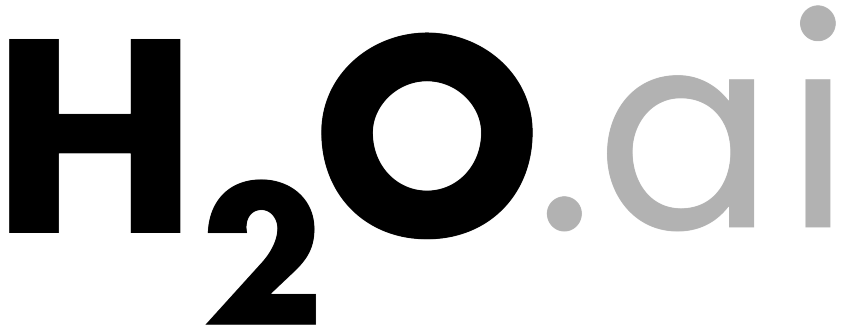
Introduction to Machine Learning with H_2O

- Introduction (30 mins)
  - From Engineering to Data Science – Why?
  - Machine Learning Basics
  - H_2O Machine Learning Platform
- Tutorial (60 mins)
  - Regression (House Price)
  - Classification (Human Activities)
  - Clustering (Water Treatment Plant)
- Extra: More About H_2O (15 mins)
  - H_2O on a Multi-Node Cluster
  - Next-Gen H_2O
- Q & A (15 mins)



Jo-fai (Joe) Chow
Data Scientist at H_2O.ai
joe@h2o.ai

Version 1.1
Download: **http://bit.ly/h2o_exeter_2017**

From Engineering to Data Science

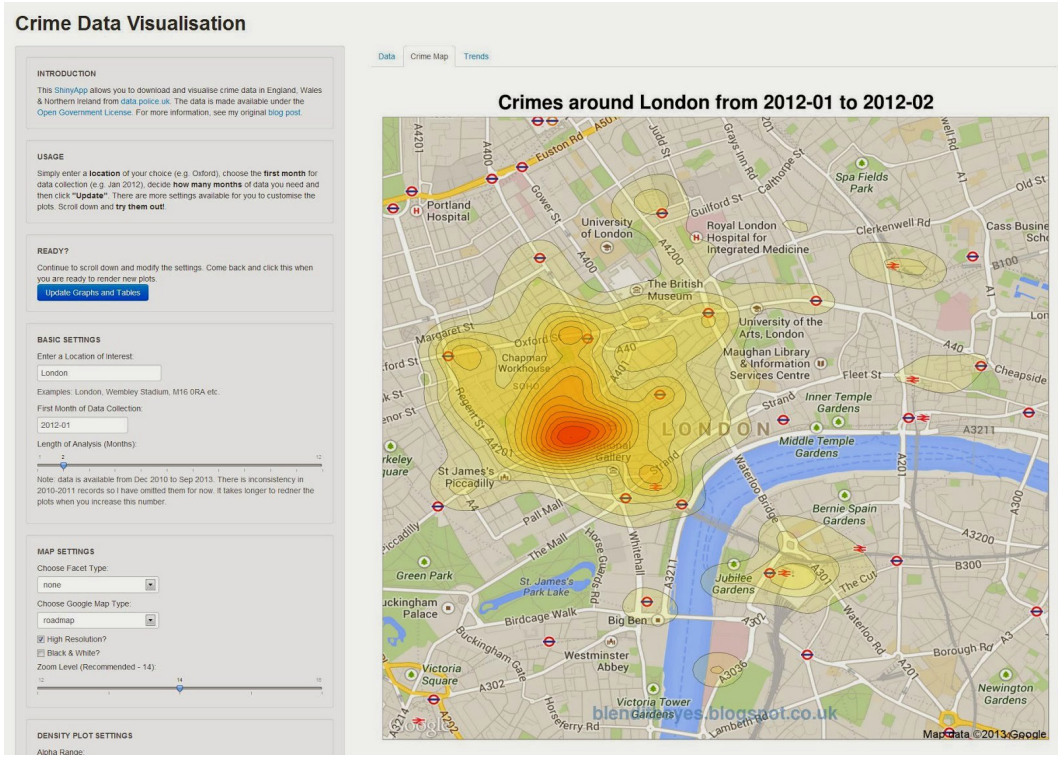
- My Story

H2O.ai

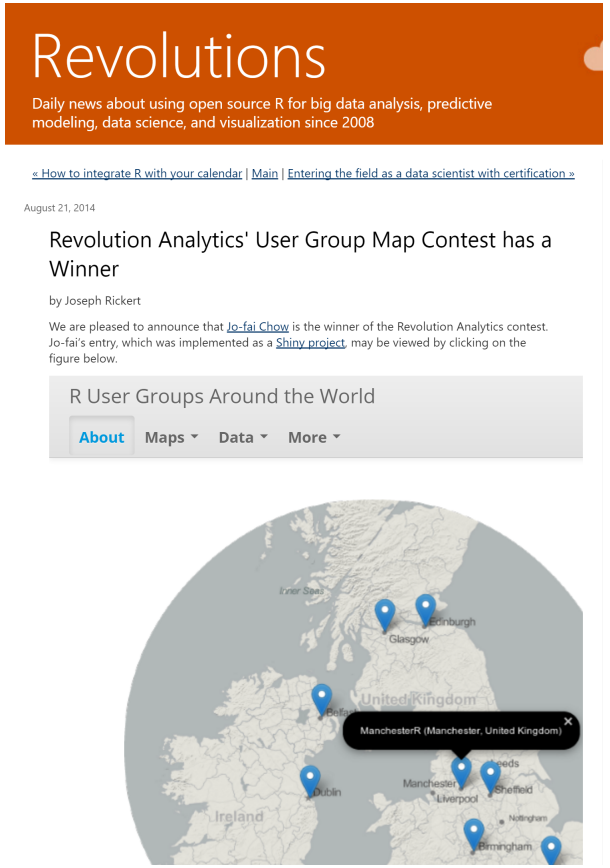
About Me

- Civil (Water) Engineer
  - 2005 – 2010
    - Consultant (SEAMS, UK)
      - Utilities / Asset Management
      - Constrained Optimization
  - 2010 – 2014
    - STREAM EngD (Exeter)
      - Infrastructure Design Optimisation
      - Machine Learning + Water Engineering
      - Discovered H_2O in 2014
- Data Scientist
  - 2015 – 2016
    - Virgin Media (UK)
    - Domino Data Lab (Silicon Valley)
  - 2016 – Present
    - H_2O.ai (Silicon Valley)
  - How?
    - bit.ly/joe_kaggle_story

About Me – I ❤ DataViz



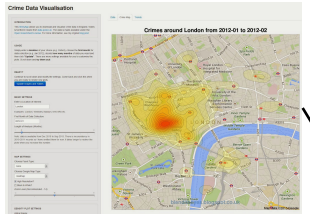
My First Data Viz & Shiny App Experience
CrimeMap (2013)



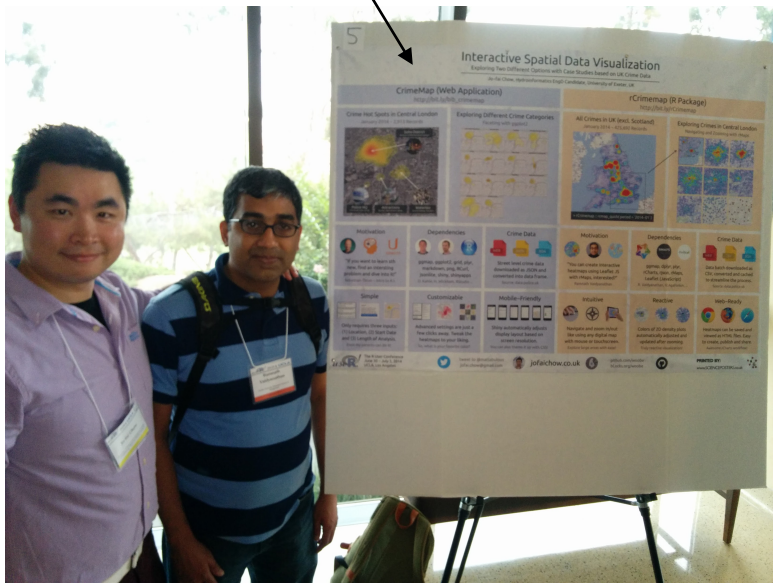
Revolution Analytics' Data Viz Contest
RUGSMAPS (2014)

H2O.ai

useR! 2014



CrimeMap -> poster

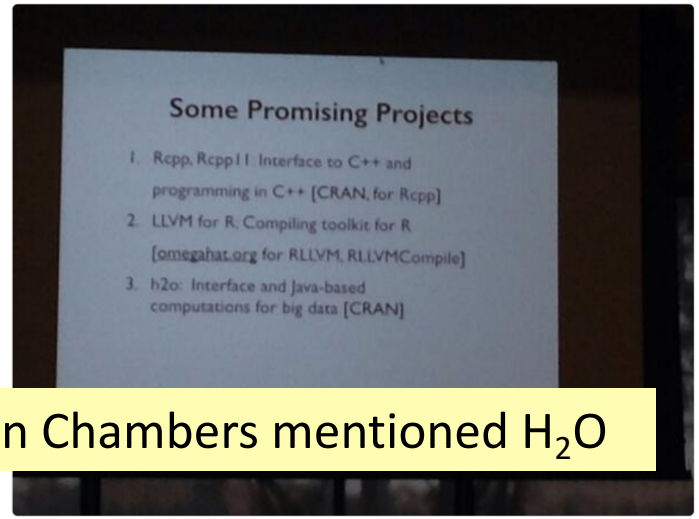


H2O.ai
@h2oai
Following

#linus for #rstat #user2014 #JohnChambers

H2O.ai
@h2oai
Following

#SparkSummit ~~> #useR2014 #h2o



John Chambers mentioned H_2O

H2O.ai @h2oai · 28 Jul 2014
Smoooooth! - if I have to explain it in one word. Oxdata made this really easy for #R users. r-bloggers.com/things-to-try-… #Thanks #JoFaiChow

Things to try after useR! – Part 1: Deep Learning wit…
Annual R User Conference 2014The useR! 2014 conference was a mind-blowing experience. Hundreds of R enthusiasts and the beautiful UCLA campus, I am rea...
r-bloggers.com

1 5 6

Jo-fai (Joe) Chow
@matlabulous

Replying to @h2oai

Hi @srisatish @ArnoCandel and every1 @hexadata thx 4 making and open-sourcing the powerful #H2O shd hv tried it during (not after) #user2014

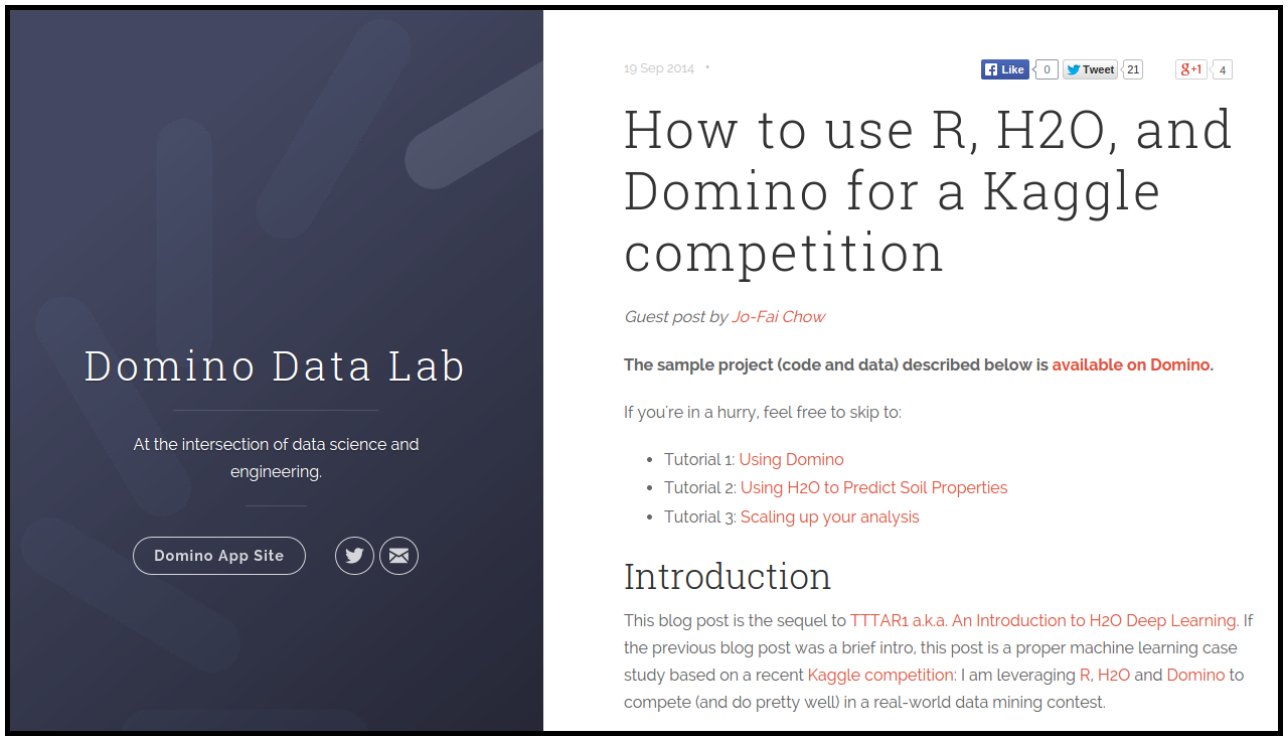
LIKES 2

1:41 PM - 28 Jul 2014

… so I gave it a try

H2O.ai

About Me – I ❤ Kaggle



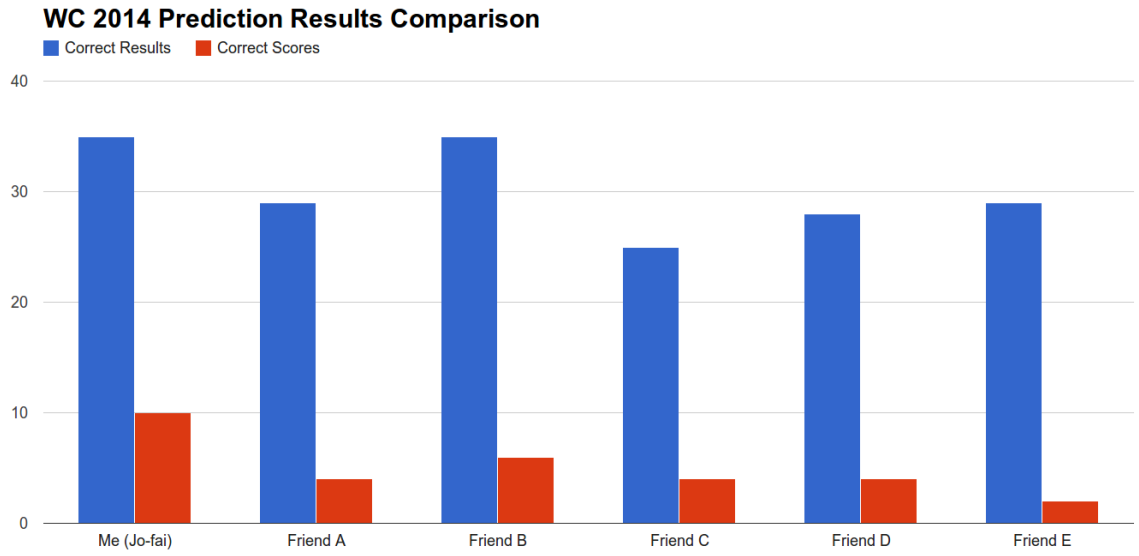
R + H_2O + Domino for Kaggle

Guest Blog Post for Domino & H_2O (2014)

- The Long Story
  - bit.ly/joe_kaggle_story

World Cup 2014

- Machine Learning vs My Friends
  - Team performance data from web
  - Simple machine learning models
  - Objective: Predict Correct Score
  - Me : 10 out of 64 (15.6%)
  - Friends' Avg : 4 out of 64 (6.3%)



From Engineering to Data Science

- Knowledge Driven Decision Making
  - Write code to deal with data based on knowledge and assumptions.
  - Strong domain knowledge.

- Data Driven Decision Making
  - Define a problem and collect data related to the problem.
  - Write code to show data to computers and let computers (algorithms) find patterns in data.
  - Domain knowledge is helpful but not necessary.

Higgs Boson Machine Learning Challenge

Use the ATLAS experiment to identify the Higgs boson

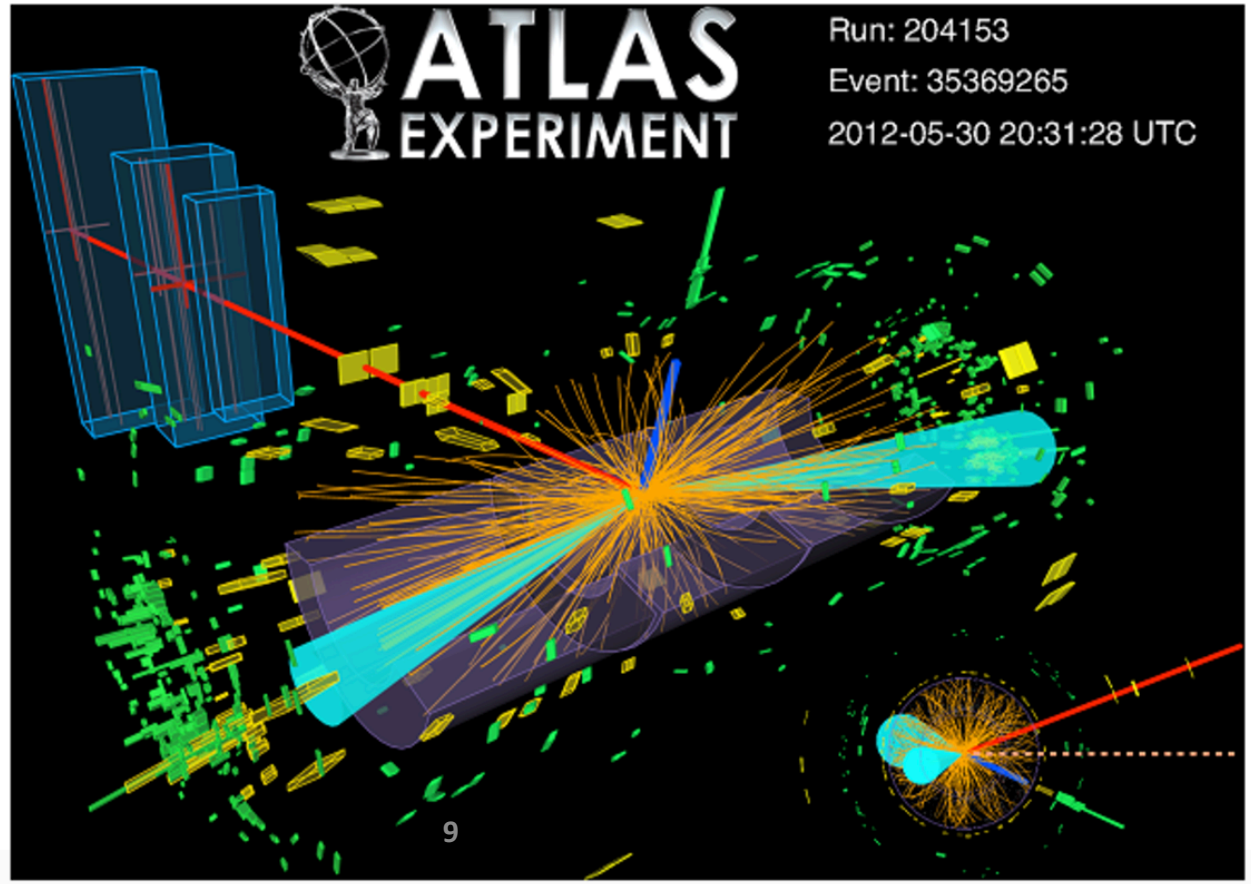
$13,000 · 1,785 teams · 3 years ago

Overview | Data | Discussion | Leaderboard | Rules | Team | My Submissions | Late Submission

https://www.kaggle.com/c/higgs-boson

Overview

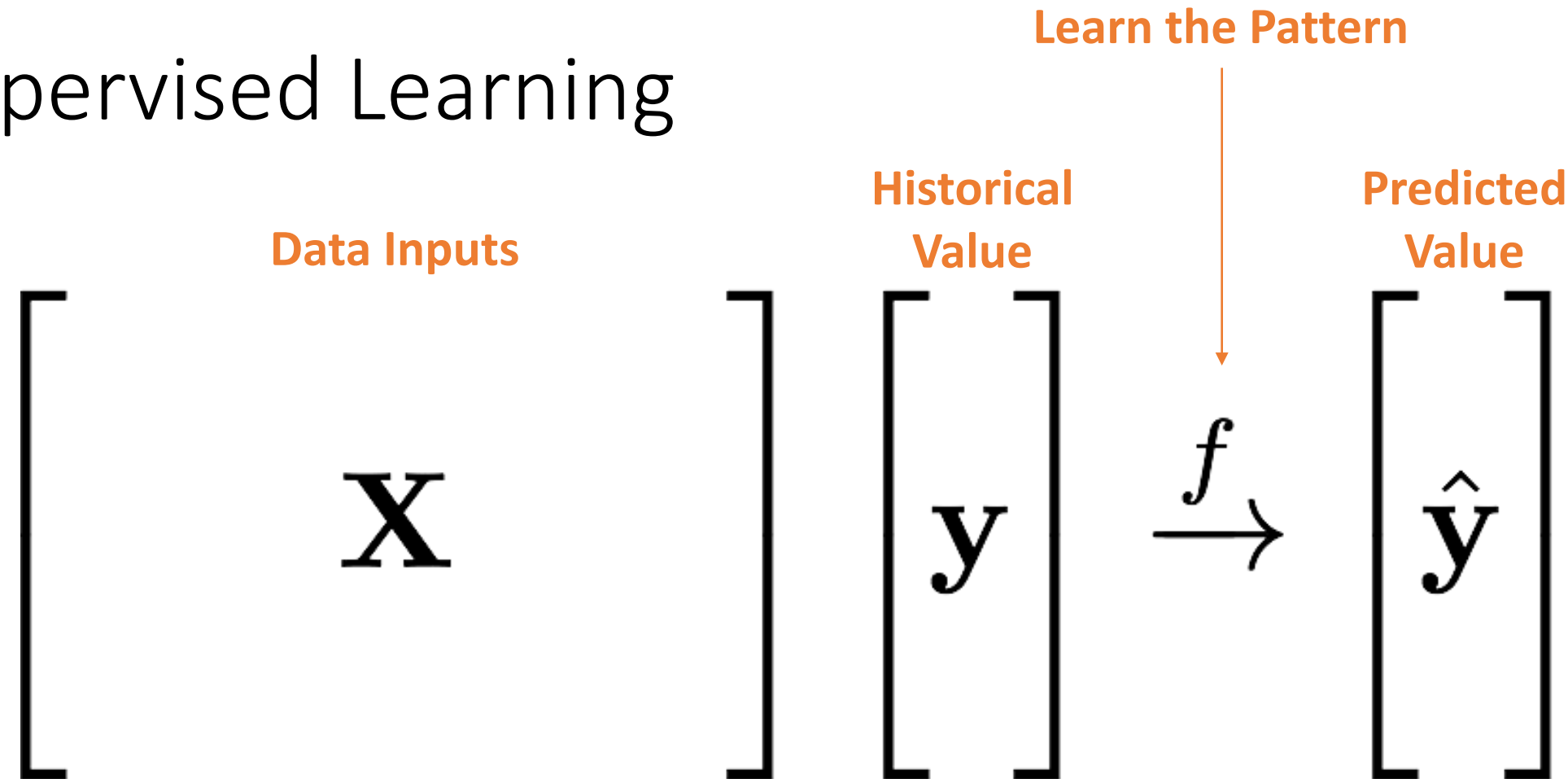
- Description
- Evaluation
- Prizes
- About The Sponsors
- Timeline
- Winners



What is Machine Learning?

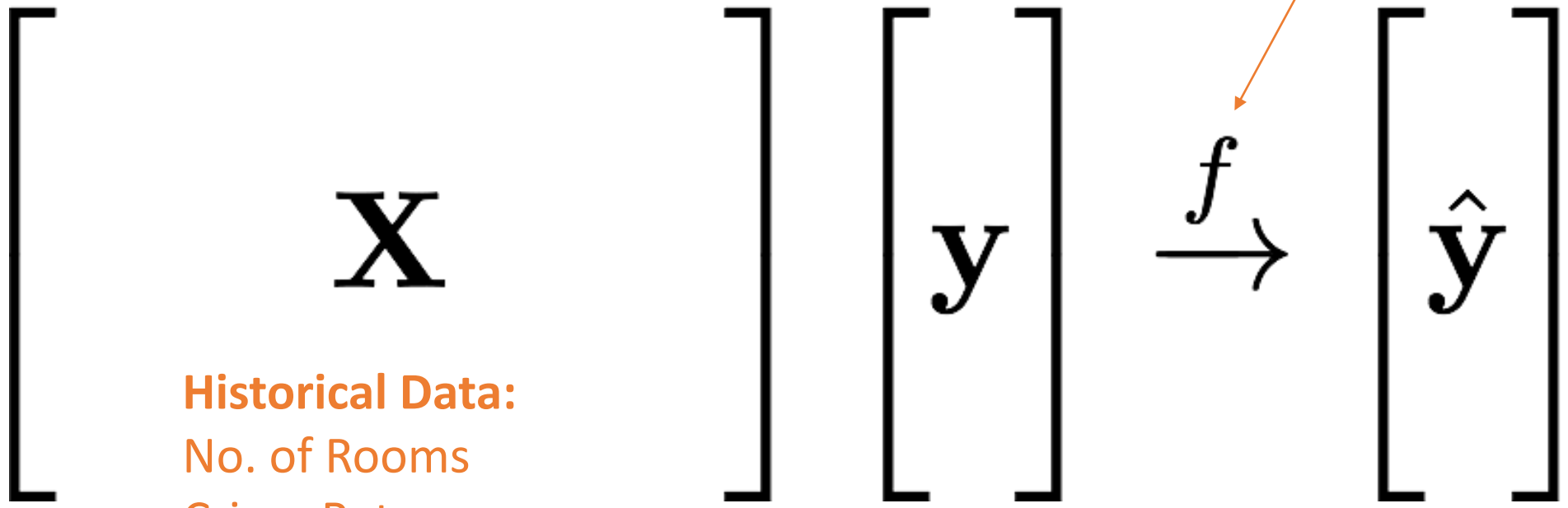
- Supervised Learning
- Unsupervised Learning

Supervised Learning



Supervised Learning Example

Machine Learning:
Learn Patterns
from Data



Historical Data:
No. of Rooms
Crime Rate
Pupil-Teacher Ratio
…

Target:
House Value

Predicted Value
(for evaluation)

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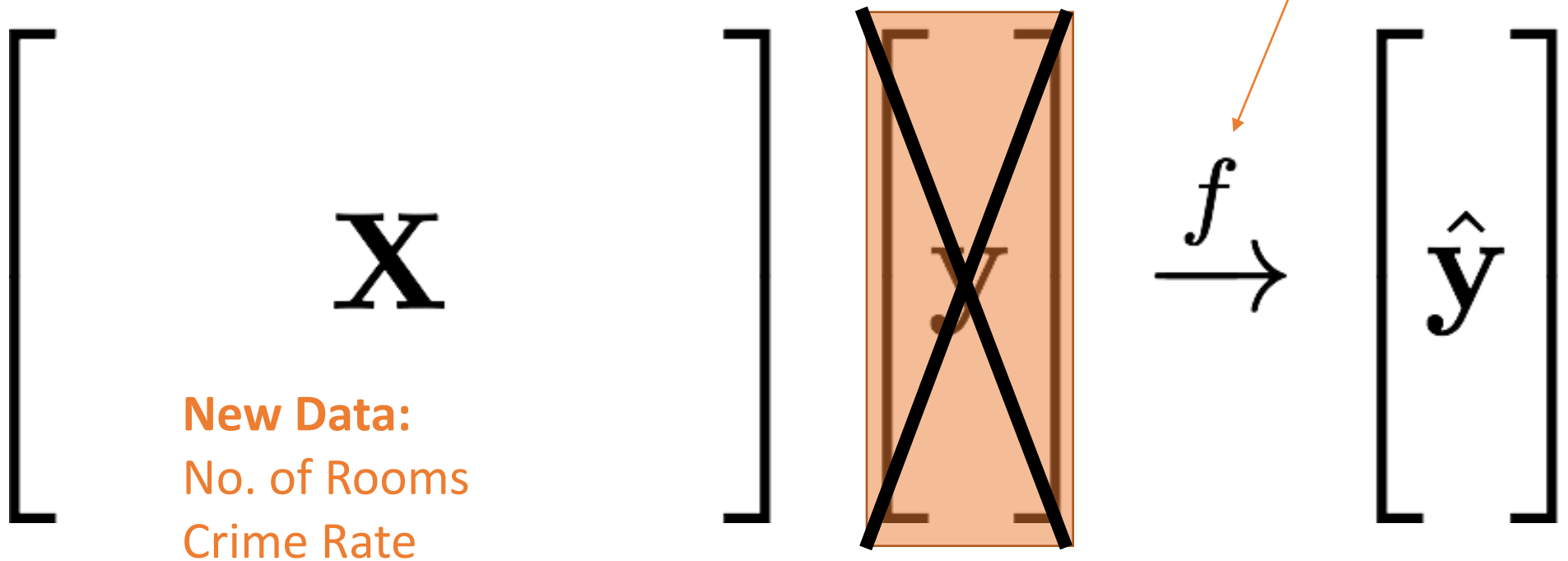
Supervised Learning Example

Patterns Learned
from Historical Data



New Data:
No. of Rooms
Crime Rate
Pupil-Teacher Ratio
…

Target:
Unknown

Predicted Value
(for decision making)

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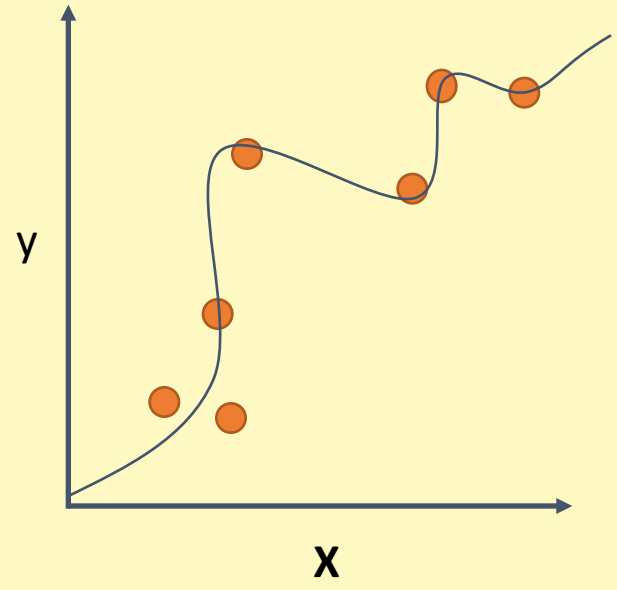
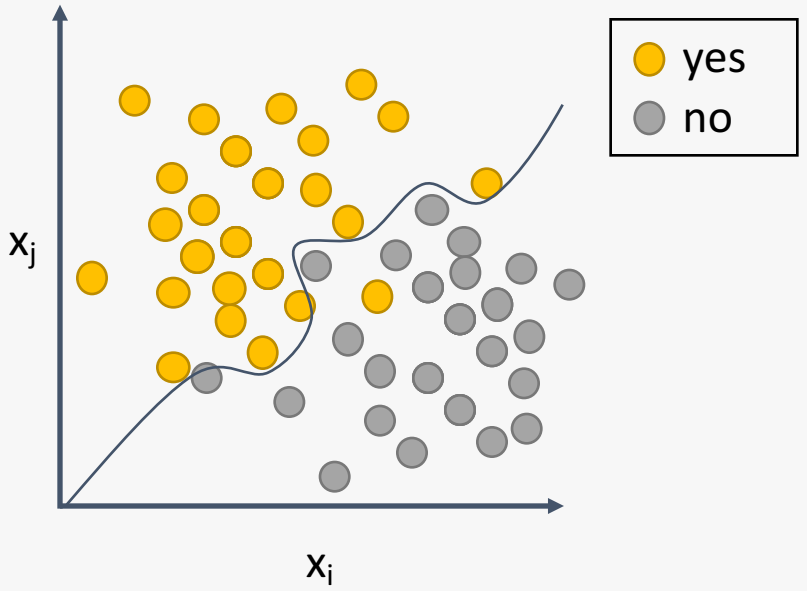
Supervised Learning – You Already Have Target Data

Regression:
How much will a customers spend?



H_2O algos:
Penalized Linear Models
Random Forest
Gradient Boosting
Neural Networks
Stacked Ensembles

Classification:
Will a customer make a purchase? Yes or No



H_2O algos:
Penalized Linear Models
Naïve Bayes
Random Forest
Gradient Boosting
Neural Networks
Stacked Ensembles

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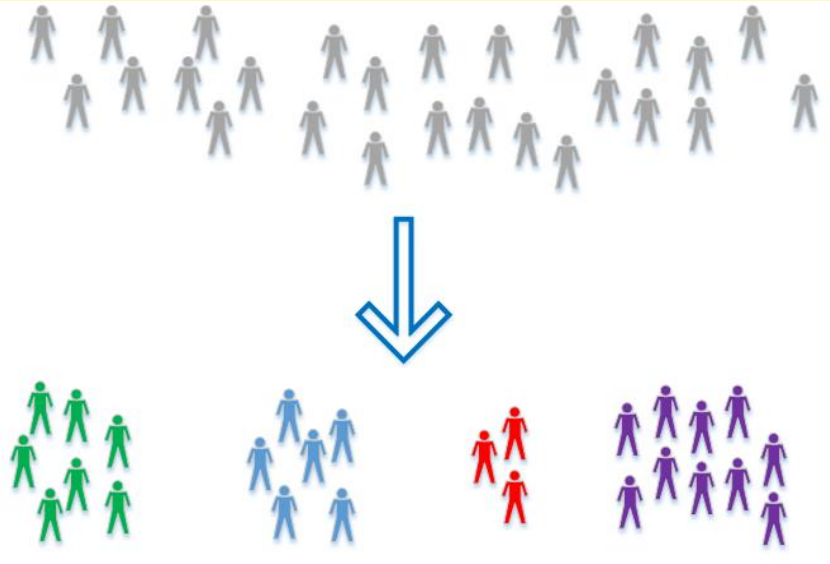
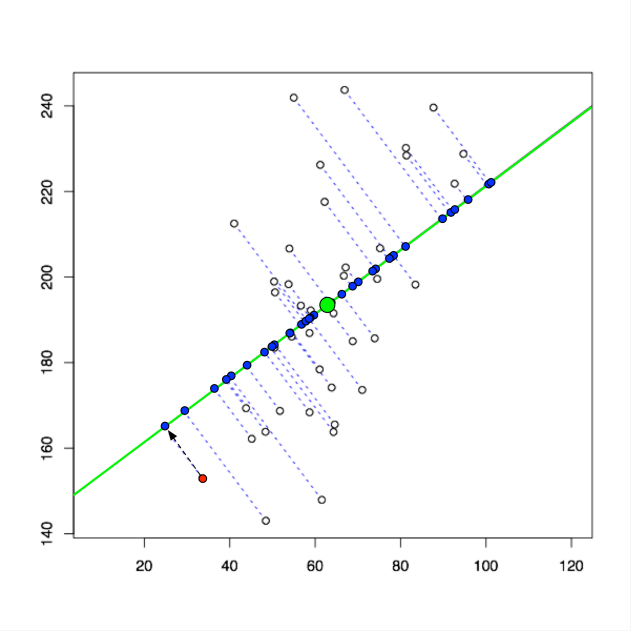
Unsupervised Learning – Discover Hidden Patterns

Clustering:
Customer Segmentation



H_2O algos:
K-Means
Generalised Low Rank Model

Dimensionality Reduction:
Linear Transformation of Variables



H_2O algos:
Principal Component Analysis
Generalised Low Rank Model

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About H_2O.ai

Company Overview

Founded	2011 Venture-backed, debuted in 2012
Products	• **H_2O Open Source In-Memory AI Prediction Engine** • Sparkling Water (H_2O + Spark) • Deep Water (H_2O + Other Deep Learning Frameworks) • Driverless AI (Next-Gen H_2O)
Mission	Operationalize Data Science, and provide a platform for users to build beautiful data products
Team	75+ employees • Distributed Systems Engineers doing Machine Learning • World-class visualization designers
Headquarters	Mountain View, CA

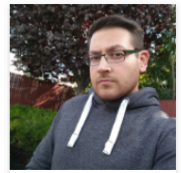




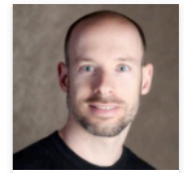

Alan Lewis


Amy Vu-Tran


Angela Bartz

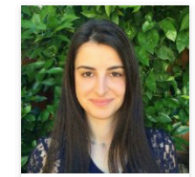

Anmol Bal


Apoorv Chaudhary


Arno Candel


Leland Wilkinson


Magnus Stensmo


Maral Mandjian


Marios Michailidis


Mark Chan


Mark Landry


Ashrith Barthur


Avkash Chauhan


Avni Wadhwa


Beth Payne

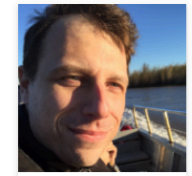

Branden Murray


Cari Andrews


Mateusz Dymczyk


Matt Dowle


Megan Kurka


Michal Kurka


Michal Malohlava


Navdeep Gill


Das Narayanan


Dmitry Larko


Erin LeDell


Fonda Ingram


Ian Gomez


Jacqueline Scott


Nidhi Mehta


Nikhil Shekhar


Nishant Kalonia


Pasha Stetsenko


Patrick Hall


Patrick Rice


Jag Bining


Jakub Hava


Jeff Fohl


Jeff Gambera

Jo-Fai Chow

Jon Mckinney

Prithvi Prabhu

Ravi Purushotma

Raymond Peck

Sanjay Joshi

SriSatish Ambati

Terone Ward

Jon Oslowski

Josephine Wang

Justin Loyola

Karen Hayrapetyan

Kerry O'Shea

Lauren DiPerna

Tom Aliotti

Tom Kraljevic

Tomas Nykodym

Venkatesh Yadav

Vinod Iyengar

Wen Phan

Scientific Advisory Council

Dr. Trevor Hastie

- John A. Overdeck Professor of Mathematics, Stanford University
- PhD in Statistics, Stanford University
- Co-author, *The Elements of Statistical Learning: Prediction, Inference and Data Mining*
- Co-author with John Chambers, *Statistical Models in S*
- Co-author, *Generalized Additive Models*

Dr. Robert Tibshirani

- Professor of Statistics and Health Research and Policy, Stanford University
- PhD in Statistics, Stanford University
- Co-author, *The Elements of Statistical Learning: Prediction, Inference and Data Mining*
- Author, *Regression Shrinkage and Selection via the Lasso*
- Co-author, *An Introduction to the Bootstrap*

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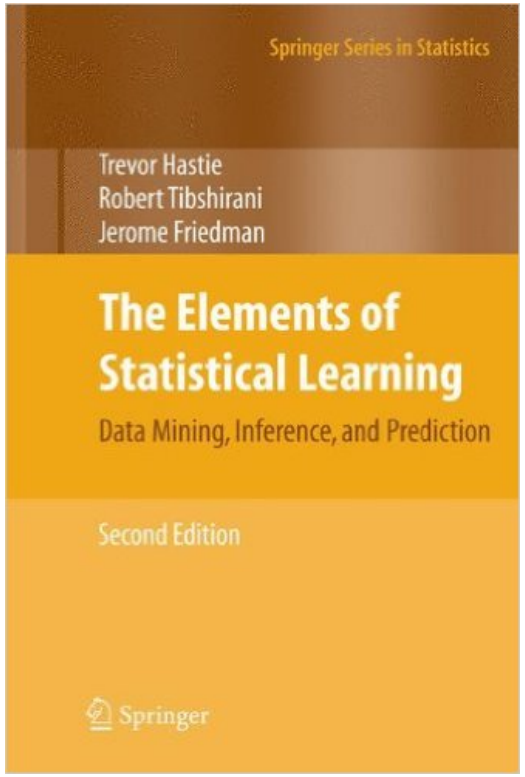
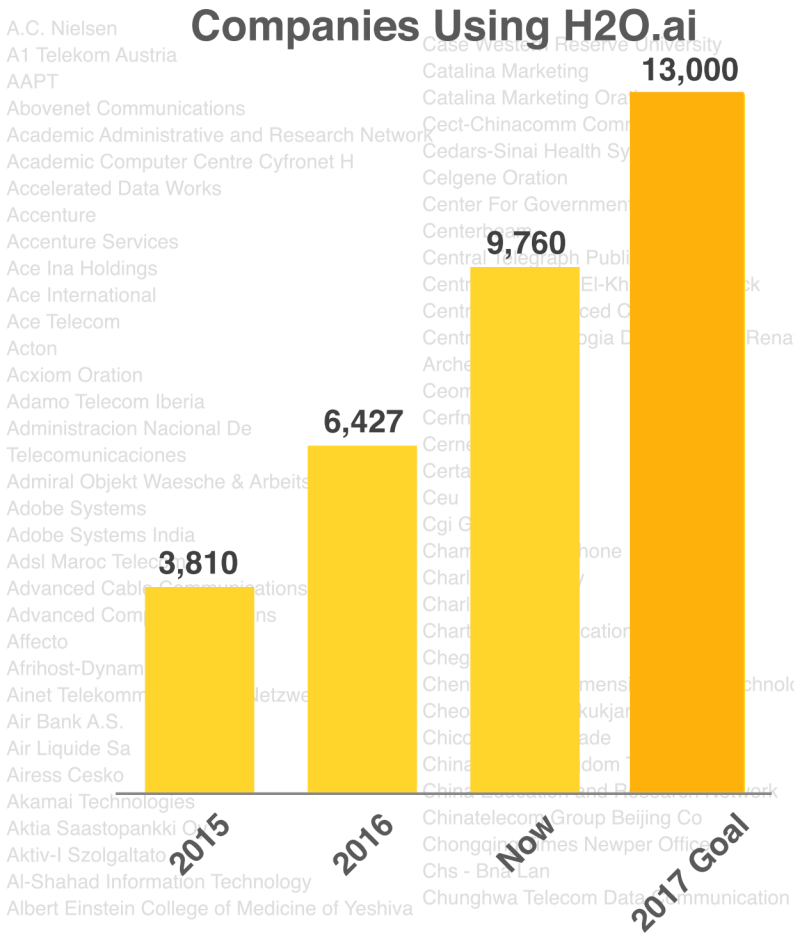
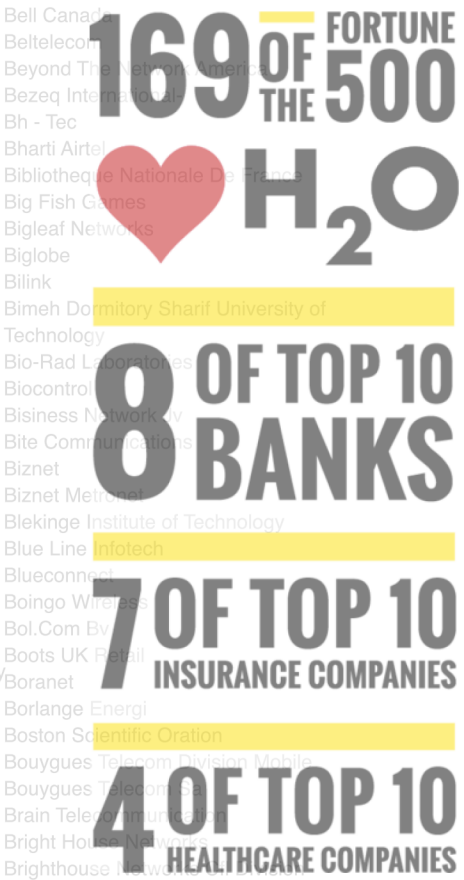
- PhD in Electrical Engineering and Computer Science, UC Berkeley
- Co-author, *Distributed Optimization and Statistical Learning via the Alternating Direction Method of Multipliers*
- Co-author, *Linear Matrix Inequalities in System and Control Theory*
- Co-author, *Convex Optimization*

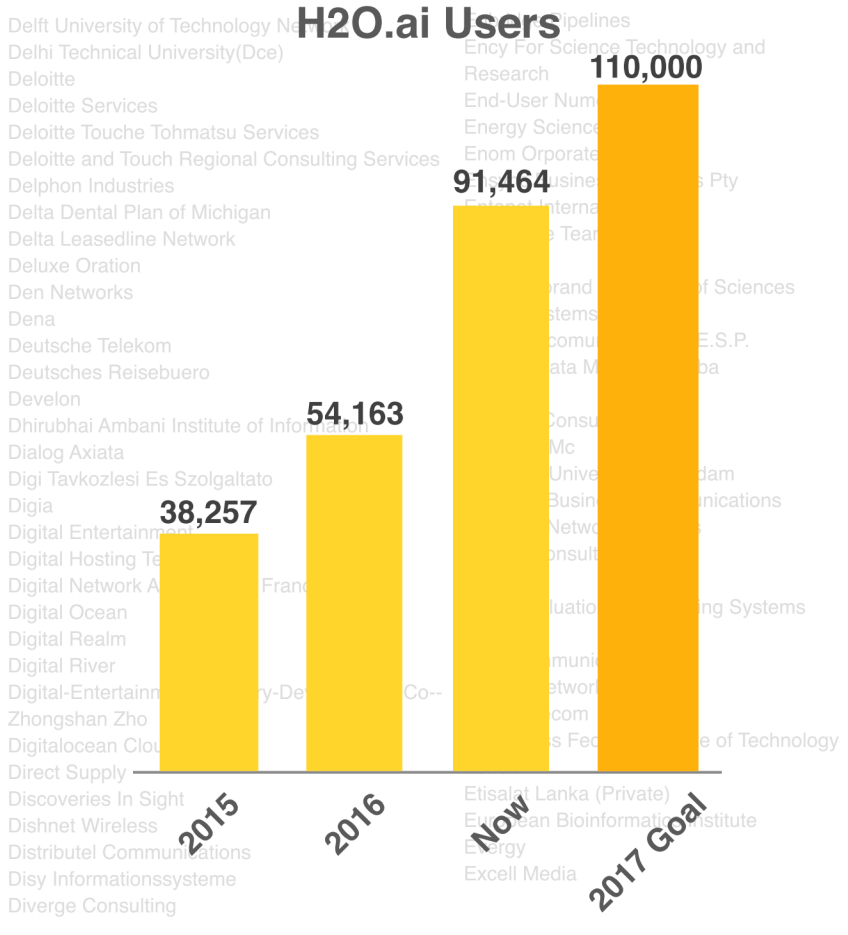


H2O.ai

H2O Community & Fortune 100 customers







Select Reference Customers:

"Overall customer satisfaction is very high." - Gartner

CapitalOne PayPal Experian WELLS FARGO ADP COMCAST at&t KAISER PERMANENTE PROGRESSIVE Nielsen Catalina Booking.com macy's H2O.ai

pwc | Global

PwC Global › About us › › Stories about our people, clients and communities

Harnessing the power of AI to transform the detection of fraud and error

Setting the scene

PwC has invested significantly in pioneering the use of artificial intelligence for the audit and has partnered with H2O.ai, a leading Silicon Valley-based AI company.

Following 18 months of development, the first outcome of this partnership is PwC's GL.ai, the first module of PwC's Audit.ai - a revolutionary bot that does what humans can't. Its AI analyses billions of different data points in seconds and applies judgement to detect anomalies in general ledger transactions.

"The reason this is such a brilliant tool is the ability to look at different risks in context at the same time. For example, it would be uneconomical for an auditor to look at every single user's pattern of activity and decide what was unusual. With GL.ai, the algorithms do it for us."

Laura Needham partner, PwC UK

PwC @PwC Follow

Exciting night at this year's @WAI_News Awards: PwC wins 2017 Audit Innovation of the Year! pwc.to/Glai17 #taandiab17

10:15 PM - 4 Oct 2017

http://www.pwc.com/gx/en/about/stories-from-across-the-world/harnessing-the-power-of-ai-to-transform-the-detection-of-fraud-and-error.html

H2O.ai

Community Expansion

Meetup

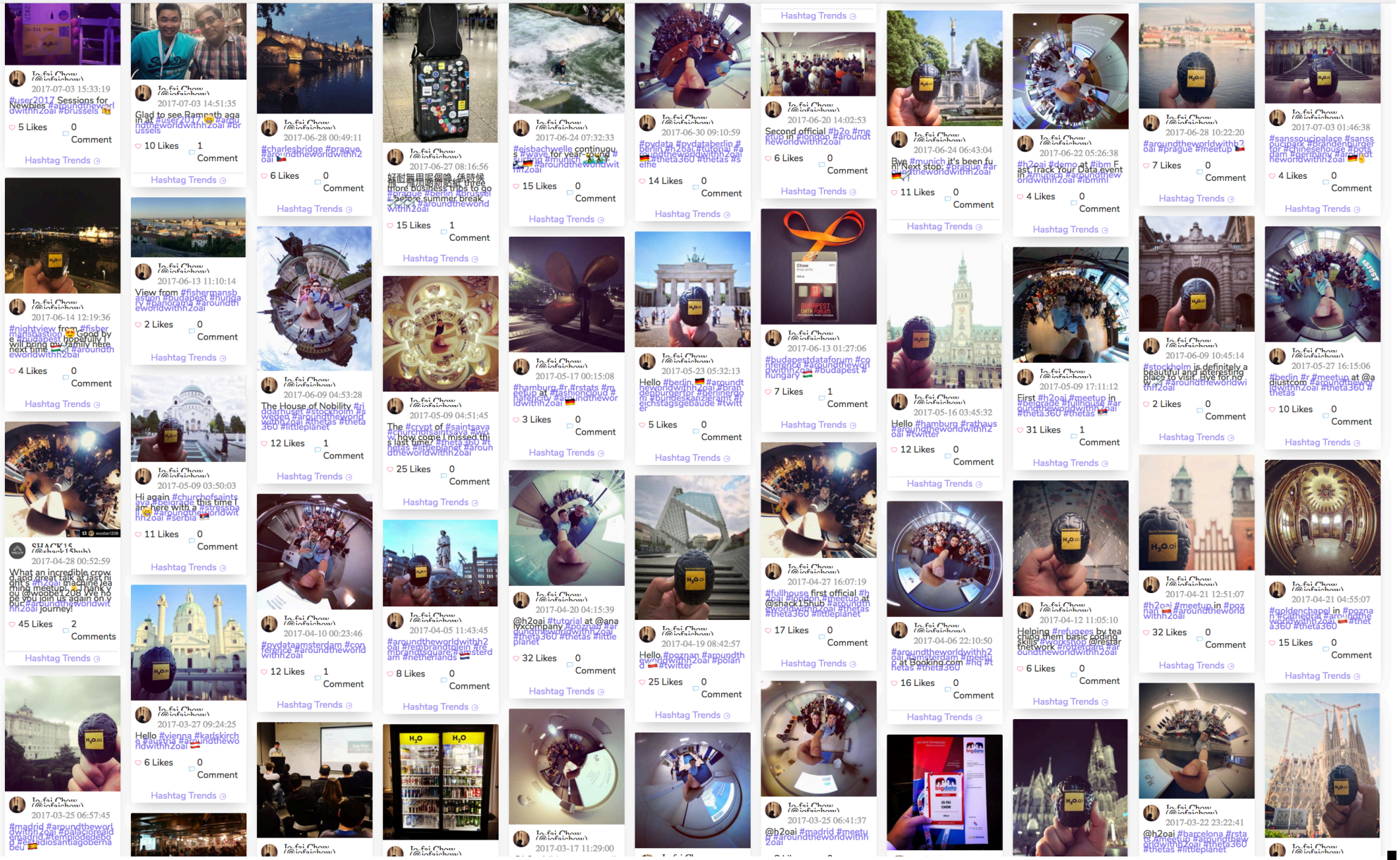
H2O.ai

56,536	32	50	44	18
members	interested	Meetups	cities	countries

15 Meetups a month

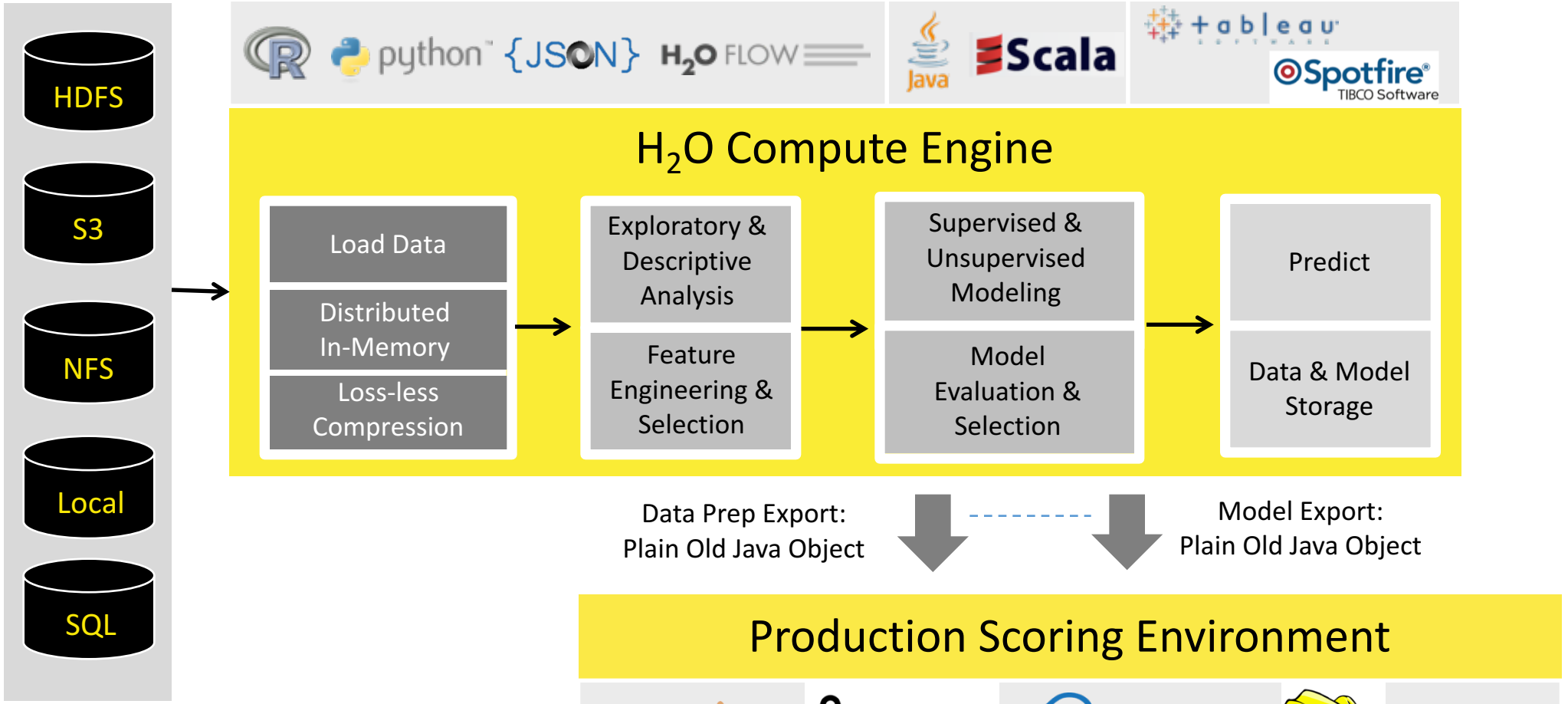
Oct 17 – Amsterdam
Nov 17 – London

#AroundTheWorldWithH2Oai



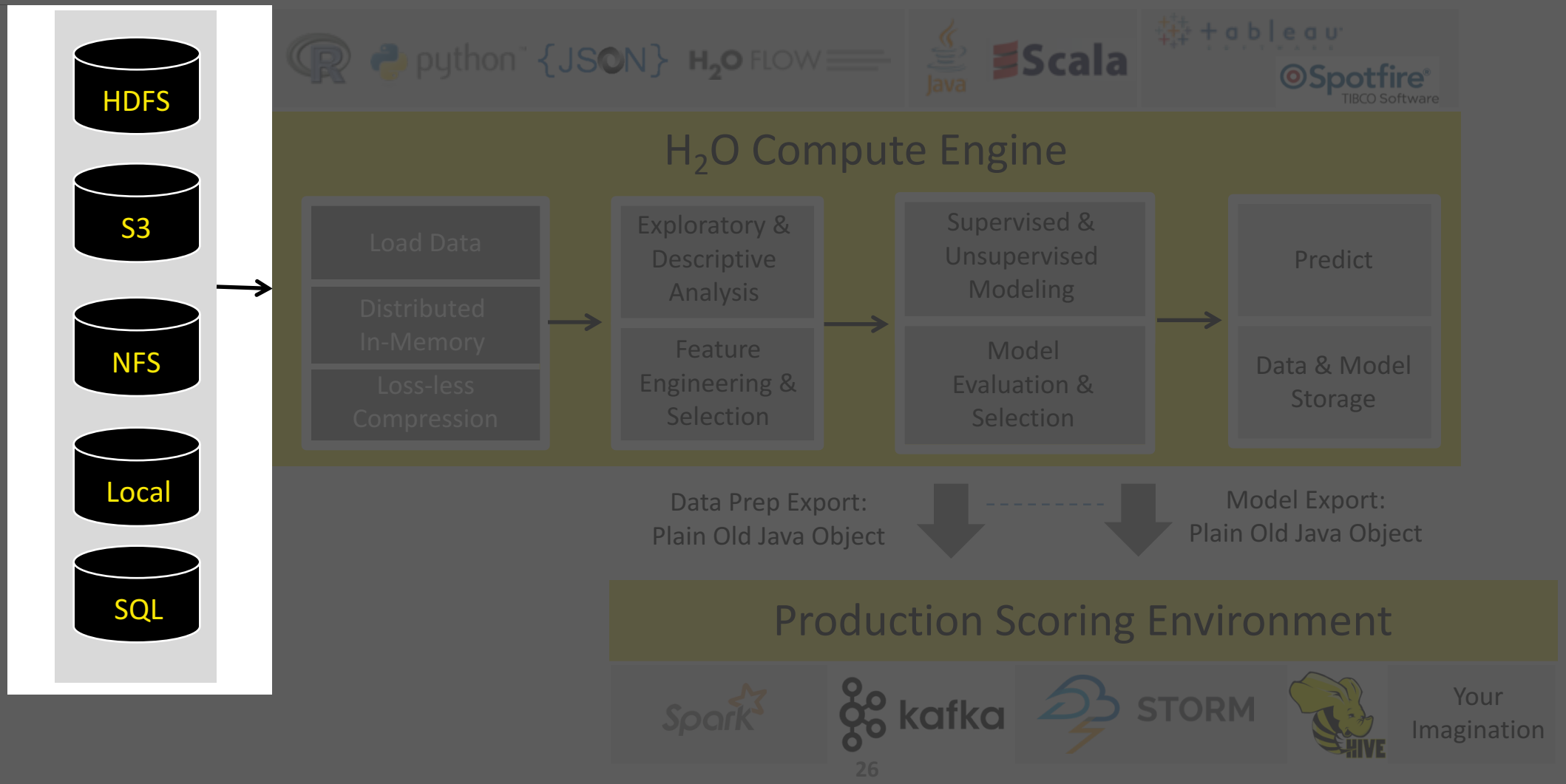
H_2O Machine Learning Platform

High Level Architecture



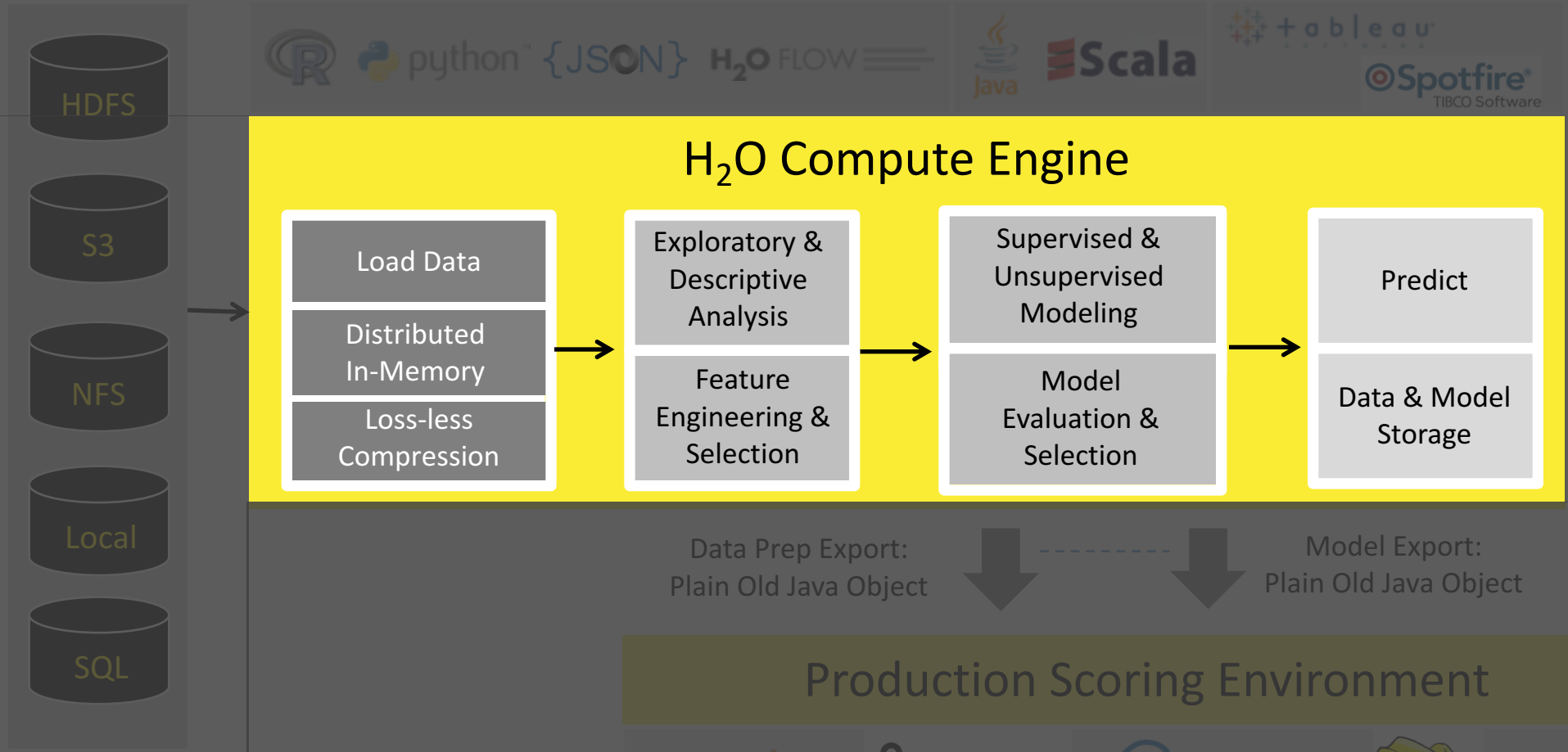
High Level Architecture

Import Data from Multiple Sources



High Level Architecture

Fast, Scalable & Distributed Compute Engine Written in Java



Algorithms Overview

Supervised Learning

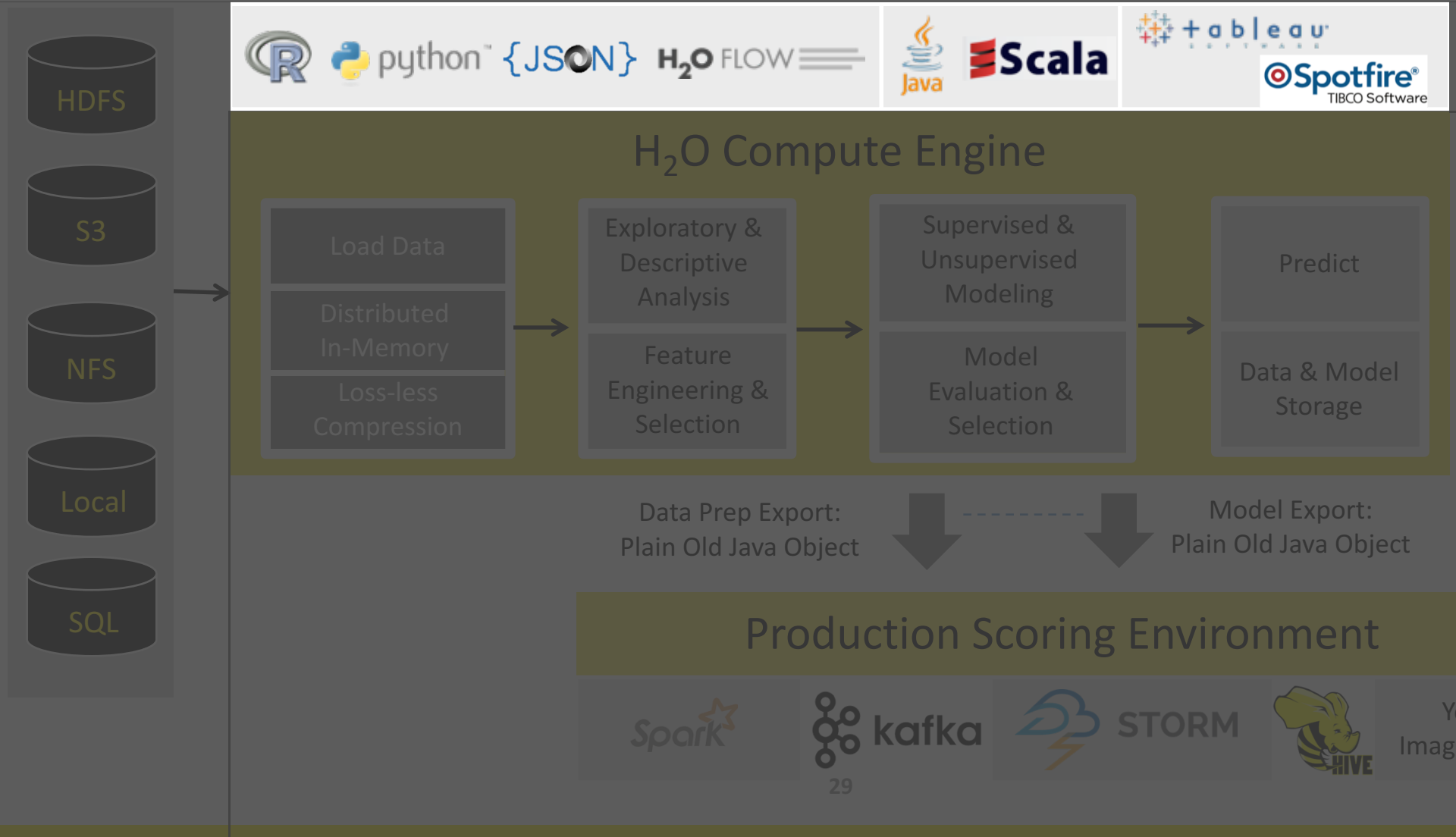
Statistical Analysis	• **Generalized Linear Models**: Binomial, Gaussian, Gamma, Poisson and Tweedie • **Naïve Bayes**
Ensembles	• **Distributed Random Forest**: Classification or regression models • **Gradient Boosting Machine**: Produces an ensemble of decision trees with increasing refined approximations
Deep Neural Networks	• **Deep learning**: Create multi-layer feed forward neural networks starting with an input layer followed by multiple layers of nonlinear transformations

Unsupervised Learning

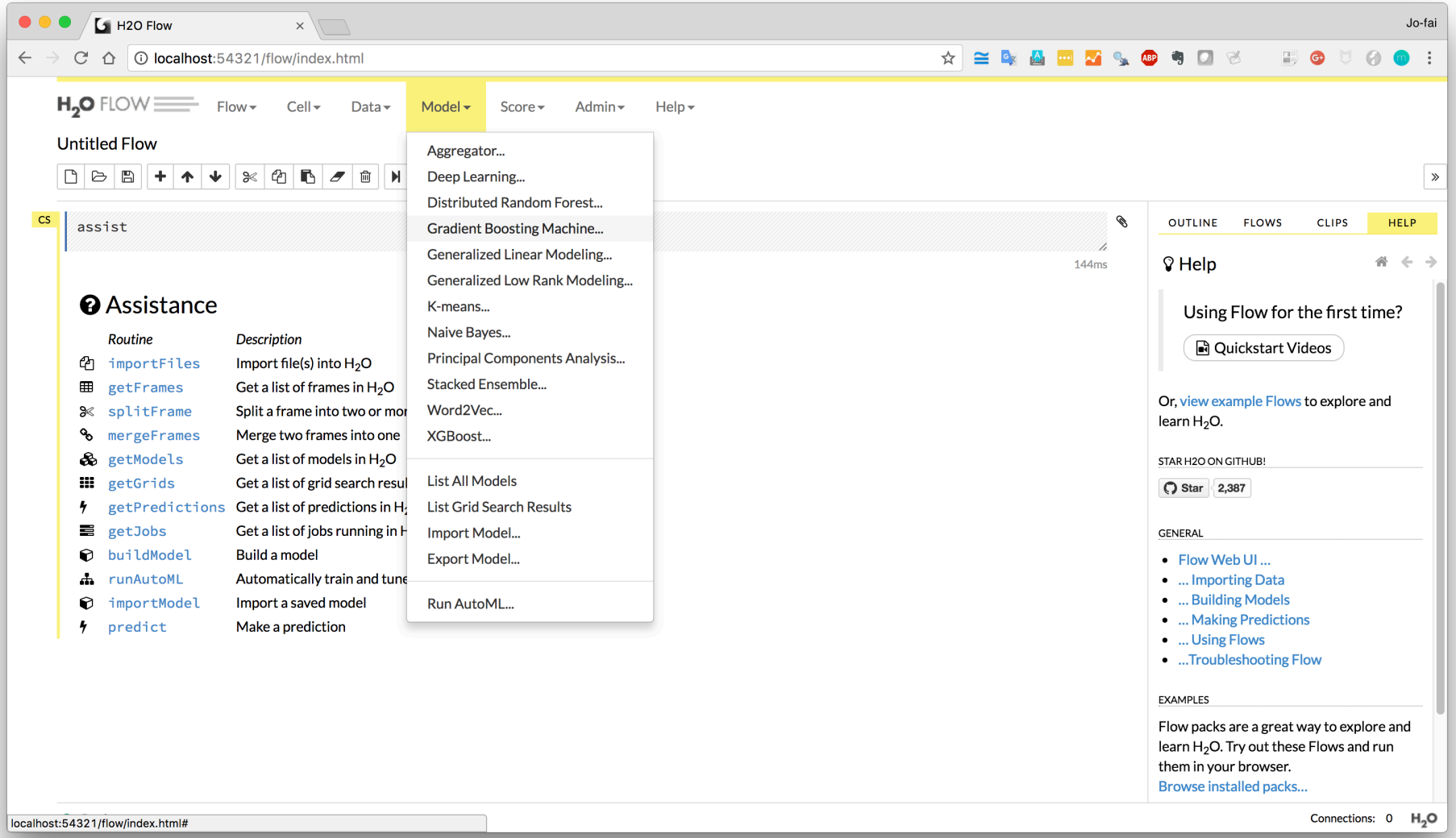
Clustering	• **K-means**: Partitions observations into k clusters/groups of the same spatial size. Automatically detect optimal k
Dimensionality Reduction	• **Principal Component Analysis**: Linearly transforms correlated variables to independent components • **Generalized Low Rank Models:** extend the idea of PCA to handle arbitrary data consisting of numerical, Boolean, categorical, and missing data
Anomaly Detection	• **Autoencoders**: Find outliers using a nonlinear dimensionality reduction using deep learning

High Level Architecture

Multiple Interfaces

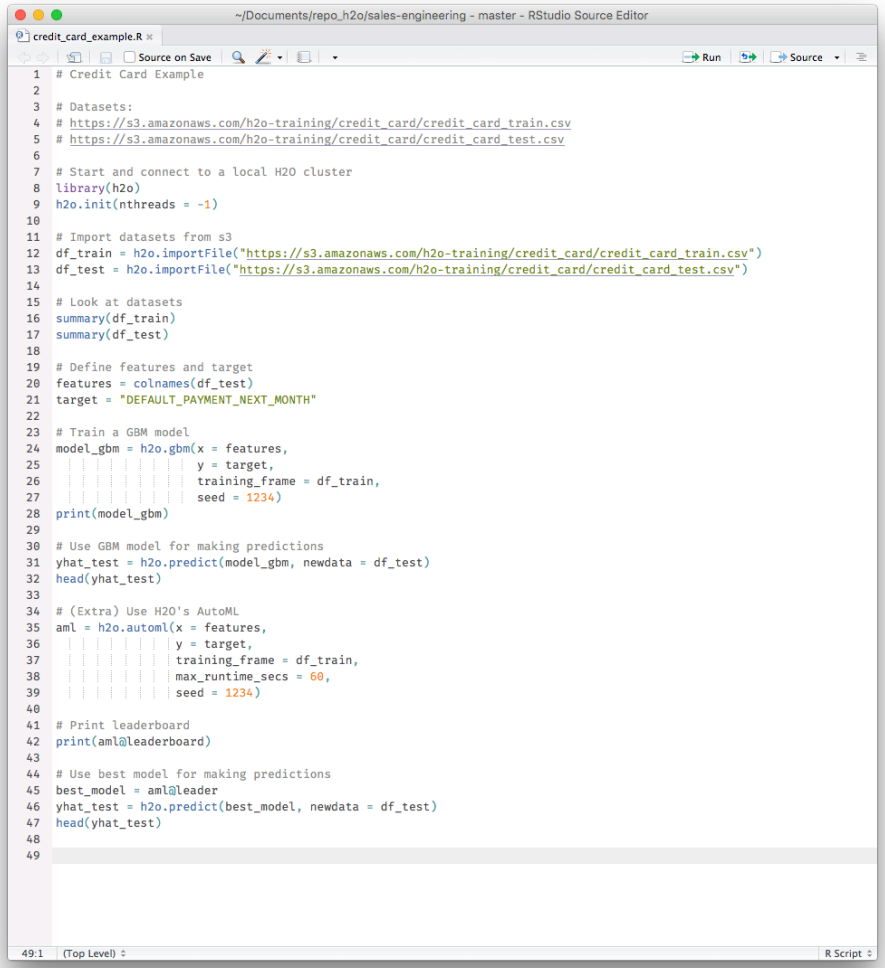


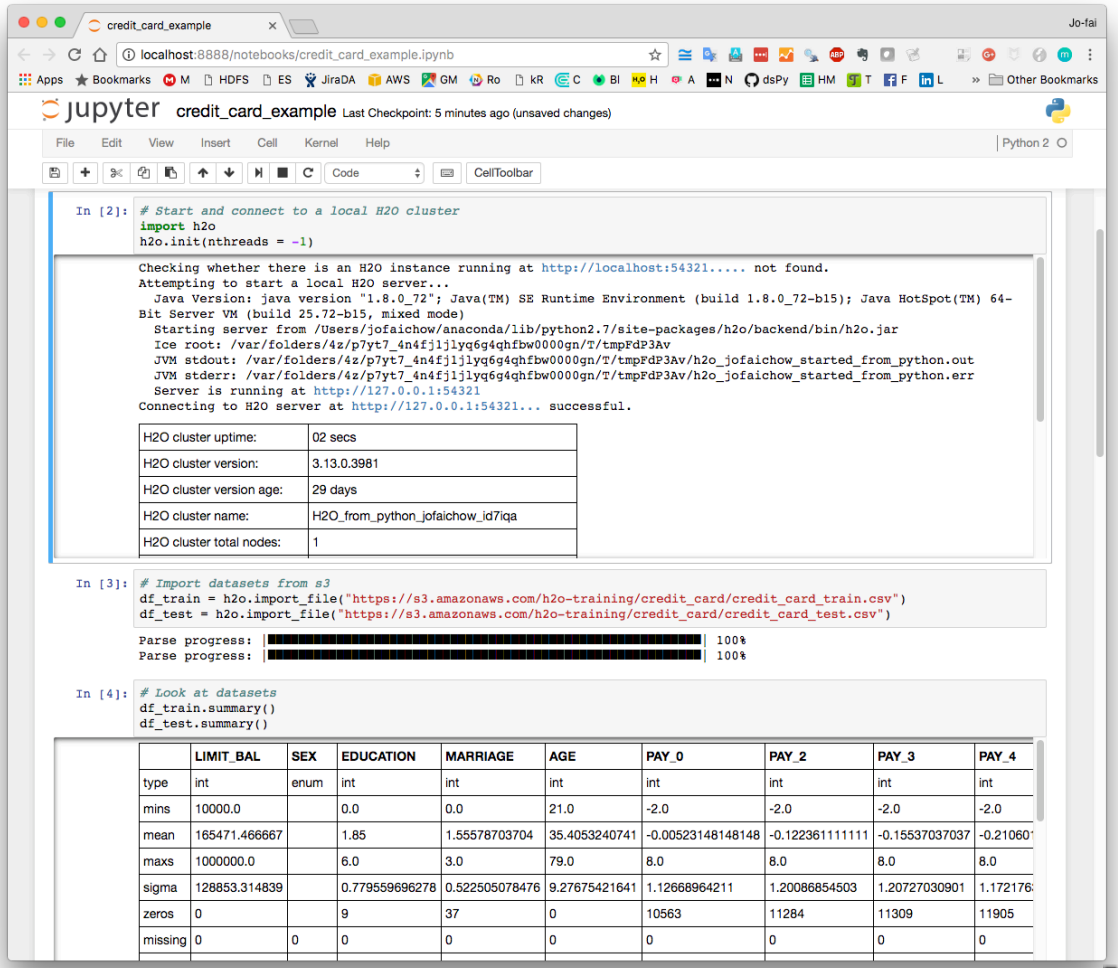
Interface – H_2O Flow (Web)



H2O.ai

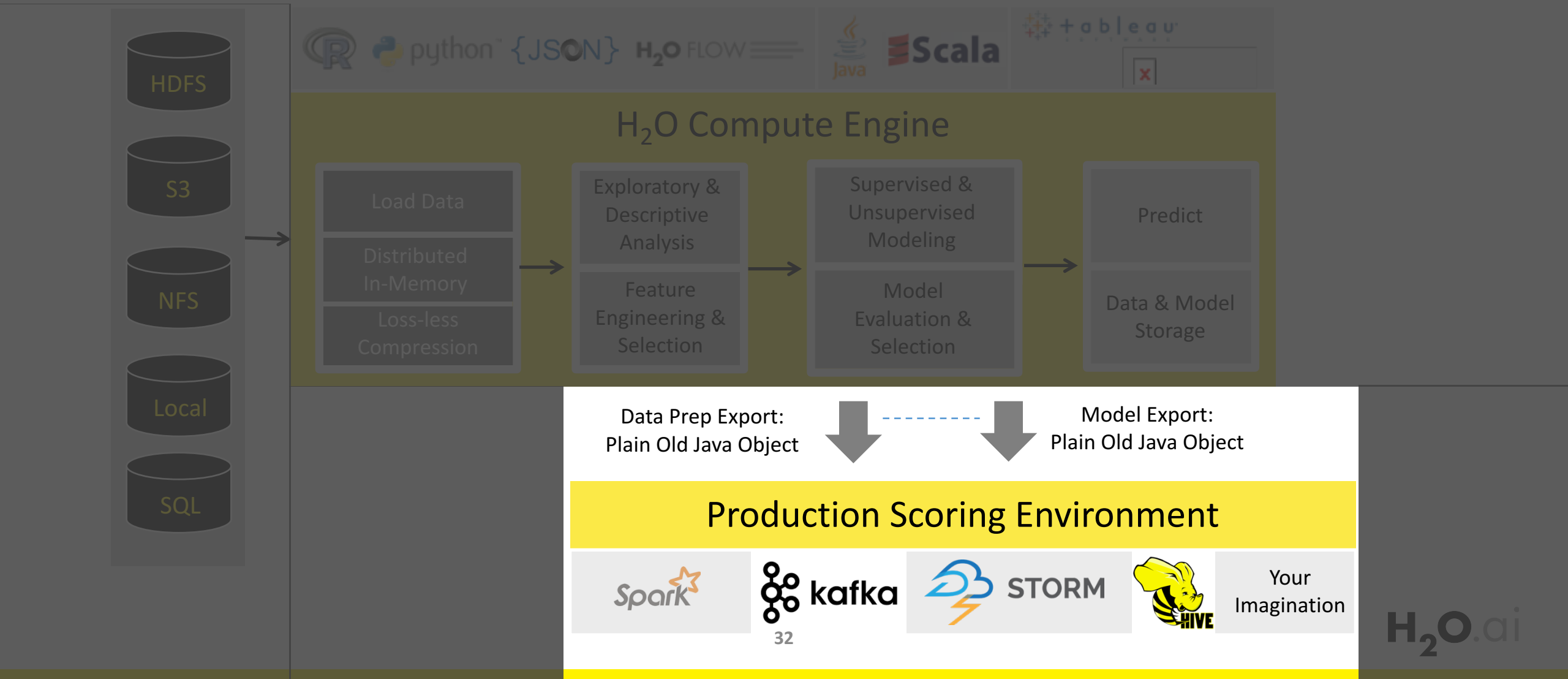
Interface – R and Python





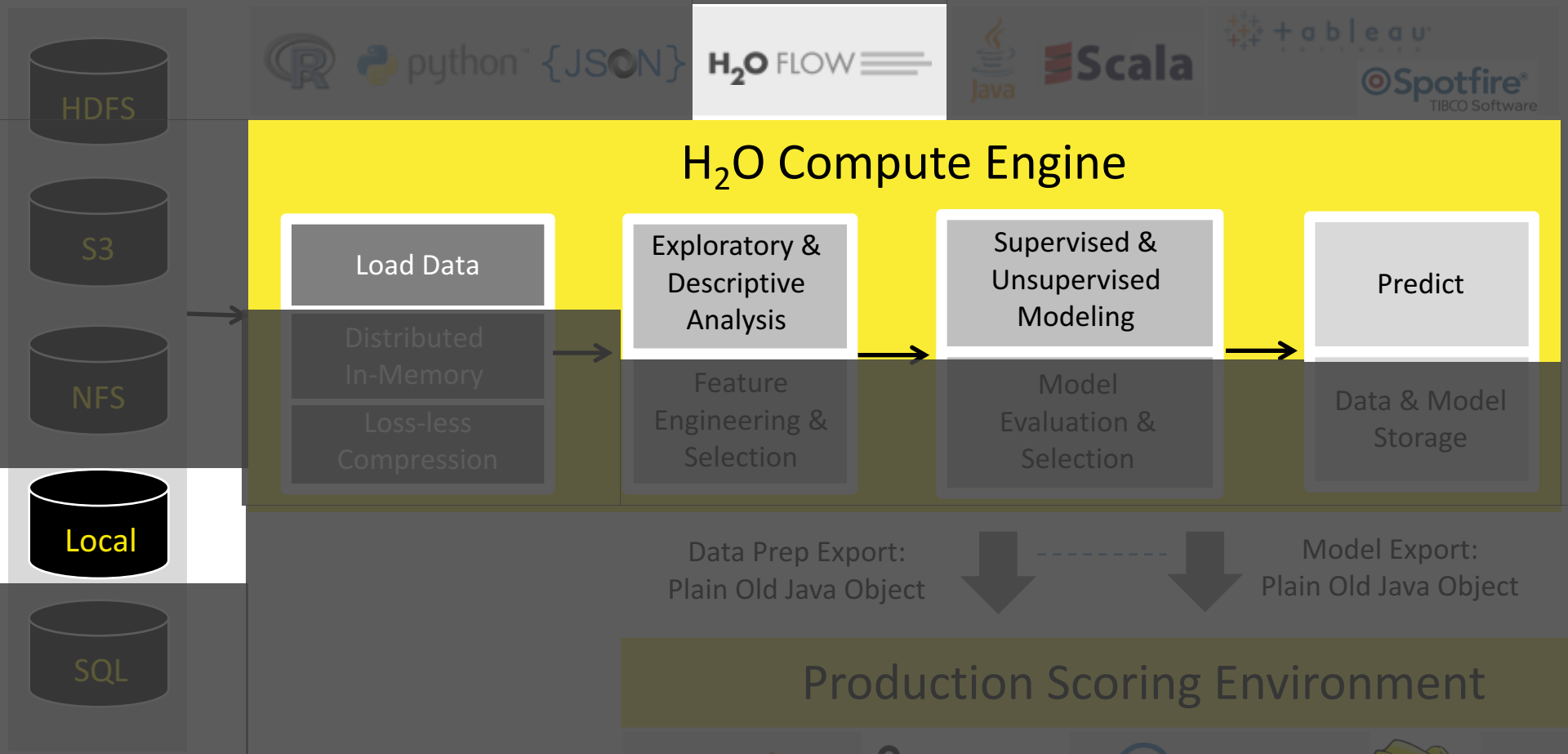
High Level Architecture

Export Standalone Models for Production



High Level Architecture

This Workshop



docs.h2o.ai

Getting Started & User Guides

H_2O

What is H2O?
H2O User Guide (Main docs)
H2O Book (O'Reilly)
Recent Changes
Open Source License (Apache V2)

Quick Start Video - Flow Web UI
Quick Start Video - R
Quick Start Video - Python

Download H_2O

Sparkling Water

What is Sparkling Water?
Sparkling Water Booklet
PySparkling Readme 2.0 | 2.1 | 2.2
RSparkling Readme
Open Source License (Apache V2)

Quick Start Video - Scala

Download Sparkling Water

Steam

What is Steam?
Steam User Guide
Recent Changes
Open Source License (AGPL)

Download Steam

Deep Water (preview)

Deep Water Readme
Deep Water Booklet
Deep Water AMI Guide
Deep Water Docker Image
Open Source License (Apache V2)

Launch Deep Water AMI
(choose p2.xlarge)

Q & A

FAQ
Issue Tracking (JIRA)
Stack Overflow
h2ostream Google Group
Gitter
Cross Validated

For Supported Enterprise Customers

Enterprise Support Web | Email

Algorithms

Supervised Learning

Generalized Linear Modeling (GLM)	Tutorial	Booklet	Reference	Tuning
Gradient Boosting Machine (GBM)	Tutorial	Booklet	Reference	Tuning
Deep Learning	Tutorial	Booklet	Reference	Tuning
Distributed Random Forest	Tutorial	Booklet	Reference	Tuning
Naive Bayes	Tutorial	Booklet	Reference	Tuning
Stacked Ensembles	Tutorial	Booklet	Reference	Tuning
XGBoost	Tutorial	Booklet	Reference	Tuning

Unsupervised Learning

Generalized Low Rank Models (GLRM)	Tutorial	Reference
K-Means Clustering	Tutorial	Reference
Principal Components Analysis (PCA)	Tutorial	Reference

Miscellaneous

Word2vec	Tutorial	Reference

TOP

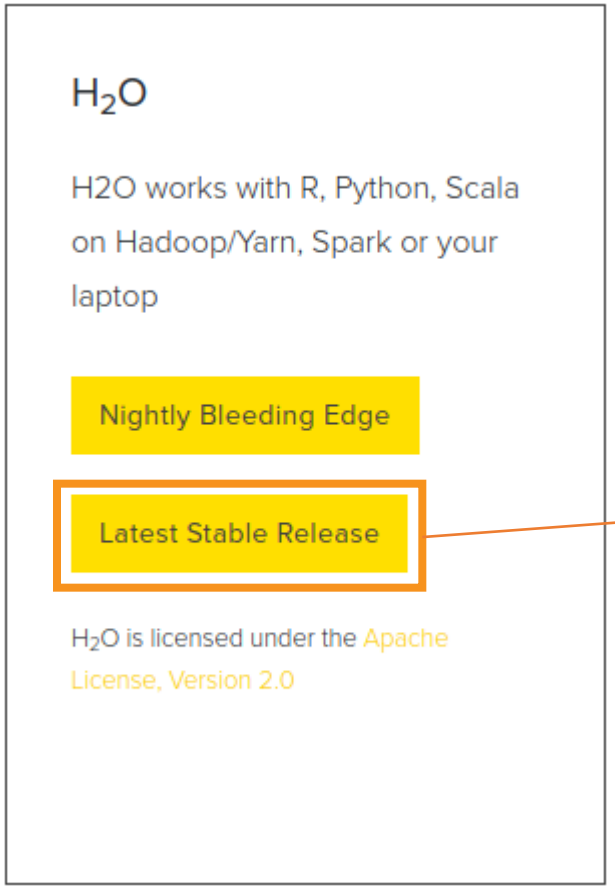
H_2O Tutorials

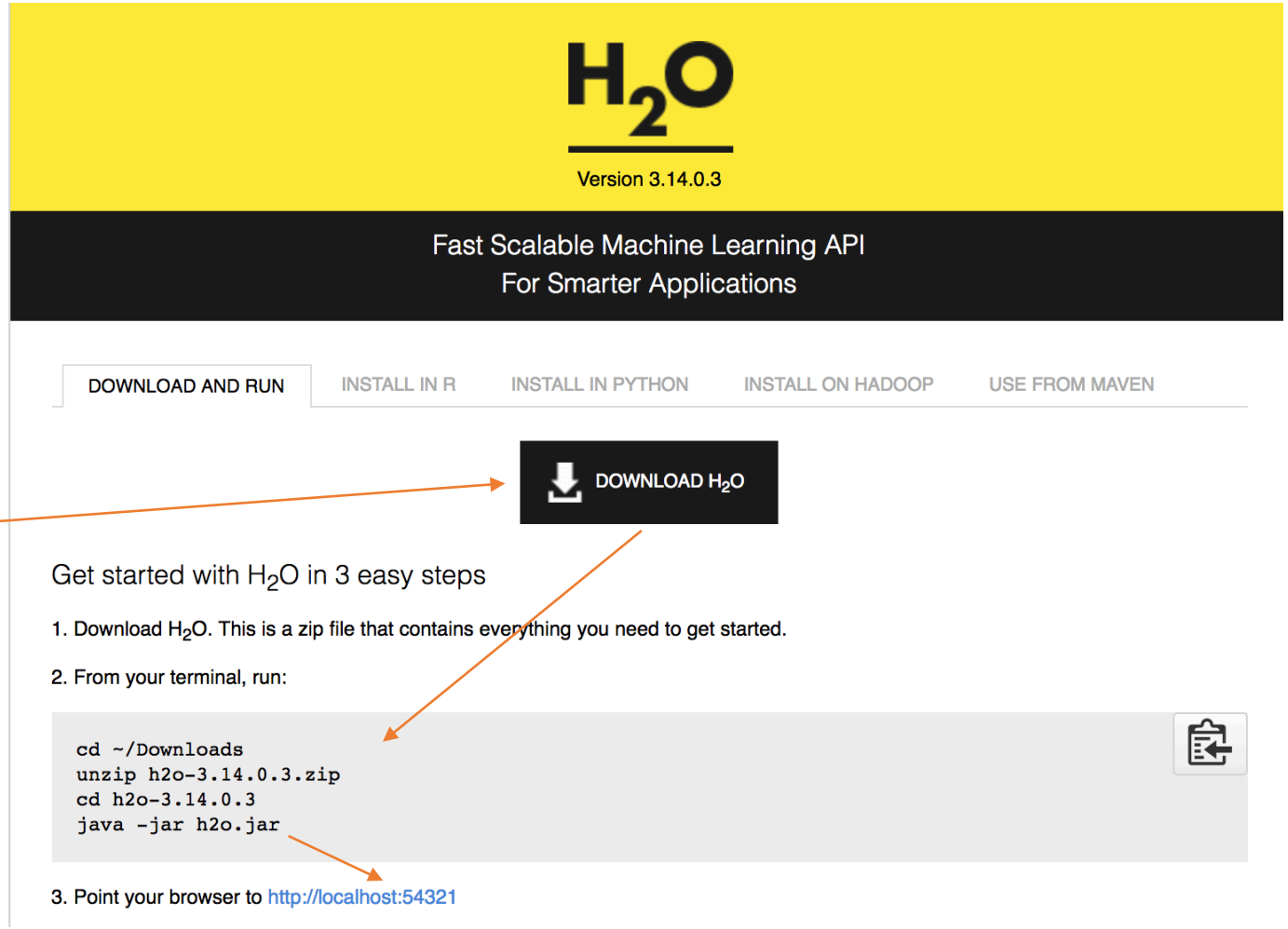
- Quick Start
- Regression
- Classification
- Clustering

H_2O Quick Start

www.h2o.ai/download

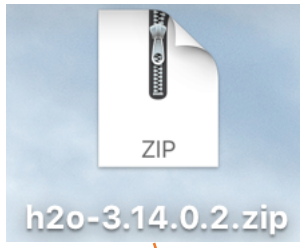
Prerequisite: Java version 7 or 8
(Note: Java version 9 is not yet supported)

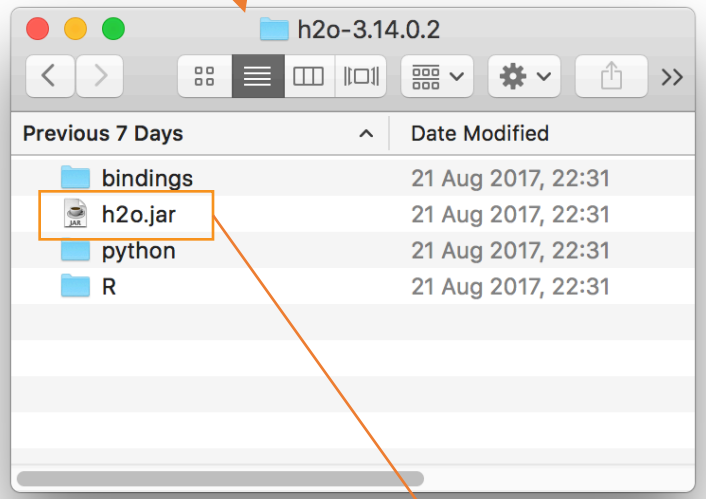


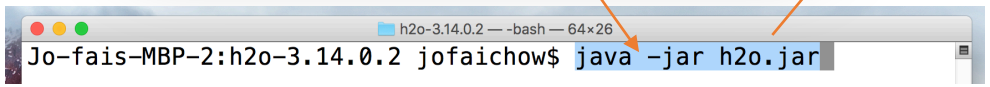


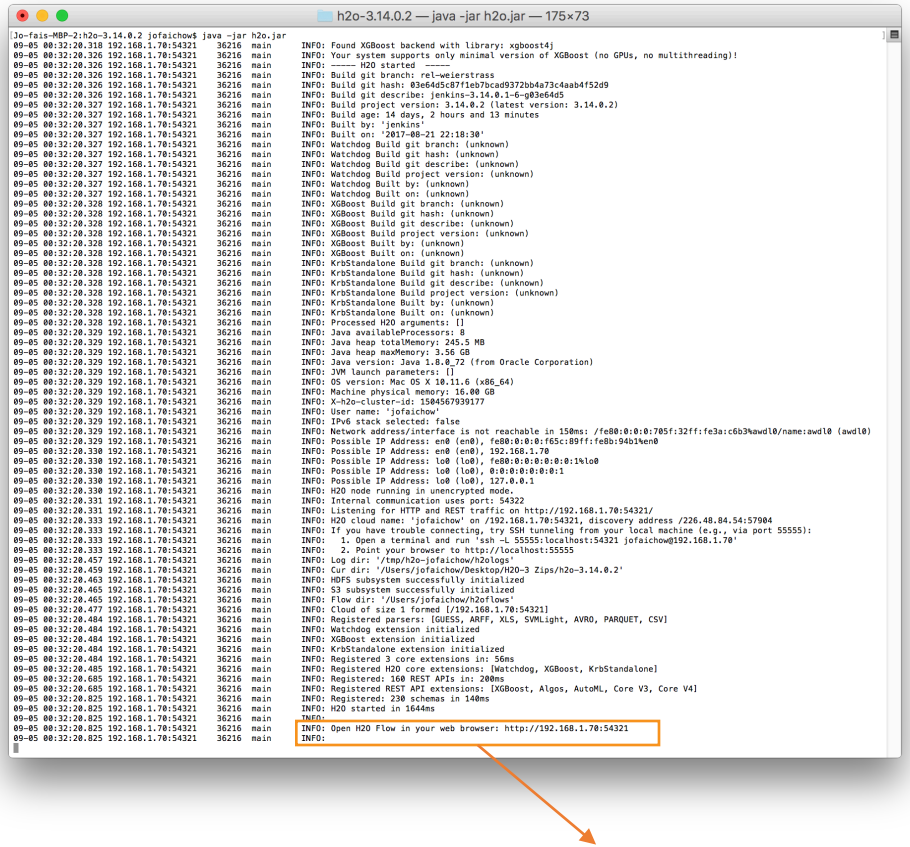
H2O.ai

Install and Start H_2O Flow (Web Interface)





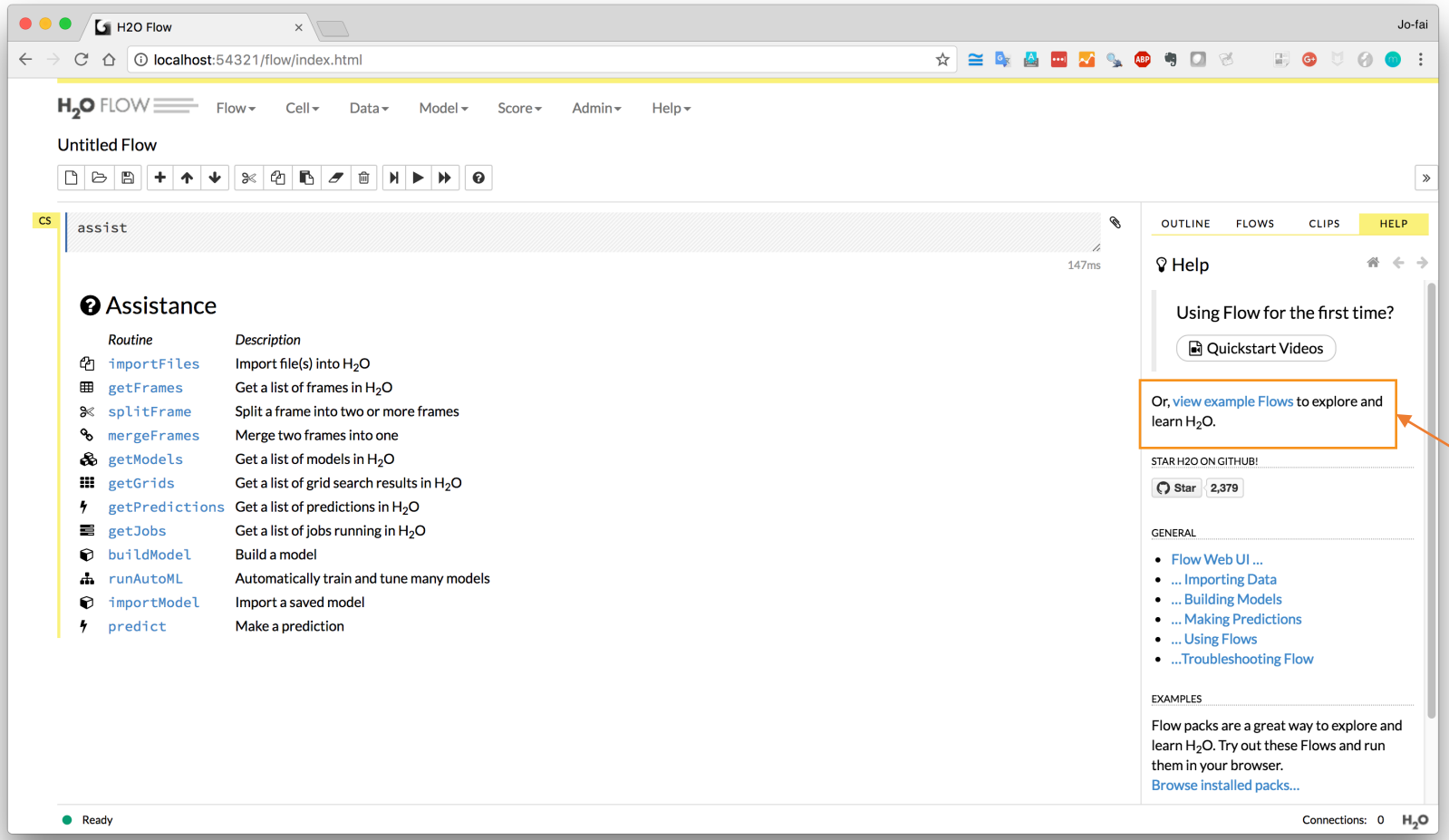




INFO: Open H2O Flow in your web browser: http://192.168.1.70:54321

H2O.ai

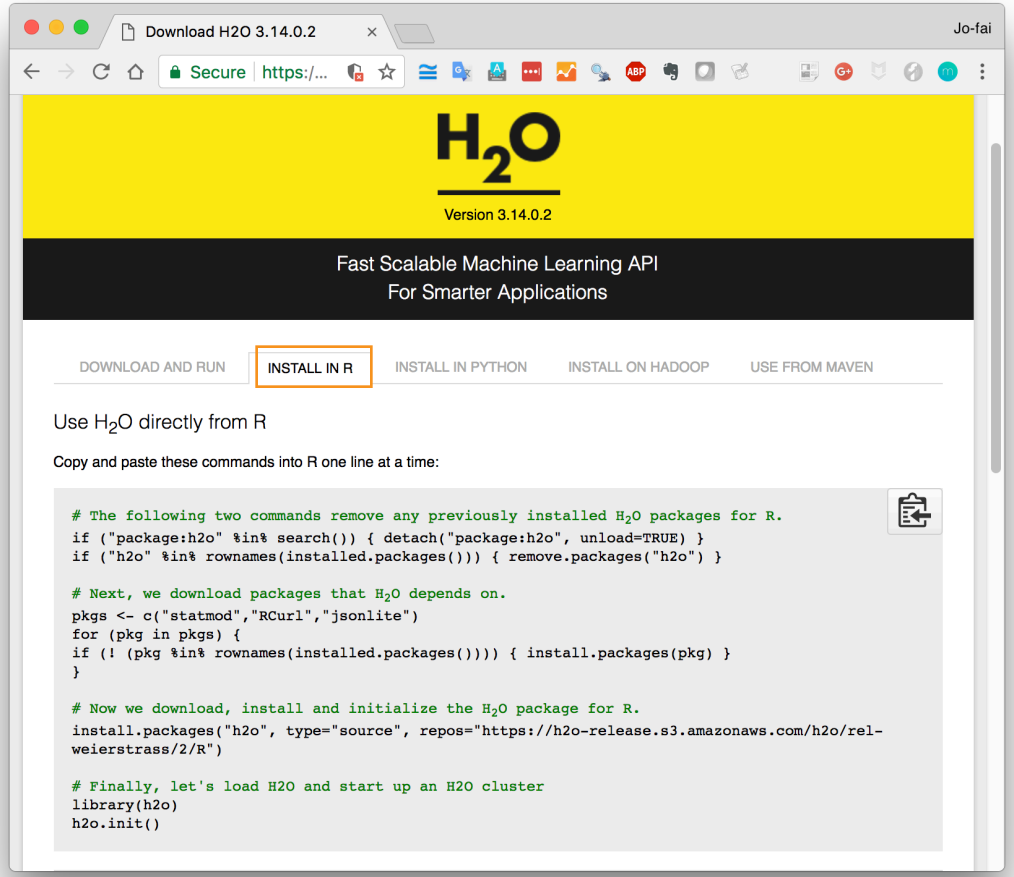
H_2O Flow (Web Interface)

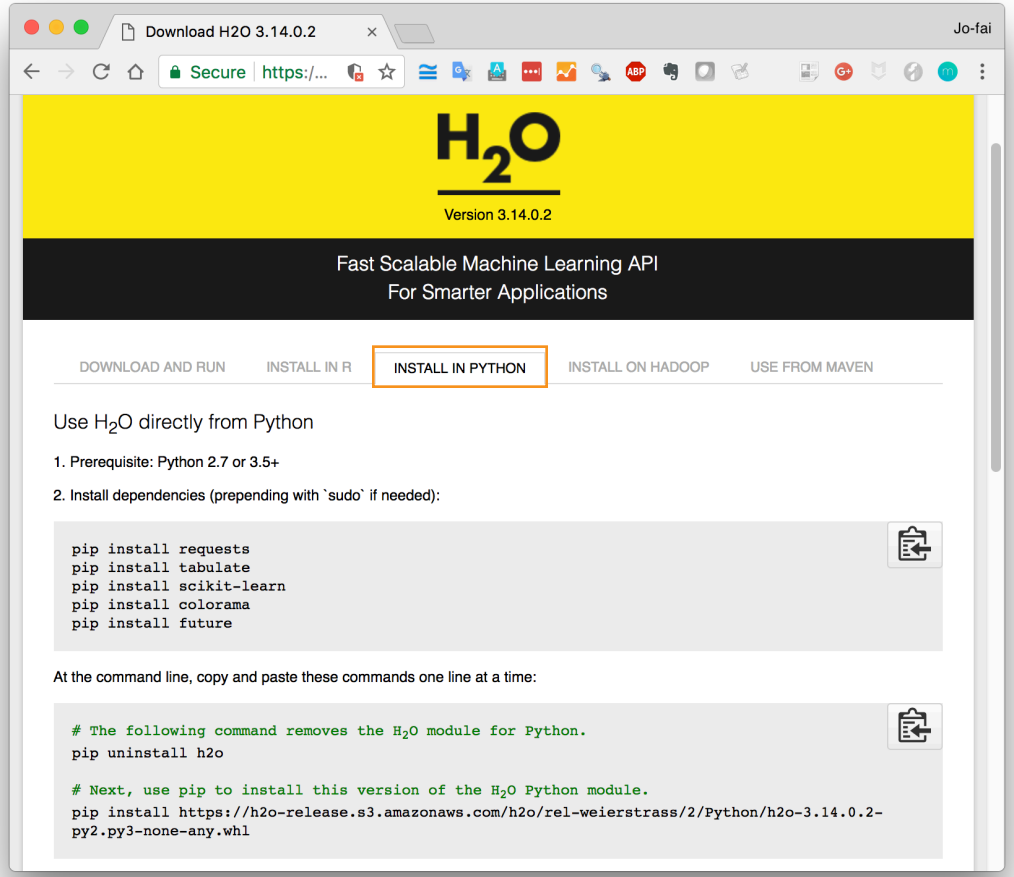


More Examples

H2O.ai

Install and Start H_2O in R / Python





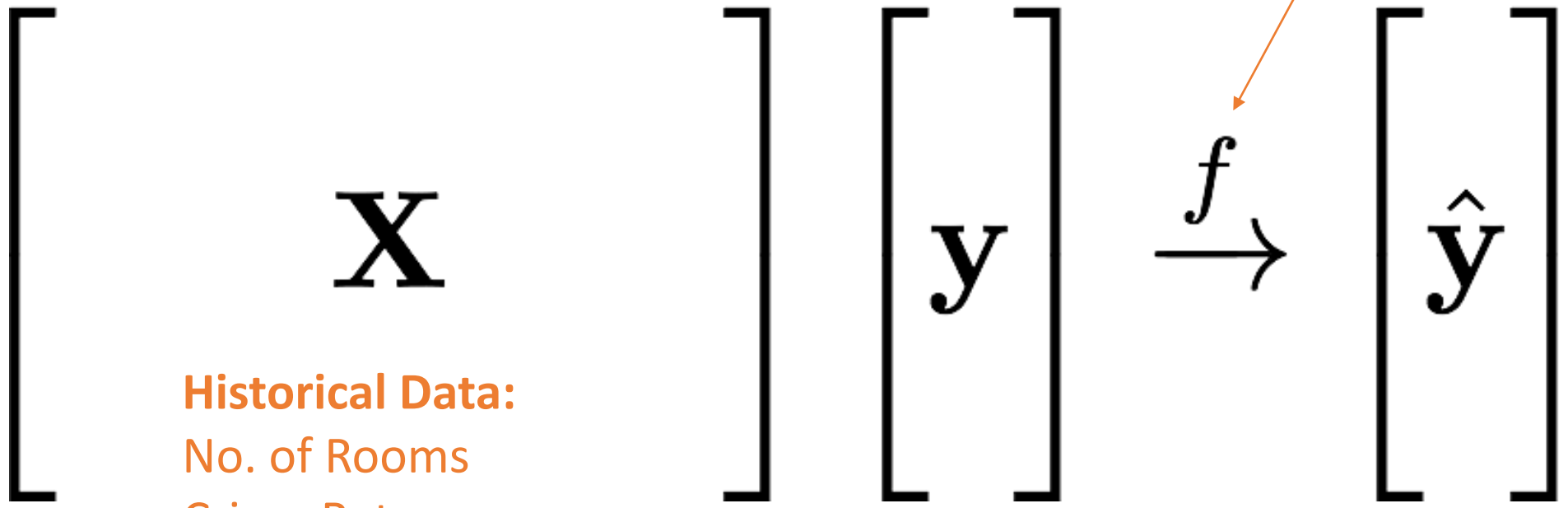
H2O.ai

Tutorial 1 - Regression

- **Data**: Boston Housing (1978)
- **Source**: http://www.cs.toronto.edu/~delve/data/boston/bostonDetail.html

Supervised Learning Example

Machine Learning:
Learn Patterns
from Data



Historical Data:
No. of Rooms
Crime Rate
Pupil-Teacher Ratio
…

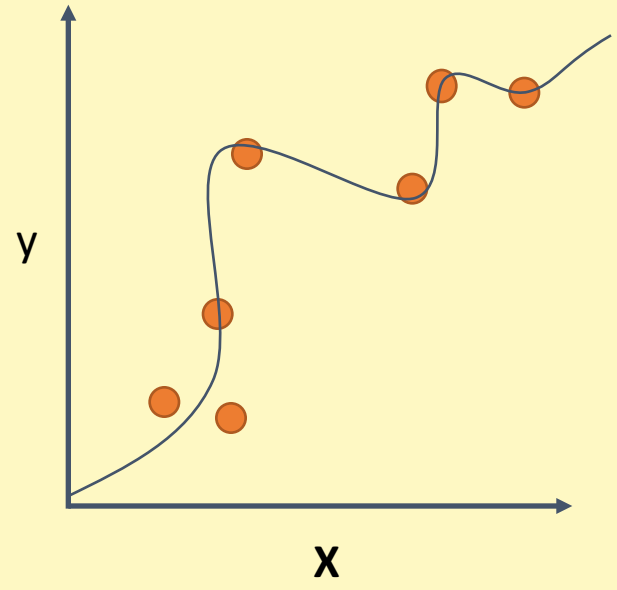
Target:
House Value

Predicted Value

H2O.ai

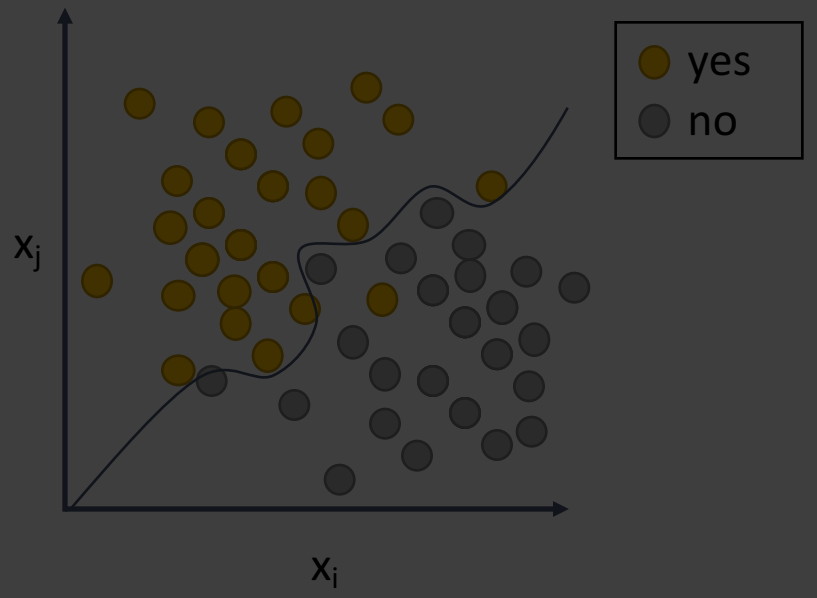
Supervised Learning – You Already Have Target Data

Regression:
How much will a customers spend?



H_2O algos:
Penalized Linear Models
Random Forest
Gradient Boosting
Neural Networks
Stacked Ensembles

Classification:
Will a customer make a purchase? Yes or No



H_2O algos:
Penalized Linear Models
Naïve Bayes
Random Forest
Gradient Boosting
Neural Networks
Stacked Ensembles

H_2O.ai

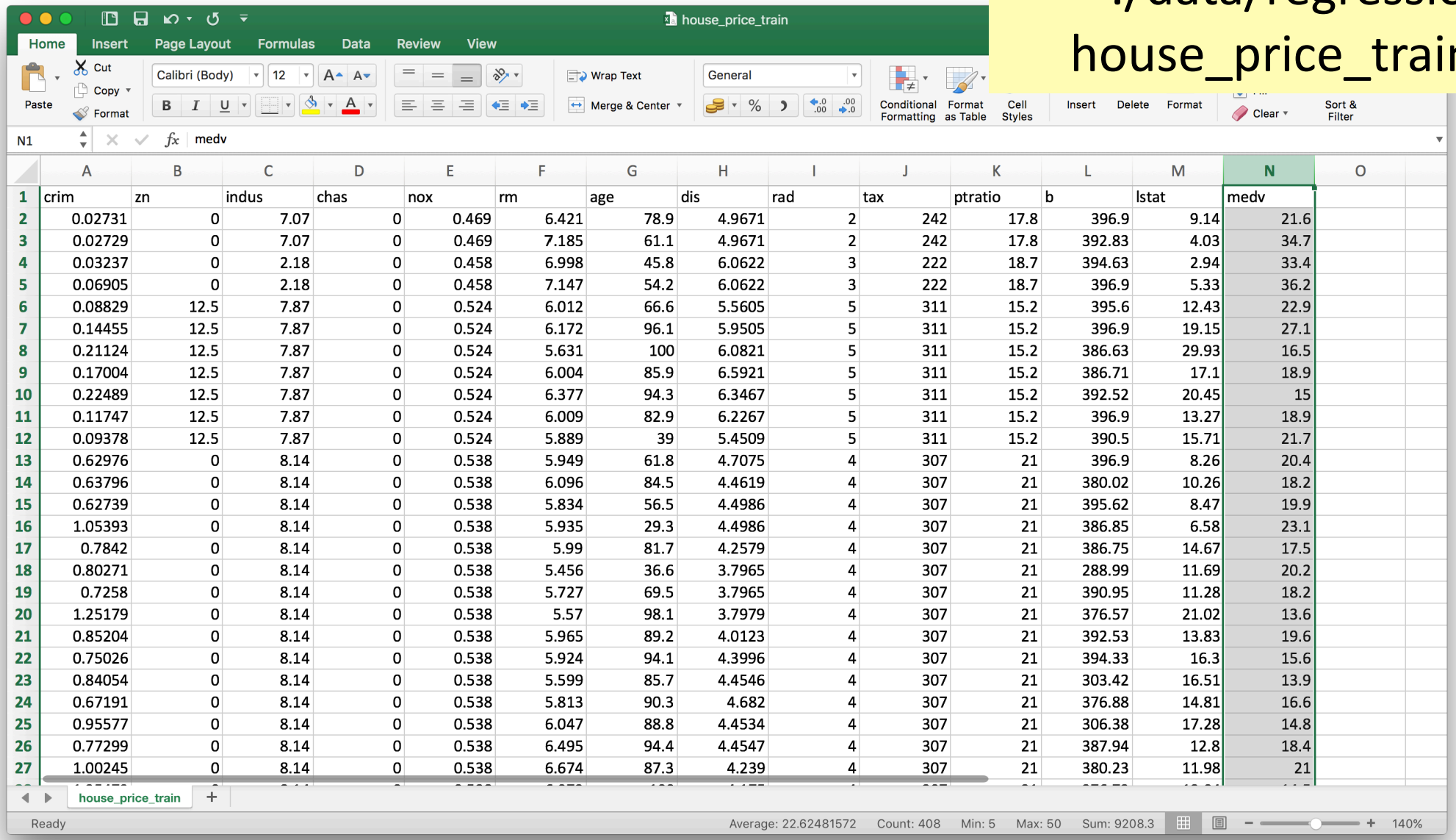
Regression – Key Steps

- Import Data (CSV Files)
  - ./data/regression/ …
  - Have a quick look
- Train a Random Forest Model
  - Look at variable importance
- Make Predictions
  - Compare with ground truth
- Build Partial Dependence Plots
  - Explain model behaviour

1. CRIM - per capita crime rate by town
2. ZN - proportion of residential land zoned for lots over 25,000 sq.ft.
3. INDUS - proportion of non-retail business acres per town.
4. CHAS - Charles River dummy variable (1 if tract bounds river; 0 otherwise)
5. NOX - nitric oxides concentration (parts per 10 million)
6. RM - average number of rooms per dwelling
7. AGE - proportion of owner-occupied units built prior to 1940
8. DIS - weighted distances to five Boston employment centres
9. RAD - index of accessibility to radial highways
10. TAX - full-value property-tax rate per $10,000
11. PTRATIO - pupil-teacher ratio by town
12. B - 1000(Bk - 0.63)^2 where Bk is the proportion of blacks by town
13. LSTAT - % lower status of the population
14. MEDV - Median value of owner-occupied homes in $1000's

Target:
House Value

./data/regression/ house_price_train.csv



house_price_train

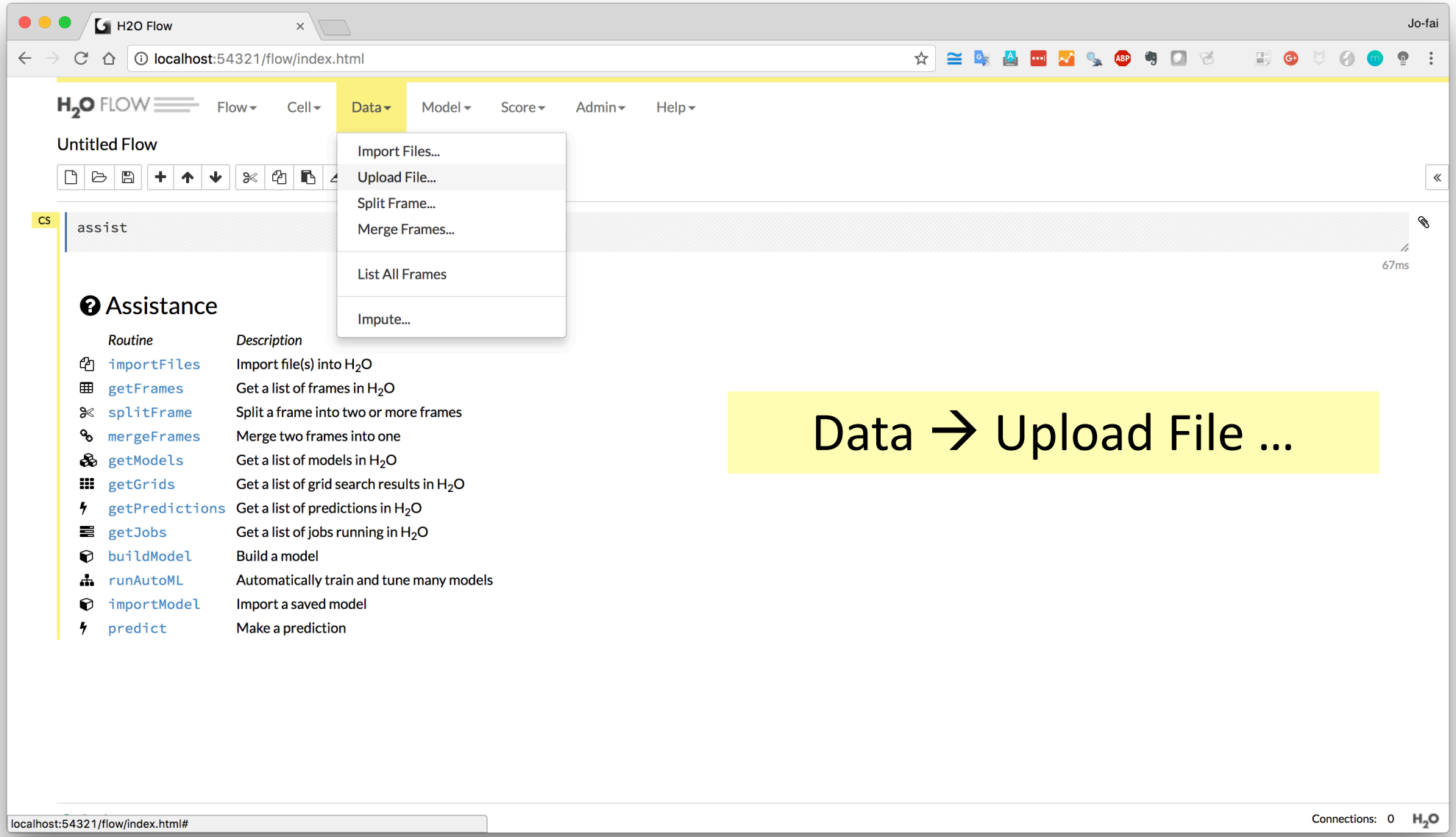
Home Insert Page Layout Formulas Data Review View

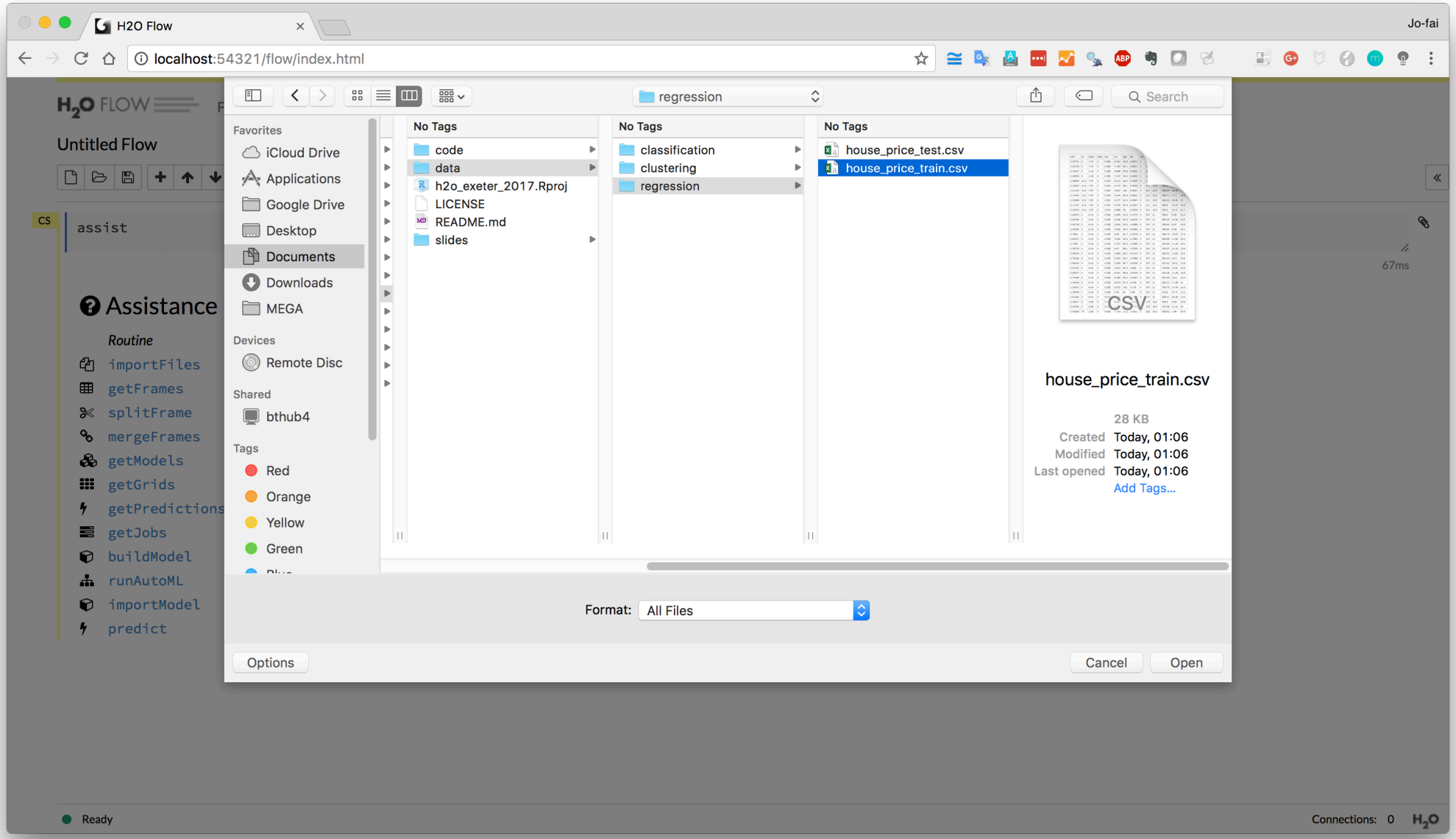
N1 | medv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	crim	zn	indus	chas	nox	rm	age	dis	rad	tax	ptratio	b	lstat	medv	
2	0.02731	0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.9	9.14	21.6	
3	0.02729	0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7	
4	0.03237	0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4	
5	0.06905	0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.9	5.33	36.2	
6	0.08829	12.5	7.87	0	0.524	6.012	66.6	5.5605	5	311	15.2	395.6	12.43	22.9	
7	0.14455	12.5	7.87	0	0.524	6.172	96.1	5.9505	5	311	15.2	396.9	19.15	27.1	
8	0.21124	12.5	7.87	0	0.524	5.631	100	6.0821	5	311	15.2	386.63	29.93	16.5	
9	0.17004	12.5	7.87	0	0.524	6.004	85.9	6.5921	5	311	15.2	386.71	17.1	18.9	
10	0.22489	12.5	7.87	0	0.524	6.377	94.3	6.3467	5	311	15.2	392.52	20.45	15	
11	0.11747	12.5	7.87	0	0.524	6.009	82.9	6.2267	5	311	15.2	396.9	13.27	18.9	
12	0.09378	12.5	7.87	0	0.524	5.889	39	5.4509	5	311	15.2	390.5	15.71	21.7	
13	0.62976	0	8.14	0	0.538	5.949	61.8	4.7075	4	307	21	396.9	8.26	20.4	
14	0.63796	0	8.14	0	0.538	6.096	84.5	4.4619	4	307	21	380.02	10.26	18.2	
15	0.62739	0	8.14	0	0.538	5.834	56.5	4.4986	4	307	21	395.62	8.47	19.9	
16	1.05393	0	8.14	0	0.538	5.935	29.3	4.4986	4	307	21	386.85	6.58	23.1	
17	0.7842	0	8.14	0	0.538	5.99	81.7	4.2579	4	307	21	386.75	14.67	17.5	
18	0.80271	0	8.14	0	0.538	5.456	36.6	3.7965	4	307	21	288.99	11.69	20.2	
19	0.7258	0	8.14	0	0.538	5.727	69.5	3.7965	4	307	21	390.95	11.28	18.2	
20	1.25179	0	8.14	0	0.538	5.57	98.1	3.7979	4	307	21	376.57	21.02	13.6	
21	0.85204	0	8.14	0	0.538	5.965	89.2	4.0123	4	307	21	392.53	13.83	19.6	
22	0.75026	0	8.14	0	0.538	5.924	94.1	4.3996	4	307	21	394.33	16.3	15.6	
23	0.84054	0	8.14	0	0.538	5.599	85.7	4.4546	4	307	21	303.42	16.51	13.9	
24	0.67191	0	8.14	0	0.538	5.813	90.3	4.682	4	307	21	376.88	14.81	16.6	
25	0.95577	0	8.14	0	0.538	6.047	88.8	4.4534	4	307	21	306.38	17.28	14.8	
26	0.77299	0	8.14	0	0.538	6.495	94.4	4.4547	4	307	21	387.94	12.8	18.4	
27	1.00245	0	8.14	0	0.538	6.674	87.3	4.239	4	307	21	380.23	11.98	21	

house_price_train

Ready Average: 22.62481572 Count: 408 Min: 5 Max: 50 Sum: 9208.3 140%


H2O Flow
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Import Files...
Upload File...
Split Frame...
Merge Frames...
List All Frames
Impute...
CS
assist
67ms
Assistance
Routine
Description
importFiles
Import file(s) into H2O
getFrames
Get a list of frames in H2O
splitFrame
Split a frame into two or more frames
mergeFrames
Merge two frames into one
getModels
Get a list of models in H2O
getGrids
Get a list of grid search results in H2O
getPredictions
Get a list of predictions in H2O
getJobs
Get a list of jobs running in H2O
buildModel
Build a model
runAutoML
Automatically train and tune many models
importModel
Import a saved model
predict
Make a prediction
Data → Upload File ...
localhost:54321/flow/index.html#
Connections: 0
H2O


H2O Flow
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H2O FLOW
Untitled Flow
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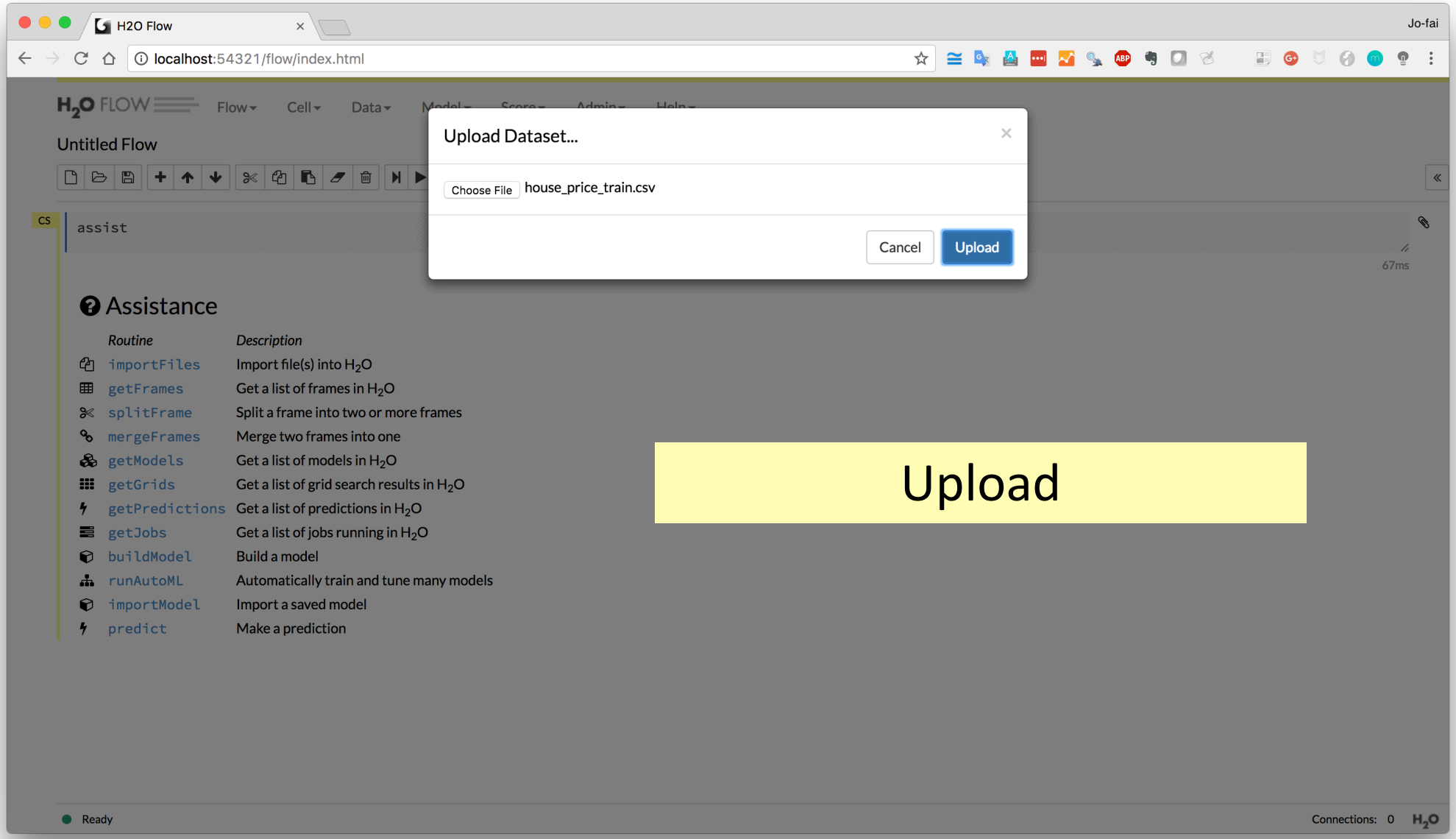
Assistance
Routine
importFiles
getFrames
splitFrame
mergeFrames
getModels
getGrids
getPredictions
getJobs
buildModel
runAutoML
importModel
predict
67ms
Ready
Connections: 0
regression
Search
Favorites
iCloud Drive
Applications
Google Drive
Desktop
Documents
Downloads
MEGA
Devices
Remote Disc
Shared
bthub4
Tags
Red
Orange
Yellow
Green
No Tags
code
data
h2o_exeter_2017.Rproj
LICENSE
README.md
slides
No Tags
classification
clustering
regression
No Tags
house_price_test.csv
house_price_train.csv
CSV
house_price_train.csv
28 KB
Created Today, 01:06
Modified Today, 01:06
Last opened Today, 01:06
Add Tags...
Format: All Files
Options
Cancel
Open


H2O Flow
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H2O FLOW
Flow
Cell
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Score
Admin
Help
Untitled Flow
Upload Dataset...
Choose File
house_price_train.csv
Cancel
Upload
CS
assist
67ms
Assistance
Routine
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Automatically train and tune many models
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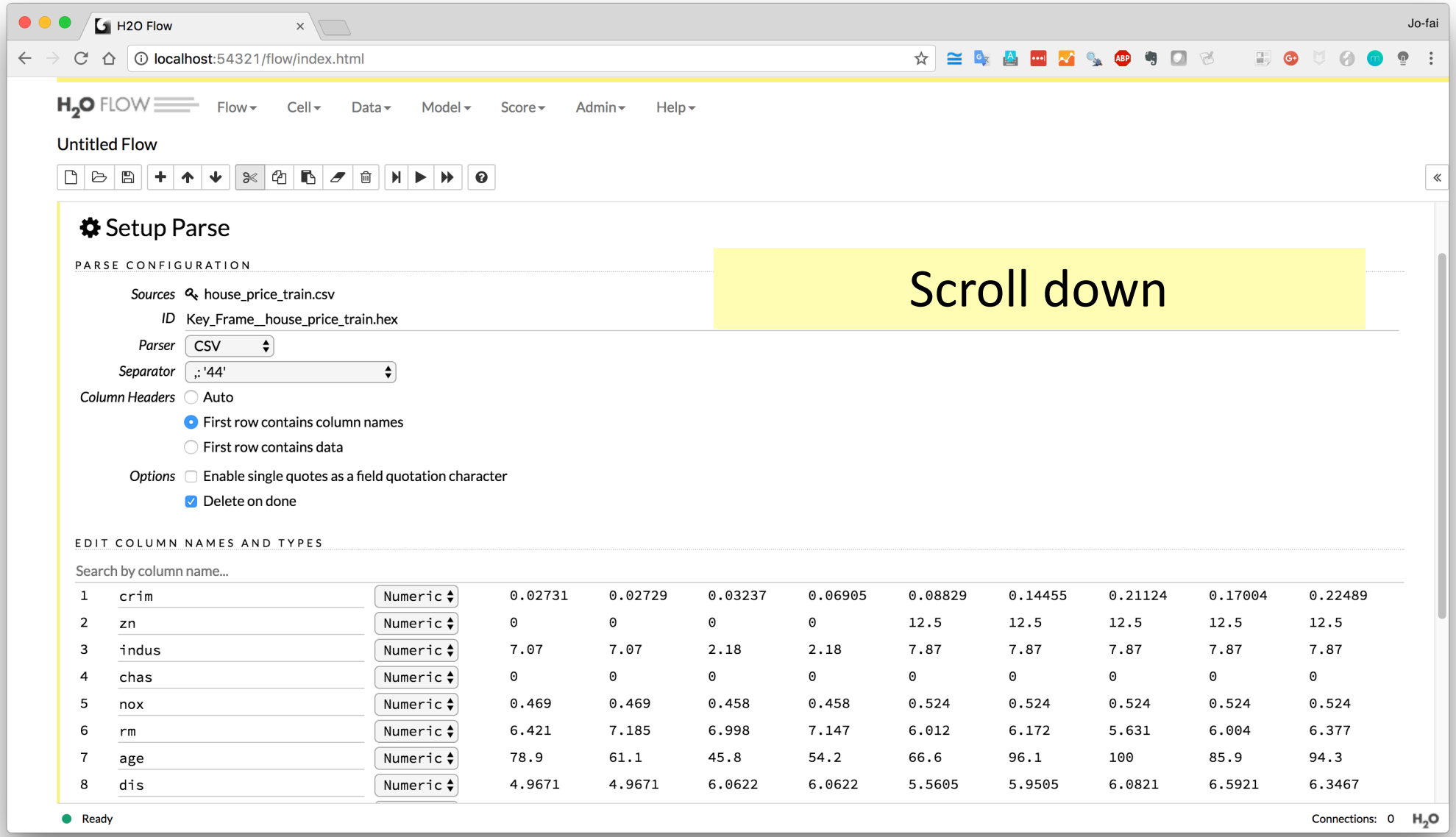
predict
Make a prediction
Upload
Ready
Connections: 0
H2O


H2O Flow
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H2O FLOW
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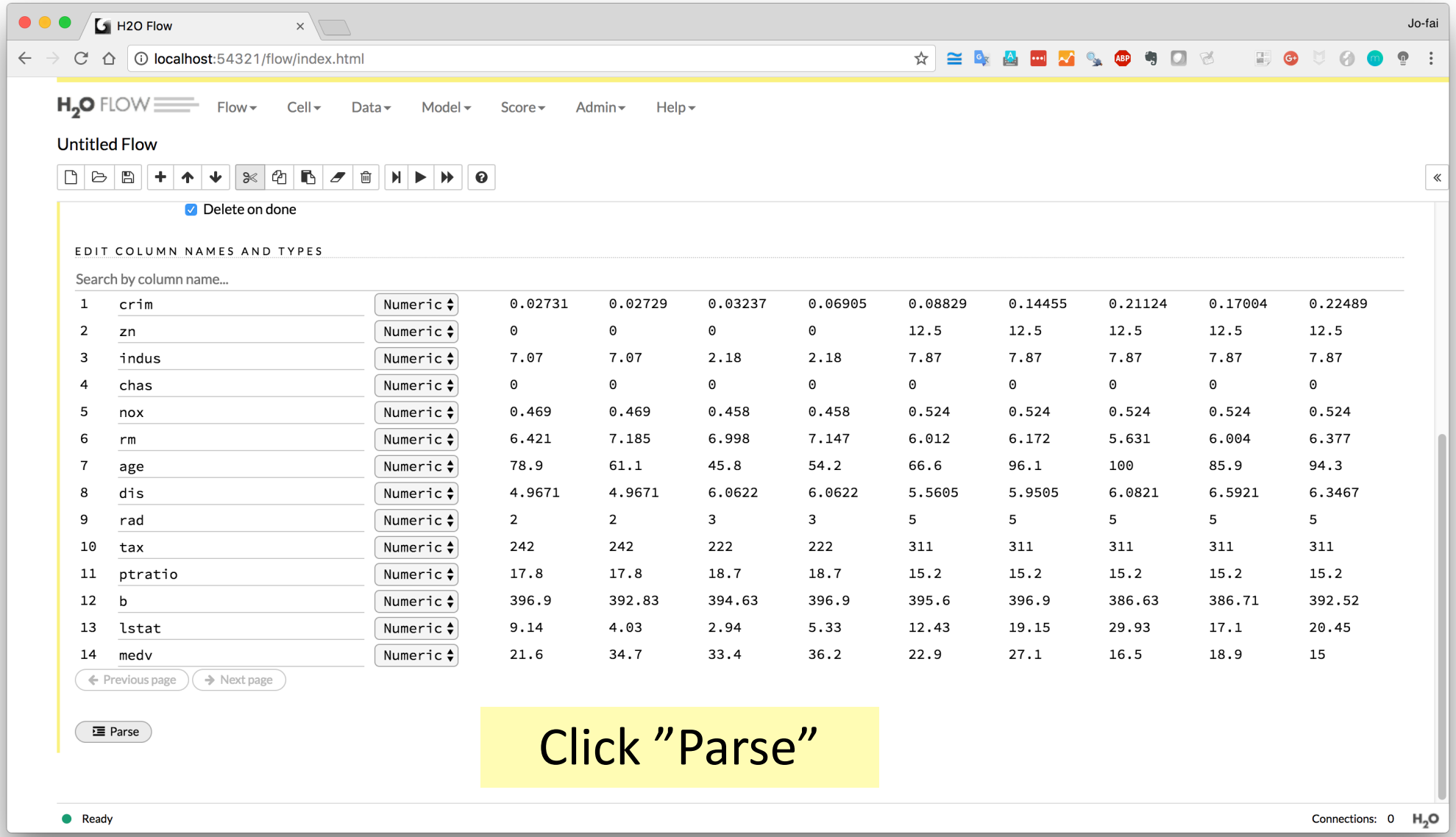
Admin
Help
Untitled Flow
Setup Parse
PARSE CONFIGURATION
Scroll down
Sources house_price_train.csv
ID Key_Frame__house_price_train.hex
Parser CSV
Separator ,: '44'
Column Headers Auto
First row contains column names
First row contains data
Options Enable single quotes as a field quotation character
Delete on done
EDIT COLUMN NAMES AND TYPES
Search by column name...
1 crim Numeric 0.02731 0.02729 0.03237 0.06905 0.08829 0.14455 0.21124 0.17004 0.22489
2 zn Numeric 0 0 0 0 12.5 12.5 12.5 12.5 12.5
3 indus Numeric 7.07 7.07 2.18 2.18 7.87 7.87 7.87 7.87 7.87
4 chas Numeric 0 0 0 0 0 0 0 0 0
5 nox Numeric 0.469 0.469 0.458 0.458 0.524 0.524 0.524 0.524 0.524
6 rm Numeric 6.421 7.185 6.998 7.147 6.012 6.172 5.631 6.004 6.377
7 age Numeric 78.9 61.1 45.8 54.2 66.6 96.1 100 85.9 94.3
8 dis Numeric 4.9671 4.9671 6.0622 6.0622 5.5605 5.9505 6.0821 6.5921 6.3467
Ready
Connections: 0
H2O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Search by column name...
1 crim Numeric 0.02731 0.02729 0.03237 0.06905 0.08829 0.14455 0.21124 0.17004 0.22489
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4 chas Numeric 0 0 0 0 0 0 0 0 0
5 nox Numeric 0.469 0.469 0.458 0.458 0.524 0.524 0.524 0.524 0.524
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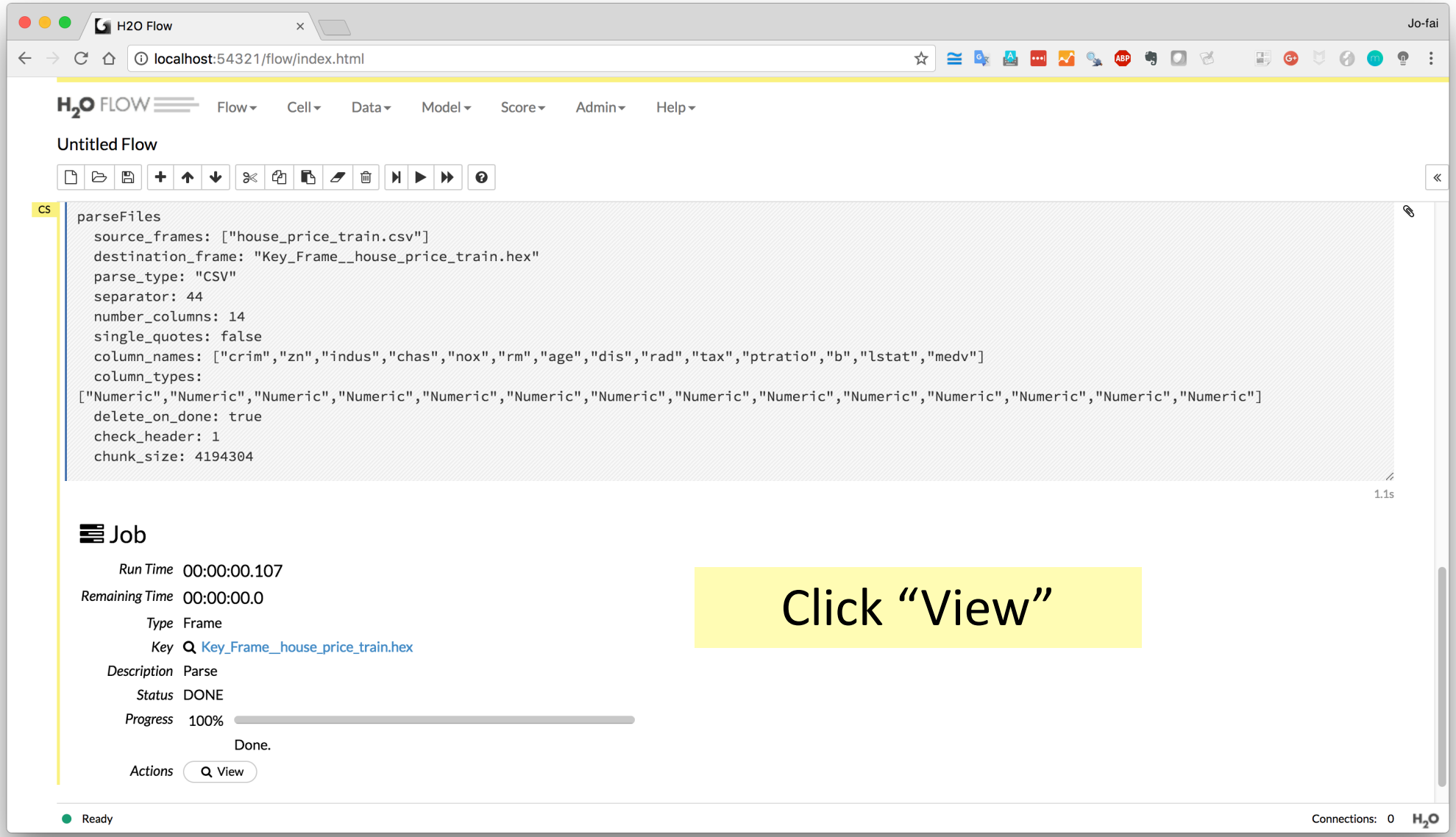
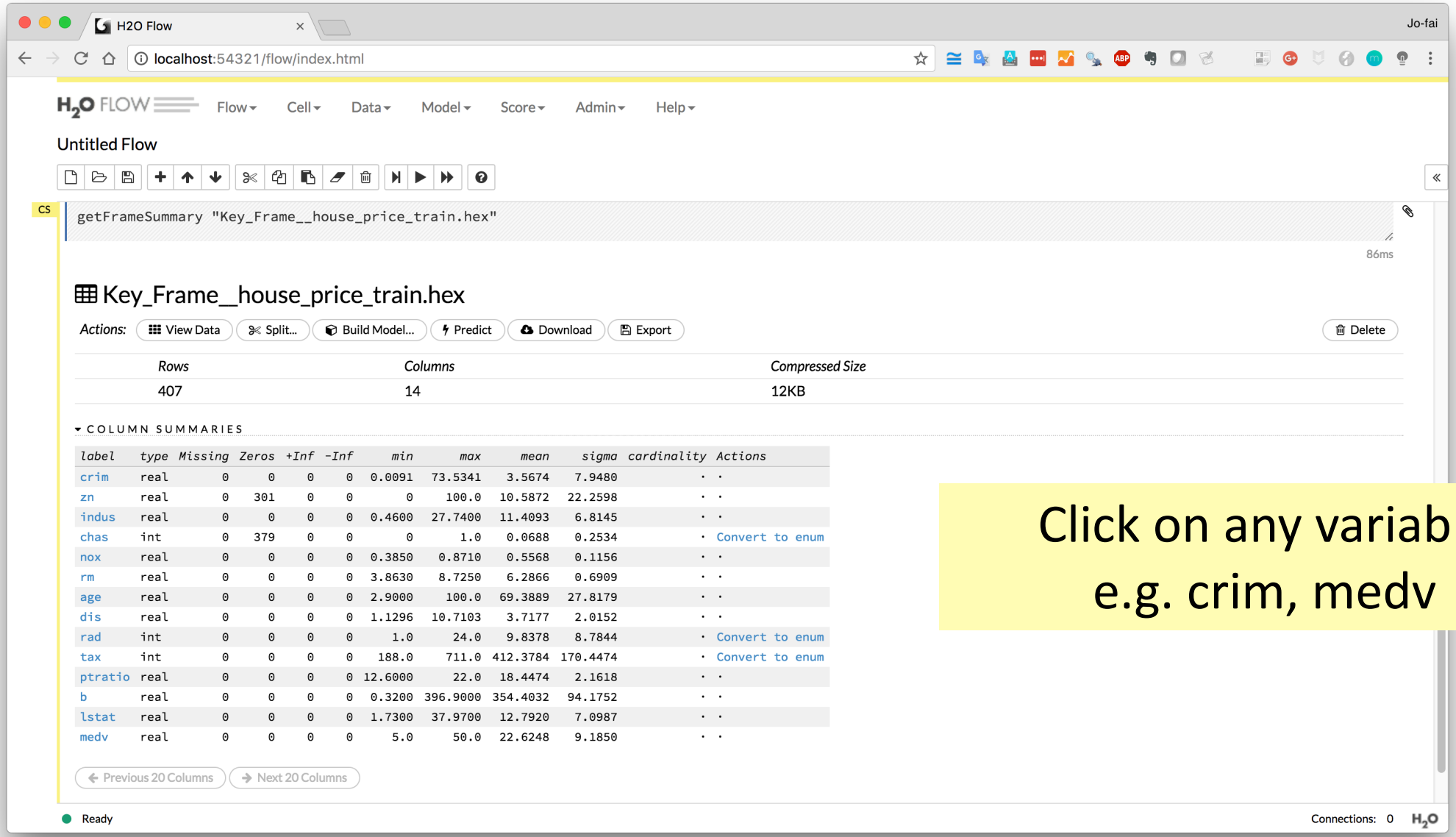
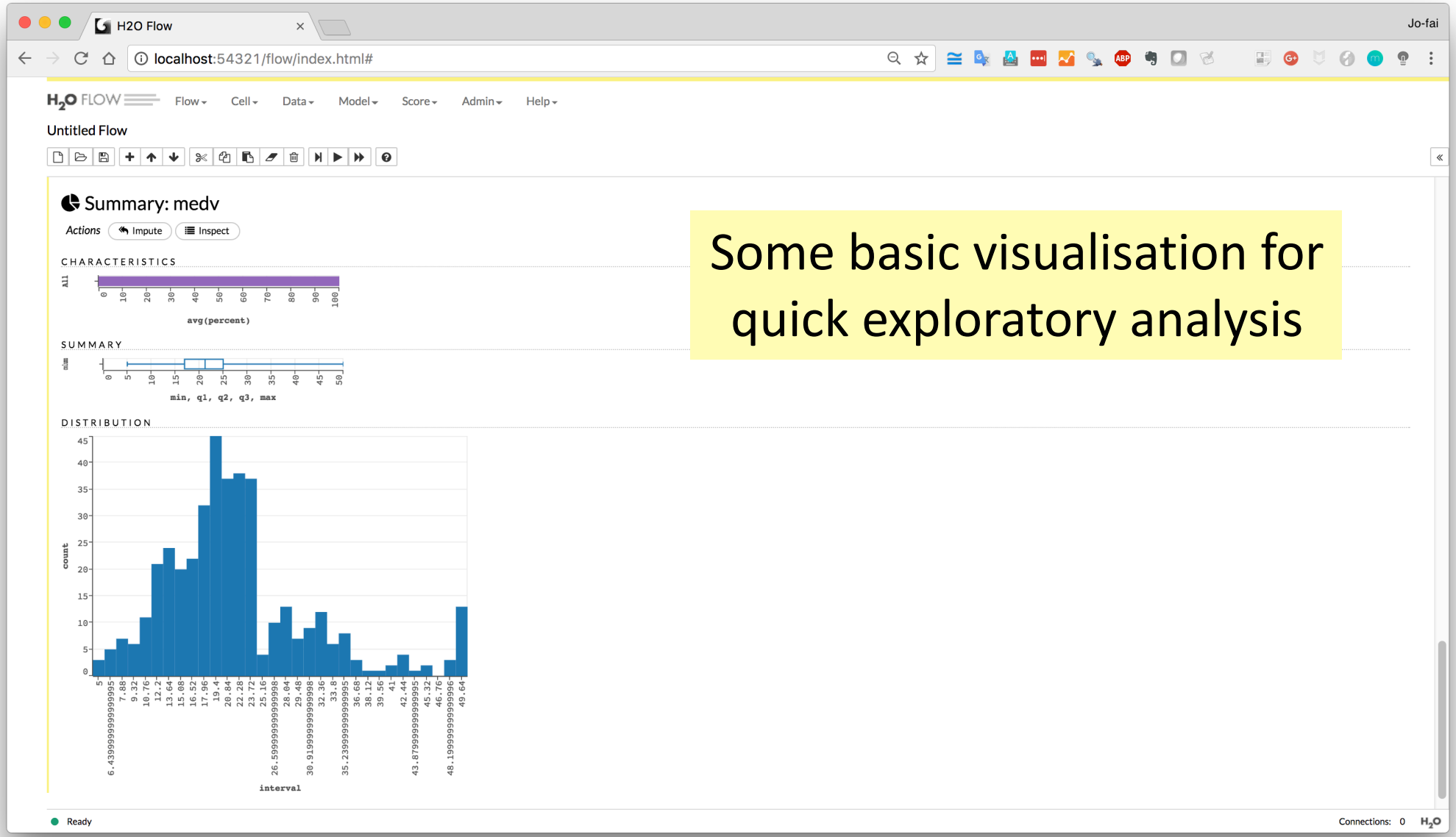
8 dis Numeric 4.9671 4.9671 6.0622 6.0622 5.5605 5.9505 6.0821 6.5921 6.3467
9 rad Numeric 2 2 3 3 5 5 5 5 5
10 tax Numeric 242 242 222 222 311 311 311 311 311
11 ptratio Numeric 17.8 17.8 18.7 18.7 15.2 15.2 15.2 15.2 15.2
12 b Numeric 396.9 392.83 394.63 396.9 395.6 396.9 386.63 386.71 392.52
13 lstat Numeric 9.14 4.03 2.94 5.33 12.43 19.15 29.93 17.1 20.45
14 medv Numeric 21.6 34.7 33.4 36.2 22.9 27.1 16.5 18.9 15
Previous page
Next page
Parse
Click ”Parse”
Ready
Connections: 0
H2O

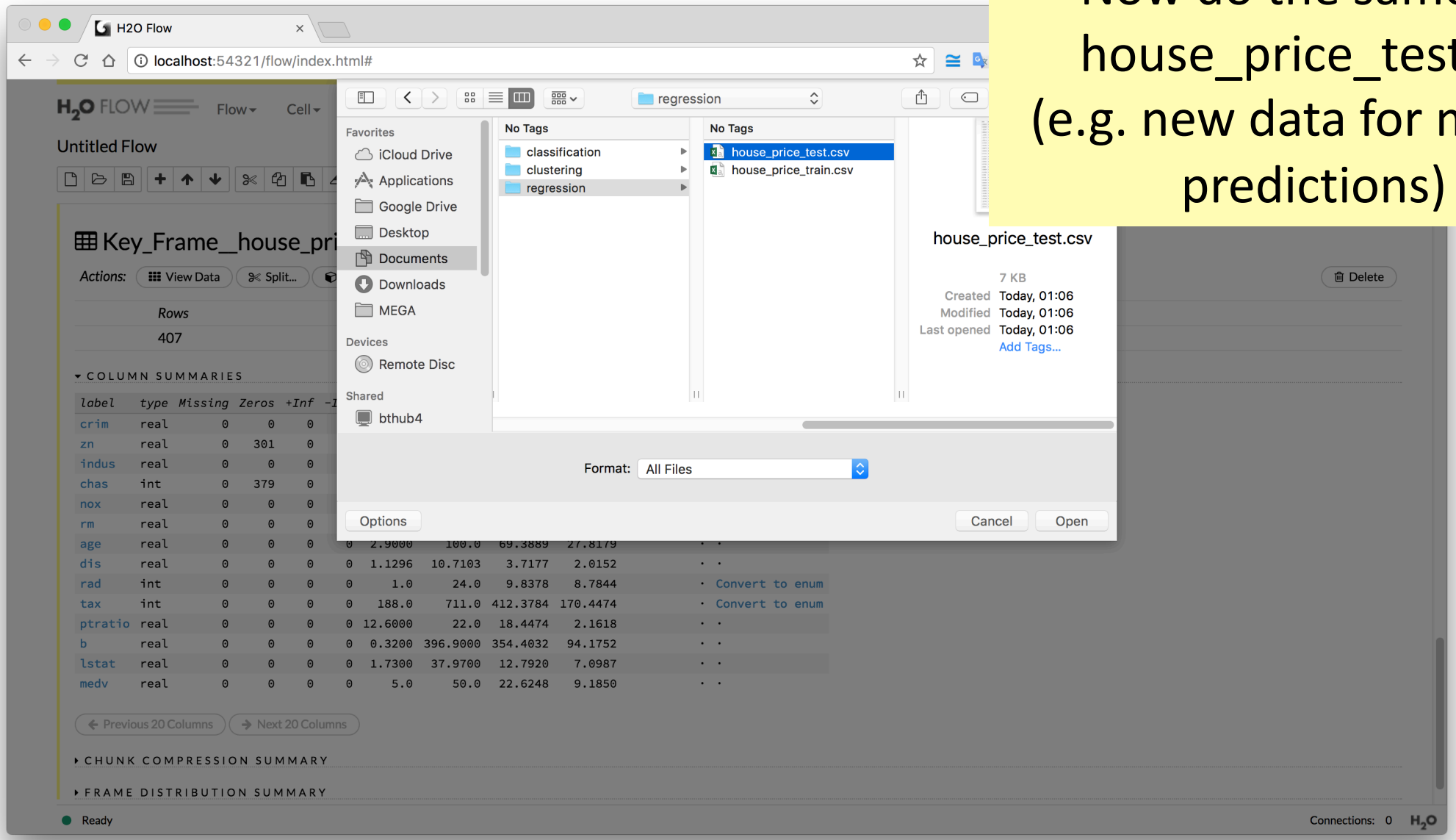

H2O Flow
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
CS
parseFiles
source_frames: ["house_price_train.csv"]
destination_frame: "Key_Frame__house_price_train.hex"
parse_type: "CSV"
separator: 44
number_columns: 14
single_quotes: false
column_names: ["crim","zn","indus","chas","nox","rm","age","dis","rad","tax","ptratio","b","lstat","medv"]
column_types:
["Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric","Numeric"]
delete_on_done: true
check_header: 1
chunk_size: 4194304
1.1s
Job
Run Time 00:00:00.107
Remaining Time 00:00:00.0
Type Frame
Key Key_Frame__house_price_train.hex
Description Parse
Status DONE
Progress 100%
Done.
Actions View
Click “View”
Ready
Connections: 0
H2O

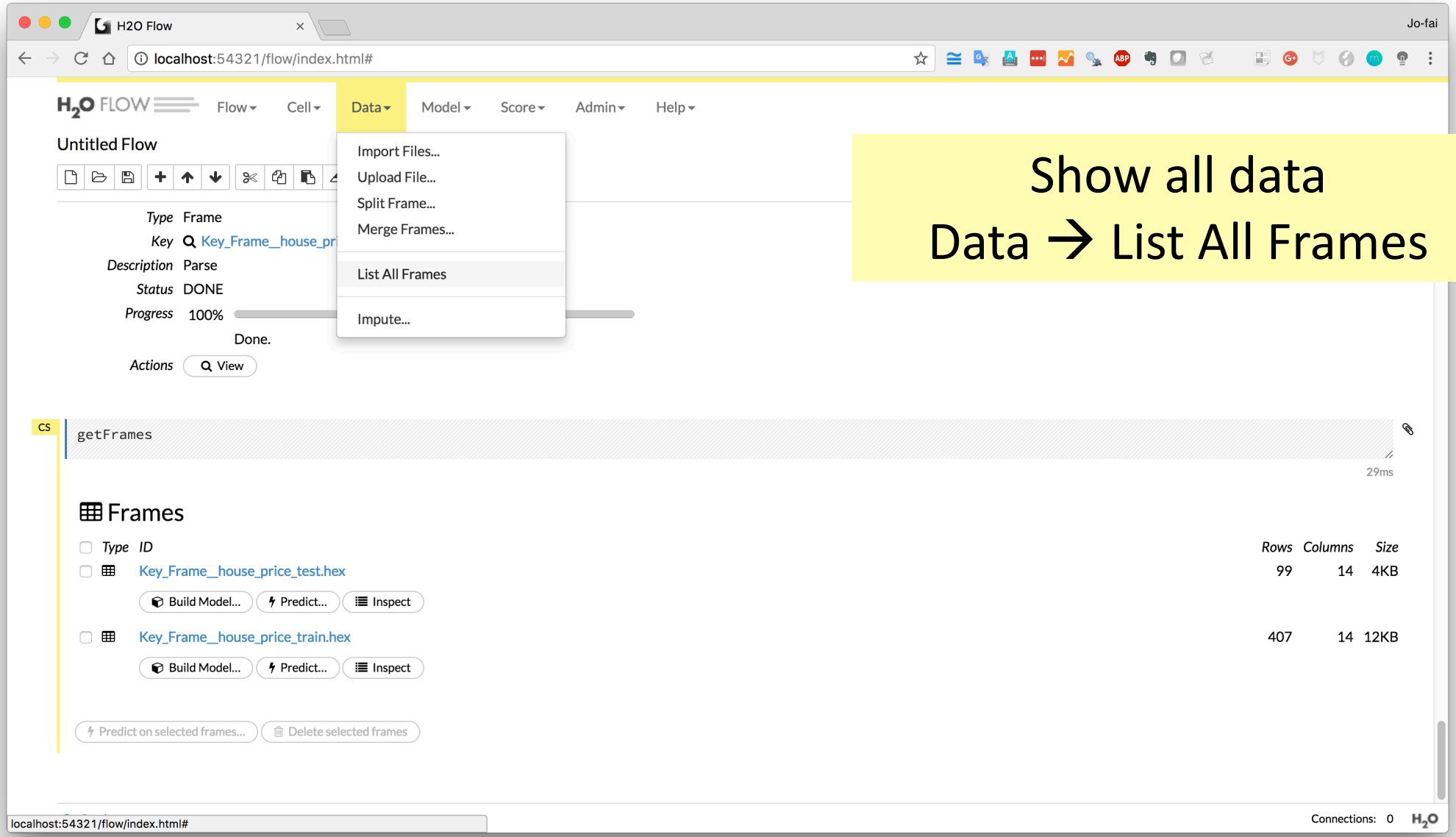


Click on any variable
e.g. crim, medv


H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Summary: medv
Actions
Impute
Inspect
CHARACTERISTICS
All
0 10 20 30 40 50 60 70 80 90 100
avg(percent)
SUMMARY
min
0 5 10 15 20 25 30 35 40 45 50
min, q1, q2, q3, max
DISTRIBUTION
count
0 5 10 15 20 25 30 35 40 45
6.4399999999999995 7.88 9.32 10.76 12.2 13.64 15.08 16.52 17.96 19.4 20.84 22.28 23.72 25.16 26.599999999999998 28.04 29.48 30.919999999999998 32.36 33.8 35.239999999999995 36.68 38.12 39.56 41 42.44 43.879999999999995 45.32 46.76 48.199999999999996 49.64
interval
Some basic visualisation for quick exploratory analysis
Ready
Connections: 0
H2O

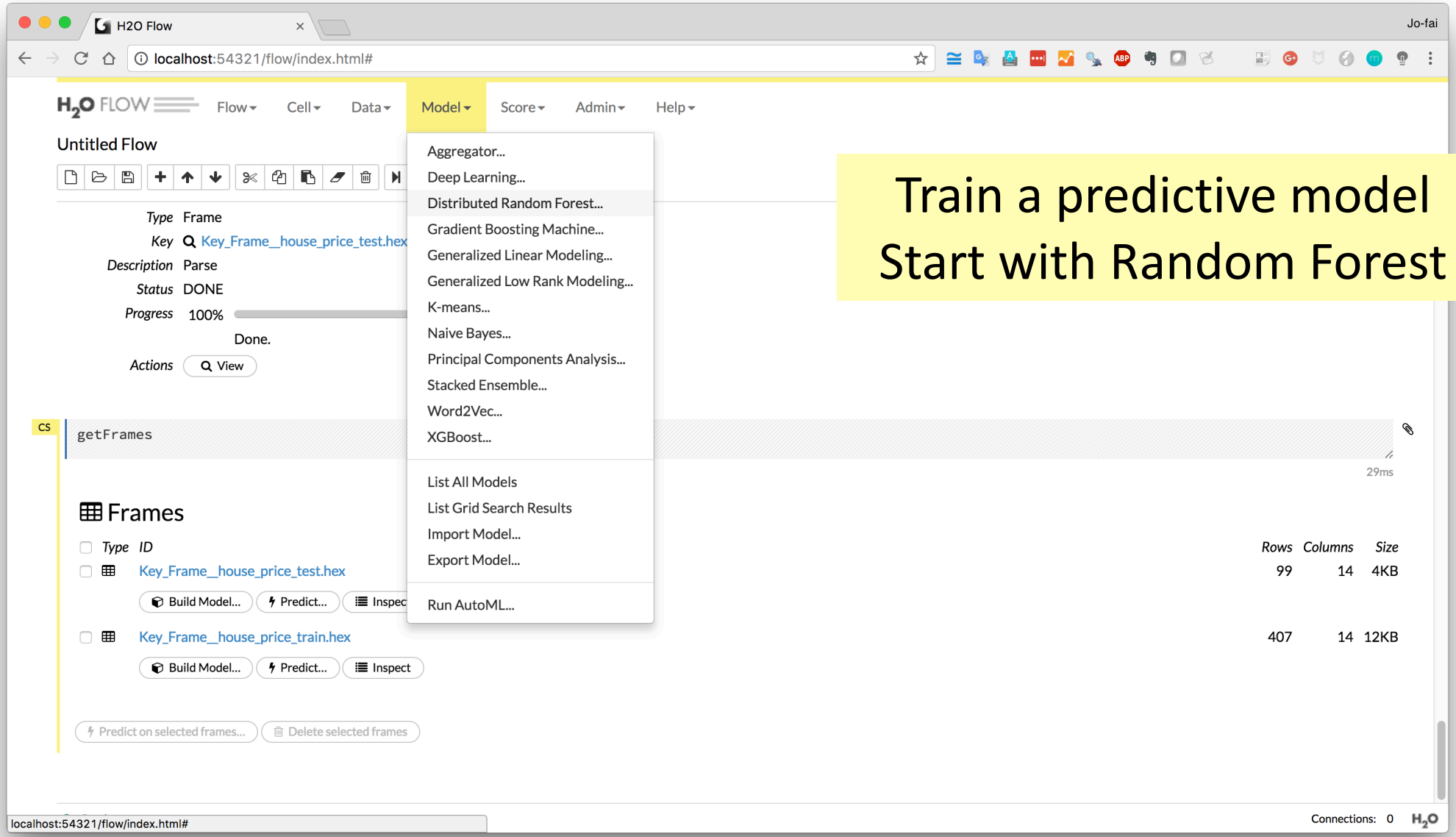
Now do the same for house_price_test.csv (e.g. new data for making predictions)



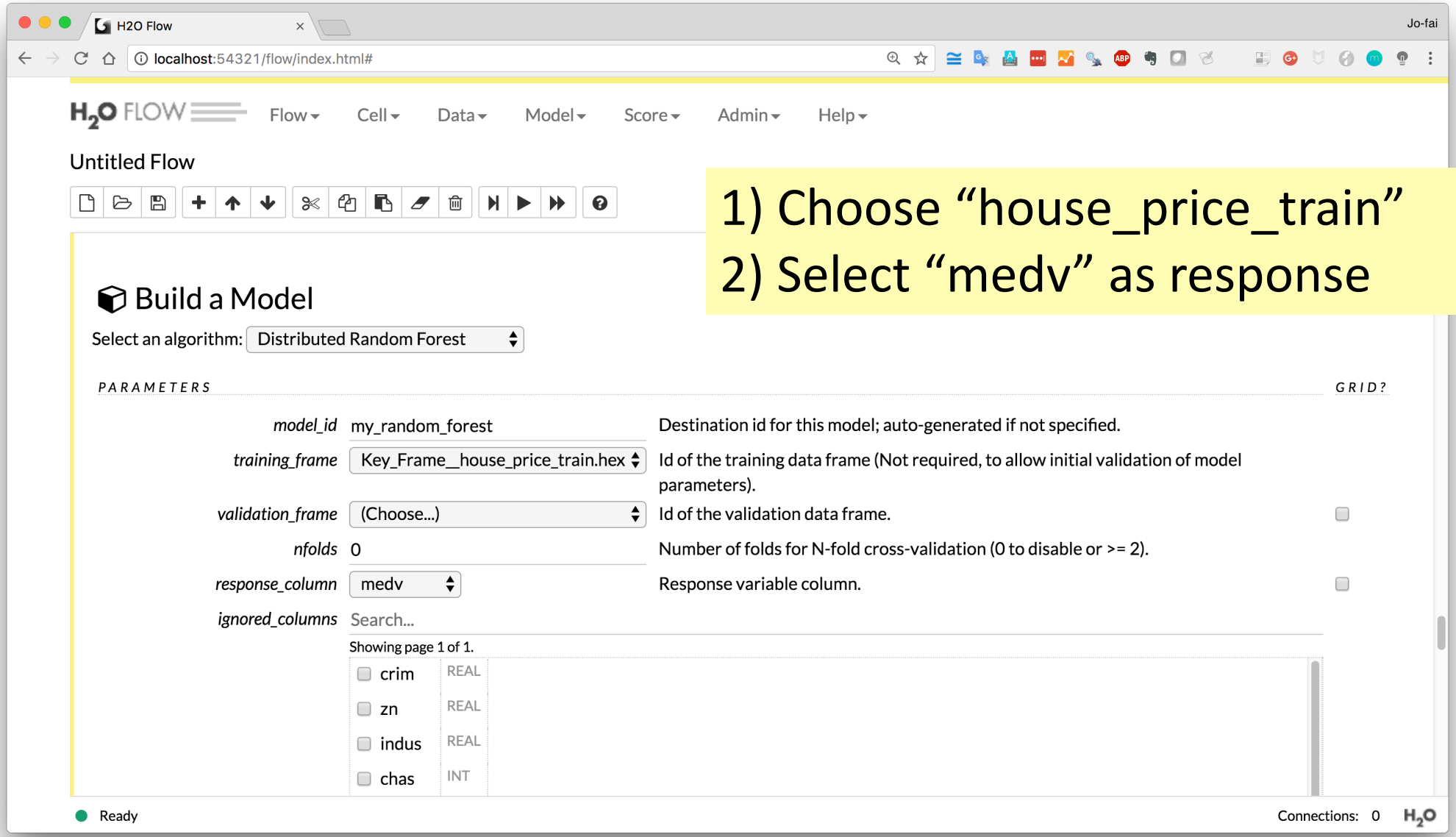


Show all data

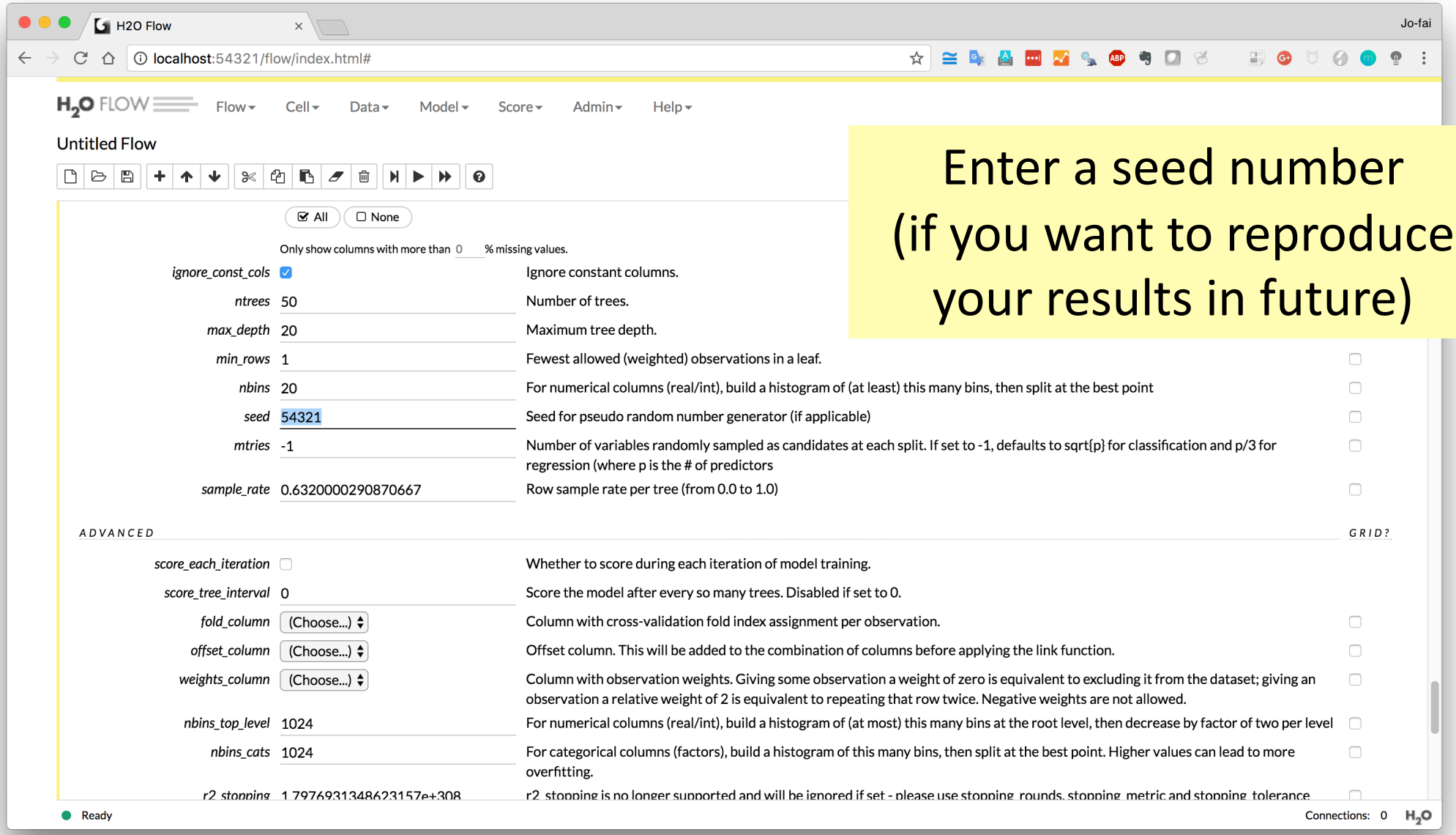
Data → List All Frames



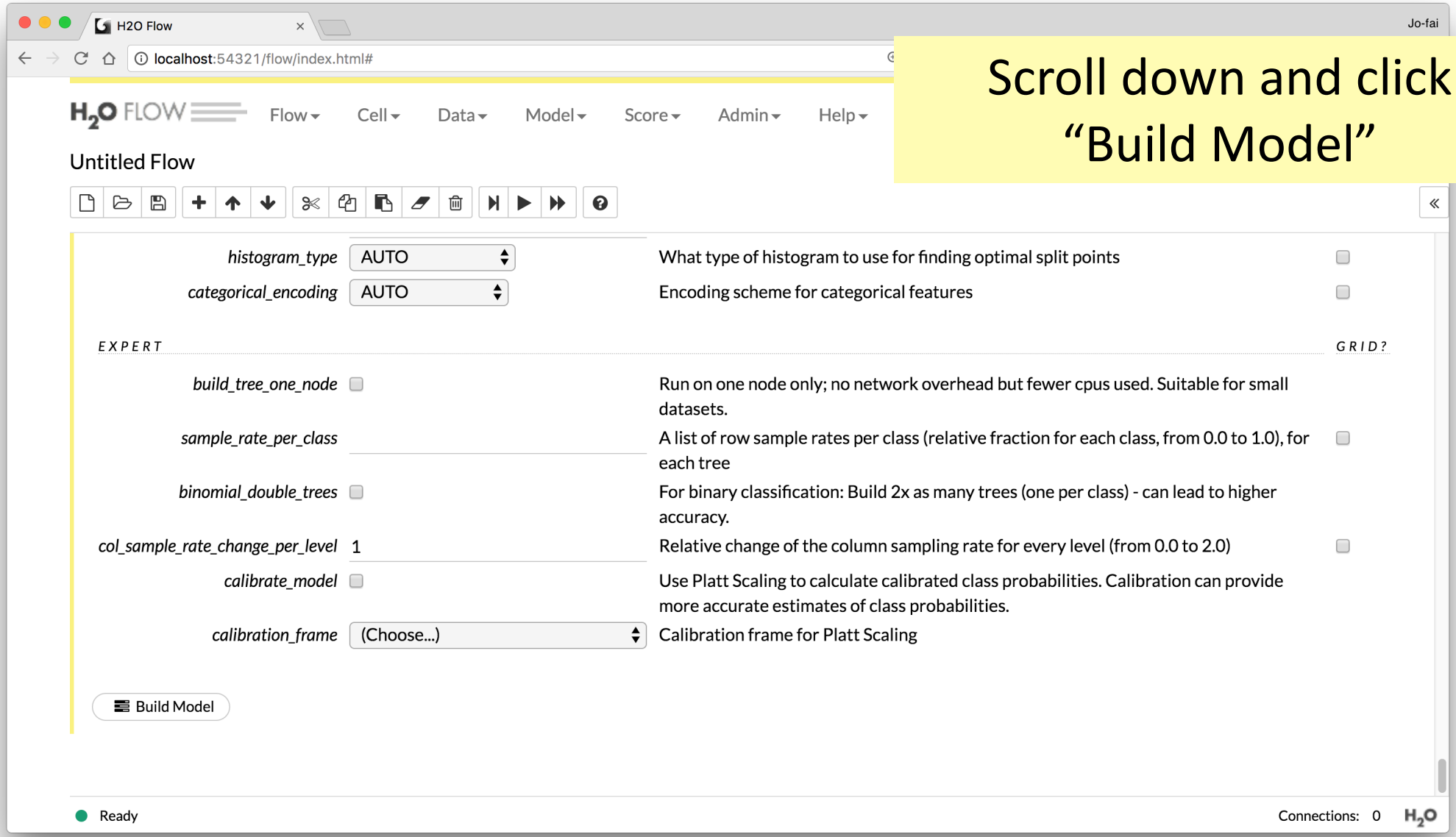
Train a predictive model
Start with Random Forest

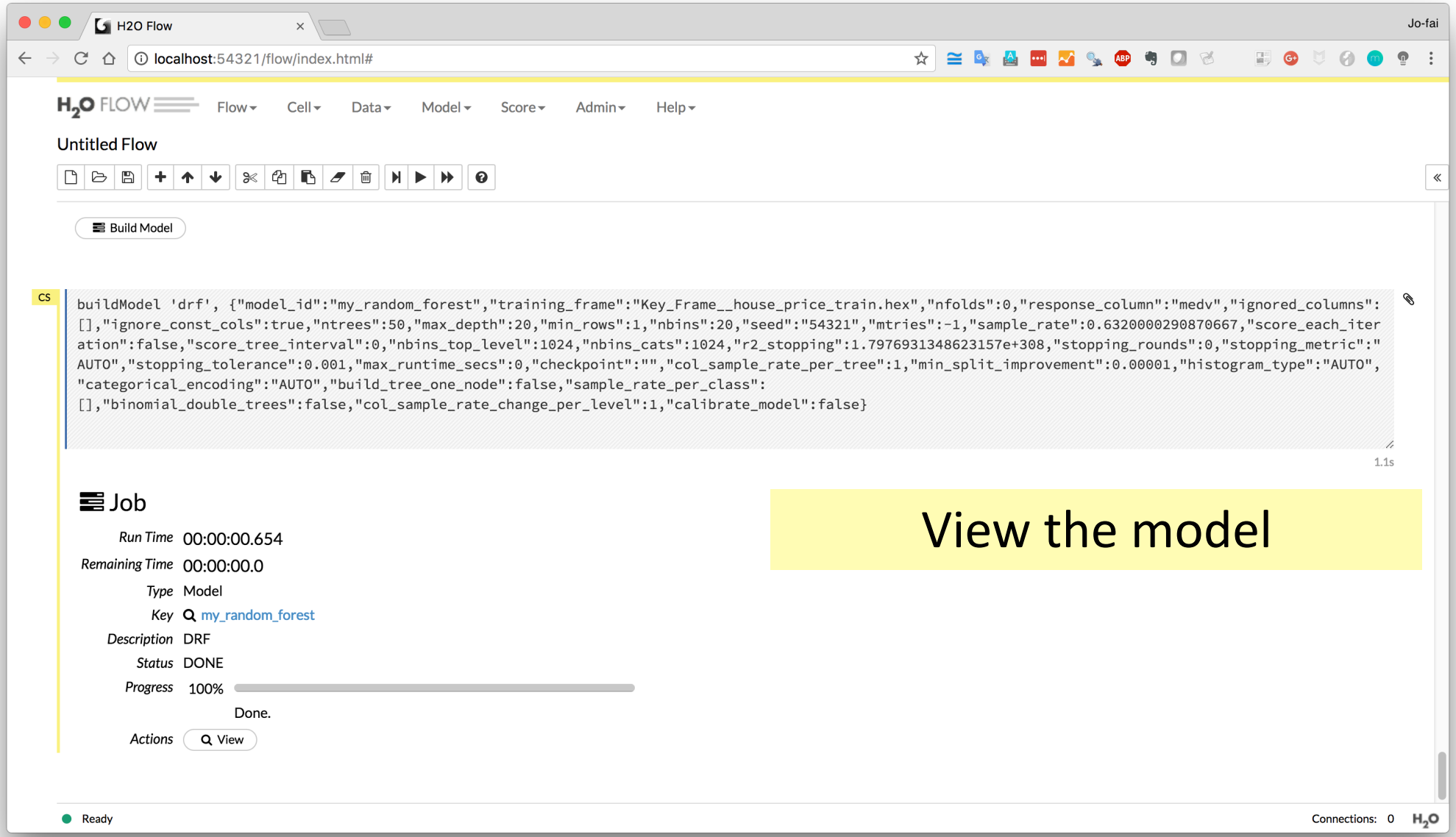


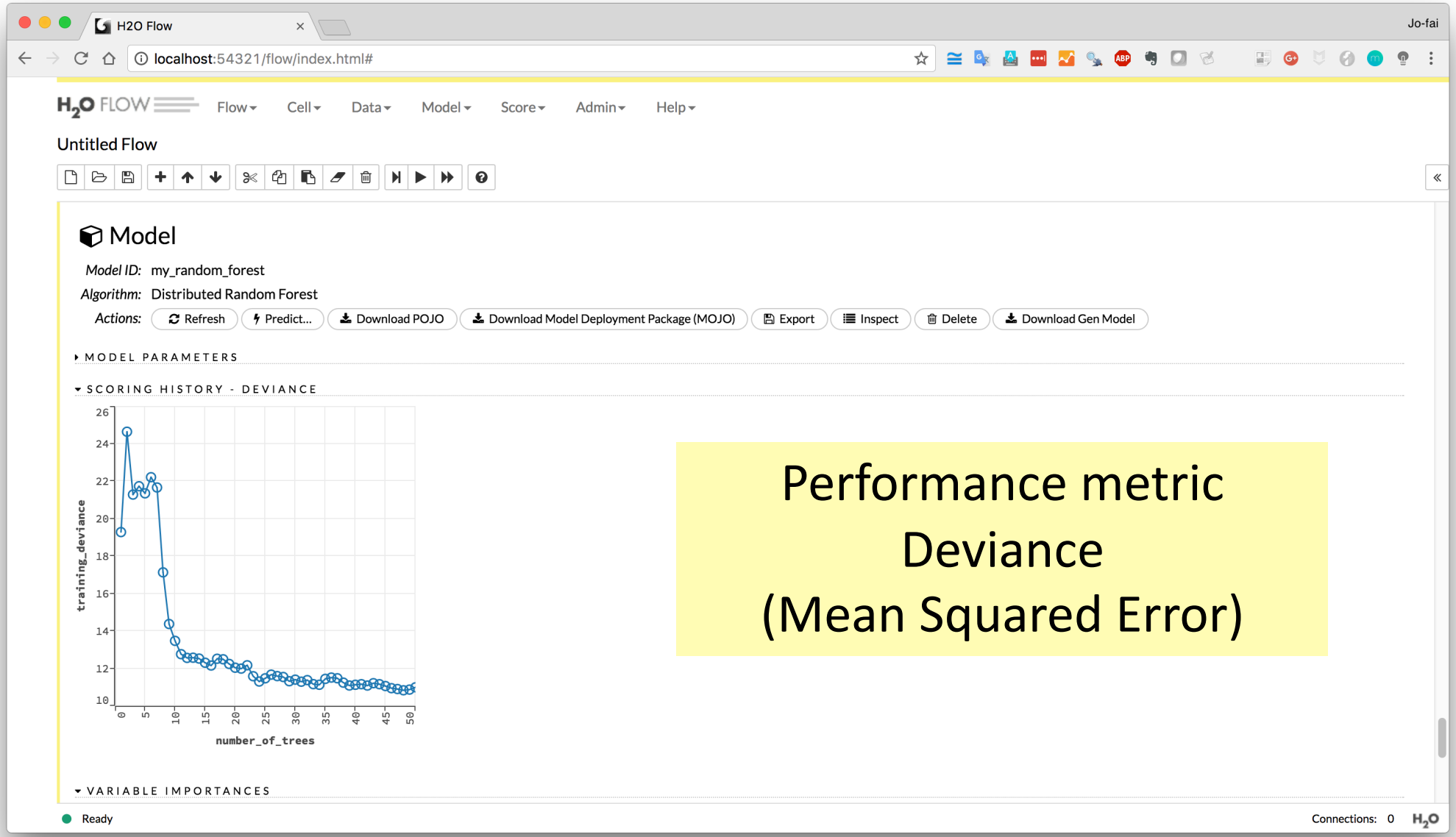
1) Choose “house_price_train”
2) Select “medv” as response



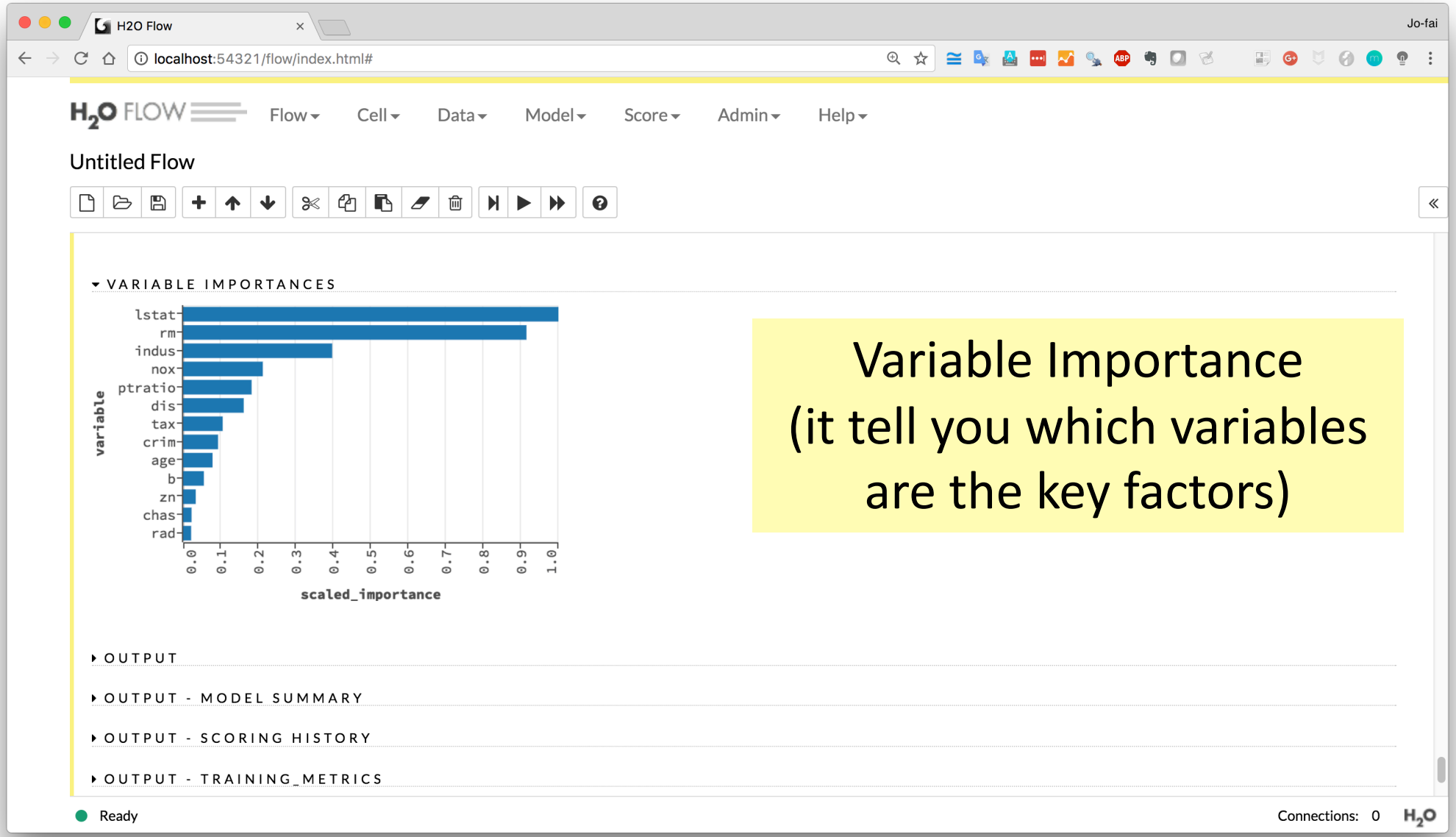
Enter a seed number
(if you want to reproduce your results in future)


H2O Flow
Jo-fai
localhost:54321/flow/index.html#
Scroll down and click "Build Model"
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
histogram_type
AUTO
What type of histogram to use for finding optimal split points
categorical_encoding
AUTO
Encoding scheme for categorical features
EXPERT
GRID?
build_tree_one_node
Run on one node only; no network overhead but fewer cpus used. Suitable for small datasets.
sample_rate_per_class
A list of row sample rates per class (relative fraction for each class, from 0.0 to 1.0), for each tree
binomial_double_trees
For binary classification: Build 2x as many trees (one per class) - can lead to higher accuracy.
col_sample_rate_change_per_level
1
Relative change of the column sampling rate for every level (from 0.0 to 2.0)
calibrate_model
Use Platt Scaling to calculate calibrated class probabilities. Calibration can provide more accurate estimates of class probabilities.
calibration_frame
(Choose...)
Calibration frame for Platt Scaling
Build Model
Ready
Connections: 0

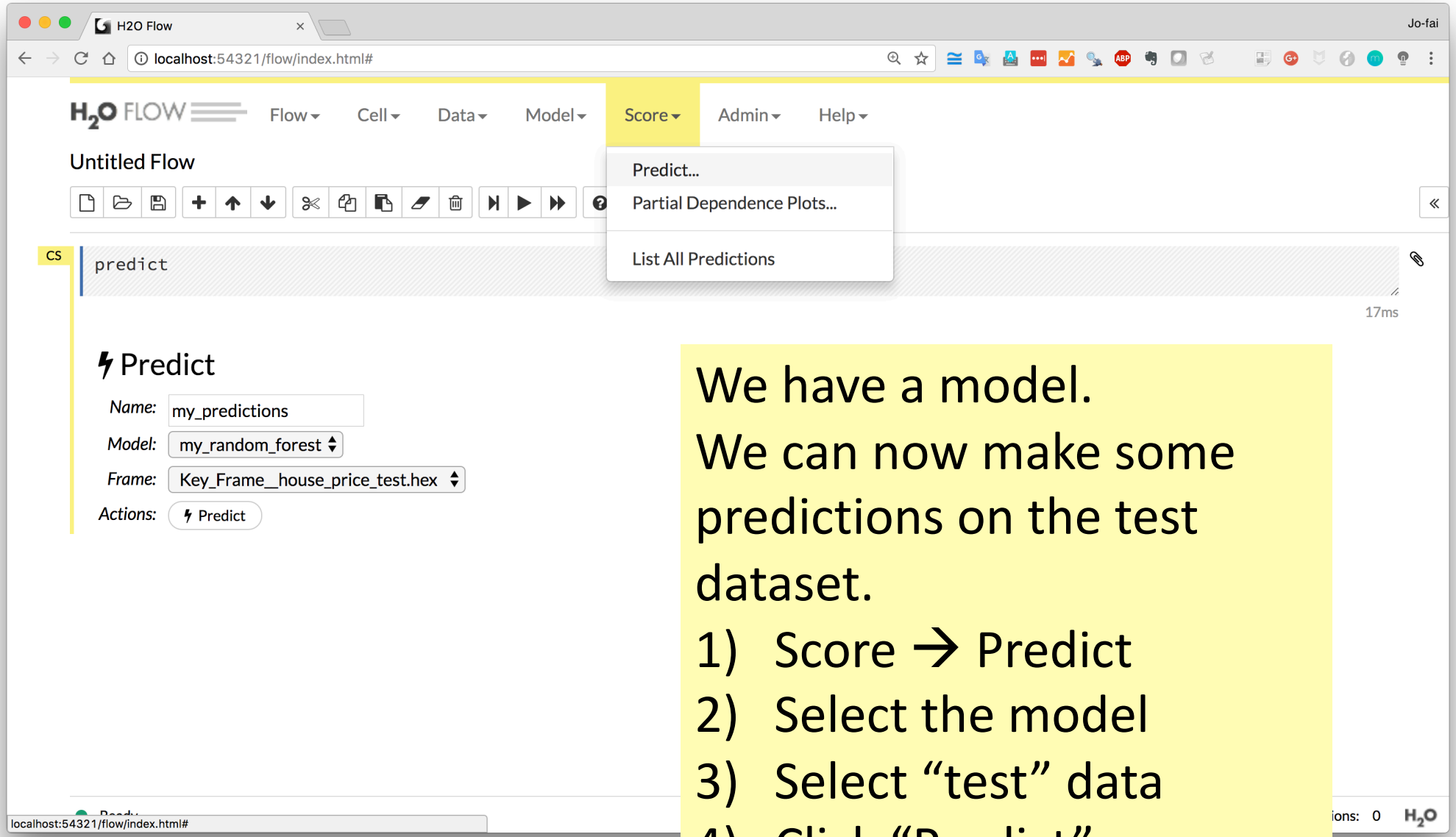

H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Build Model
CS
buildModel 'drf', {"model_id":"my_random_forest","training_frame":"Key_Frame__house_price_train.hex","nfolds":0,"response_column":"medv","ignored_columns":[],"ignore_const_cols":true,"ntrees":50,"max_depth":20,"min_rows":1,"nbins":20,"seed":"54321","mtries":-1,"sample_rate":0.6320000290870667,"score_each_iteration":false,"score_tree_interval":0,"nbins_top_level":1024,"nbins_cats":1024,"r2_stopping":1.7976931348623157e+308,"stopping_rounds":0,"stopping_metric":"AUTO","stopping_tolerance":0.001,"max_runtime_secs":0,"checkpoint":"","col_sample_rate_per_tree":1,"min_split_improvement":0.00001,"histogram_type":"AUTO","categorical_encoding":"AUTO","build_tree_one_node":false,"sample_rate_per_class":[],"binomial_double_trees":false,"col_sample_rate_change_per_level":1,"calibrate_model":false}
1.1s
Job
Run Time 00:00:00.654
Remaining Time 00:00:00.0
Type Model
Key my_random_forest
Description DRF
Status DONE
Progress 100%
Done.
Actions View
View the model
Ready
Connections: 0
H2O



Performance metric
Deviance
(Mean Squared Error)

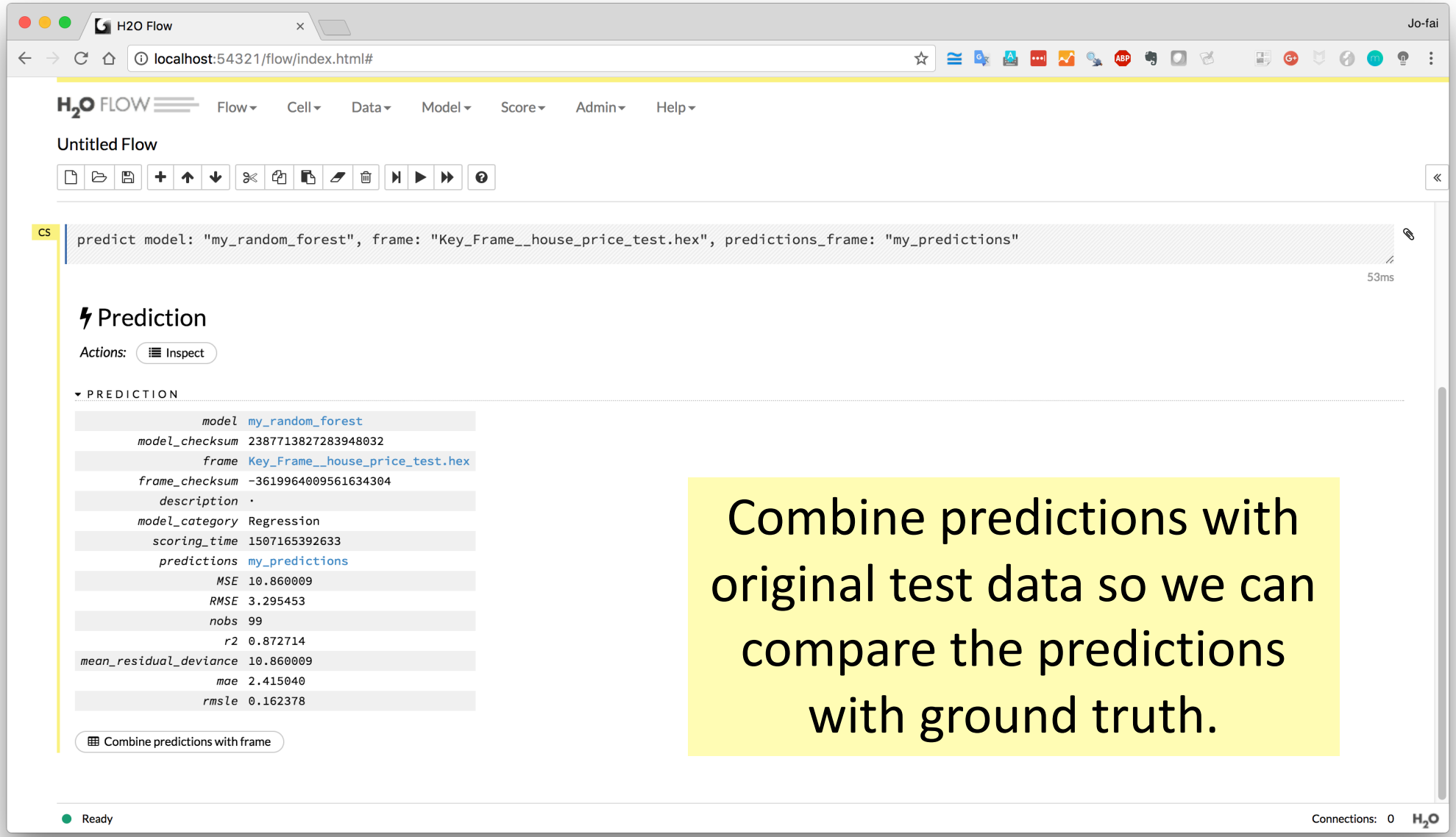


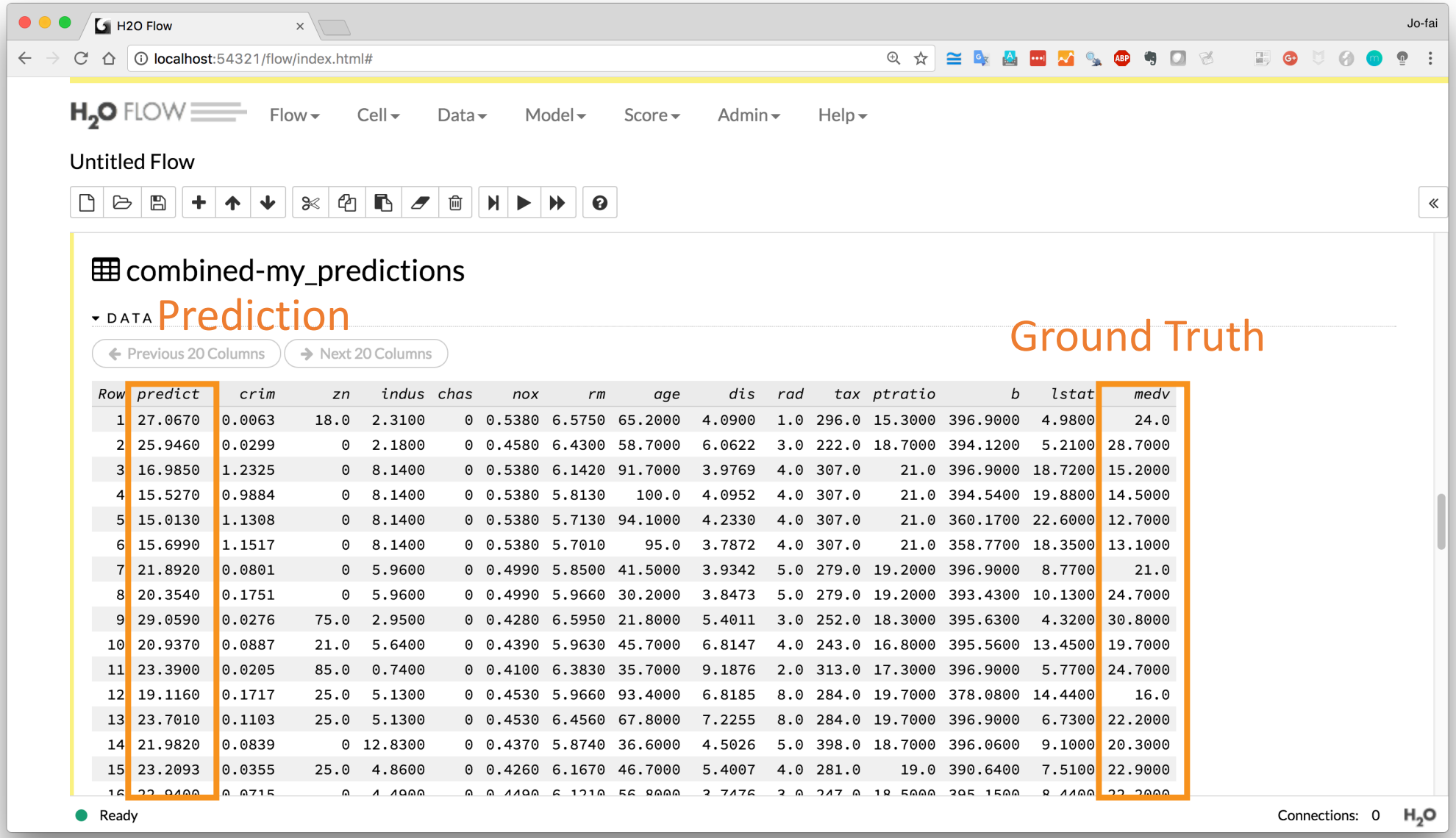
Variable Importance
(it tell you which variables are the key factors)



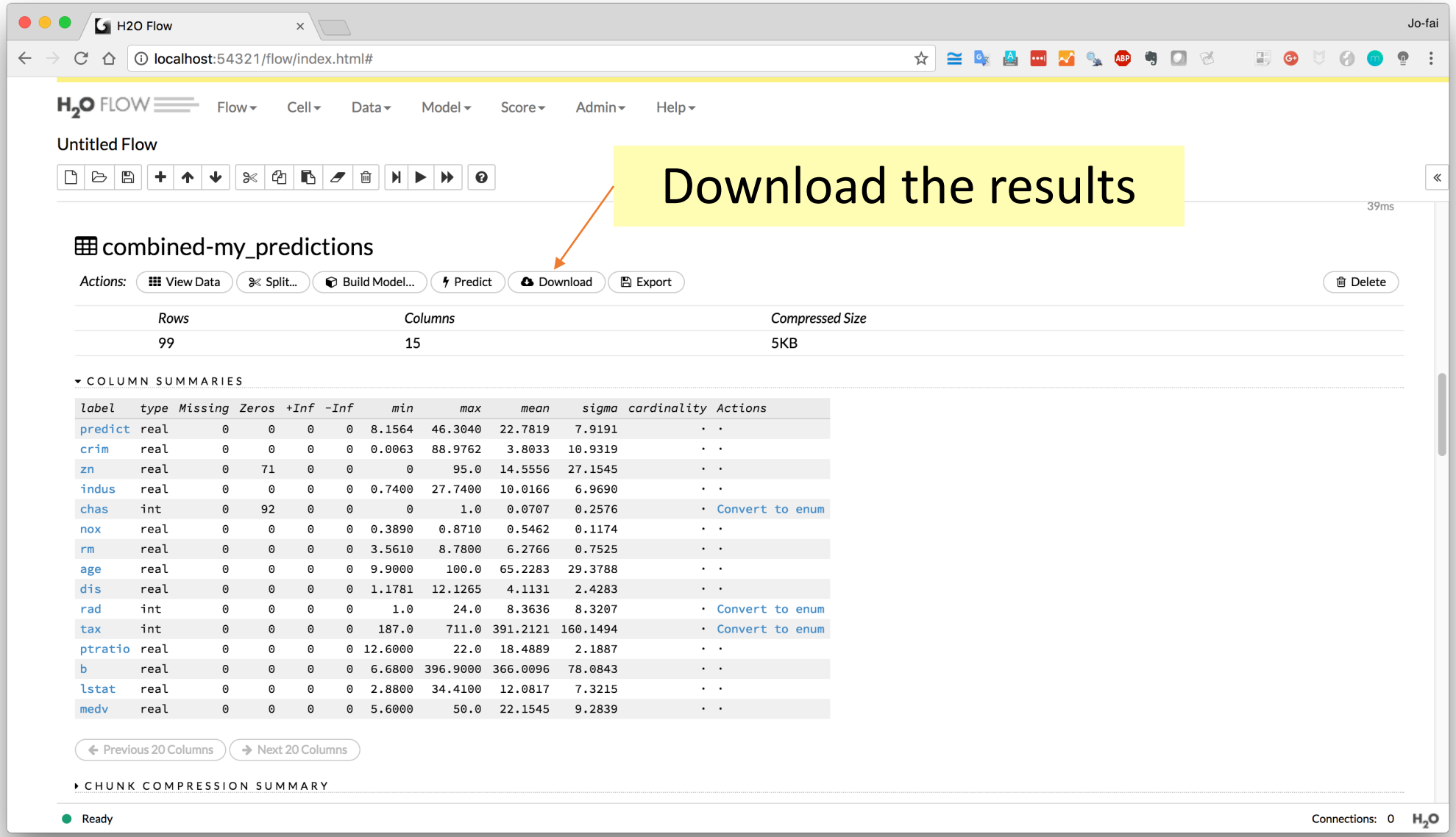
We have a model.
We can now make some predictions on the test dataset.

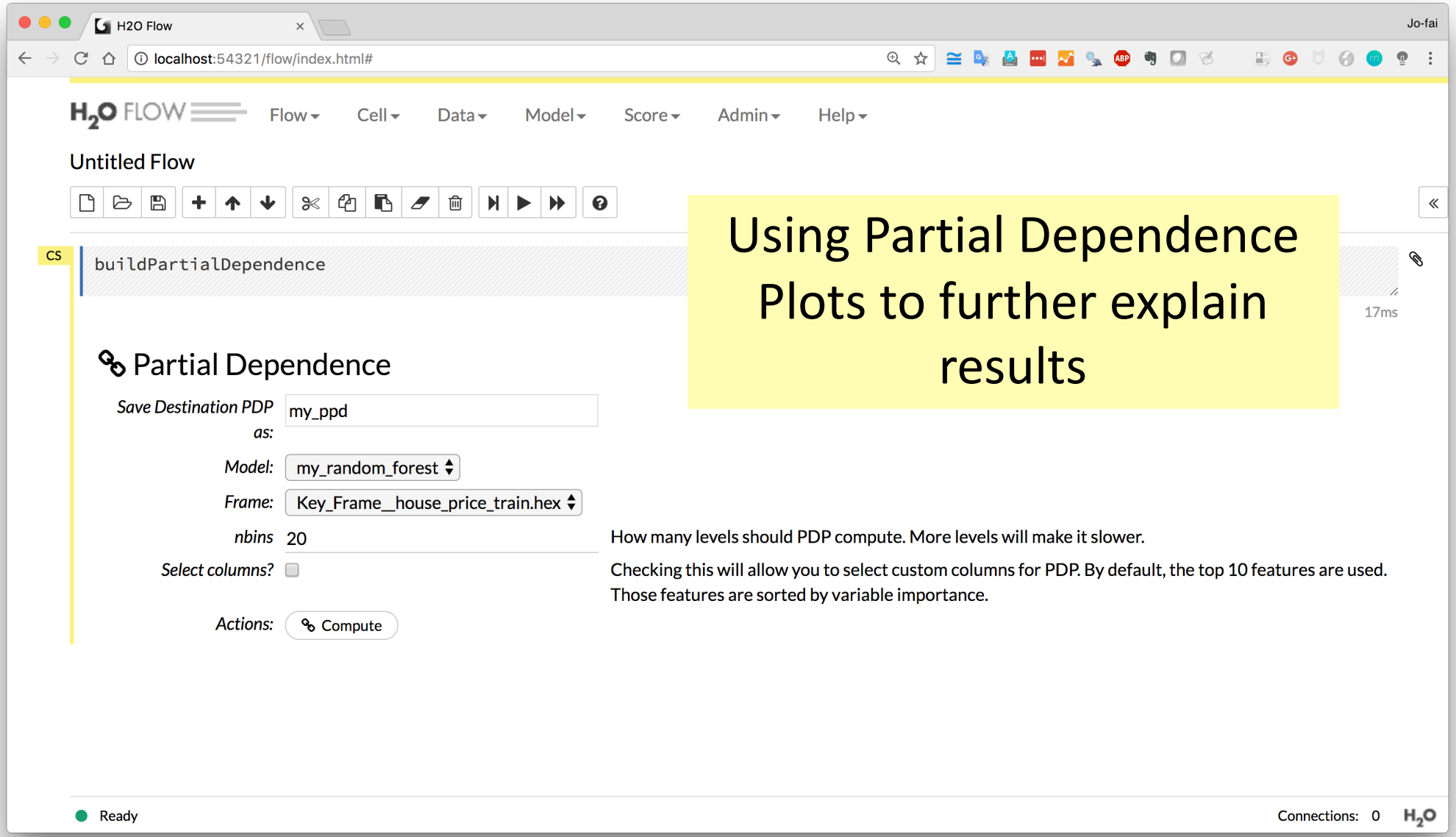
1) Score → Predict
2) Select the model
3) Select “test” data
4) Click “Predict”


H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
CS
predict model: "my_random_forest", frame: "Key_Frame__house_price_test.hex", predictions_frame: "my_predictions"
53ms
Prediction
Actions:
Inspect
PREDICTION
model my_random_forest
model_checksum 2387713827283948032
frame Key_Frame__house_price_test.hex
frame_checksum -3619964009561634304
description ·
model_category Regression
scoring_time 1507165392633
predictions my_predictions
MSE 10.860009
RMSE 3.295453
nobs 99
r2 0.872714
mean_residual_deviance 10.860009
mae 2.415040
rmsle 0.162378
Combine predictions with frame
Combine predictions with original test data so we can compare the predictions with ground truth.
Ready
Connections: 0
H2O

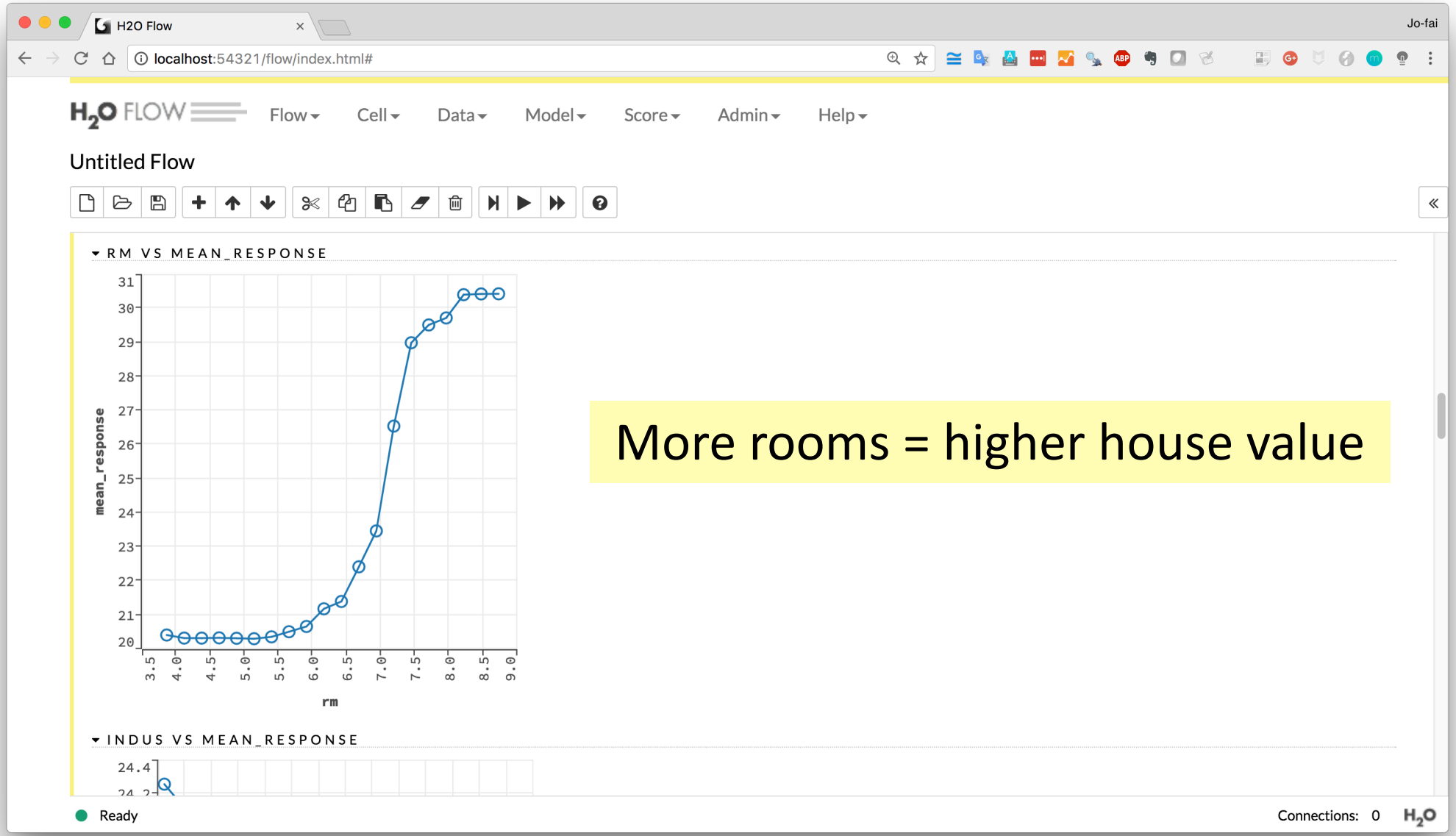


Row	predict	crim	zn	indus	chas	nox	rm	age	dis	rad	tax	ptratio	b	lstat	medv
1	27.0670	0.0063	18.0	2.3100	0	0.5380	6.5750	65.2000	4.0900	1.0	296.0	15.3000	396.9000	4.9800	24.0
2	25.9460	0.0299	0	2.1800	0	0.4580	6.4300	58.7000	6.0622	3.0	222.0	18.7000	394.1200	5.2100	28.7000
3	16.9850	1.2325	0	8.1400	0	0.5380	6.1420	91.7000	3.9769	4.0	307.0	21.0	396.9000	18.7200	15.2000
4	15.5270	0.9884	0	8.1400	0	0.5380	5.8130	100.0	4.0952	4.0	307.0	21.0	394.5400	19.8800	14.5000
5	15.0130	1.1308	0	8.1400	0	0.5380	5.7130	94.1000	4.2330	4.0	307.0	21.0	360.1700	22.6000	12.7000
6	15.6990	1.1517	0	8.1400	0	0.5380	5.7010	95.0	3.7872	4.0	307.0	21.0	358.7700	18.3500	13.1000
7	21.8920	0.0801	0	5.9600	0	0.4990	5.8500	41.5000	3.9342	5.0	279.0	19.2000	396.9000	8.7700	21.0
8	20.3540	0.1751	0	5.9600	0	0.4990	5.9660	30.2000	3.8473	5.0	279.0	19.2000	393.4300	10.1300	24.7000
9	29.0590	0.0276	75.0	2.9500	0	0.4280	6.5950	21.8000	5.4011	3.0	252.0	18.3000	395.6300	4.3200	30.8000
10	20.9370	0.0887	21.0	5.6400	0	0.4390	5.9630	45.7000	6.8147	4.0	243.0	16.8000	395.5600	13.4500	19.7000
11	23.3900	0.0205	85.0	0.7400	0	0.4100	6.3830	35.7000	9.1876	2.0	313.0	17.3000	396.9000	5.7700	24.7000
12	19.1160	0.1717	25.0	5.1300	0	0.4530	5.9660	93.4000	6.8185	8.0	284.0	19.7000	378.0800	14.4400	16.0
13	23.7010	0.1103	25.0	5.1300	0	0.4530	6.4560	67.8000	7.2255	8.0	284.0	19.7000	396.9000	6.7300	22.2000
14	21.9820	0.0839	0	12.8300	0	0.4370	5.8740	36.6000	4.5026	5.0	398.0	18.7000	396.0600	9.1000	20.3000
15	23.2093	0.0355	25.0	4.8600	0	0.4260	6.1670	46.7000	5.4007	4.0	281.0	19.0	390.6400	7.5100	22.9000
16	22.9400	0.0715	0	4.4900	0	0.4490	6.1210	56.8000	3.7476	3.0	247.0	18.5000	395.1500	8.4400	22.2000

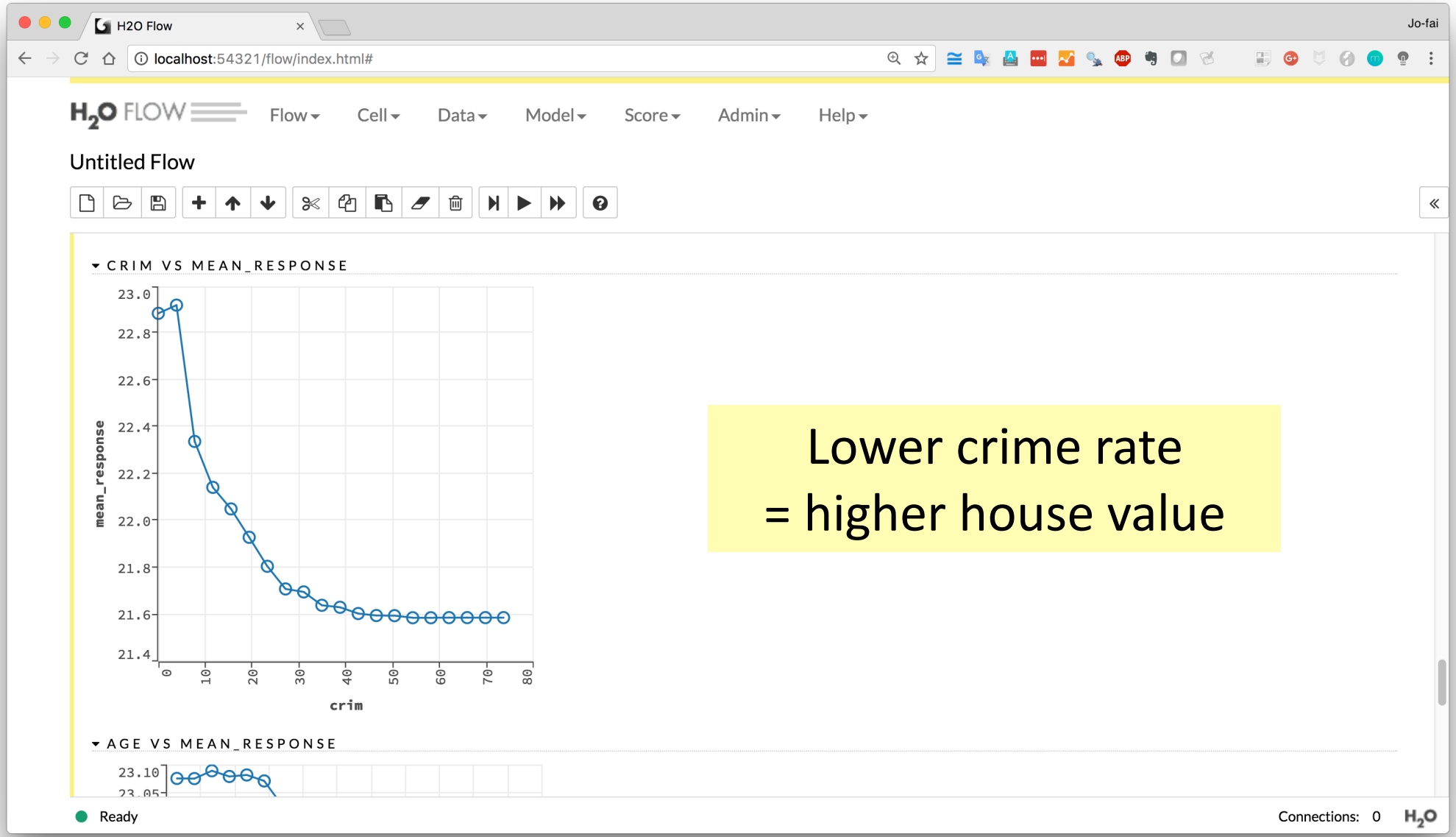

H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Download the results
39ms
combined-my_predictions
Actions:
View Data
Split...
Build Model...
Predict
Download
Export
Delete
Rows
Columns
Compressed Size
99
15
5KB
COLUMN SUMMARIES
label type Missing Zeros +Inf -Inf min max mean sigma cardinality Actions
predict real 0 0 0 0 8.1564 46.3040 22.7819 7.9191 · ·
crim real 0 0 0 0 0.0063 88.9762 3.8033 10.9319 · ·
zn real 0 71 0 0 0 95.0 14.5556 27.1545 · ·
indus real 0 0 0 0 0.7400 27.7400 10.0166 6.9690 · ·
chas int 0 92 0 0 0 1.0 0.0707 0.2576 · Convert to enum
nox real 0 0 0 0 0.3890 0.8710 0.5462 0.1174 · ·
rm real 0 0 0 0 3.5610 8.7800 6.2766 0.7525 · ·
age real 0 0 0 0 9.9000 100.0 65.2283 29.3788 · ·
dis real 0 0 0 0 1.1781 12.1265 4.1131 2.4283 · ·
rad int 0 0 0 0 1.0 24.0 8.3636 8.3207 · Convert to enum
tax int 0 0 0 0 187.0 711.0 391.2121 160.1494 · Convert to enum
ptratio real 0 0 0 0 12.6000 22.0 18.4889 2.1887 · ·
b real 0 0 0 0 6.6800 396.9000 366.0096 78.0843 · ·
lstat real 0 0 0 0 2.8800 34.4100 12.0817 7.3215 · ·
medv real 0 0 0 0 5.6000 50.0 22.1545 9.2839 · ·
Previous 20 Columns
Next 20 Columns
CHUNK COMPRESSION SUMMARY
Ready
Connections: 0
H2O



Using Partial Dependence Plots to further explain results



More rooms = higher house value



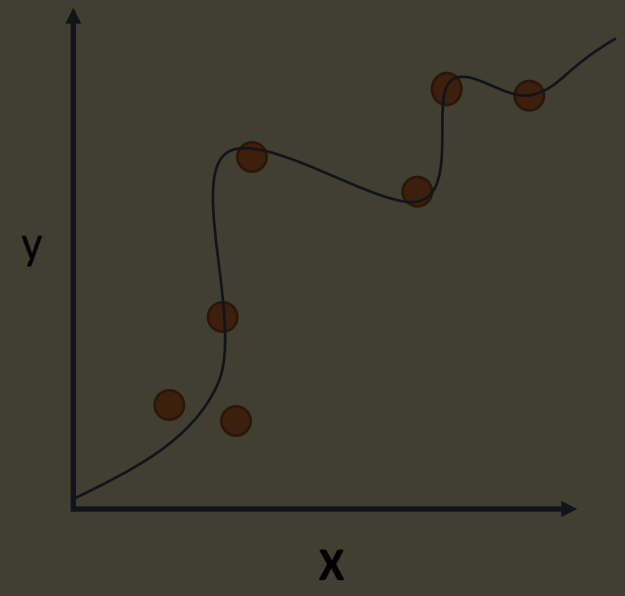
Lower crime rate
= higher house value

Tutorial 2 - Classification

- **Data**: Human Activity Recognition Using Smartphone Sensors (2012)
- **Source**: https://archive.ics.uci.edu/ml/datasets/human+activity+recognition+using+smartphones

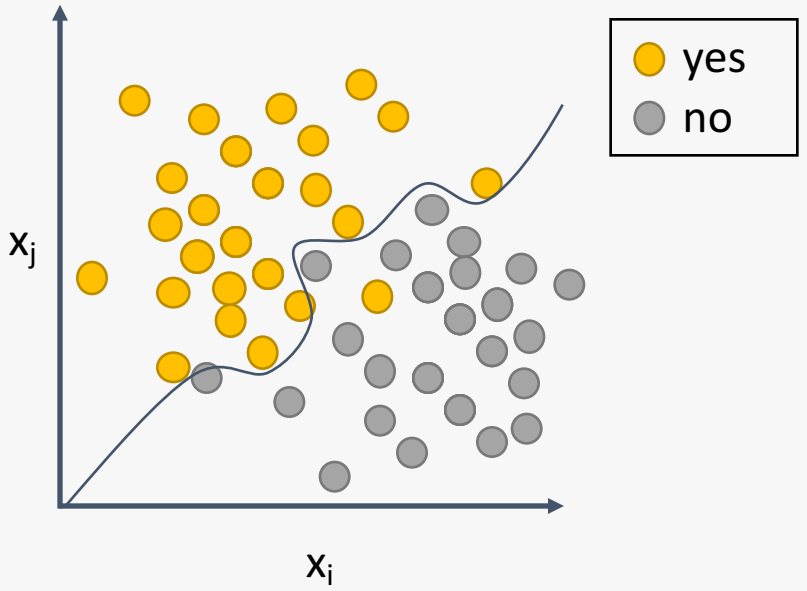
Supervised Learning – You Already Have Target Data

Regression:
How much will a customers spend?



H_2O algos:
Penalized Linear Models
Random Forest
Gradient Boosting
Neural Networks
Stacked Ensembles

Classification:
Will a customer make a purchase? Yes or No



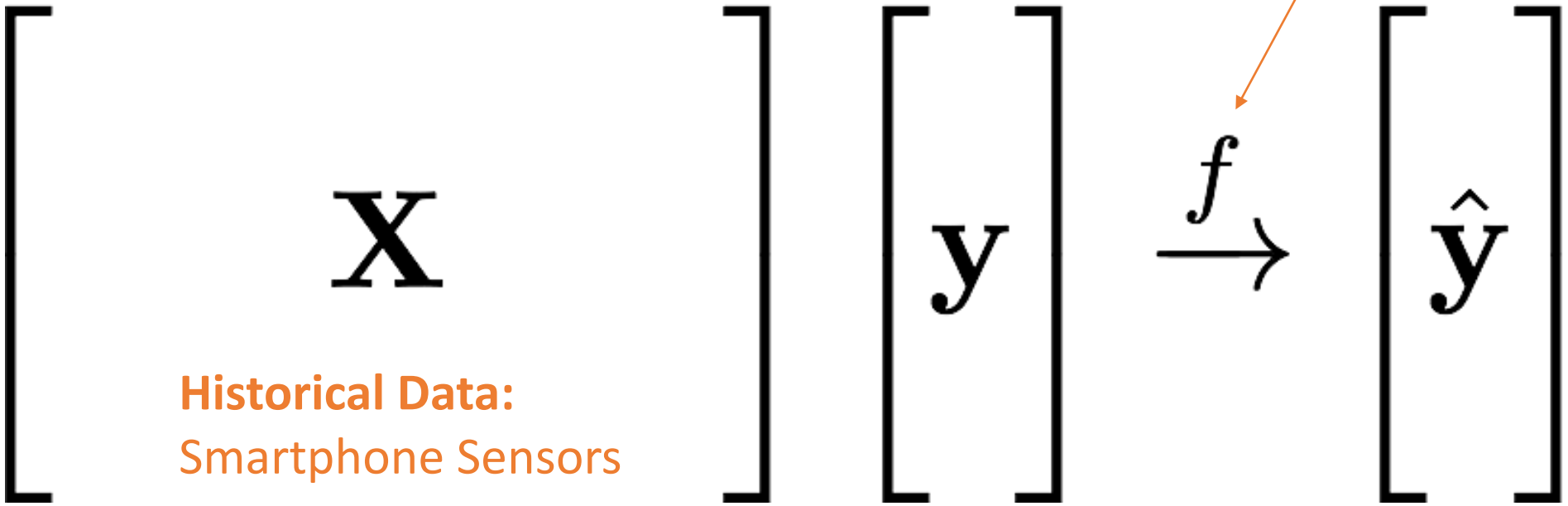
H_2O algos:
Penalized Linear Models
Naïve Bayes
Random Forest
Gradient Boosting
Neural Networks
Stacked Ensembles

H2O.ai

- Smartphone Sensor Data
  - 561 Features
  - 6 Activities
    - Walking
    - Walking Upstairs
    - Walking Downstairs
    - Sitting
    - Standing
    - Laying
  - Train (7k)
  - Test (3k)

Supervised Learning Example

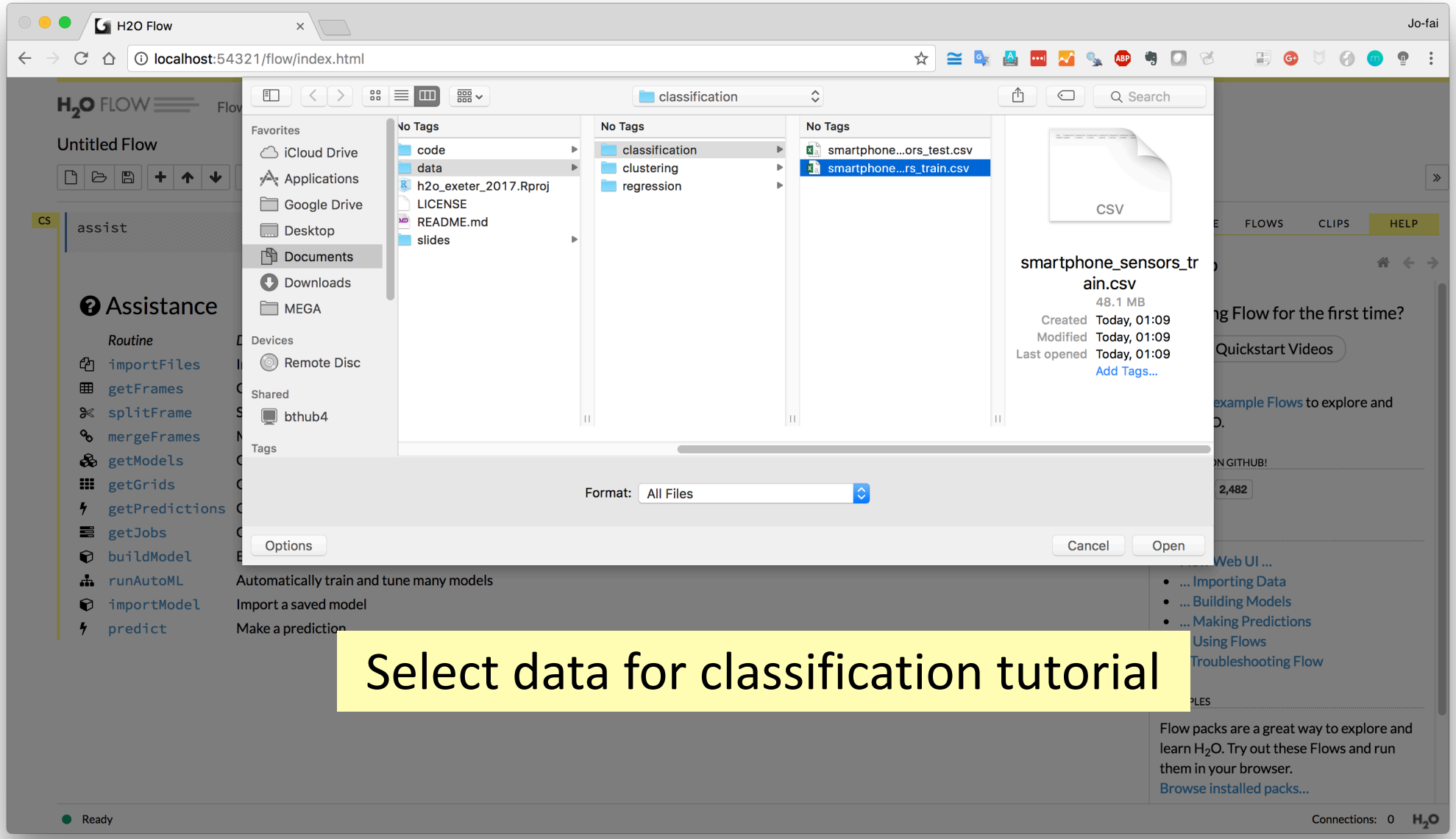
Machine Learning:
Learn Patterns
from Data

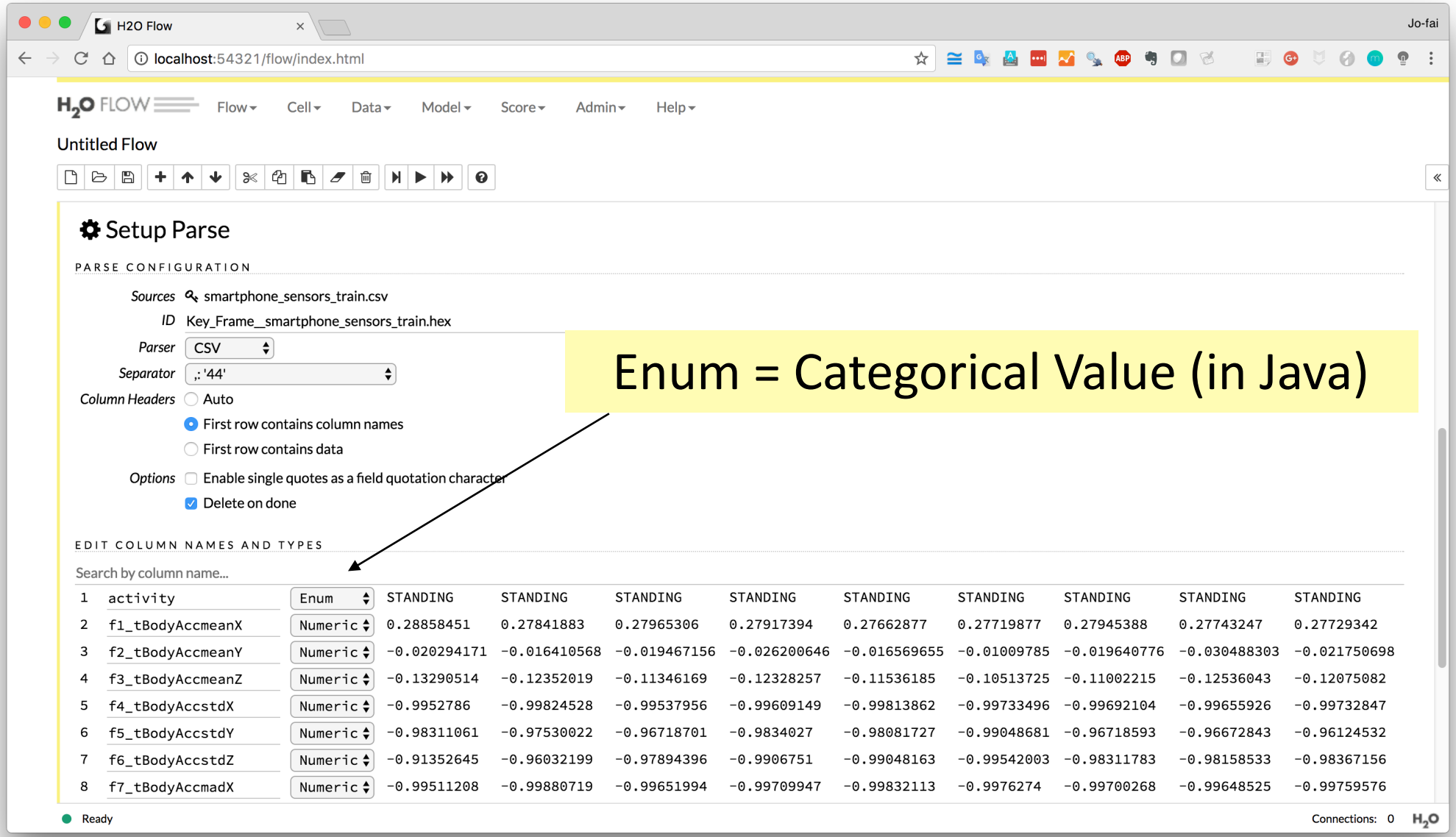


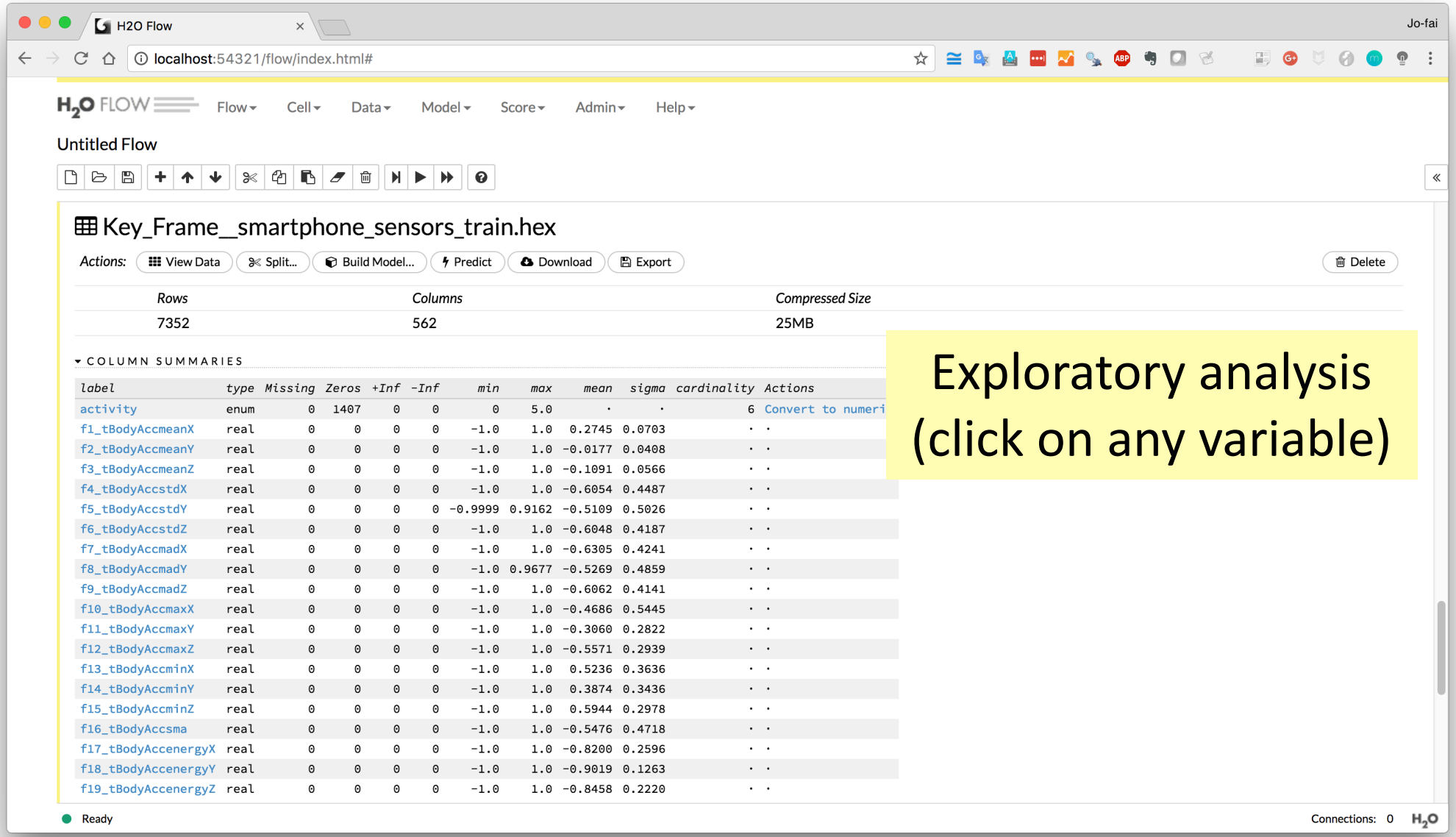
Historical Data:
Smartphone Sensors

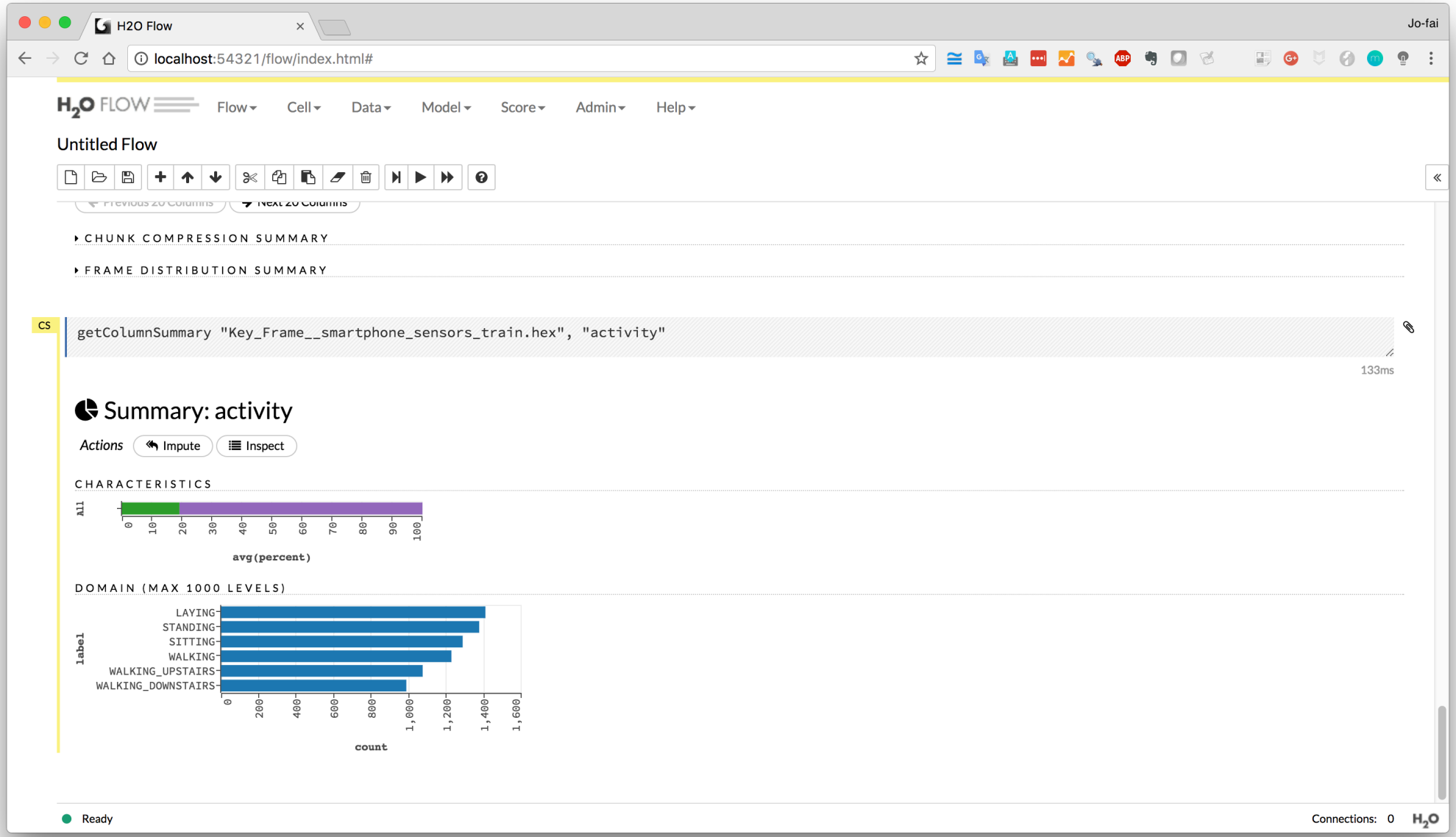
Target:
Six Different
Human Activities

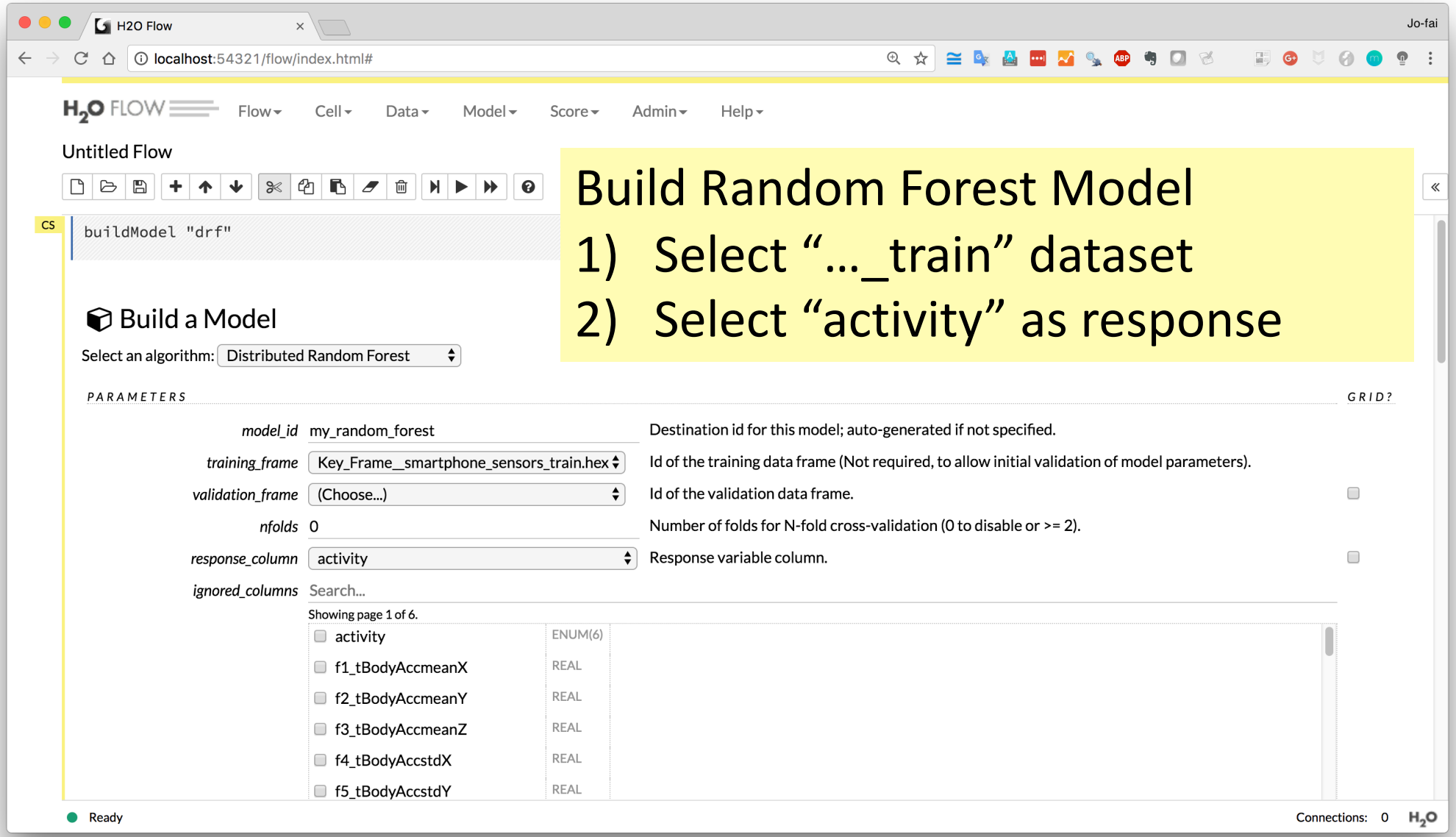
Predicted Activity


H2O Flow
localhost:54321/flow/index.html
Untitled Flow
assist
Assistance
Routine
importFiles
getFrames
splitFrame
mergeFrames
getModels
getGrids
getPredictions
getJobs
buildModel
runAutoML
importModel
predict
Automatically train and tune many models
Import a saved model
Make a prediction
classification
Search
Favorites
iCloud Drive
Applications
Google Drive
Desktop
Documents
Downloads
MEGA
Devices
Remote Disc
Shared
bthub4
Tags
No Tags
code
data
h2o_exeter_2017.Rproj
LICENSE
README.md
slides
classification
clustering
regression
smartphone...ors_test.csv
smartphone...rs_train.csv
CSV
smartphone_sensors_train.csv
48.1 MB
Created Today, 01:09
Modified Today, 01:09
Last opened Today, 01:09
Add Tags...
Format: All Files
Options
Cancel
Open
Select data for classification tutorial
Ready
Connections: 0


H2O Flow
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Setup Parse
PARSE CONFIGURATION
Sources smartphone_sensors_train.csv
ID Key_Frame__smartphone_sensors_train.hex
Parser CSV
Separator ,: '44'
Column Headers Auto
First row contains column names
First row contains data
Options Enable single quotes as a field quotation character
Delete on done
Enum = Categorical Value (in Java)
EDIT COLUMN NAMES AND TYPES
Search by column name...
1 activity Enum STANDING STANDING STANDING STANDING STANDING STANDING STANDING STANDING STANDING
2 f1_tBodyAccmeanX Numeric 0.28858451 0.27841883 0.27965306 0.27917394 0.27662877 0.27719877 0.27945388 0.27743247 0.27729342
3 f2_tBodyAccmeanY Numeric -0.020294171 -0.016410568 -0.019467156 -0.026200646 -0.016569655 -0.01009785 -0.019640776 -0.030488303 -0.021750698
4 f3_tBodyAccmeanZ Numeric -0.13290514 -0.12352019 -0.11346169 -0.12328257 -0.11536185 -0.10513725 -0.11002215 -0.12536043 -0.12075082
5 f4_tBodyAccstdX Numeric -0.9952786 -0.99824528 -0.99537956 -0.99609149 -0.99813862 -0.99733496 -0.99692104 -0.99655926 -0.99732847
6 f5_tBodyAccstdY Numeric -0.98311061 -0.97530022 -0.96718701 -0.9834027 -0.98081727 -0.99048681 -0.96718593 -0.96672843 -0.96124532
7 f6_tBodyAccstdZ Numeric -0.91352645 -0.96032199 -0.97894396 -0.9906751 -0.99048163 -0.99542003 -0.98311783 -0.98158533 -0.98367156
8 f7_tBodyAccmadX Numeric -0.99511208 -0.99880719 -0.99651994 -0.99709947 -0.99832113 -0.9976274 -0.99700268 -0.99648525 -0.99759576
Ready
Connections: 0
H2O

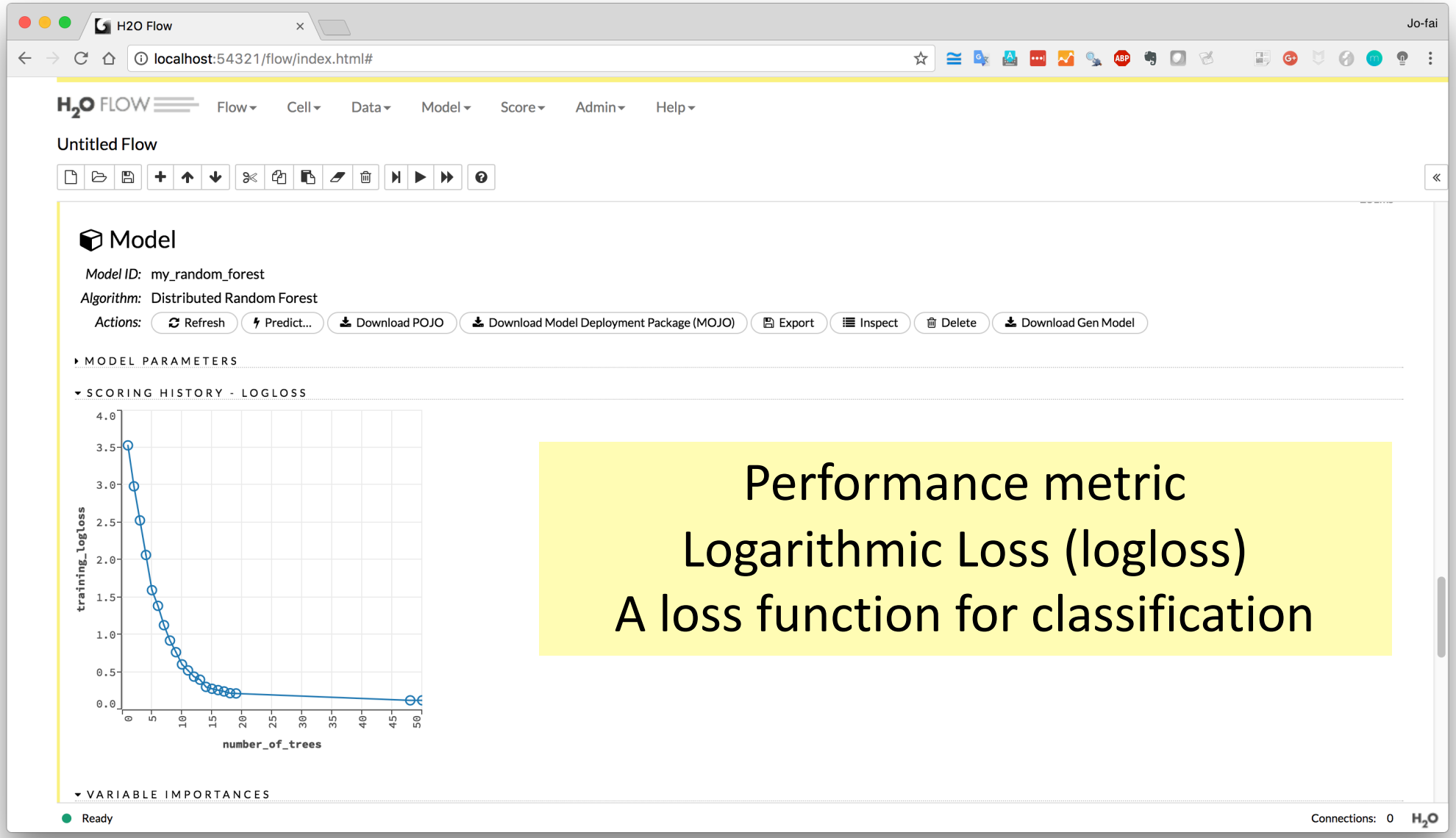

H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Key_Frame__smartphone_sensors_train.hex
Actions:
View Data
Split...
Build Model...
Predict
Download
Export
Delete
Rows
Columns
Compressed Size
7352
562
25MB
COLUMN SUMMARIES
label type Missing Zeros +Inf -Inf min max mean sigma cardinality Actions
activity enum 0 1407 0 0 0 5.0 · · 6 Convert to numeri
f1_tBodyAccmeanX real 0 0 0 0 -1.0 1.0 0.2745 0.0703 · ·
f2_tBodyAccmeanY real 0 0 0 0 -1.0 1.0 -0.0177 0.0408 · ·
f3_tBodyAccmeanZ real 0 0 0 0 -1.0 1.0 -0.1091 0.0566 · ·
f4_tBodyAccstdX real 0 0 0 0 -1.0 1.0 -0.6054 0.4487 · ·
f5_tBodyAccstdY real 0 0 0 0 -0.9999 0.9162 -0.5109 0.5026 · ·
f6_tBodyAccstdZ real 0 0 0 0 -1.0 1.0 -0.6048 0.4187 · ·
f7_tBodyAccmadX real 0 0 0 0 -1.0 1.0 -0.6305 0.4241 · ·
f8_tBodyAccmadY real 0 0 0 0 -1.0 0.9677 -0.5269 0.4859 · ·
f9_tBodyAccmadZ real 0 0 0 0 -1.0 1.0 -0.6062 0.4141 · ·
f10_tBodyAccmaxX real 0 0 0 0 -1.0 1.0 -0.4686 0.5445 · ·
f11_tBodyAccmaxY real 0 0 0 0 -1.0 1.0 -0.3060 0.2822 · ·
f12_tBodyAccmaxZ real 0 0 0 0 -1.0 1.0 -0.5571 0.2939 · ·
f13_tBodyAccminX real 0 0 0 0 -1.0 1.0 0.5236 0.3636 · ·
f14_tBodyAccminY real 0 0 0 0 -1.0 1.0 0.3874 0.3436 · ·
f15_tBodyAccminZ real 0 0 0 0 -1.0 1.0 0.5944 0.2978 · ·
f16_tBodyAccsma real 0 0 0 0 -1.0 1.0 -0.5476 0.4718 · ·
f17_tBodyAccenergyX real 0 0 0 0 -1.0 1.0 -0.8200 0.2596 · ·
f18_tBodyAccenergyY real 0 0 0 0 -1.0 1.0 -0.9019 0.1263 · ·
f19_tBodyAccenergyZ real 0 0 0 0 -1.0 1.0 -0.8458 0.2220 · ·
Exploratory analysis
(click on any variable)
Ready
Connections: 0
H2O

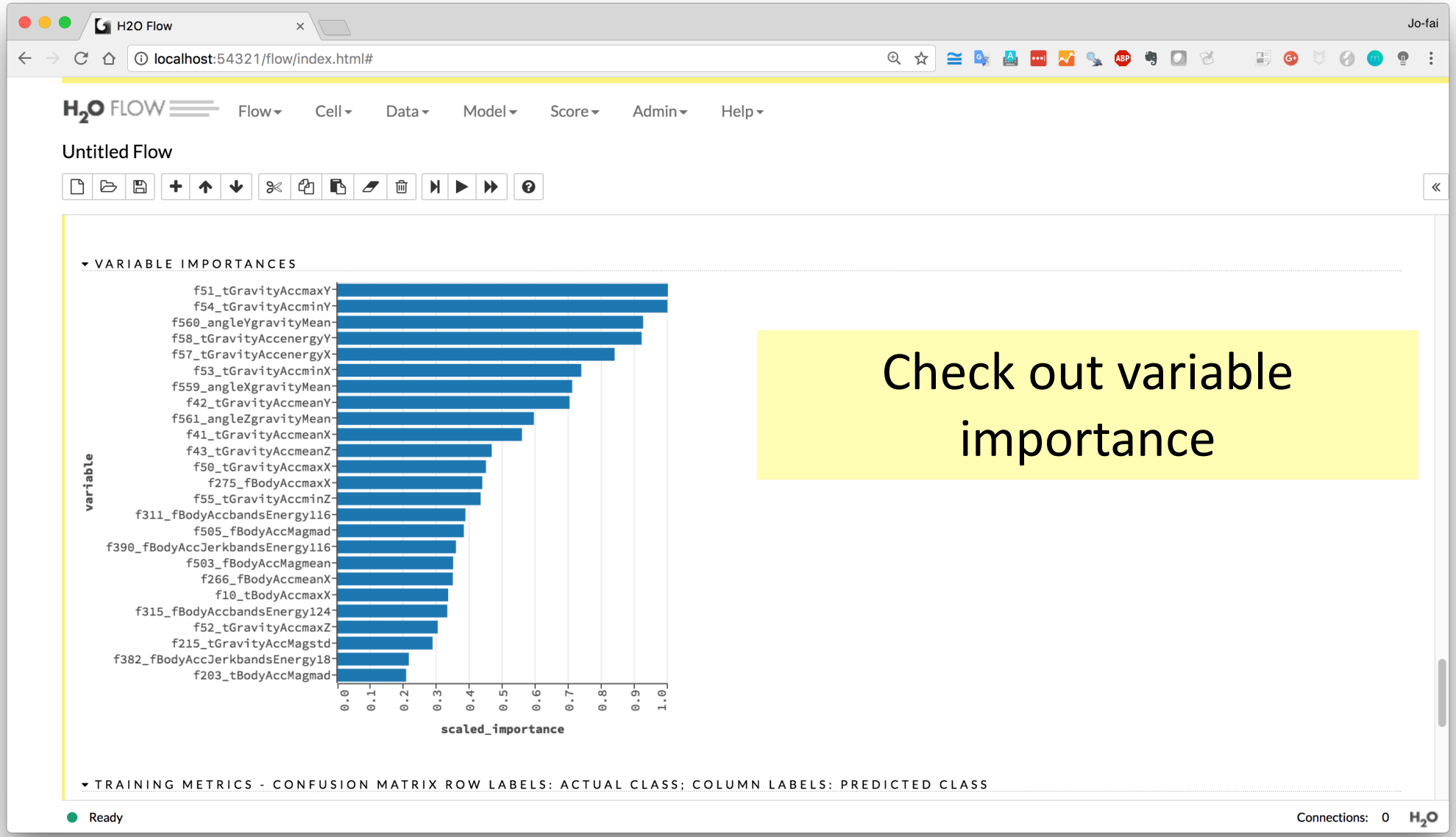

H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
CHUNK COMPRESSION SUMMARY
FRAME DISTRIBUTION SUMMARY
CS
getColumnSummary "Key_Frame__smartphone_sensors_train.hex", "activity"
133ms
Summary: activity
Actions
Impute
Inspect
CHARACTERISTICS
All
0
10
20
30
40
50
60
70
80
90
100
avg(percent)
DOMAIN (MAX 1000 LEVELS)
label
LAYING
STANDING
SITTING
WALKING
WALKING_UPSTAIRS
WALKING_DOWNSTAIRS
0
200
400
600
800
1,000
1,200
1,400
1,600
count
Ready
Connections: 0
H2O



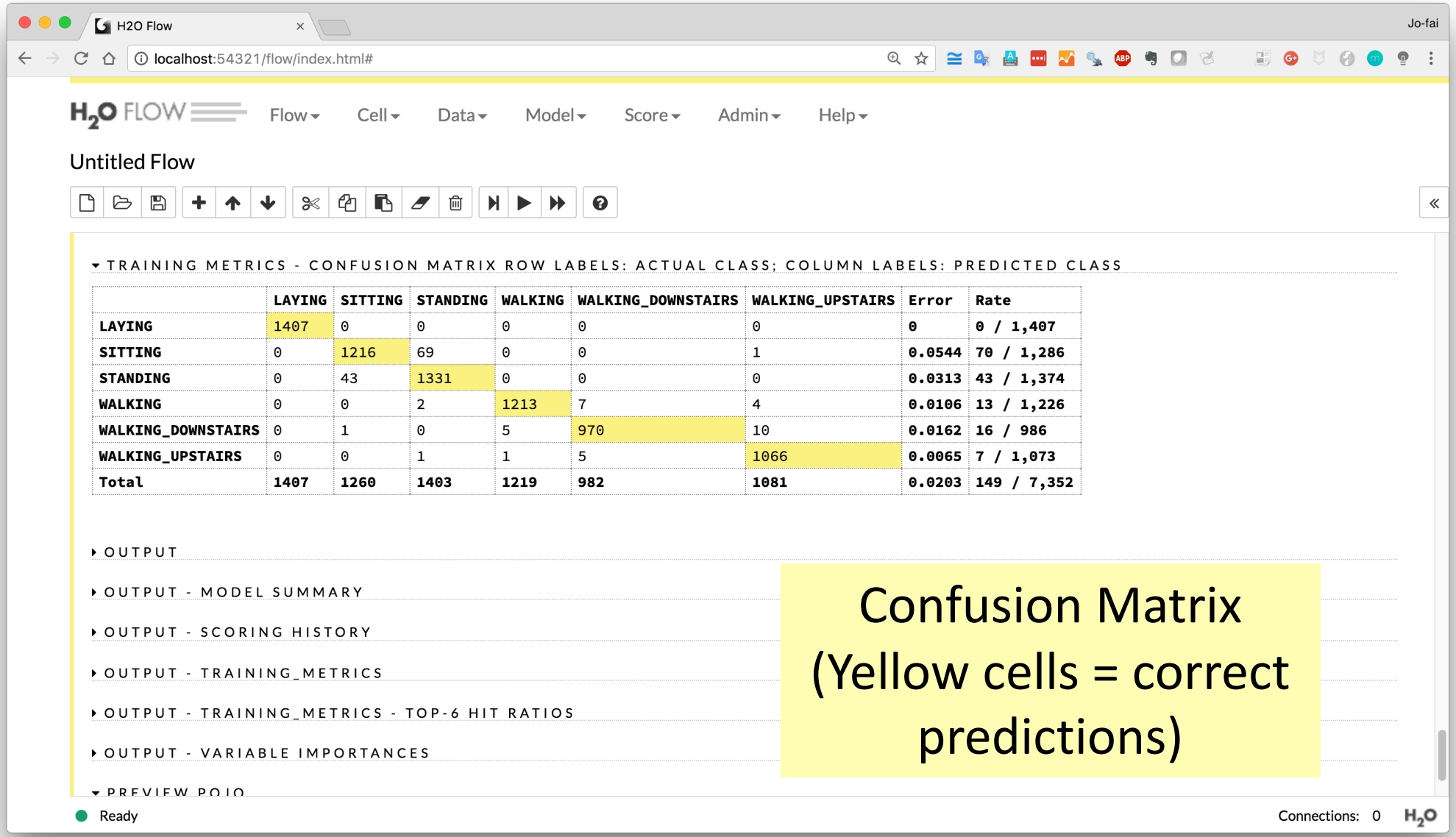
Build Random Forest Model

1) Select "..._train" dataset
2) Select "activity" as response


H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Model
Model ID: my_random_forest
Algorithm: Distributed Random Forest
Actions: Refresh Predict... Download POJO Download Model Deployment Package (MOJO) Export Inspect Delete Download Gen Model
MODEL PARAMETERS
SCORING HISTORY - LOGLOSS
training_logloss
number_of_trees
VARIABLE IMPORTANCES
Ready
Connections: 0
Performance metric
Logarithmic Loss (logloss)
A loss function for classification

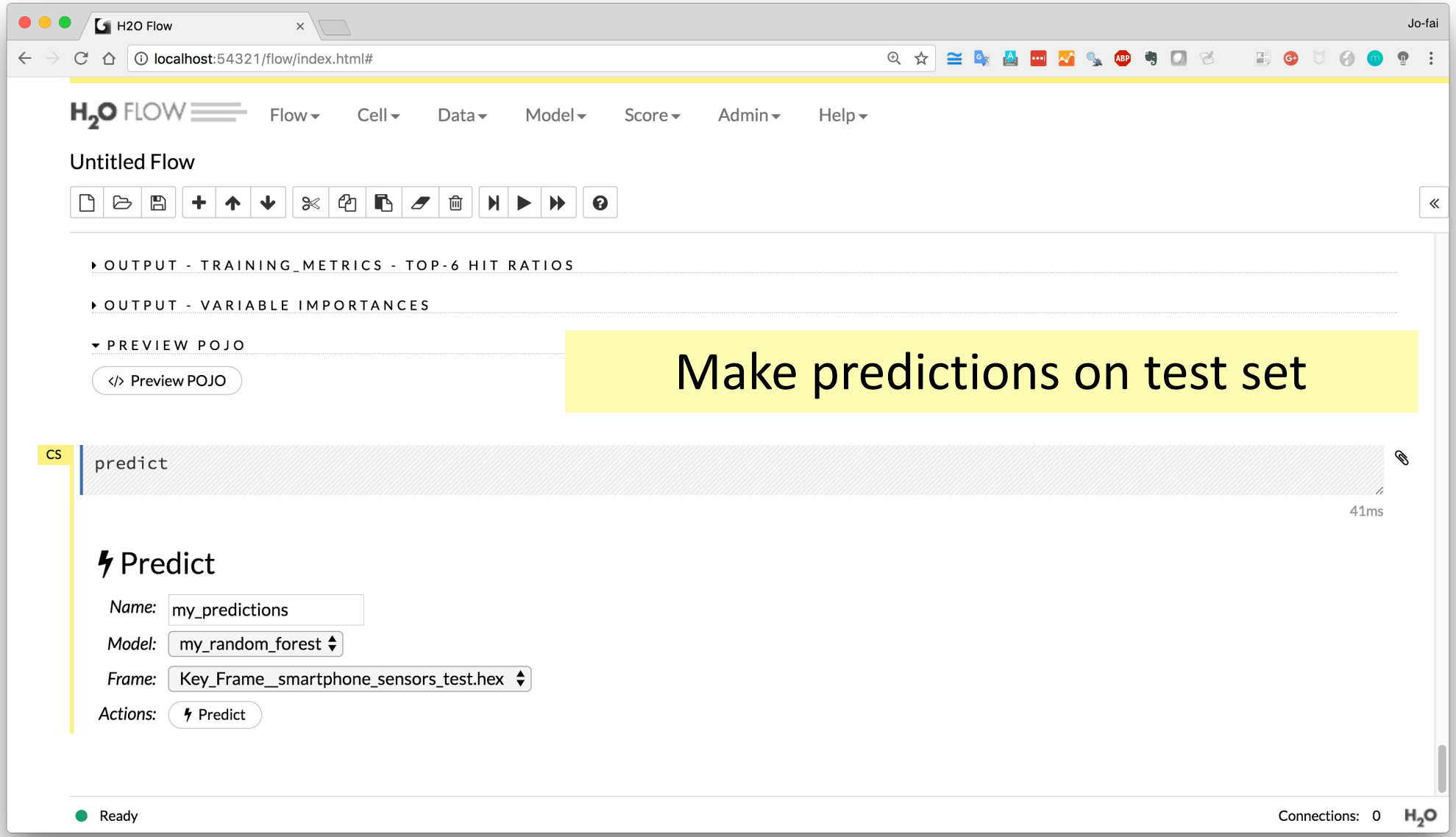


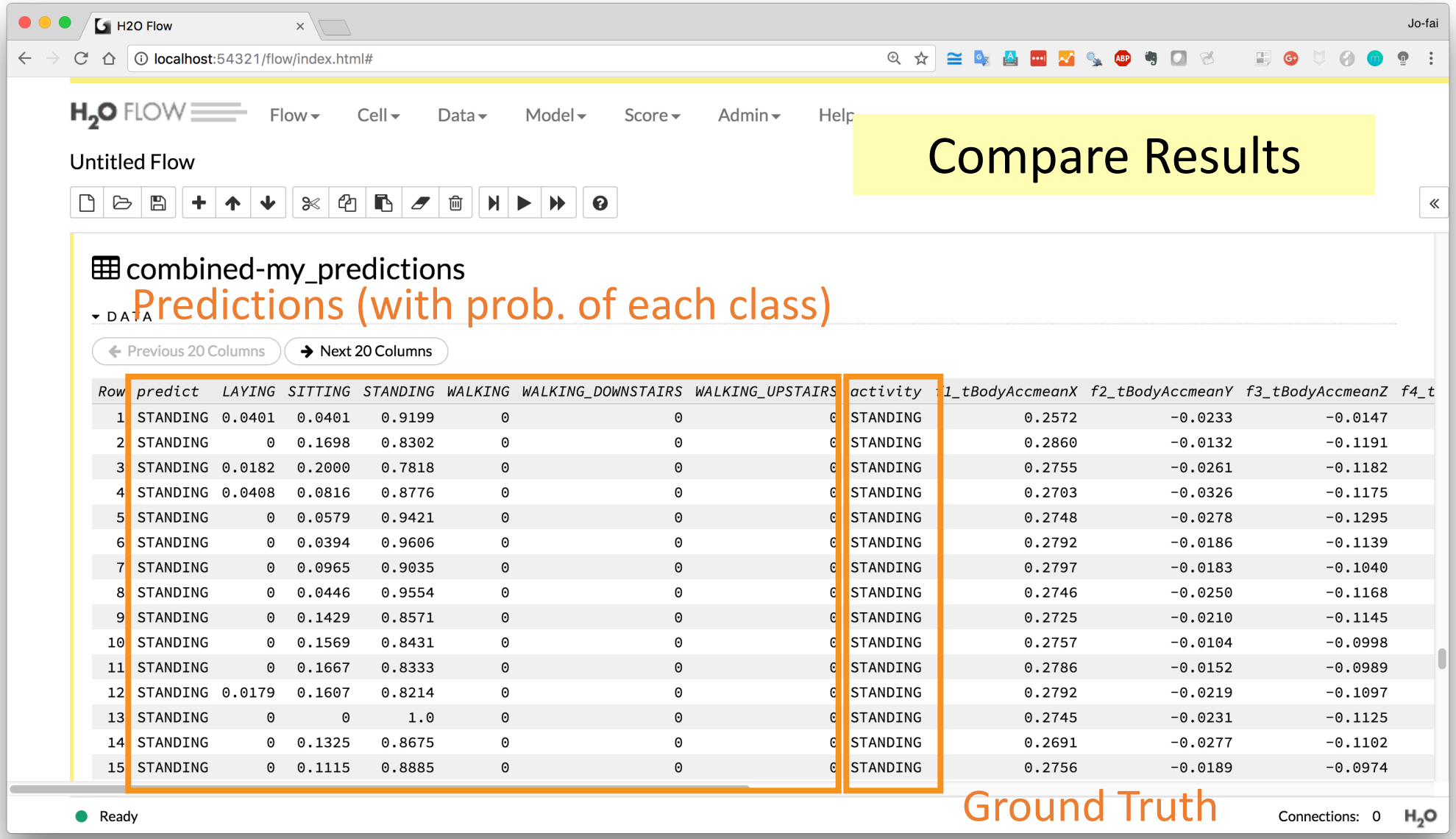
Check out variable importance



	LAYING	SITTING	STANDING	WALKING	WALKING_DOWNSTAIRS	WALKING_UPSTAIRS	Error	Rate
LAYING	1407	0	0	0	0	0	**0**	**0 / 1,407**
SITTING	0	1216	69	0	0	1	**0.0544**	**70 / 1,286**
STANDING	0	43	1331	0	0	0	**0.0313**	**43 / 1,374**
WALKING	0	0	2	1213	7	4	**0.0106**	**13 / 1,226**
WALKING_DOWNSTAIRS	0	1	0	5	970	10	**0.0162**	**16 / 986**
WALKING_UPSTAIRS	0	0	1	1	5	1066	**0.0065**	**7 / 1,073**
Total	**1407**	**1260**	**1403**	**1219**	**982**	**1081**	**0.0203**	**149 / 7,352**

Confusion Matrix (Yellow cells = correct predictions)


H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
OUTPUT - TRAINING_METRICS - TOP-6 HIT RATIOS
OUTPUT - VARIABLE IMPORTANCES
PREVIEW POJO
Preview POJO
Make predictions on test set
CS
predict
41ms
Predict
Name: my_predictions
Model: my_random_forest
Frame: Key_Frame__smartphone_sensors_test.hex
Actions: Predict
Ready
Connections: 0
H2O


H2O Flow
Jo-fai
localhost:54321/flow/index.html#
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Compare Results
combined-my_predictions
Predictions (with prob. of each class)
DATA
Previous 20 Columns
Next 20 Columns
Row predict LAYING SITTING STANDING WALKING WALKING_DOWNSTAIRS WALKING_UPSTAIRS activity f1_tBodyAccmeanX f2_tBodyAccmeanY f3_tBodyAccmeanZ f4_t
1 STANDING 0.0401 0.0401 0.9199 0 0 0 STANDING 0.2572 -0.0233 -0.0147
2 STANDING 0 0.1698 0.8302 0 0 0 STANDING 0.2860 -0.0132 -0.1191
3 STANDING 0.0182 0.2000 0.7818 0 0 0 STANDING 0.2755 -0.0261 -0.1182
4 STANDING 0.0408 0.0816 0.8776 0 0 0 STANDING 0.2703 -0.0326 -0.1175
5 STANDING 0 0.0579 0.9421 0 0 0 STANDING 0.2748 -0.0278 -0.1295
6 STANDING 0 0.0394 0.9606 0 0 0 STANDING 0.2792 -0.0186 -0.1139
7 STANDING 0 0.0965 0.9035 0 0 0 STANDING 0.2797 -0.0183 -0.1040
8 STANDING 0 0.0446 0.9554 0 0 0 STANDING 0.2746 -0.0250 -0.1168
9 STANDING 0 0.1429 0.8571 0 0 0 STANDING 0.2725 -0.0210 -0.1145
10 STANDING 0 0.1569 0.8431 0 0 0 STANDING 0.2757 -0.0104 -0.0998
11 STANDING 0 0.1667 0.8333 0 0 0 STANDING 0.2786 -0.0152 -0.0989
12 STANDING 0.0179 0.1607 0.8214 0 0 0 STANDING 0.2792 -0.0219 -0.1097
13 STANDING 0 0 1.0 0 0 0 STANDING 0.2745 -0.0231 -0.1125
14 STANDING 0 0.1325 0.8675 0 0 0 STANDING 0.2691 -0.0277 -0.1102
15 STANDING 0 0.1115 0.8885 0 0 0 STANDING 0.2756 -0.0189 -0.0974
Ground Truth
Ready
Connections: 0
H2O

H_2O Demo at IBM Conference

First, we can see two major clusters.
One for movement (walking, walking upstairs and walking downstairs)

From the graph above, we can see that:

- it could be difficult to distinguish between **Standing** and **Sitting** as there are large overlaps in their sensor data.
- **Laying** has its own cluster so it should be easy to classify.
- **Walking**, **Walking Upstairs** and **Walking Downstairs** are understandably closer to each other yet they are quite different to **Sitting**, **Standing** and **Laying**.

Another one for sitting, standing and laying.

IBM Fast Track Your Data (ML Conference) Munich

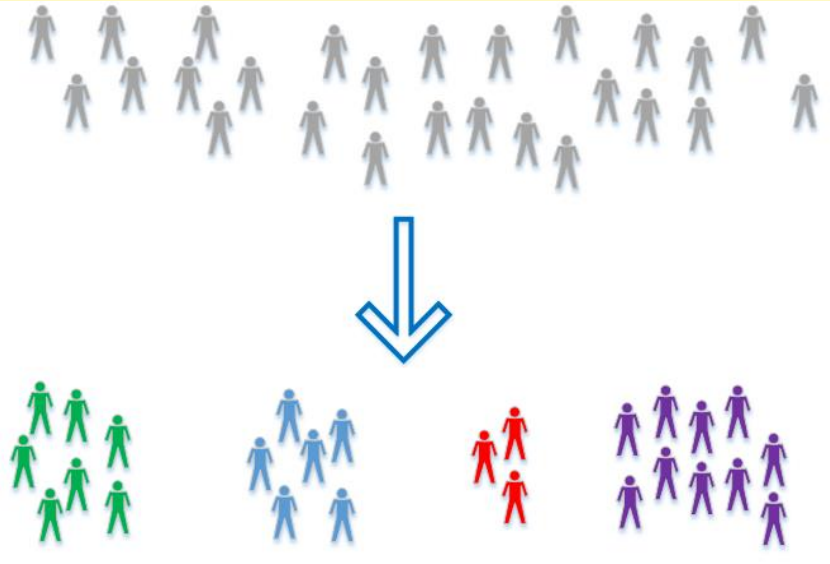
https://github.com/woobe/h2o_demo_for_ibm_dsx

Tutorial 3 - Clustering

- **Data**: Water Treatment Plant (1993)
- **Source**: https://archive.ics.uci.edu/ml/datasets/water+treatment+plant

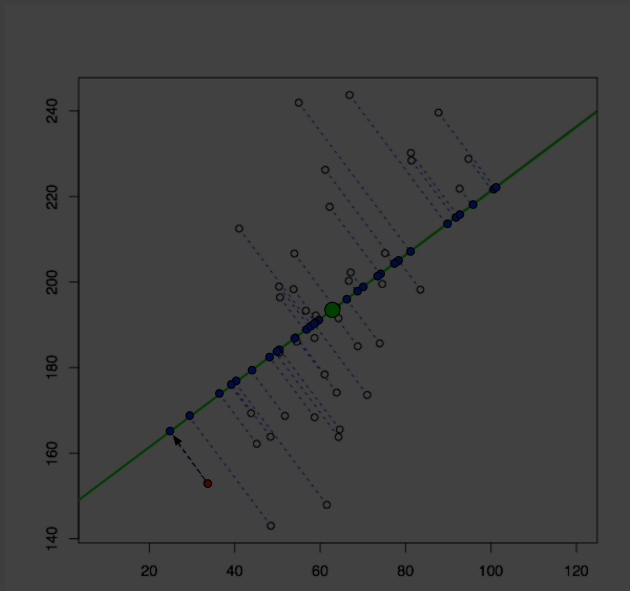
Unsupervised Learning – Discover Hidden Patterns

Clustering:
Customer Segmentation



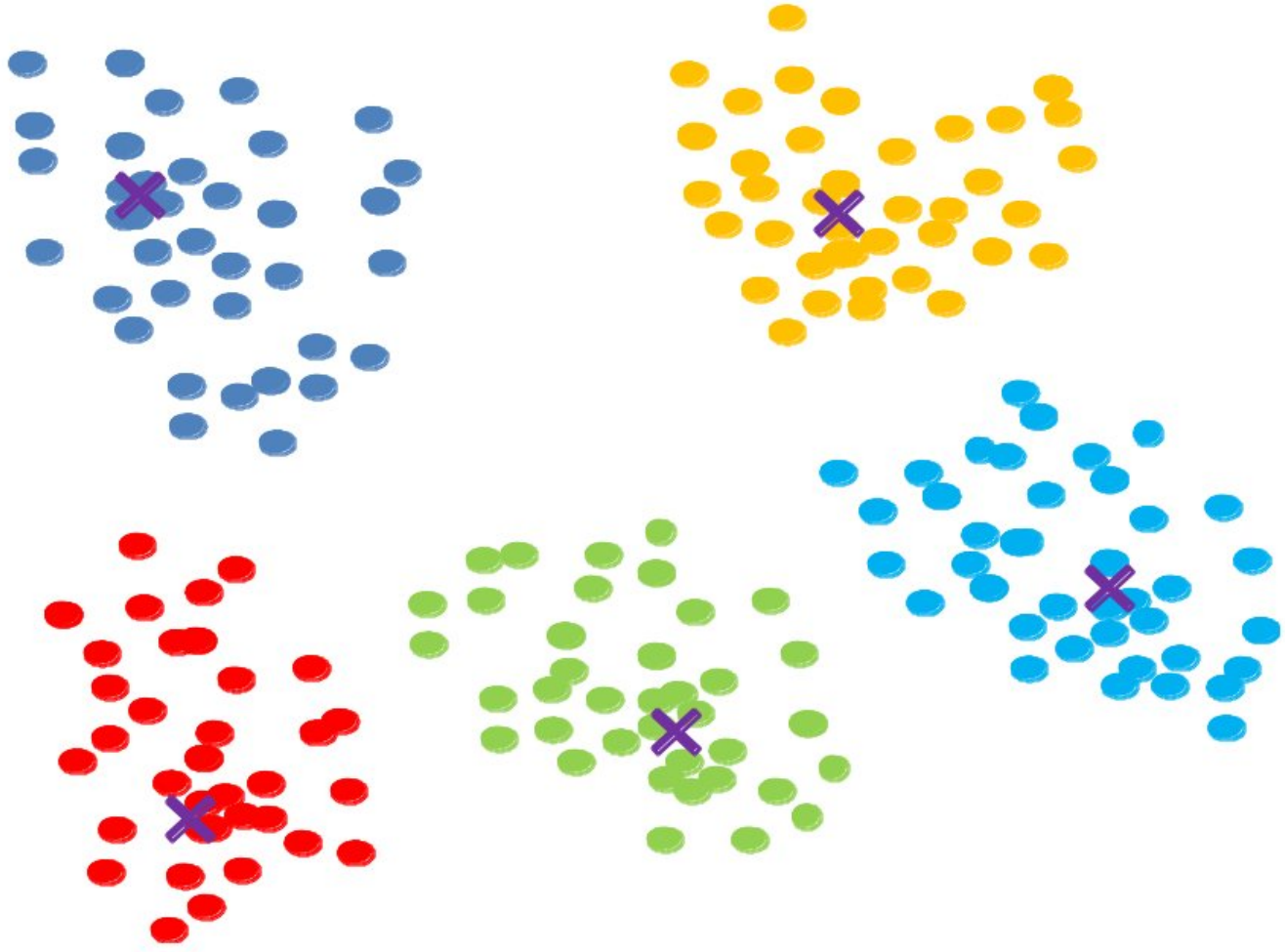
H_2O algos:
K-Means
Generalised Low Rank Model

Dimensionality Reduction:
Linear Transformation of Variables



H_2O algos:
Principal Component Analysis
Generalised Low Rank Model

K-Means Clustering



UCI Machine Learning Repository

Center for Machine Learning and Intelligent Systems

Water Treatment Plant Data Set

Download: Data Folder, Data Set Description

Abstract: Multiple classes predict plant state

Data Set Characteristics:	Multivariate	**Number of Instances:**	527	**Area:**	Physical
Attribute Characteristics:	Integer, Real	**Number of Attributes:**	38	**Date Donated**	1993-06-01
Associated Tasks:	Clustering	**Missing Values?**	N/A	**Number of Web Hits:**	91704

Source:

Creators:

Manel Poch (igte2 '@' cc.uab.es)
Unitat d'Enginyeria Quimica
Universitat Autonoma de Barcelona. Bellaterra. Barcelona; Spain

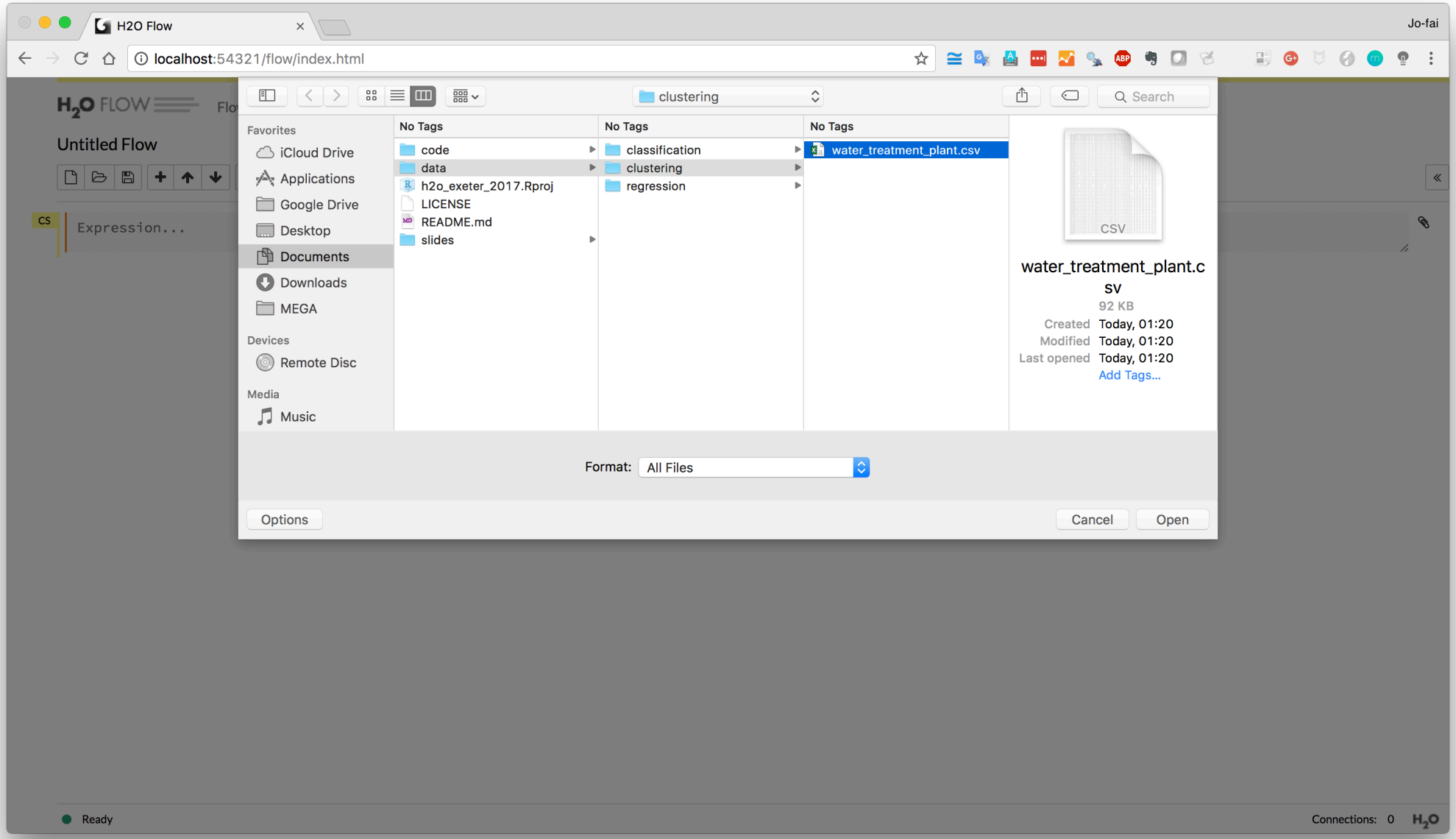
Donor:

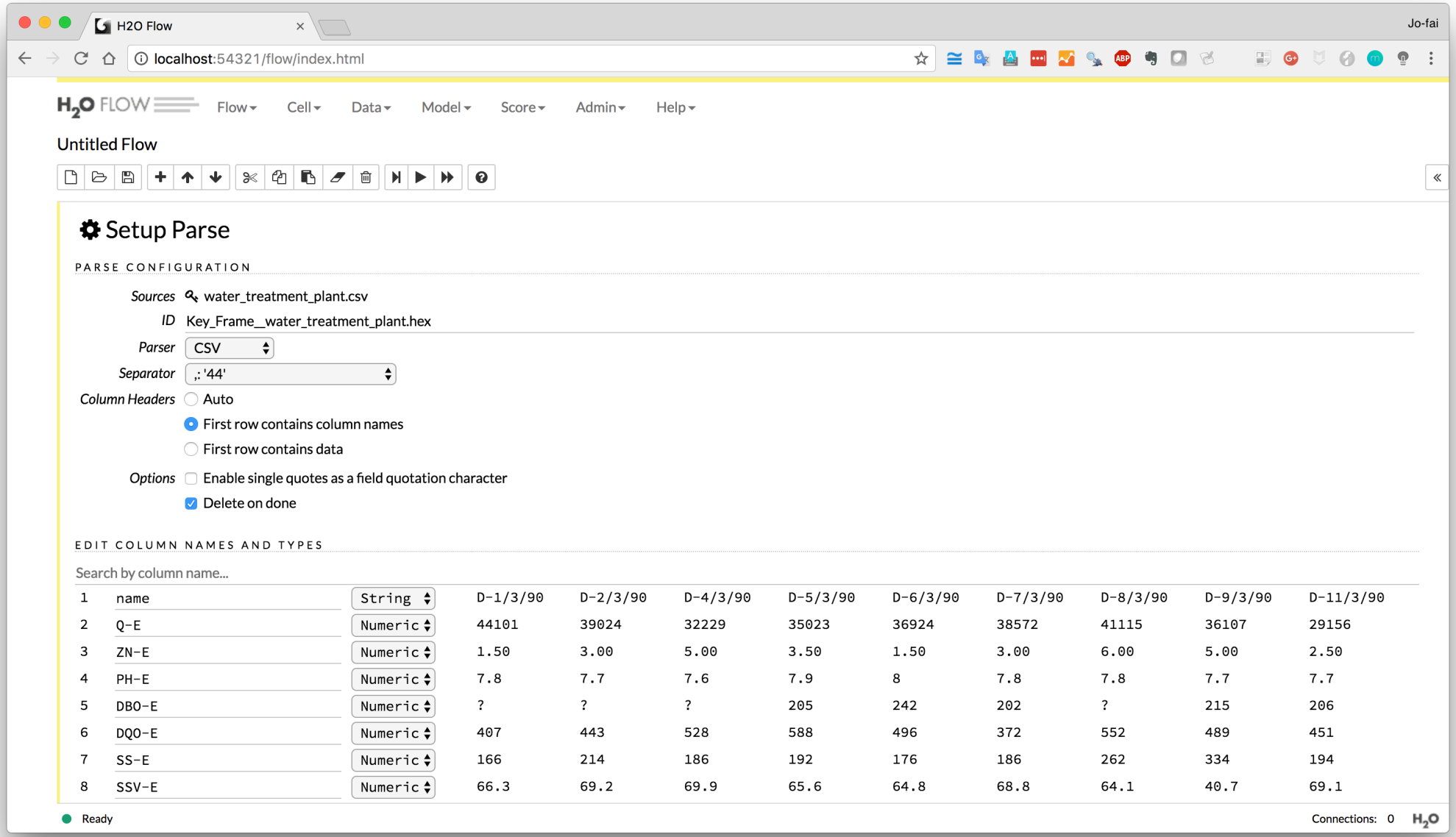
Javier Bejar and Ulises Cortes (bejar '@' lsi.upc.es)
Dept. Llenguatges i Sistemes Informatics;
Universitat Politecnica de Catalunya. Barcelona; Spain

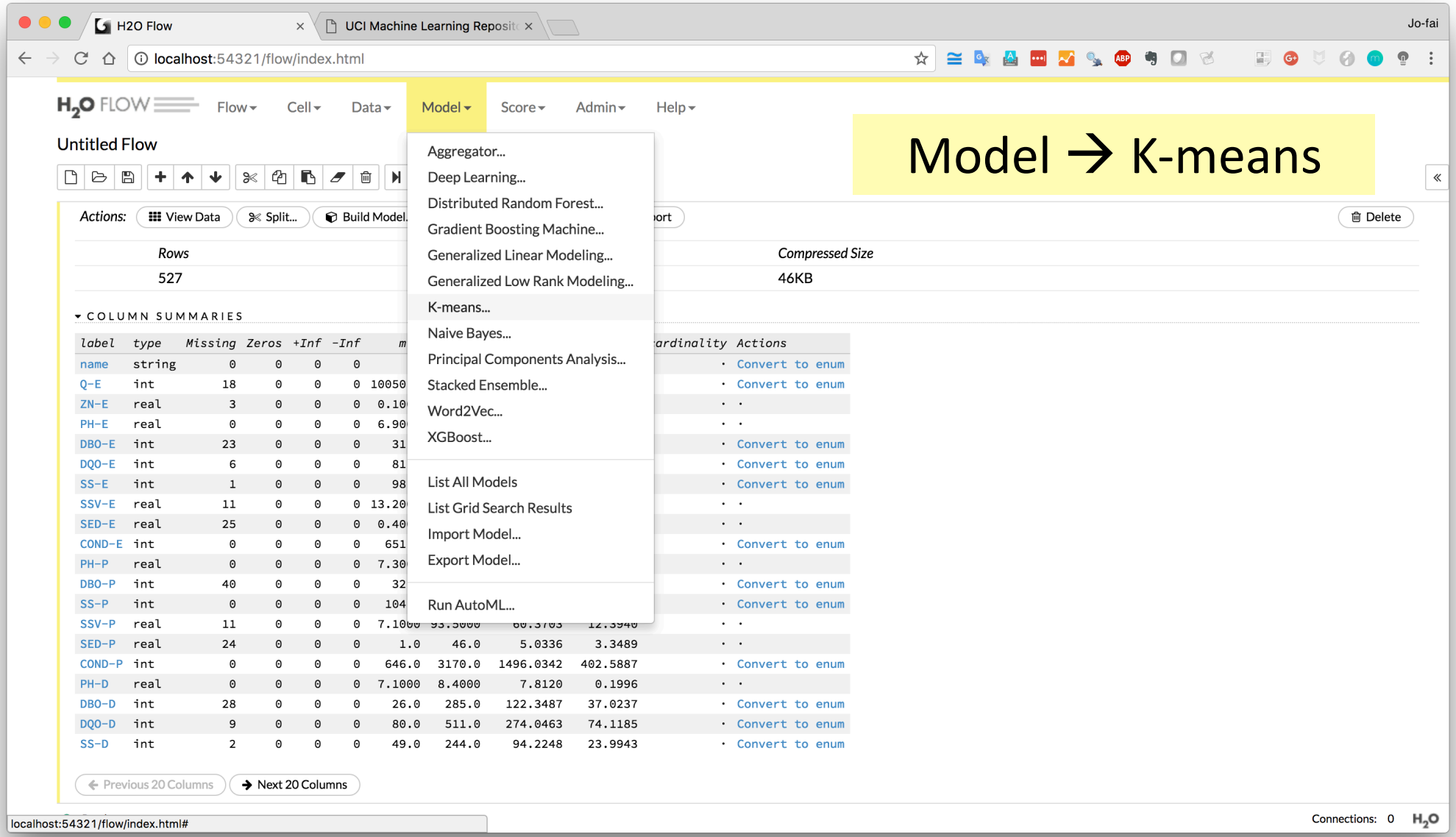
Attribute Information:

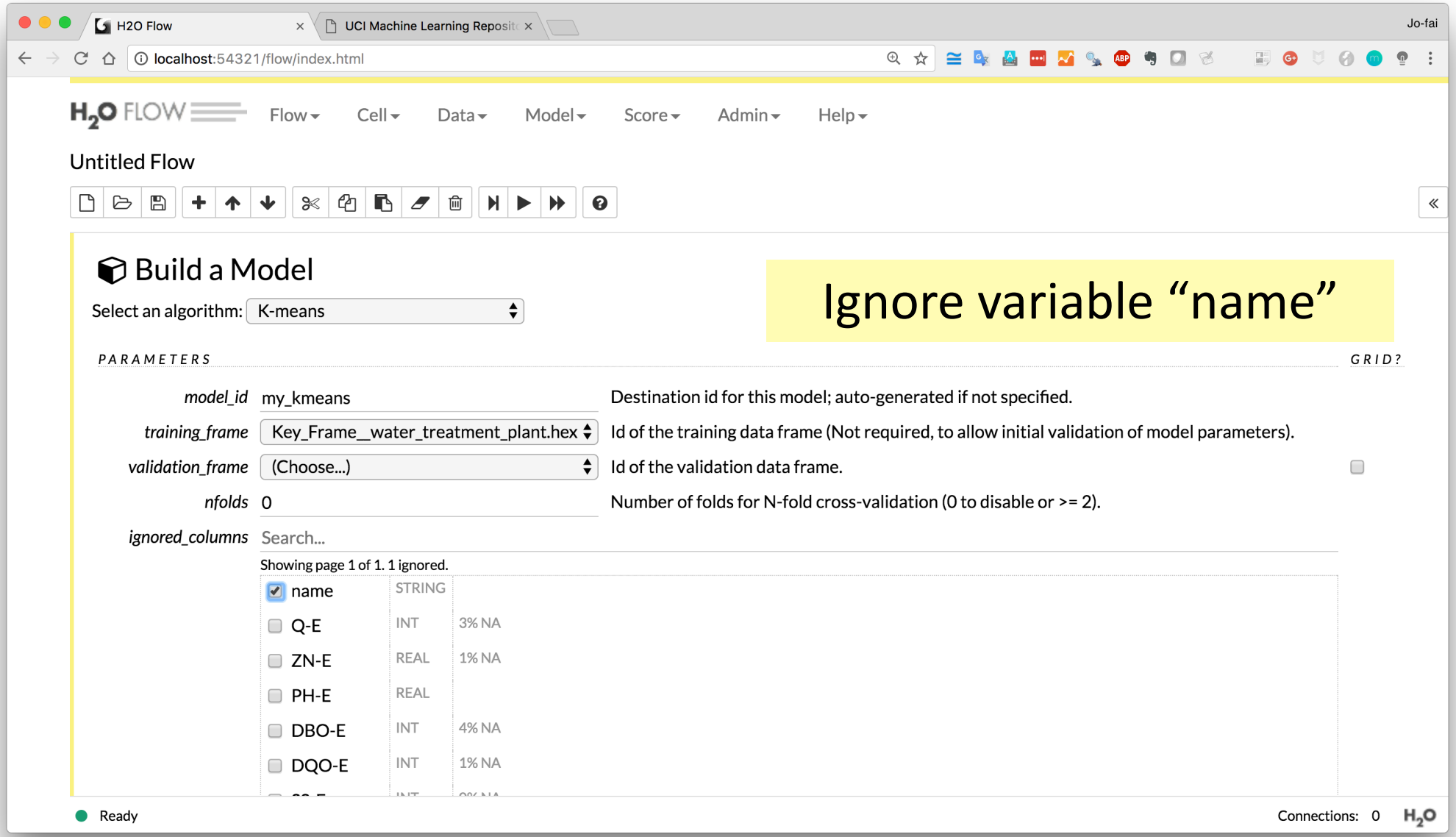
All atrributes are numeric and continuous

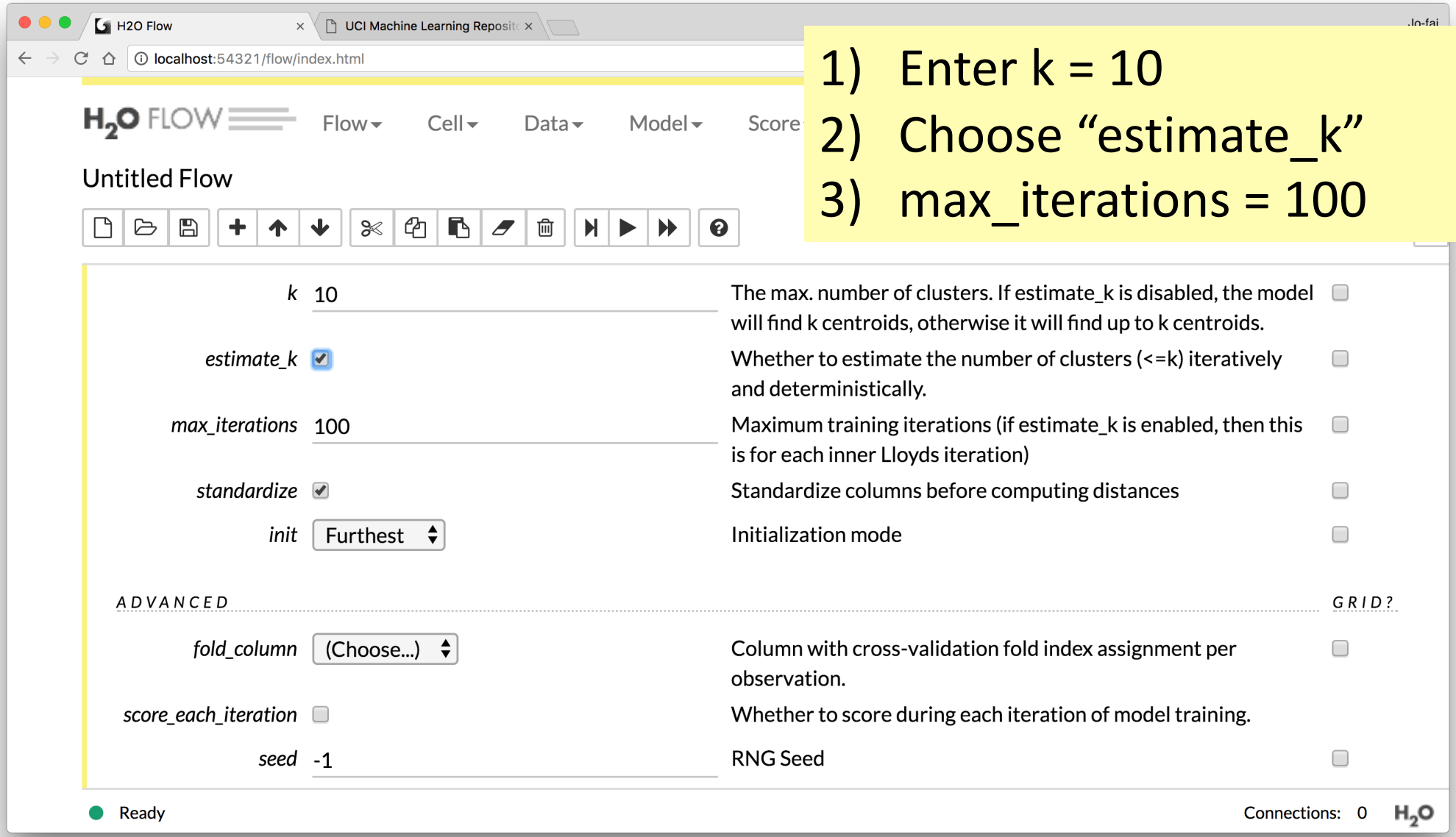
N. Attrib.
1 Q-E (input flow to plant)
2 ZN-E (input Zinc to plant)
3 PH-E (input pH to plant)
4 DBO-E (input Biological demand of oxygen to plant)
5 DQO-E (input chemical demand of oxygen to plant)
6 SS-E (input suspended solids to plant)
7 SSV-E (input volatile supended solids to plant)
8 SED-E (input sediments to plant)
9 COND-E (input conductivity to plant)
10 PH-P (input pH to primary settler)
11 DBO-P (input Biological demand of oxygen to primary settler)
12 SS-P (input suspended solids to primary settler)
13 SSV-P (input volatile supended solids to primary settler)
14 SED-P (input sediments to primary settler)
15 COND-P (input conductivity to primary settler)
16 PH-D (input pH to secondary settler)
17 DBO-D (input Biological demand of oxygen to secondary settler)
18 DQO-D (input chemical demand of oxygen to secondary settler)
19 SS-D (input suspended solids to secondary settler)
20 SSV-D (input volatile supended solids to secondary settler)
21 SED-D (input sediments to secondary settler)
22 COND-D (input conductivity to secondary settler)
23 PH-S (output pH)
24 DBO-S (output Biological demand of oxygen)
25 DQO-S (output chemical demand of oxygen)
26 SS-S (output suspended solids)
27 SSV-S (output volatile supended solids)
28 SED-S (output sediments)
29 COND-S (output conductivity)
30 RD-DBO-P (performance input Biological demand of oxygen in primary settler)
31 RD-SS-P (performance input suspended solids to primary settler)
32 RD-SED-P (performance input sediments to primary settler)
33 RD-DBO-S (performance input Biological demand of oxygen to secondary settler)
34 RD-DQO-S (performance input chemical demand of oxygen to secondary settler)
35 RD-DBO-G (global performance input Biological demand of oxygen)
36 RD-DQO-G (global performance input chemical demand of oxygen)
37 RD-SS-G (global performance input suspended solids)
38 RD-SED-G (global performance input sediments)


H2O Flow
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Untitled Flow
CS
Expression...
clustering
Search
Favorites
iCloud Drive
Applications
Google Drive
Desktop
Documents
Downloads
MEGA
Devices
Remote Disc
Media
Music
No Tags
code
data
h2o_exeter_2017.Rproj
LICENSE
README.md
slides
No Tags
classification
clustering
regression
No Tags
water_treatment_plant.csv
CSV
water_treatment_plant.csv
92 KB
Created Today, 01:20
Modified Today, 01:20
Last opened Today, 01:20
Add Tags...
Format: All Files
Options
Cancel
Open
Ready
Connections: 0

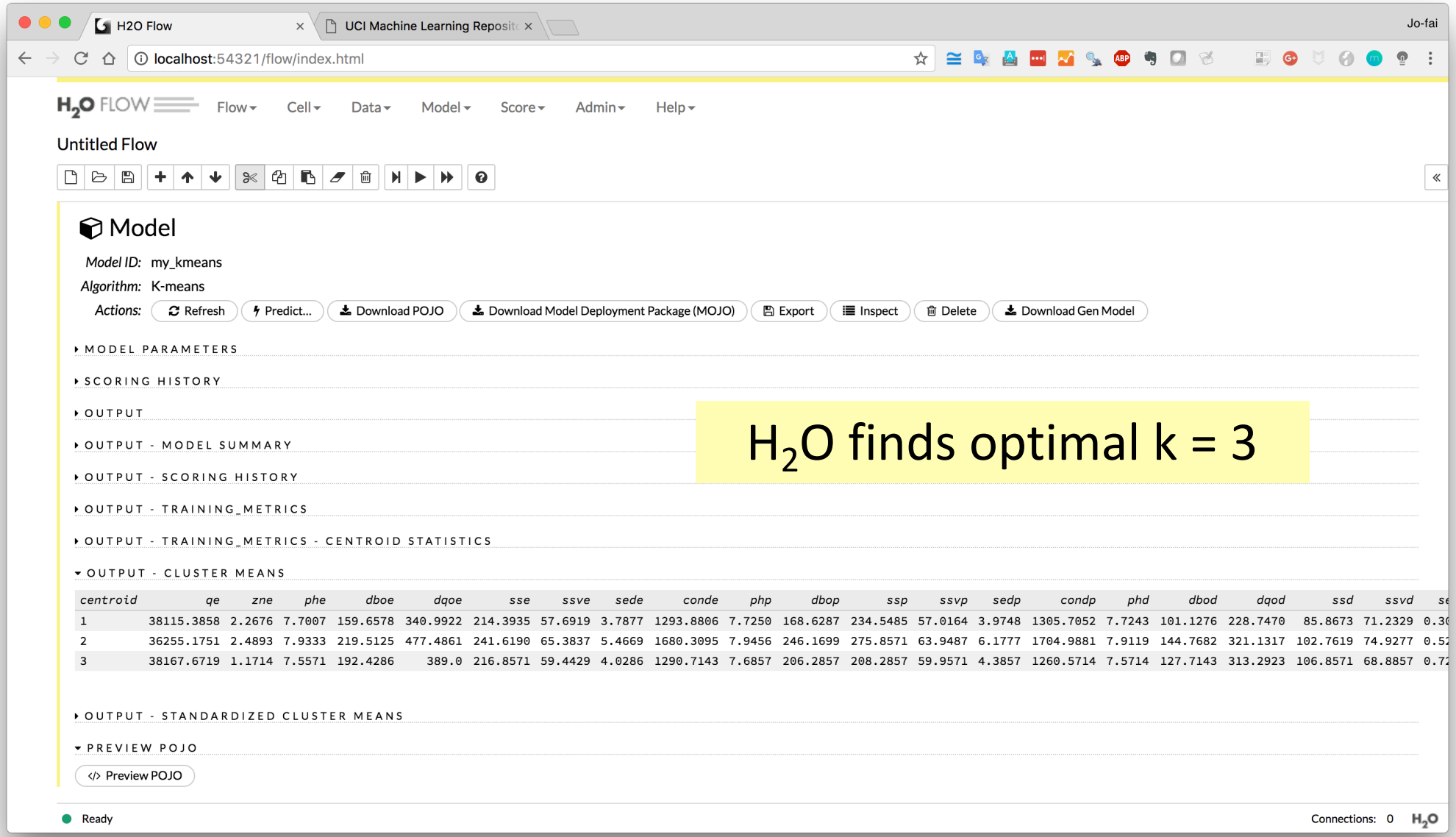

H2O Flow
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Setup Parse
PARSE CONFIGURATION
Sources water_treatment_plant.csv
ID Key_Frame__water_treatment_plant.hex
Parser CSV
Separator ,: '44'
Column Headers Auto
First row contains column names
First row contains data
Options Enable single quotes as a field quotation character
Delete on done
EDIT COLUMN NAMES AND TYPES
Search by column name...
1 name String D-1/3/90 D-2/3/90 D-4/3/90 D-5/3/90 D-6/3/90 D-7/3/90 D-8/3/90 D-9/3/90 D-11/3/90
2 Q-E Numeric 44101 39024 32229 35023 36924 38572 41115 36107 29156
3 ZN-E Numeric 1.50 3.00 5.00 3.50 1.50 3.00 6.00 5.00 2.50
4 PH-E Numeric 7.8 7.7 7.6 7.9 8 7.8 7.8 7.7 7.7
5 DBO-E Numeric ? ? ? 205 242 202 ? 215 206
6 DQO-E Numeric 407 443 528 588 496 372 552 489 451
7 SS-E Numeric 166 214 186 192 176 186 262 334 194
8 SSV-E Numeric 66.3 69.2 69.9 65.6 64.8 68.8 64.1 40.7 69.1
Ready
Connections: 0


H2O Flow
UCI Machine Learning Reposit
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Model → K-means
Aggregator...
Deep Learning...
Distributed Random Forest...
Gradient Boosting Machine...
Generalized Linear Modeling...
Generalized Low Rank Modeling...
K-means...
Naive Bayes...
Principal Components Analysis...
Stacked Ensemble...
Word2Vec...
XGBoost...
List All Models
List Grid Search Results
Import Model...
Export Model...
Run AutoML...
Actions:
View Data
Split...
Build Model...
Delete
Rows
527
Compressed Size
46KB
COLUMN SUMMARIES
label type Missing Zeros +Inf -Inf Actions
name string 0 0 0 0 Convert to enum
Q-E int 18 0 0 0 10050 Convert to enum
ZN-E real 3 0 0 0 0.10 · ·
PH-E real 0 0 0 0 6.90 · ·
DBO-E int 23 0 0 0 31 Convert to enum
DQO-E int 6 0 0 0 81 Convert to enum
SS-E int 1 0 0 0 98 Convert to enum
SSV-E real 11 0 0 0 13.20 · ·
SED-E real 25 0 0 0 0.40 · ·
COND-E int 0 0 0 0 651 Convert to enum
PH-P real 0 0 0 0 7.30 · ·
DBO-P int 40 0 0 0 32 Convert to enum
SS-P int 0 0 0 0 104 Convert to enum
SSV-P real 11 0 0 0 7.1000 93.5000 60.3703 12.3940 · ·
SED-P real 24 0 0 0 1.0 46.0 5.0336 3.3489 · ·
COND-P int 0 0 0 0 646.0 3170.0 1496.0342 402.5887 Convert to enum
PH-D real 0 0 0 0 7.1000 8.4000 7.8120 0.1996 · ·
DBO-D int 28 0 0 0 26.0 285.0 122.3487 37.0237 Convert to enum
DQO-D int 9 0 0 0 80.0 511.0 274.0463 74.1185 Convert to enum
SS-D int 2 0 0 0 49.0 244.0 94.2248 23.9943 Convert to enum
Previous 20 Columns
Next 20 Columns
localhost:54321/flow/index.html#
Connections: 0
H2O

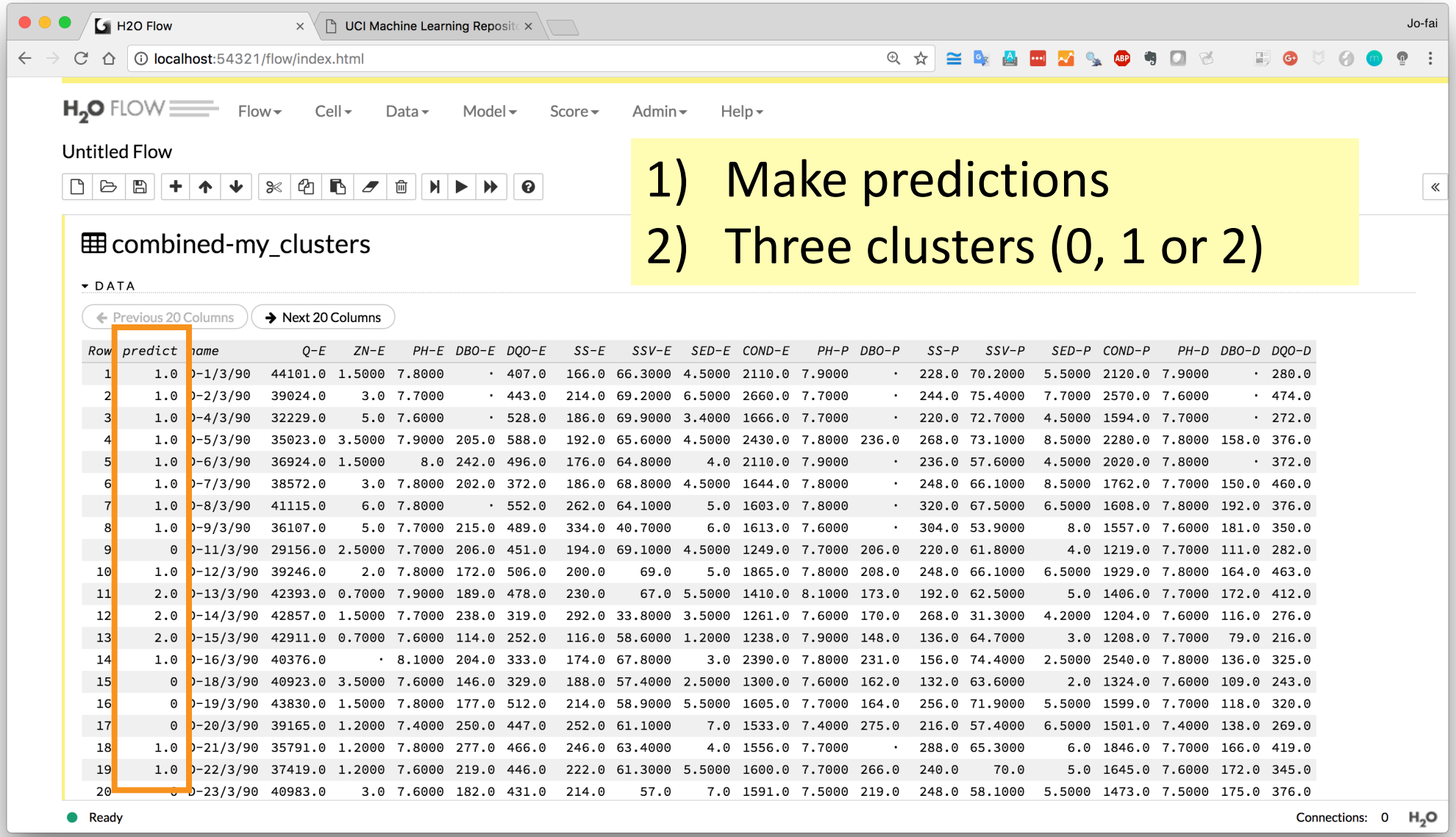

H2O Flow
UCI Machine Learning Reposit
Jo-fai
localhost:54321/flow/index.html
H2O FLOW
Flow
Cell
Data
Model
Score
Admin
Help
Untitled Flow
Build a Model
Select an algorithm: K-means
Ignore variable “name”
PARAMETERS
GRID?
model_id my_kmeans
Destination id for this model; auto-generated if not specified.
training_frame Key_Frame__water_treatment_plant.hex
Id of the training data frame (Not required, to allow initial validation of model parameters).
validation_frame (Choose...)
Id of the validation data frame.
nfolds 0
Number of folds for N-fold cross-validation (0 to disable or >= 2).
ignored_columns Search...
Showing page 1 of 1. 1 ignored.
name STRING
Q-E INT 3% NA
ZN-E REAL 1% NA
PH-E REAL
DBO-E INT 4% NA
DQO-E INT 1% NA
Ready
Connections: 0
H2O



1) Enter k = 10
2) Choose “estimate_k”
3) max_iterations = 100



H_2O finds optimal k = 3



Row	predict	name	Q-E	ZN-E	PH-E	DBO-E	DQO-E	SS-E	SSV-E	SED-E	COND-E	PH-P	DBO-P	SS-P	SSV-P	SED-P	COND-P	PH-D	DBO-D	DQO-D
1	1.0	D-1/3/90	44101.0	1.5000	7.8000	·	407.0	166.0	66.3000	4.5000	2110.0	7.9000	·	228.0	70.2000	5.5000	2120.0	7.9000	·	280.0
2	1.0	D-2/3/90	39024.0	3.0	7.7000	·	443.0	214.0	69.2000	6.5000	2660.0	7.7000	·	244.0	75.4000	7.7000	2570.0	7.6000	·	474.0
3	1.0	D-4/3/90	32229.0	5.0	7.6000	·	528.0	186.0	69.9000	3.4000	1666.0	7.7000	·	220.0	72.7000	4.5000	1594.0	7.7000	·	272.0
4	1.0	D-5/3/90	35023.0	3.5000	7.9000	205.0	588.0	192.0	65.6000	4.5000	2430.0	7.8000	236.0	268.0	73.1000	8.5000	2280.0	7.8000	158.0	376.0
5	1.0	D-6/3/90	36924.0	1.5000	8.0	242.0	496.0	176.0	64.8000	4.0	2110.0	7.9000	·	236.0	57.6000	4.5000	2020.0	7.8000	·	372.0
6	1.0	D-7/3/90	38572.0	3.0	7.8000	202.0	372.0	186.0	68.8000	4.5000	1644.0	7.8000	·	248.0	66.1000	8.5000	1762.0	7.7000	150.0	460.0
7	1.0	D-8/3/90	41115.0	6.0	7.8000	·	552.0	262.0	64.1000	5.0	1603.0	7.8000	·	320.0	67.5000	6.5000	1608.0	7.8000	192.0	376.0
8	1.0	D-9/3/90	36107.0	5.0	7.7000	215.0	489.0	334.0	40.7000	6.0	1613.0	7.6000	·	304.0	53.9000	8.0	1557.0	7.6000	181.0	350.0
9	0	D-11/3/90	29156.0	2.5000	7.7000	206.0	451.0	194.0	69.1000	4.5000	1249.0	7.7000	206.0	220.0	61.8000	4.0	1219.0	7.7000	111.0	282.0
10	1.0	D-12/3/90	39246.0	2.0	7.8000	172.0	506.0	200.0	69.0	5.0	1865.0	7.8000	208.0	248.0	66.1000	6.5000	1929.0	7.8000	164.0	463.0
11	2.0	D-13/3/90	42393.0	0.7000	7.9000	189.0	478.0	230.0	67.0	5.5000	1410.0	8.1000	173.0	192.0	62.5000	5.0	1406.0	7.7000	172.0	412.0
12	2.0	D-14/3/90	42857.0	1.5000	7.7000	238.0	319.0	292.0	33.8000	3.5000	1261.0	7.6000	170.0	268.0	31.3000	4.2000	1204.0	7.6000	116.0	276.0
13	2.0	D-15/3/90	42911.0	0.7000	7.6000	114.0	252.0	116.0	58.6000	1.2000	1238.0	7.9000	148.0	136.0	64.7000	3.0	1208.0	7.7000	79.0	216.0
14	1.0	D-16/3/90	40376.0	·	8.1000	204.0	333.0	174.0	67.8000	3.0	2390.0	7.8000	231.0	156.0	74.4000	2.5000	2540.0	7.8000	136.0	325.0
15	0	D-18/3/90	40923.0	3.5000	7.6000	146.0	329.0	188.0	57.4000	2.5000	1300.0	7.6000	162.0	132.0	63.6000	2.0	1324.0	7.6000	109.0	243.0
16	0	D-19/3/90	43830.0	1.5000	7.8000	177.0	512.0	214.0	58.9000	5.5000	1605.0	7.7000	164.0	256.0	71.9000	5.5000	1599.0	7.7000	118.0	320.0
17	0	D-20/3/90	39165.0	1.2000	7.4000	250.0	447.0	252.0	61.1000	7.0	1533.0	7.4000	275.0	216.0	57.4000	6.5000	1501.0	7.4000	138.0	269.0
18	1.0	D-21/3/90	35791.0	1.2000	7.8000	277.0	466.0	246.0	63.4000	4.0	1556.0	7.7000	·	288.0	65.3000	6.0	1846.0	7.7000	166.0	419.0
19	1.0	D-22/3/90	37419.0	1.2000	7.6000	219.0	446.0	222.0	61.3000	5.5000	1600.0	7.7000	266.0	240.0	70.0	5.0	1645.0	7.6000	172.0	345.0
20	0	D-23/3/90	40983.0	3.0	7.6000	182.0	431.0	214.0	57.0	7.0	1591.0	7.5000	219.0	248.0	58.1000	5.5000	1473.0	7.5000	175.0	376.0

Remember …

- All models are wrong but some are useful.

More About H_2O

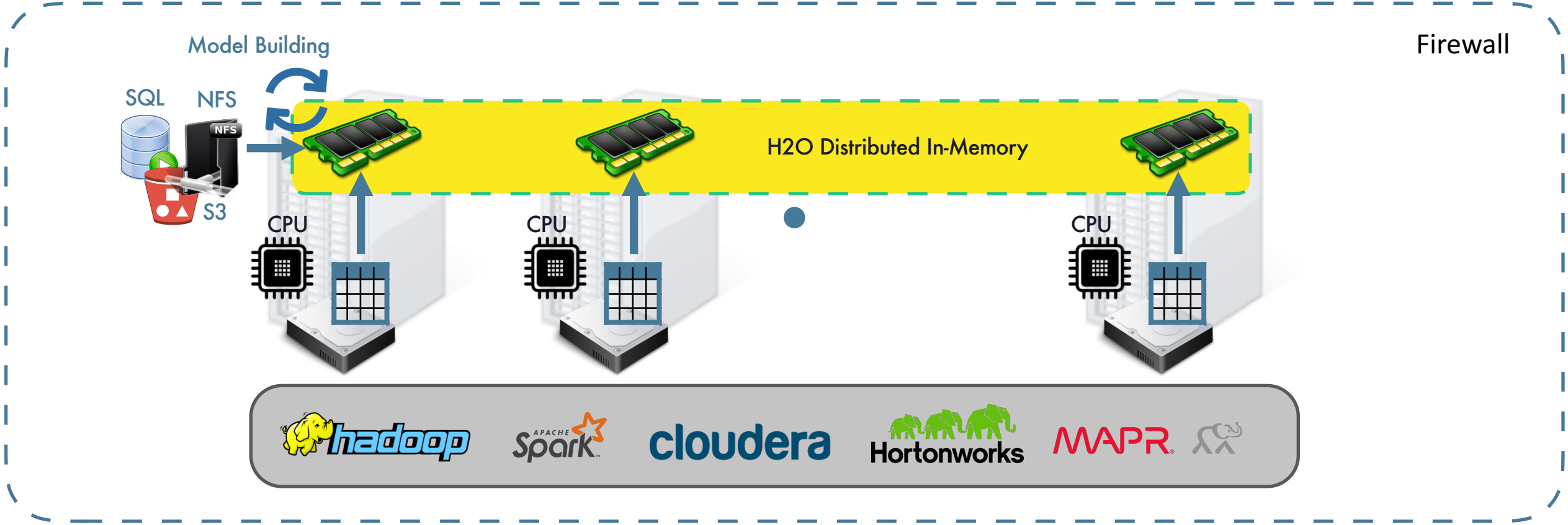
- Running H_2O on Multi-Node Cluster
- Next-Gen H_2O Products

H_2O on Multi-Node Cluster

H_2O on Single Machine

H_2O on Multi-Node Cluster

H_2O with Distributed Data Storage Systems



Higgs Boson Machine Learning Challenge

Use the ATLAS experiment to identify the Higgs boson

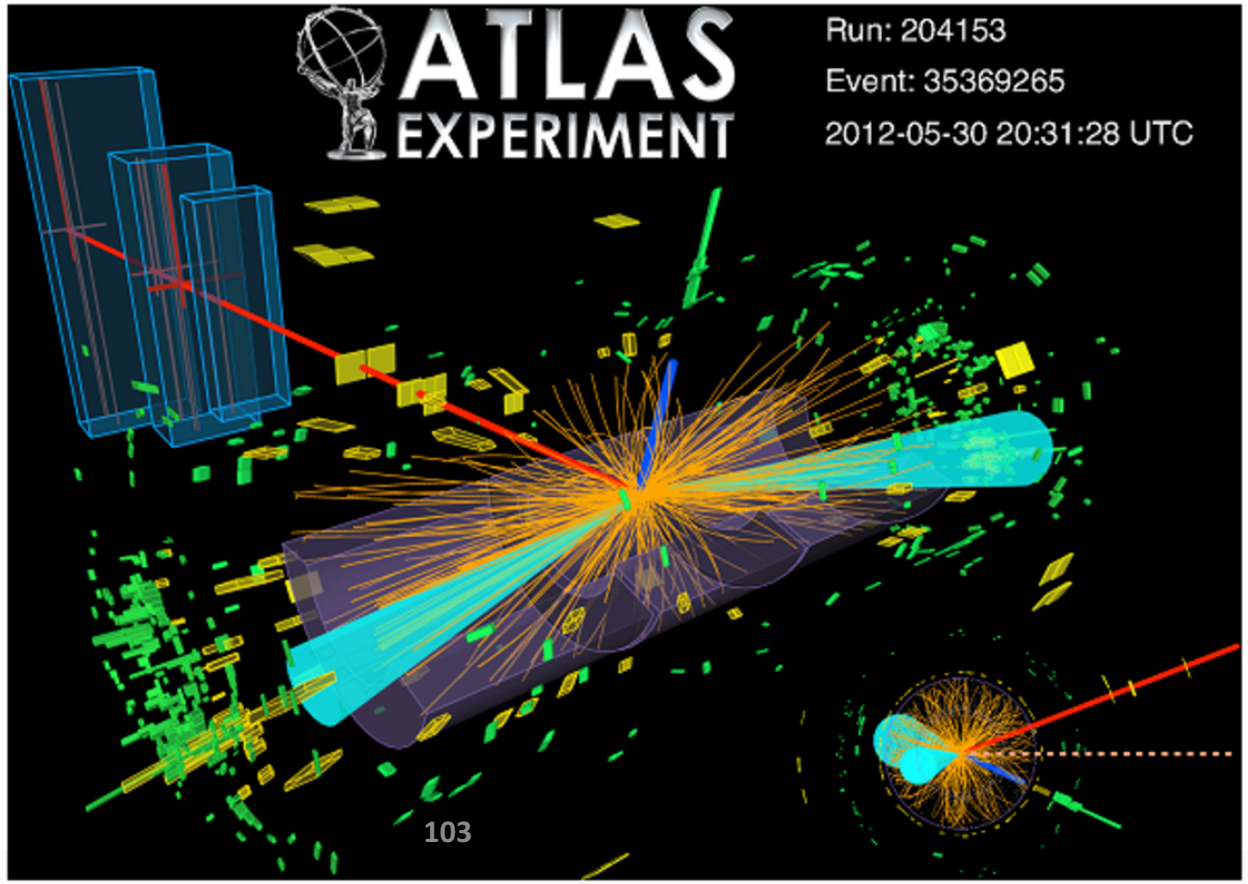
$13,000 · 1,785 teams · 3 years ago

Overview | Data | Discussion | Leaderboard | Rules | Team | My Submissions | Late Submission

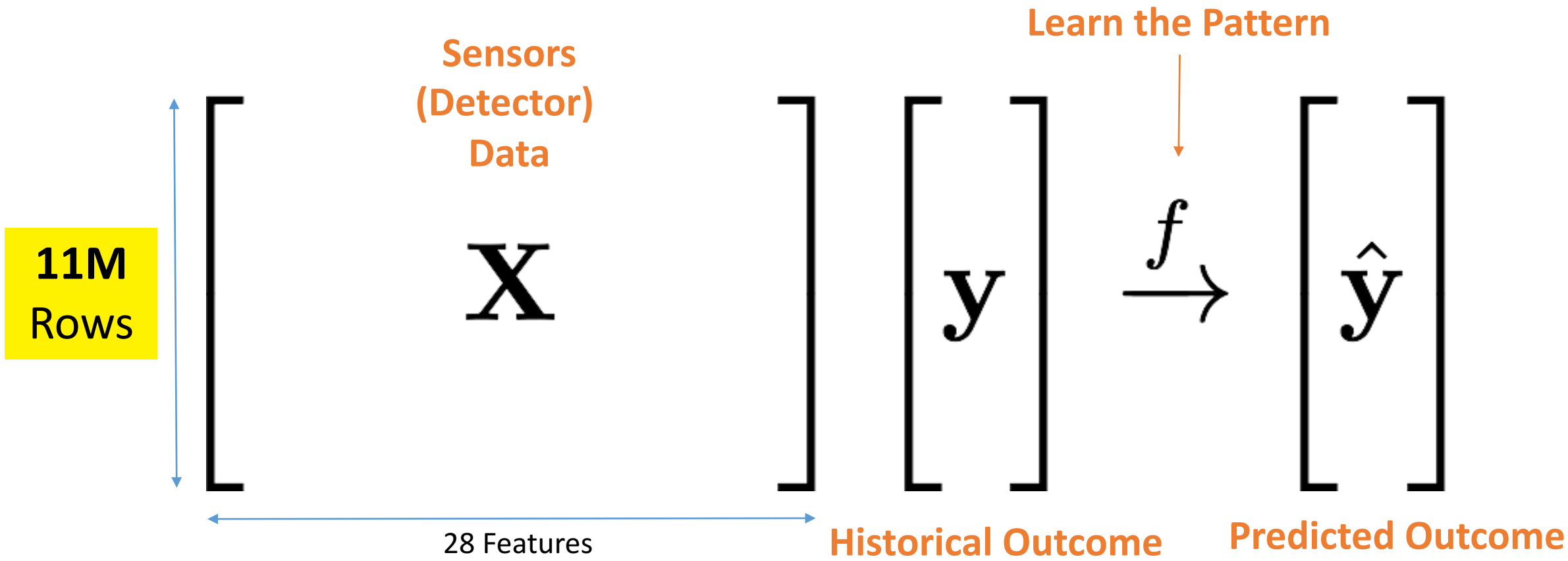
https://www.kaggle.com/c/higgs-boson

Overview

- Description
- Evaluation
- Prizes
- About The Sponsors
- Timeline
- Winners



Learning from Higgs Boson Dataset



Raw Data Size: **7.48 GB**

11M Rows

Size (Raw): **7.48 GB**
Compressed: **2.00 GB** (≈ 27% of Raw)

HIGGS.hex

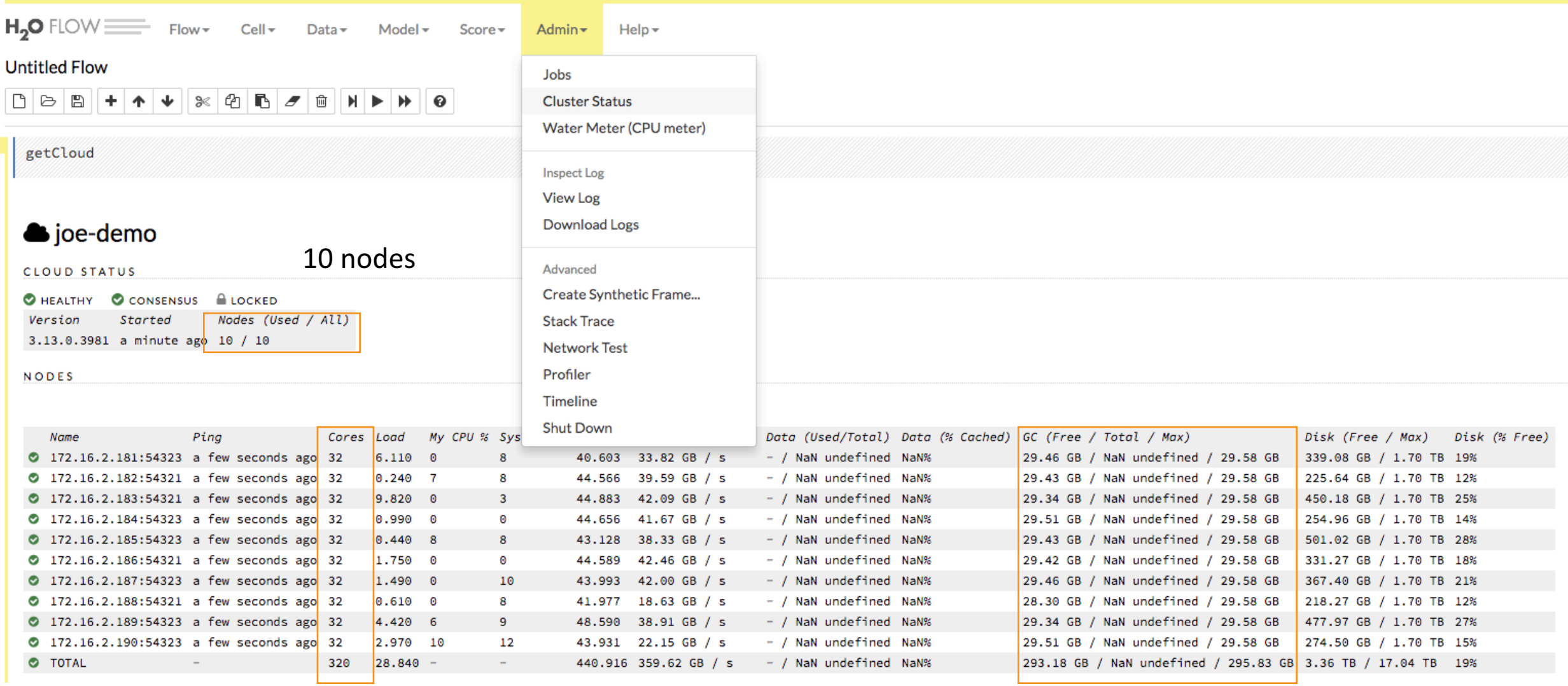
Actions: View Data | Split... | Build Model... | Predict | Download | Export

Rows	Columns	Compressed Size
11000000	29	2GB

COLUMN SUMMARIES

label	type	Missing	Zeros	+Inf	-Inf	min	max	mean	sigma	cardinality	Actions
C1	enum	0	5170877	0	0	0	1.0	0.5299	0.4991	2	Convert to numeric
C2	real	0	0	0	0	0.2747	12.0989	0.9915	0.5654	·	·
C3	real	0	0	0	0	-2.4350	2.4349	-0.0	1.0088	·	·
C4	real	0	0	0	0	-1.7425	1.7432	-0.0	1.0063	·	·
C5	real	0	0	0	0	0.0002	15.3968	0.9985	0.6000	·	·
C6	real	0	0	0	0	-1.7439	1.7433	0.0	1.0063	·	·
C7	real	0	0	0	0	0.1375	9.9404	0.9909	0.4750	·	·
C8	real	0	0	0	0	-2.9697	2.9697	-0.0	1.0093	·	·
C9	real	0	0	0	0	-1.7412	1.7415	0.0	1.0059	·	·
C10	real	0	5394611	0	0	0	2.1731	1.0	1.0278	·	·
C11	real	0	0	0	0	0.1890	11.6471	0.9927	0.5000	·	·
C12	real	0	0	0	0	-2.9131	2.9132	-0.0	1.0093	·	·
C13	real	0	0	0	0	-1.7424	1.7432	-0.0	1.0062	·	·
C14	real	0	5523912	0	0	0	2.2149	1.0	1.0494	·	·
C15	real	0	0	0	0	0.2636	14.7090	0.9923	0.4877	·	·
C16	real	0	0	0	0	-2.7297	2.7300	0.0	1.0087	·	·
C17	real	0	0	0	0	-1.7421	1.7429	0.0	1.0063	·	·
C18	real	0	6265240	0	0	0	2.5482	1.0	1.1937	·	·
C19	real	0	0	0	0	0.3654	12.8826	0.9861	0.5058	·	·
C20	real	0	0	0	0	-2.4973	2.4980	-0.0	1.0077	·	·

H2O.ai

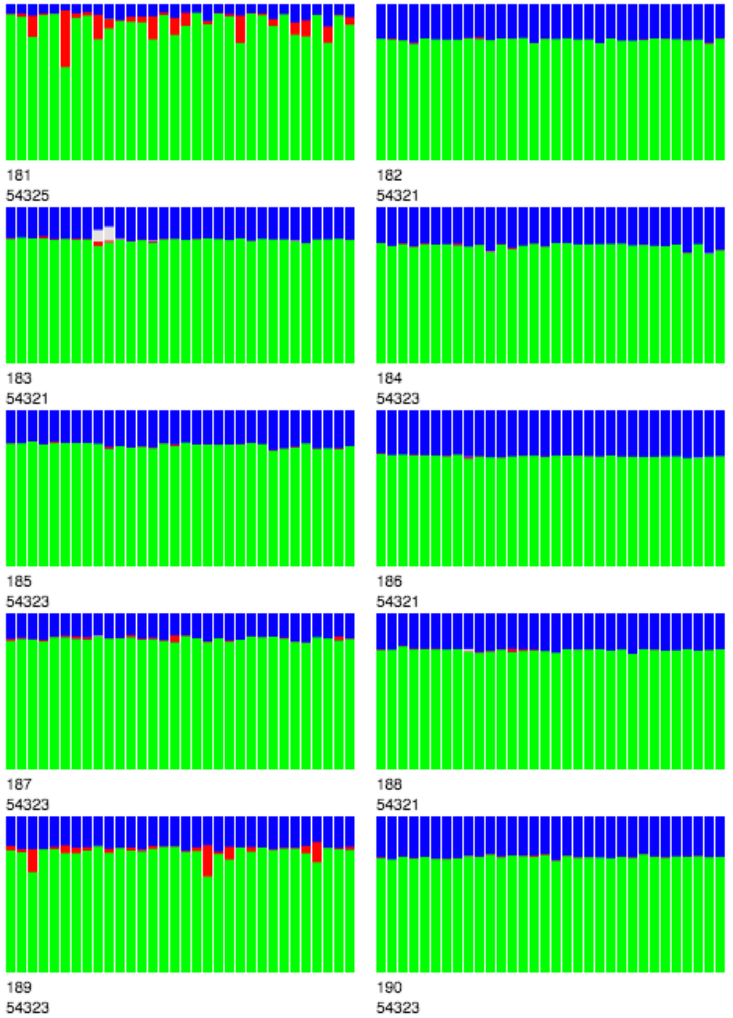


10 x 32 =
320 Cores

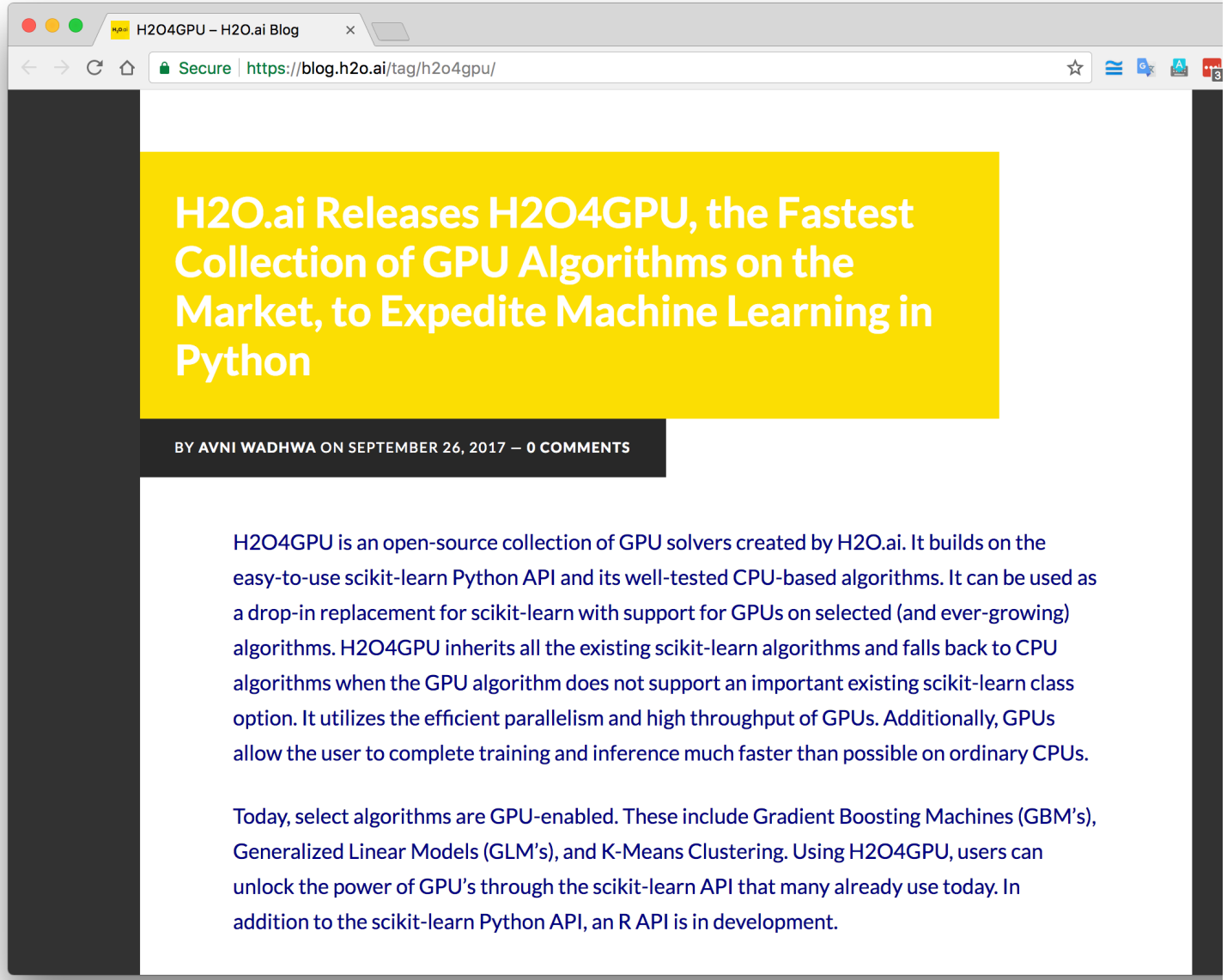
10 x 29.6 = 296
GB Memory

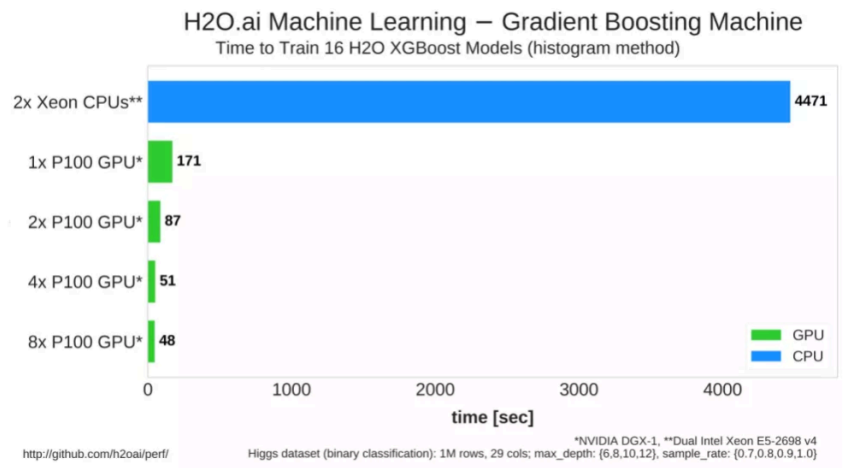
H_2O Water Meter (CPU Usage Monitor)

10 x 32 = 320 Cores



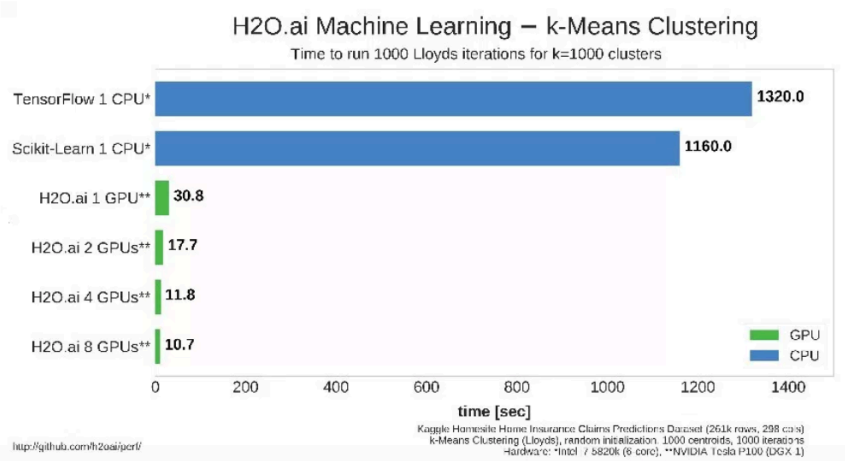
H2O4GPU





k-Means Clustering

- Based on NVIDIA prototype of k-Means algorithm in CUDA
- Improvements to original implementation:
  - Significantly faster than scikit-learn implementation (50x) and other GPU implementations (5-10x)
  - Supports multiple GPUs



https://blog.h2o.ai/tag/h2o4gpu/

Driverless AI

H2O.ai and NVIDIA Bring Fast, ×

Jo-fai

www.businesswire.com/news/home/20170926006769/en/H2O.ai-NVIDIA-Bring-Fast-Accurate-Interpretable...

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H2O.ai and NVIDIA Bring Fast, Accurate and Interpretable Driverless AI with Automated Machine Learning and Feature Engineering

Businesses Can Leapfrog Data Scientist Shortage and Accelerate Adoption of AI with H2O.ai Driverless AI on NVIDIA DGX Systems

September 26, 2017 04:57 PM Eastern Daylight Time

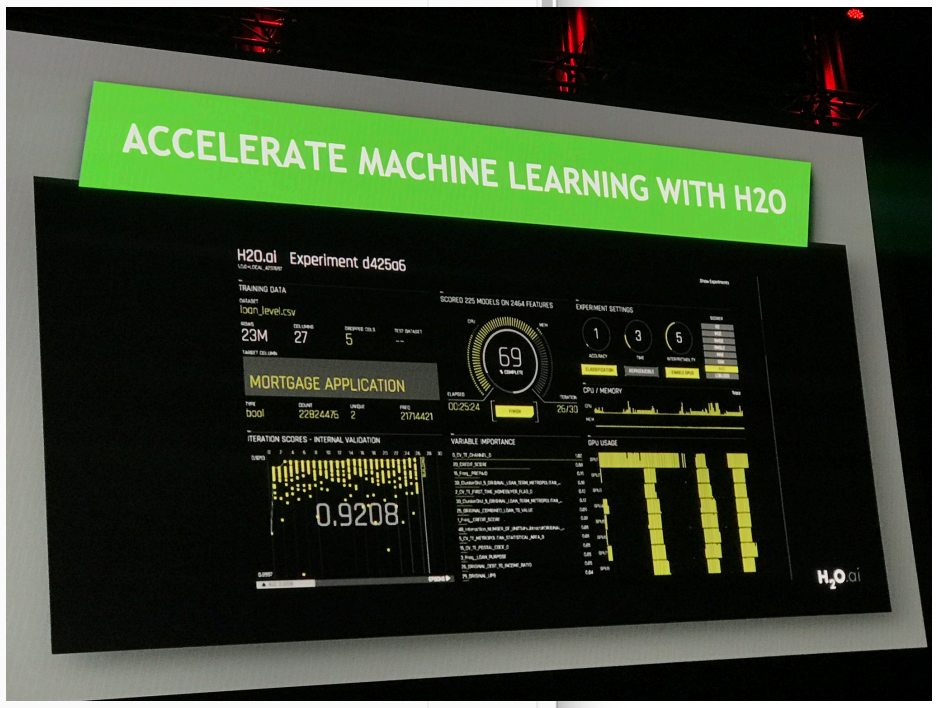
NEW YORK--(BUSINESS WIRE)--**Strata Data Conference —** H2O.ai today announced an offering built on NVIDIA DGX Systems to further democratize machine learning and address the growing demands placed on a limited number of trained data scientists.

"Interpretable AI builds trust in AI and automates report generation for regulatory purposes. Driverless AI on GPU Computing Platforms accelerates learning and data products with AI in enterprises."

Tweet this

Traditional approaches to machine learning require organizations to rely on highly skilled data scientists with years of domain knowledge. These experts continuously experiment to discover features that make machine learning algorithms more accurate and interpretable for business teams to consume. With most of the world's elite data scientists flocking to Software AI giants, there is a vacuum in the diverse talent needed to transform businesses with AI.

H2O.ai's Driverless AI platform, fully integrated on NVIDIA DGX systems, lets business users, analysts and data scientists use an incredibly fast, intuitive computing platform. Now customers can apply Automatic Feature Engineering and quickly develop hundreds of machine learning models to help businesses mitigate risks and maximize revenue



DK0KfLaUMAEp....jpg-large

Show All

http://www.businesswire.com/news/home/20170926006769/en/H2O.ai-NVIDIA-Bring-Fast-Accurate-Interpretable-Driverless

H2O.ai

Thank you!

- My STREAM Supervisors
  - Prof. Dragan Savić
  - Prof. Zoran Kapelan
- Code, Slides & Documents
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  - docs.h2o.ai
  - bit.ly/h2o_meetups
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  - @matlabulous
  - github.com/woobe
- Please search/ask questions on **Stack Overflow**
  - Use the tag `**h2o**` (not H2 zero)