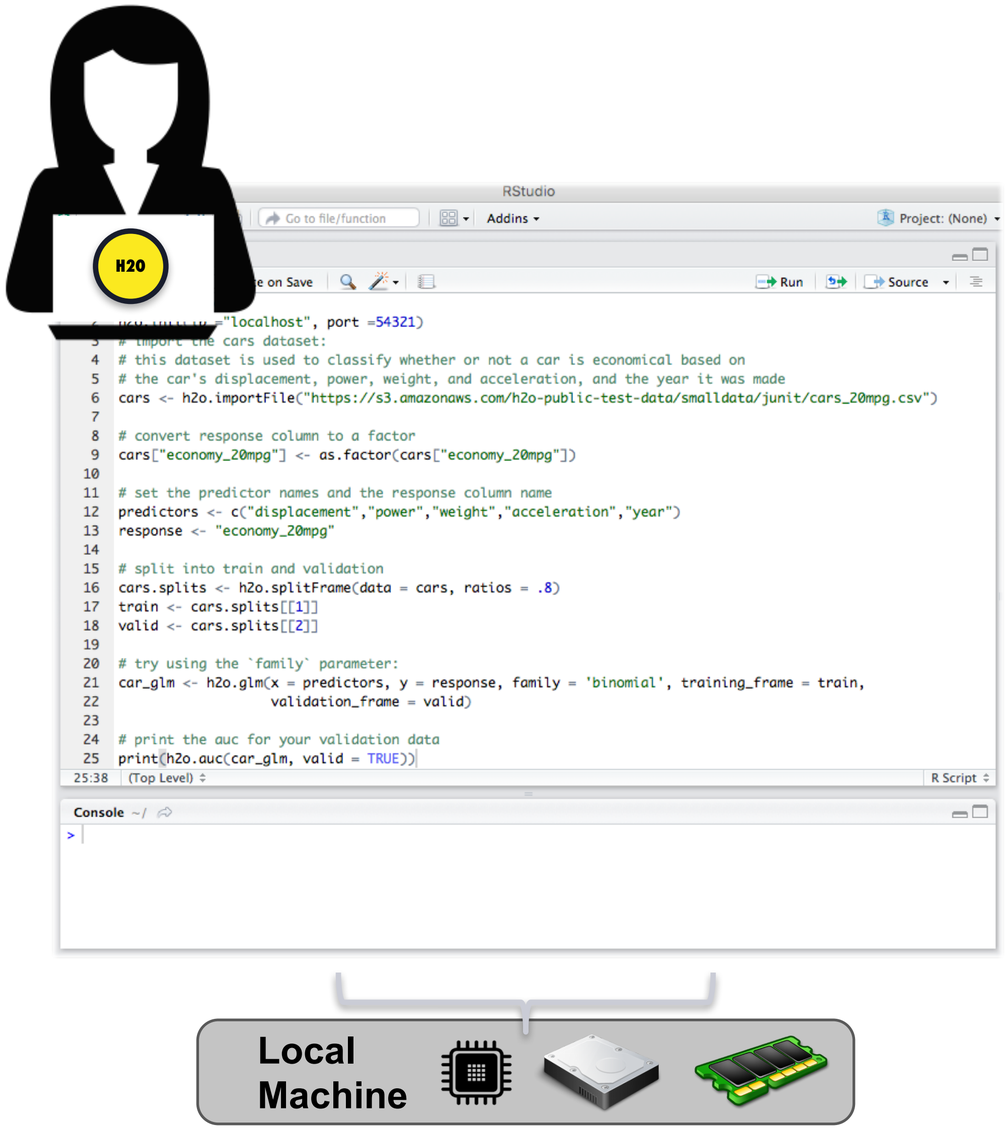
Local Machine

H2O Cluster



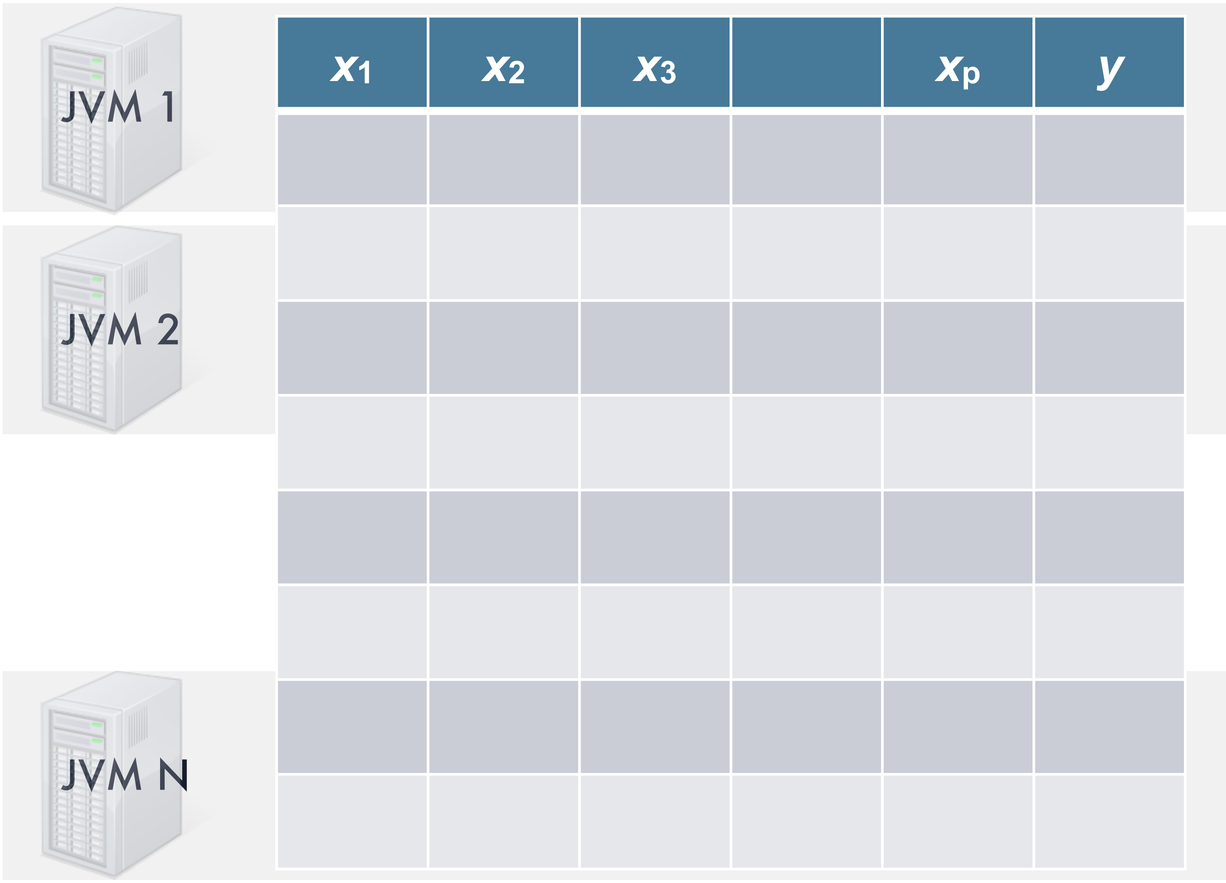
H2O.ai

Fifth: Cluster Does Heavy Lifting



REST/ JSON

H2O Cluster



H2O.ai

H2O Clients

cluster returns frame key

RStudio

Go to file/function | Addins | Project: (None)

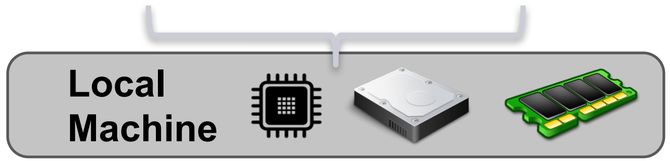
Run | Source

```
# import the cars dataset:
# this dataset is used to classify whether or not a car is economical based on
# the car's displacement, power, weight, and acceleration, and the year it was made
cars <- h2o.importFile("https://s3.amazonaws.com/h2o-public-test-data/smalldata/junit/cars_20mpg.csv")

# convert response column to a factor
cars["economy_20mpg"] <- as.factor(cars["economy_20mpg"])

# set the predictor names and the response column name
predictors <- c("displacement","power","weight","acceleration","year")
response <- "economy_20mpg"

# split into train and validation
cars.splits <- h2o.splitFrame(data = cars, ratios = .8)
train <- cars.splits[[1]]
valid <- cars.splits[[2]]

# try using the `family` parameter:
car_glm <- h2o.glm(x = predictors, y = response, family = 'binomial', training_frame = train,
                   validation_frame = valid)

# print the auc for your validation data
print(h2o.auc(car_glm, valid = TRUE))
```

25:38 (Top Level) | R Script

Console ~/

>



REST/ JSON

x_1	x_2	x_3		x_p	y

H2O.ai

Access a Frame Through its Key

Console ~/

```
> library(h2o)
> h2o.init()
 Connection successful!

R is connected to the H2O cluster:
    H2O cluster uptime:         3 minutes 54 seconds
    H2O cluster version:        3.14.0.6
    H2O cluster version age:    9 days
    H2O cluster name:           H2O_started_from_R_laurend_msu572
    H2O cluster total nodes:    1
    H2O cluster total memory:   3.54 GB
    H2O cluster total cores:    8
    H2O cluster allowed cores:  8
    H2O cluster healthy:        TRUE
    H2O Connection ip:          localhost
    H2O Connection port:        54321
    H2O Connection proxy:       NA
    H2O Internal Security:      FALSE
    H2O API Extensions:         XGBoost, Algos, AutoML, Core V3, Core V4
    R Version:                  R version 3.3.1 (2016-06-21)

> path <-"https://s3.amazonaws.com/h2o-public-test-data/smalldata/junit/cars_20mpg.csv"
> destination_frame = "cars.hex"
> cars <- h2o.importFile(path=path, destination_frame = destination_frame)
>
> head(cars)
                     name economy cylinders displacement power weight acceleration year economy_20mpg
1 AMC Ambassador Brougham    13.0         8          360   175   3821         11.0   73             0
2      AMC Ambassador DPL    15.0         8          390   190   3850          8.5   70             0
3      AMC Ambassador SST    17.0         8          304   150   3672         11.5   72             0
4        AMC Concord DL 6    20.2         6          232    90   3265         18.2   79             1
5          AMC Concord DL    18.1         6          258   120   3410         15.1   78             0
6          AMC Concord DL    23.0         4          151   NaN   3035         20.5   82             1
```

Assigning the Frame's Key

```
Console ~/
> library(h2o)
> h2o.init()
 Connection successful!

R is connected to the H2O cluster:
    H2O cluster uptime:         3 minutes 54 seconds
    H2O cluster version:        3.14.0.6
    H2O cluster version age:    9 days
    H2O cluster name:           H2O_started_from_R_laurend_msu572
    H2O cluster total nodes:    1
    H2O cluster total memory:   3.54 GB
    H2O cluster total cores:    8
    H2O cluster allowed cores:  8
    H2O cluster healthy:        TRUE
    H2O Connection ip:          localhost
    H2O Connection port:        54321
    H2O Connection proxy:       NA
    H2O Internal Security:      FALSE
    H2O API Extensions:         XGBoost, Algos, AutoML, Core V3, Core V4
    R Version:                  R version 3.3.1 (2016-06-21)

> path <-"https://s3.amazonaws.com/h2o-public-test-data/smalldata/junit/cars_20mpg.csv"
> destination_frame = "cars.hex"
> cars <- h2o.importFile(path=path, destination_frame = destination_frame)
>
> head(cars)
                      name economy cylinders displacement power weight acceleration year economy_20mpg
1 AMC Ambassador Brougham    13.0         8          360   175   3821         11.0   73              0
2      AMC Ambassador DPL    15.0         8          390   190   3850          8.5   70              0
3      AMC Ambassador SST    17.0         8          304   150   3672         11.5   72              0
4        AMC Concord DL 6    20.2         6          232    90   3265         18.2   79              1
5          AMC Concord DL    18.1         6          258   120   3410         15.1   78              0
6          AMC Concord DL    23.0         4          151   NaN   3035         20.5   82              1
```

Local Variable vs Key

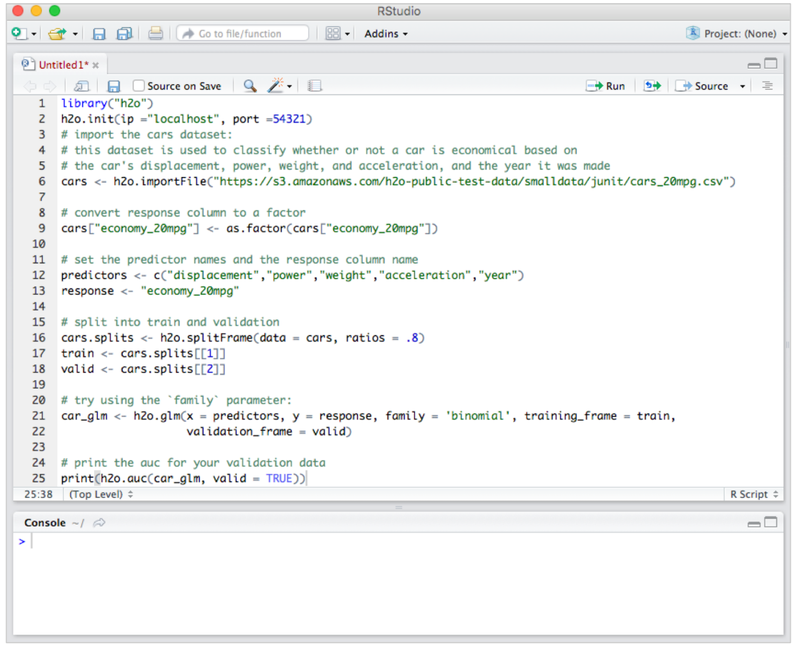
```
> cars <- 5
> head(cars)
[1] 5
```

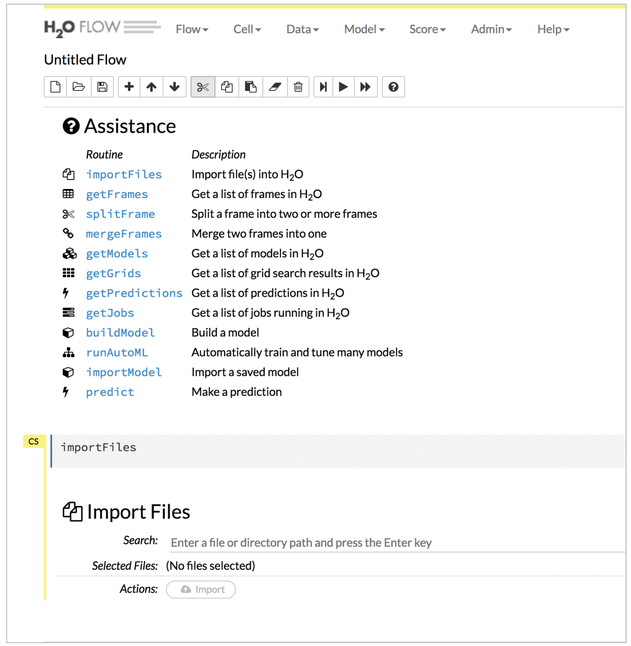
Reassign Local Variable to the Frame

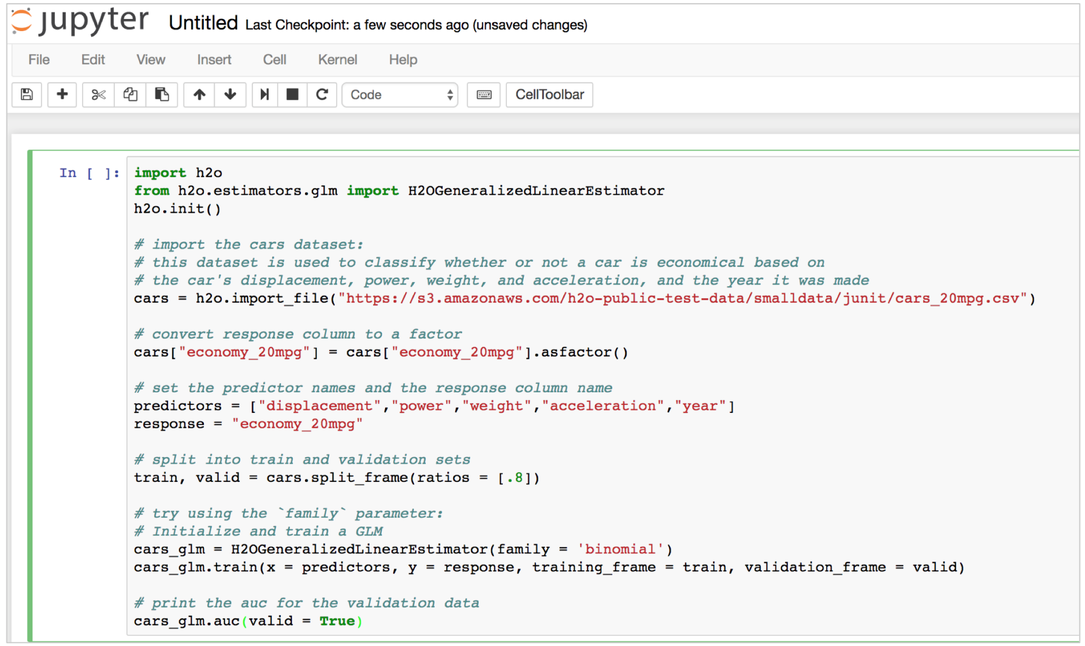
```
> cars <- h2o.getFrame('cars.hex')
> head(cars)
                      name economy cylinders displacement power weight acceleration year economy_20mpg
1 AMC Ambassador Brougham    13.0         8          360   175   3821         11.0   73              0
2      AMC Ambassador DPL    15.0         8          390   190   3850          8.5   70              0
3      AMC Ambassador SST    17.0         8          304   150   3672         11.5   72              0
4        AMC Concord DL 6    20.2         6          232    90   3265         18.2   79              1
5          AMC Concord DL    18.1         6          258   120   3410         15.1   78              0
6          AMC Concord DL    23.0         4          151   NaN   3035         20.5   82              1
```

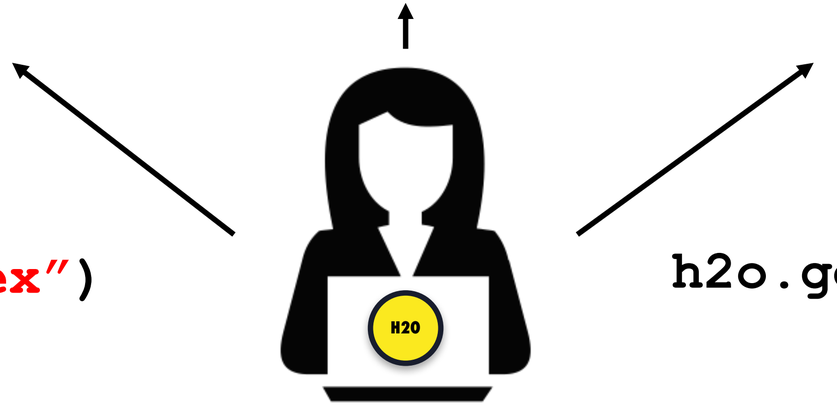
Access a Frame From Anywhere

All you need is the **key**









`h2o.getFrame("cars.hex")`

`h2o.get_frame("cars.hex")`

H2O.ai

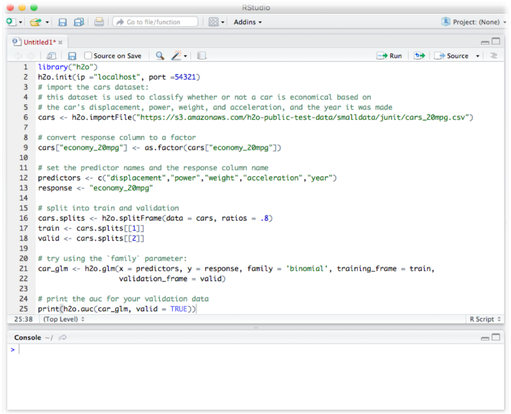
Who Does the Heavy Lifting?

The Client

The Cluster

What does the Client Do?

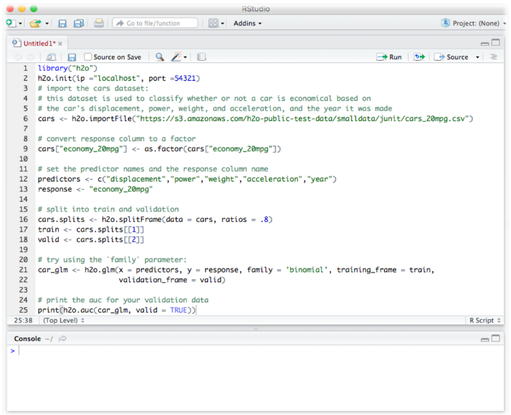
R Only Tells the Cloud What to Do



Hi Cluster,
Can you please get me …

Client Only Passes Requests

Big Data Never Flows Through R
Unless **Explicitly** Asked



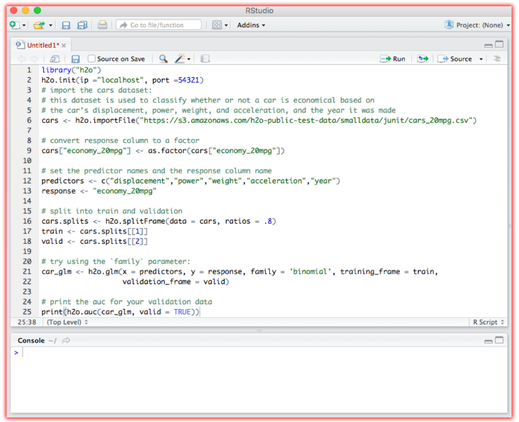
No, you take care of the heavy lifting

H2O.ai

What if?

Pulling Big Data into R Can Overwhelm Your Session

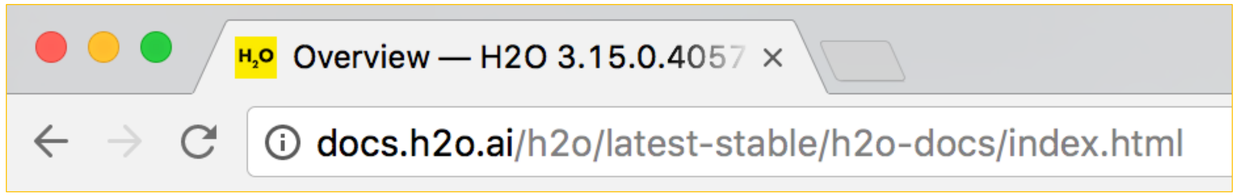

```
as.data.frame(my_big_dataframe)
```



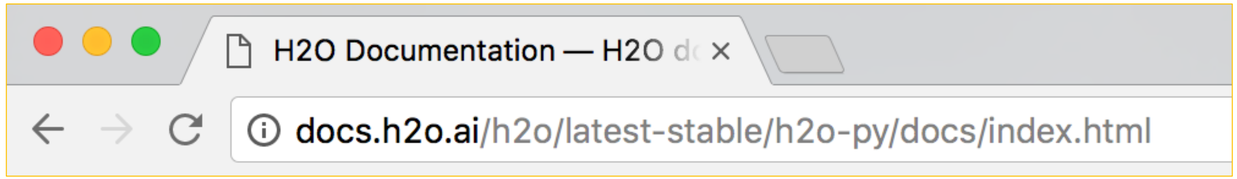
H2O.ai

Documentation Resources

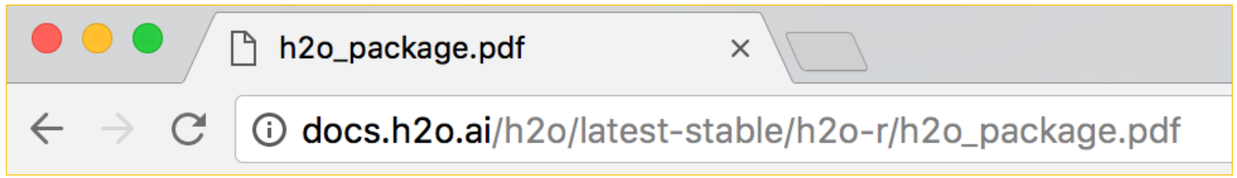
All Documentation @ http://docs.h2o.ai/h2o/latest-stable/index.html



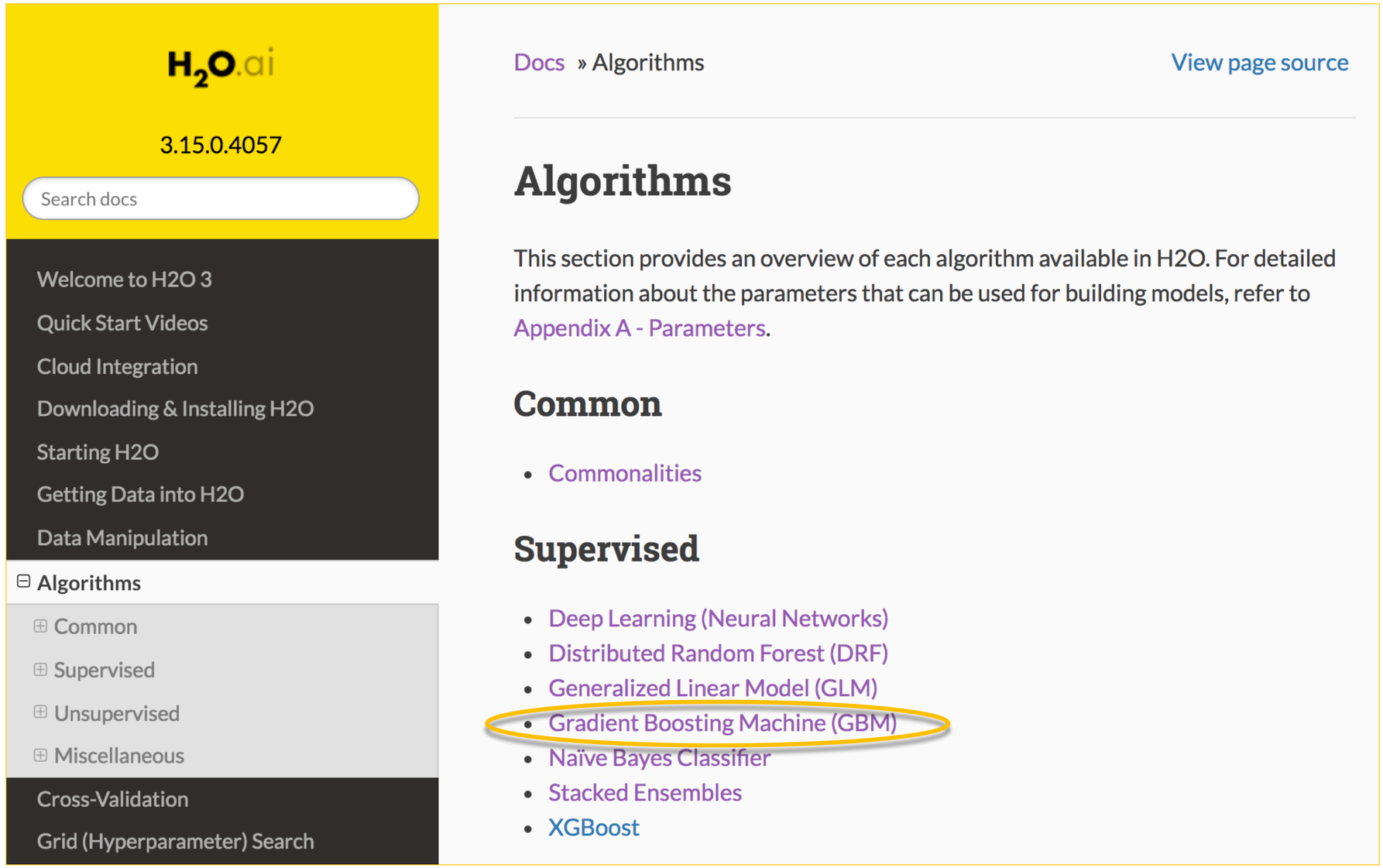
Python Docs @ http://docs.h2o.ai/h2o/latest-stable/h2o-py/docs/index.html



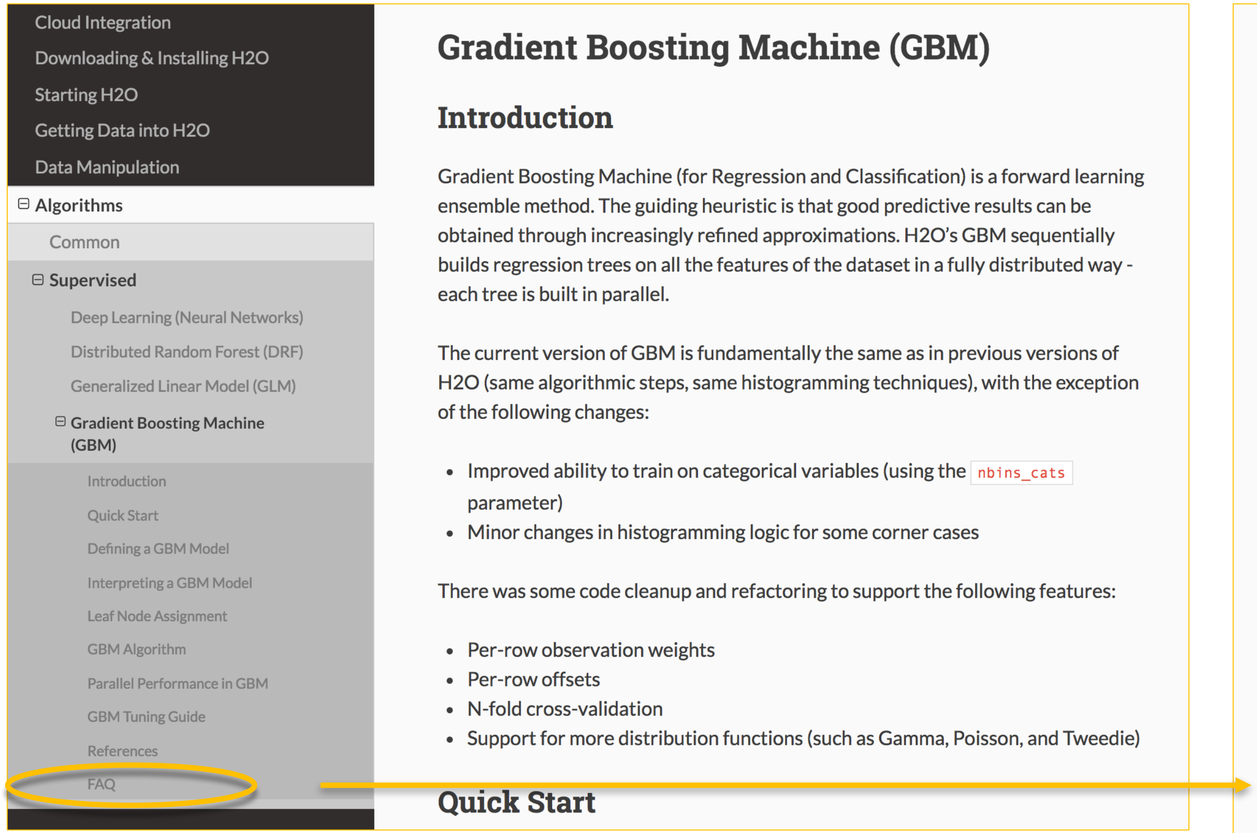
R Docs @ http://docs.h2o.ai/h2o/latest-stable/h2o-r/h2o_package.pdf



Where to Learn about GBM



Where to Learn about GBM in General



FAQ

This section describes some common questions asked by users. The questions are broken down based on one of the types below.

- Preprocessing Steps
- Histograms and Binning
- Missing Values
- Default Values
- Building the First Tree
- Splitting
- Cross Validation
- About the Data
- Reproducibility
- Generated Metrics
- Scoring
- Tuning a GBM

Previous Next

Where to Learn about GBM Parameters

THE USER GUIDE

Appendix A - Parameters

This Appendix provides detailed descriptions of parameters that can be specified in the H2O algorithms. In addition, each parameter also includes the algorithms that support the parameter, whether the parameter is a hyperparameter (can be used in grid search), links to any related parameters, and R and Python examples showing the parameter in use.

Notes:

- This Appendix is a work in progress.
- For parameters that are supported in multiple algorithms, the included example uses the GBM or GLM algorithm.

`learn_rate`

- Available in: GBM, XGBoost
- Hyperparameter:

Description

This option is used to specify the rate at which GBM learns when building a model. Lower learning rates are generally better, but then more trees are required (using `ntrees`) to achieve the same level of fit as if you had used a higher learning rate. This method helps avoid overfitting.

You can use this option along with the `learn_rate_annealing` option to reduce the learning rate by a specified factor for every tree. This can help speed of convergence without sacrificing too much accuracy. For faster scans, use (for example) `learn_rate=0.5` and `learn_rate_annealing=0.99`.

Related Parameters

- learn_rate_annealing
- ntrees

Example

H2O.ai

Where to Learn about GBM Parameters

`learn_rate`

- Available in: GBM, XGBoost
- Hyperparameter:

Description

This option is used to specify the rate at which GBM learns when building a model. Lower learning rates are generally better, but then more trees are required (using `ntrees`) to achieve the same level of fit as if you had used a higher learning rate. This method helps avoid overfitting.

You can use this option along with the `learn_rate_annealing` option to reduce the learning rate by a specified factor for every tree. This can help speed of convergence without sacrificing too much accuracy. For faster scans, use (for example) `learn_rate=0.5` and `learn_rate_annealing=0.99`.

Related Parameters

- learn_rate_annealing
- ntrees

Example

Example

r python

```
library(h2o)
h2o.init()
# import the titanic dataset:
# This dataset is used to classify whether a passenger will survive '1' or not '0'
# original dataset can be found at https://stat.ethz.ch/R-manual/R-devel/library/datasets
titanic <-  h2o.importFile("https://s3.amazonaws.com/h2o-public-test-data/smalldata/gbm_t

# convert response column to a factor
titanic['survived'] <- as.factor(titanic['survived'])

# set the predictor names and the response column name
# predictors include all columns except 'name' and the response column ("survived")
predictors <- setdiff(colnames(titanic), colnames(titanic)[2:3])
response <- "survived"

# split into train and validation
titanic.splits <- h2o.splitFrame(data =  titanic, ratios = .8, seed = 1234)
train <- titanic.splits[[1]]
valid <- titanic.splits[[2]]

# try using the `learn_rate` parameter:
# because we use a small learning_rate, we set ntrees to a much higer number
# early stopping makes it okay to use 'more than enough' trees
titanic.gbm <- h2o.gbm(x = predictors, y = response, training_frame = train, validation_f
                       ntrees = 10000, learn_rate = .01,
                       # use early stopping once the validation AUC doesn't improve by at
                       # for 5 consecutive scoring events
                       stopping_rounds = 5,
                       stopping_tolerance = 1e-4,
                       stopping_metric = "AUC", seed = 1234)

# print the auc for the validation data
print(h2o.auc(titanic.gbm, valid = TRUE))
```

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