

Machine Learning Spain XXVII

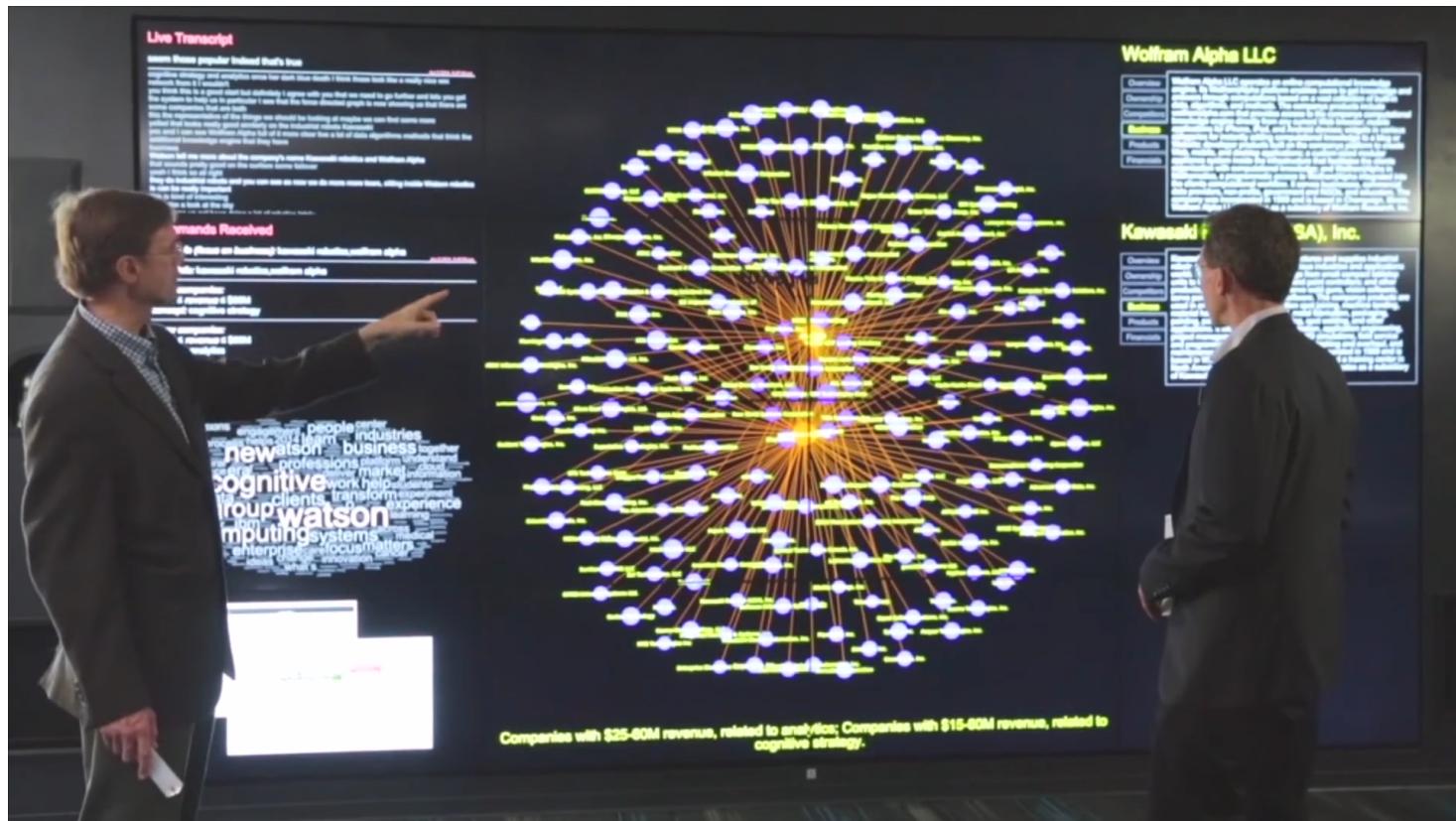
(14/03/2018)

Machine Learning Automatizado

Presentación

- Físico. MBA y Máster BI y BigData
- Consultor Freelance
- Kaggle Máster
- Socio Asociación de Usuarios de R de España
- santiago_mota@yahoo.es
- <http://es.linkedin.com/in/santiagomota>

Dario Gil: Cognitive systems and the future of expertise TED (22/12/2014)



<https://www.youtube.com/watch?v=0heqP8d6vtQ>

ML Automatizado / <https://github.com/santiagomota>



IBM anuncia Watson Analytics, un servicio de analítica cognitiva de negocio (19/09/2014)

- “*IBM Watson Analytics automatiza, además, algunos pasos del análisis, como la preparación de los datos, el análisis predictivo y la visualización... “.*
- “*Diálogo en lenguaje natural: el nuevo producto entiende el lenguaje natural, por lo que solo es necesario teclear lo que al usuario le gustaría ver...”.*
- “*Analítica predictiva "guiada": el servicio es capaz de guiar al usuario en patrones y resultados de los datos en los que el usuario tradicionalmente no se fijaría”.*



Gartner. Data Science y ML Platforms



<https://www.gartner.com/doc/reprints?id=1-4RQ3VEZ&ct=180223&st=sb>

Tools that Data Scientists actually use



https://thomaswdinsmore.com/2018/02/26/notes-on-gartners-2018-data-science-and-machine-learning-mq/?lipi=urn%3Ali%3Apage%3Ad_flagship3_feed%3BvtLwdqeRTBCwlam84Qf%2BOw%3D%3D
ML Automatizado 7 <https://github.com/santiagomota>



Proyecto de datos

id	superficie_sq_ft	tipo	parcela_acres	habitaciones	banos	precio_venta
1	719	Casa	1,64	1	1	88.000
2	2.017	Apartamento		3	2	164.000
3	697	Apartamento		1	1	72.000
4	948	Casa	1,02	2	3	85.000
5	3.375	Apartamento		3	4	271.000
6	3.968	Apartamento		4	4	482.000
7	790	Apartamento		1	2	88.000
8	1.341	Casa	0,66	3	3	128.000
9	2.379	Apartamento		3	3	235.000
10	2.495	Casa	0,21	3	4	309.000
11	1.356	Apartamento		1	1	163.000
12	3.361	Casa	1,64	3	4	375.000
13	1.060	Casa	0,05	1	1	98.000
14	582	Casa	0,61	1	1	50.000
15	1.640	Apartamento		2	3	145.000
16	3.546	Casa	0,40	4	4	394.000
17	903	Apartamento		2	2	82.000
18	1.096	Casa	0,40	3	4	105.000
19	1.280	Casa	0,15	2	2	129.000
20	1.139	Apartamento		1	1	106.000

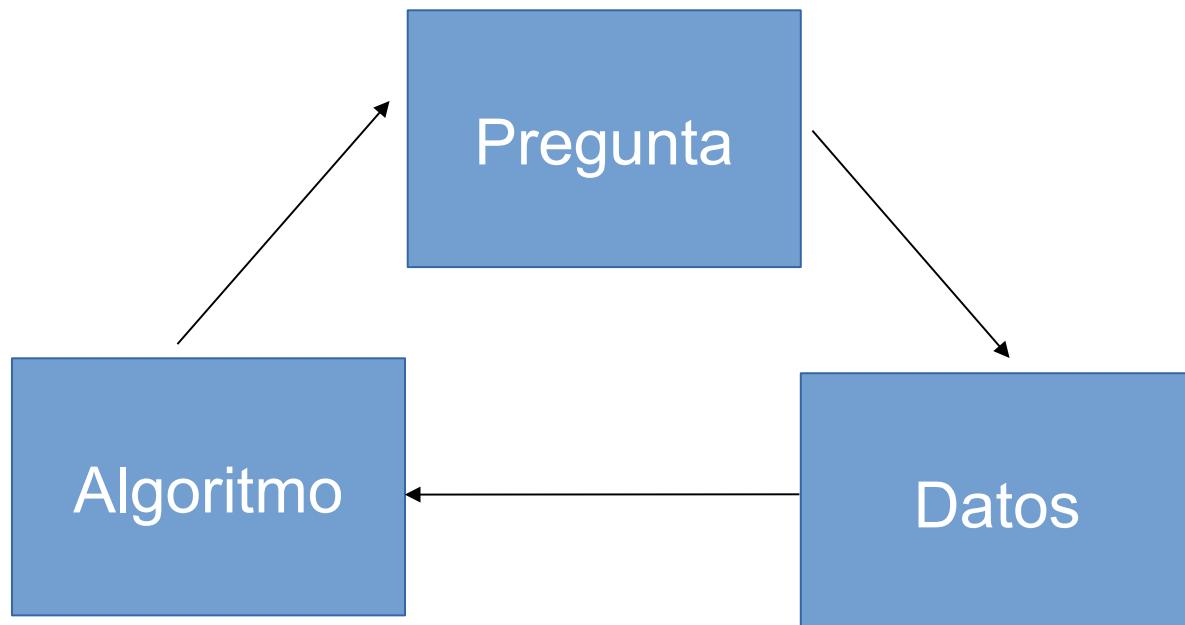
Proyecto de datos

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4	948	Casa	1,02	2	3	85.000		
5	3.375	Apartamento		3	4	271.000		
6	3.968	Apartamento		4	4	482.000		
7	790	Apartamento		1	2	88.000		
8	1.341	Casa	0,66	3	3	128.000		
9	2.379	Apartamento		3	3	235.000		
10	2.495	Casa	0,21	3	4	309.000		
11	1.356	Apartamento		1	1	163.000		
12	3.361	Casa	1,64	3	4	375.000		
13	1.060	Casa	0,05	1	1	98.000	Prediccion	Error
14	582	Casa	0,61	1	1	50.000	41.000	-9.000
15	1.640	Apartamento		2	3	145.000	165.000	20.000
16	3.546	Casa	0,40	4	4	394.000	380.000	-14.000
17	903	Apartamento		2	2	82.000	76.000	-6.000
18	1.096	Casa	0,40	3	4	105.000	128.000	23.000
19	1.280	Casa	0,15	2	2	129.000	115.000	-14.000
20	1.139	Apartamento		1	1	106.000	94.000	-12.000

Proyecto de datos

- Hay casas con mas baños que habitaciones
- División Casa / Apartamento
- Elementos vacíos, outliers (ELT)
- Nuevas columnas (feature engineering)
- Cross Validation
- Nuevos algoritmos
- De donde vienen los datos y, sobre todo: **Cuenta de resultados**

Proyecto de datos



Machine Learning automatizado

- Trifacta Wrangler ([link](#))
- IBM Watson ([link](#))
- Datarobot ([link](#))
- Daitaku ([link](#))
- Domino ([link](#))
- Seldon ([link](#))
- Alterix ([link](#))
- H2O

H2O

- Creada en 2011 (inicialmente 0xdata)
- Noviembre 2015: +\$20M (B) ya tenían \$14M
- Noviembre 2017: +\$40M (C) Total **\$75M.** (Nvidia, Wells Fargo)
- Personas
- Kaggle

Oferta de H2O

Getting Started & User Guides

 Open Source |  Commercial

H2O

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 H₂O](#)

Sparkling Water

What is Sparkling Water?
[Sparkling Water User Guide](#) **2.0** **2.1** **2.2**
Sparkling Water Booklet
RSparkling Readme
PySparkling Readme **2.0** **2.1** **2.2**
Recent Changes **2.0** **2.1** **2.2**
Open Source License (Apache V2)

Quick Start Video - Scala

[Download Sparkling Water](#)

Driverless AI

What is Driverless AI?
Driverless AI User Guide [HTML](#) [PDF](#)
Recent Changes
Driverless AI Booklet
MLI with Driverless AI Booklet

Driverless AI Webinars

[Download Driverless AI](#)

H2O4GPU (alpha)

H2O4GPU Readme
Open Source License (Apache V2)

[Download H2O4GPU](#)

Enterprise Steam

Enterprise Steam Installation Guide [HTML](#) [PDF](#)
Enterprise Steam User Guide [HTML](#) [PDF](#)

[Get Enterprise Steam
\(sales@h2o.ai\)](#)

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
\(choose p2.xlarge\)](#)

http://docs.h2o.ai/?_ga=2.107667714.1485748875.1520325919-538902739.1512117166

ML Automatizado / <https://github.com/santiagomota>



H2O

- Basada en java
- Facilidades para escalar
- Paralización. Para R, substituto data.table
- Maquina local, cluster o en cloud
- Funciona como API, pero tiene navegador
- Acceso desde R o Python
- Pagina ([link](#)), blog ([link](#)) y para iniciarse ([link](#) y [link](#))

Localhost H2O

H2O FLOW Flow Cell Data Model Score Admin Help

Untitled Flow

Flow Tools

splitFrame mergeFrames getModels getGrids getPredictions getJobs buildModel runAutoML importModel predict

Split a frame into two or more frames
Merge two frames into one
Get a list of models in H2O
Get a list of grid search results in H2O
Get a list of predictions in H2O
Get a list of jobs running in H2O
Build a model
Automatically train and tune many models
Import a saved model
Make a prediction

getJobs

Jobs

Type	Destination	Description	Start Time	End Time	Run Time	Status
Frame	training	Parse	2018-03-12 10:11:00	2018-03-12 10:11:06	00:00:05.999	DONE
Frame	validating	Parse	2018-03-12 10:11:11	2018-03-12 10:11:12	00:00:00.756	DONE
Frame	testing	Parse	2018-03-12 10:11:13	2018-03-12 10:11:14	00:00:00.189	DONE
Auto Model	AutoML_20180312_101114	AutoML build	2018-03-12 10:11:14	2018-03-12 11:45:53	01:34:39.7	RUNNING
Model	Quantiles_model_1520845829907_1	Quantiles	2018-03-12 10:11:15	2018-03-12 10:11:15	00:00:00.31	DONE
Model	Quantiles_model_1520845829907_2	Quantiles	2018-03-12 10:11:15	2018-03-12 10:11:15	00:00:00.0	DONE
Model	Quantiles_model_1520845829907_3	Quantiles	2018-03-12 10:11:15	2018-03-12 10:11:15	00:00:00.0	DONE
Model	DRF_0_AutoML_20180312_101114	DRF	2018-03-12 10:11:15	2018-03-12 10:35:30	00:24:15.435	DONE
Model	XRT_0_AutoML_20180312_101114	DRF	2018-03-12 10:35:31	2018-03-12 11:04:25	00:28:54.356	DONE
Grid	GLM_grid_0_AutoML_20180312_101114	GLM Grid Search	2018-03-12 11:04:26	2018-03-12 11:04:26	00:00:00.244	DONE
Grid	GBM_grid_0_AutoML_20180312_101114	GBM Grid Search	2018-03-12 11:04:27	2018-03-12 11:18:57	00:14:30.348	DONE
Grid	GBM_grid_0_AutoML_20180312_101114	GBM Grid Search	2018-03-12 11:18:58	2018-03-12 11:33:09	00:14:10.541	DONE
Grid	GBM_grid_0_AutoML_20180312_101114	GBM Grid Search	2018-03-12 11:33:09	2018-03-12 11:45:53	00:12:43.496	RUNNING

CS 125ms

OUTLINE FLOWS CLIPS HELP

Help

Using Flow for the first time?

Quickstart Videos

Or, view example Flows to explore and learn H2O.

STAR H2O ON GITHUB!

Star 2,907

GENERAL

- Flow Web UI ...
 - ... Importing Data
 - ... Building Models
 - ... Making Predictions
 - ... Using Flows
 - ... Troubleshooting Flow

EXAMPLES

Flow packs are a great way to explore and learn H2O. Try out these Flows and run them in your browser.
Browse installed packs...

H2O REST API

- Routes
- Schemas

Connections: 0 H2O



Instalación desde R

[DOWNLOAD AND RUN](#)[INSTALL IN R](#)[INSTALL IN PYTHON](#)[INSTALL ON HADOOP](#)[USE FROM MAVEN](#)

Use H₂O directly from R

Copy and paste these commands into R one line at a time:

```
# The following two commands remove any previously installed H2O packages for R.
if ("package:h2o" %in% search()) { detach("package:h2o", unload=TRUE) }
if ("h2o" %in% rownames(installed.packages())) { remove.packages("h2o") }

# Next, we download packages that H2O depends on.
pkgs <- c("RCurl","jsonlite")
for (pkg in pkgs) {
  if (! (pkg %in% rownames(installed.packages()))) { install.packages(pkg) }

# Now we download, install and initialize the H2O package for R.
install.packages("h2o", type="source", repos="http://h2o-release.s3.amazonaws.com/h2o/rel-wolpert/4/R")

# Finally, let's load H2O and start up an H2O cluster
library(h2o)
h2o.init()
```



<http://h2o-release.s3.amazonaws.com/h2o/rel-wolpert/4/index.html>

ML Automatizado / <https://github.com/santiagomota>



Coneectar dos servidores

CLOUD STATUS

✓ HEALTHY ✓ CONSENSUS 🔒 LOCKED
Version Started Nodes (Used / All)
3.18.0.2 3 minutes ago 2 / 2

NODES

Name	Ping	Cores	Load	My CPU %	Sys CPU %	GFLOPS	Memory Bandwidth	Data (Used/Total)	Data (% Cached)	GC (Free / Total / Max)
✓ 192.168.1.68:55555	a few seconds ago	16	0.032	-1	-1	13.799	11.54 GB / s	- / NaN undefined NaN%	12.84 GB / NaN undefined / 13.33 GB	
✓ 192.168.1.148:55555	a few seconds ago	4	0.510	-1	-1	12.229	17.03 GB / s	- / NaN undefined NaN%	6.95 GB / NaN undefined / 6.97 GB	
✓ TOTAL	-	20	0.542	-	-	26.028	28.57 GB / s	- / NaN undefined NaN%	19.78 GB / NaN undefined / 20.30 GB	

 Refresh

<http://docs.h2o.ai/h2o/latest-stable/h2o-docs/faq/tunneling.html>

ML Automatizado / <https://github.com/santiagomota>



Analizar retrasos en vuelos con H2O

- Video ([link](#)), en flow ([link](#)), en R ([link](#)) y datos ([link](#))

The screenshot shows the H2O Flow web application. The title bar reads "H2O Flow" and the address bar shows "sri.h2o.ai/flow/index.html". The main menu includes Evernote, File, Edit, View, Note, Format, Window, Help, and a user icon for "Amy". Below the menu is a toolbar with various icons for file operations like Open, Save, Import, Export, and a search bar.

The central area is titled "Predicting Airline Delays". A sub-section titled "The Data" explains that the data comes from RITA and provides three download options: 2 Thousand Rows - 4.3MB, 5.8 Million Rows - 580MB, and 152 Million Rows (Years: 1987-2013) - 14.5GB.

The "Business Benefits" section discusses how predicting delays can help businesses make better decisions and avoid logistic issues.

At the bottom, there is a code editor window containing R code for importing files from S3:

```
importFiles [ "s3n://h2o-airlines-unpacked/allyears.1987.2013.csv" ]  
setupParse paths: [ "s3n://h2o-airlines-unpacked/allyears.1987.2013.csv" ]  
  
parseFiles  
  paths: [ "s3n://h2o-airlines-unpacked/allyears.1987.2013.csv" ]  
  destination_frame: "allyears2k.hex"  
  parse_type: "CSV"  
  separator: 44  
  number_columns: 31
```

The status bar at the bottom right indicates "Connections: 0" and the H2O logo.

<http://university.h2o.ai/data-science-101/lesson2.html>

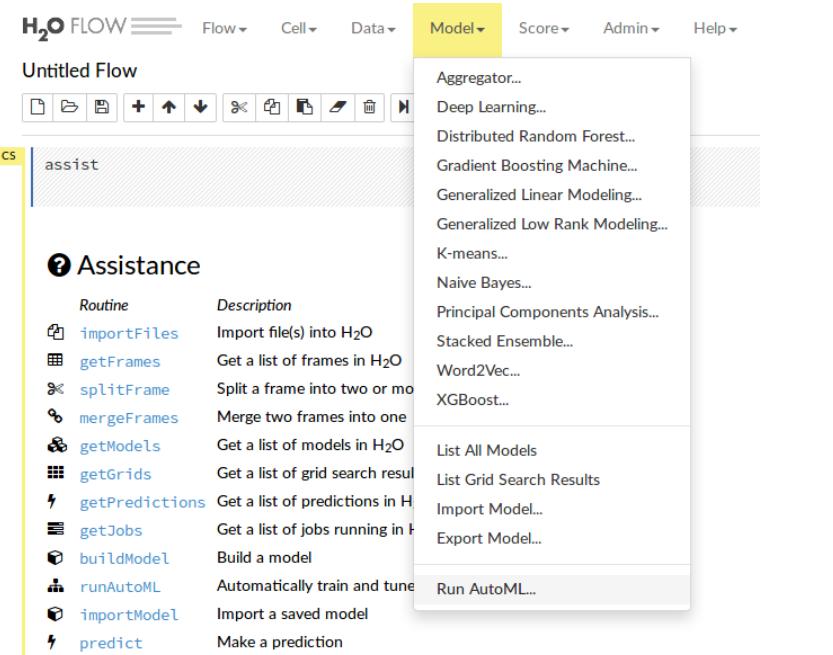
ML Automatizado / <https://github.com/santiagomota>



AutoML

- Sólo hay que darle el dataset, target y tiempo
- Básicamente hace un stacking de modelos

```
tiempo_inicio <- Sys.time()
automl_models_h2o <- h2o.automl(
  x = x,
  y = y,
  training_frame = training_h2o,
  validation_frame = validating_h2o,
  # leaderboard_frame = test_h2o,
  max_runtime_secs = 6000, # 180
  stopping_metric = "AUTO")
print(Sys.time()-tiempo_inicio)
```



Demo. Crímenes en L.A.

- Basada en estos posts ([link1](#) y [link2](#))
- Con datos de opendata de Los Ángeles ([link](#)). Hay que bajarlos
- Los datos necesitan de tratamiento previo
- Necesitaría mas ETL y mas feature engineering
- Página de github ([link](#))

DriverlessAI

- Licencia
- Coste (precio anual + equipos)
- Docker
- Vídeo

DriverlessAI. Requerimientos

- 64G de RAM
- GPU con CUDA (Pascal o Volta)
- Docker (o Nvidia docker)
- Cloud, Server, Desktop
- Linux, Mac, Windows 10

<http://docs.h2o.ai/driverless-ai/latest-stable/docs/userguide/installing.html>

ML Automatizado / <https://github.com/santiagomota>



DriverlessAI

H2O.ai Experiment

1.0.20

DATASETS EXPERIMENTS MLI H2O-3 HELP PY_CLIENT LOGOUT H2OAI

TRAINING DATA

DATASET

CreditCard_train.csv

ROWS

17K

COLUMNS

25

DROPPED COLS

1

VALIDATION DATASET

Yes

CreditCard_valid.csv

TEST DATASET

Yes

CreditCard_test.csv

TARGET COLUMN

default payment next

FOLD COLUMN

--

WEIGHT COLUMN

--

TIME COLUMN

[AUTO]

TYPE

bool

COUNT

16784

UNIQUE

2

FREQ

3740

EXPERIMENT SETTINGS HELP



ACCURACY



TIME



INTERPRETABILITY

SCORER

- GINI
- MCC
- F1
- LOGLOSS
- AUC
- AUCPR

CLASSIFICATION

REPRODUCIBLE

ENABLE GPUS

LAUNCH EXPERIMENT

<http://docs.h2o.ai/driverless-ai/latest-stable/docs/userguide/launching.html>

ML Automatizado / <https://github.com/santiagomota>



DriverlessAI



<http://docs.h2o.ai/driverless-ai/latest-stable/docs/userguide/launching.html>

ML Automatizado / <https://github.com/santiagomota>



DriverlessAI

H2O.ai Experiment hirivuke 1.0.20

TRAINING DATA

DATASET CreditCard_train.csv

ROWS 17K COLUMNS 25 DROPPED COLS 1 VALIDATION DATASET Yes TEST DATASET Yes CreditCard_valid.csv CreditCard_test.csv

TARGET COLUMN default payment next FOLD COLUMN --

WEIGHT COLUMN -- TIME COLUMN [OFF]

TYPE bool COUNT 16784 UNIQUE 2 FREQ 3740

ITERATION DATA - VALIDATION

0.7837

VARIABLE IMPORTANCE

Variable	Importance
11_WoE:PAY_0:PAY_5.0	1.00
29_CVTE:PAY_0:PAY_2:PAY_3.0	0.30
59_NumToCatWoEMonotonic:BILL_AMT2:PAY_3:PAY_AMT1.0	0.06
67_NumToCatWoEMonotonic:PAY_4:PAY_5:PAY_AMT2.0	0.05
92_CVTE:PAY_0.0	0.05
75_BILL_AMT1	0.05
61_NumToCatWoEMonotonic:LIMIT_BAL:PAY_4:PAY_AMT6.0	0.04
12_CVTE:PAY_2:PAY_5.0	0.04
107_WoE:EDUCATION:MARRIAGE:SEX:0	0.04
56_NumToCatWoE:PAY_AMT3.0	0.03
38_NumToCatWoE:BILL_AMT5.0	0.03
108_CVCTNumEnc:LIMIT_BAL:PAY_0:SEX:BILL_AMT4:mean...	0.03
68_NumToCatWoEMonotonic:LIMIT_BAL:PAY_4:PAY_AMT5:...	0.03
26_WoE:AGE:EDUCATION:MARRIAGE:0	0.03

EXPERIMENT SETTINGS

SCORER GINI MCC F1 LOGLOSS AUC AUCPR

STATUS: COMPLETE

INTERPRET THIS MODEL ON ORIGINAL FEATURES
INTERPRET THIS MODEL ON TRANSFORMED FEATURES
SCORE ON ANOTHER DATASET...
TRANSFORM ANOTHER DATASET...

CLASSIFICATION REPRODUCIBLE ENABLE GPUs

EXPERIMENT SETTINGS

EXPERIMENT SETTINGS

CPU / MEMORY

CPU MEM

ROC CURVE

EXPERIMENT: hirivuke, 2018-02-12 18:51, 1.0.20
Settings: B/2/B, seed=51540401, GPUs enabled
Train data: CreditCard_train.csv (16784, 24)
Validation data: CreditCard_valid.csv (2387, 24)
Test data: CreditCard_test.csv (4828, 23)
Target column: default payment next month (binary, 22.263% target class)
System specs: Docker/Linux, 220 GB RAM, 40 CPU cores, 2/2 GPUs
Recipe: AutoDL (10 Iterations, 4 individuals)
Validation scheme: user-given validation data
Feature engineering: 408 features tested (69 selected)
Timing:
Data preparation: 4.01 secs
Model parameter tuning: 37.66 secs (9 models trained)
Feature engineering: 111.36 secs (27 models trained)
Final model training: 31.30 secs (2 models trained)
Validation score: AUC = 0.78269 +/- 0.012227 (Iteration 1)
Validation score: AUC = 0.78371 +/- 0.011307 (final model)
Test score: AUC = 0.76401 +/- 0.0082813 (final model)

2017-2018 H2O.ai. All rights reserved.

https://www.youtube.com/watch?time_continue=43&v=KkvWX3FD7y

ML Automatizado / <https://github.com/santiagomota>



DriverlessAI. Prueba en Kaggle Favorita

- Concurso Kaggle Favorita ([link](#))
- Estación de trabajo Z800. 16 cores. 24G RAM sin GPU
- Posición final: 126 de 1675 (medalla de bronce)
- Métrica: Normalized Weighted Root Mean Squared Logarithmic Error
- Mis mejores resultados: 0,520 (combinado) y 0,521 con un modelo LGBM.
- Resultado del ganador: 0,509
- Mejor resultado DriverlessAI: 1,240 (posición 1.131)

<https://www.kaggle.com/c/favorita-grocery-sales-forecasting/leaderboard>

ML Automatizado / <https://github.com/santiagomota>



Una solución: Pred028. 1,264. 1:20:00

H2O.ai Experiment 7bf05b 1.0.10

TRAINING DATA

Dataset: train.csv
Rows: 125M Columns: 6 Dropped Cols: -- Test Dataset: Yes

Target Column: unit_sales

Weight Column: --

Type: real Count: 125497040 Mean: 8.555 Std Dev: 23.605

TIME COLUMN: [AUTO]

ITERATION SCORES - INTERNAL VALIDATION

RMSE: 15.5910

EPOCHS ▶

STATUS: COMPLETE

- INTERPRET THIS MODEL
- SCORE ON ANOTHER DATASET
- TRANSFORM ANOTHER DATASET

EXPERIMENT SETTINGS

- ACCURACY: 4
- TIME: 2
- INTERPRETABILITY: 1

SCORER: R2, MSE, RMSE, RMSLE, MAE, GINI, AUC, MCC, F1, LOGLOSS

CLASSIFICATION, REPRODUCIBLE, ENABLE GPUs

CPU / MEMORY

CPU: Trace

MEM: Trace

VARIABLE IMPORTANCE

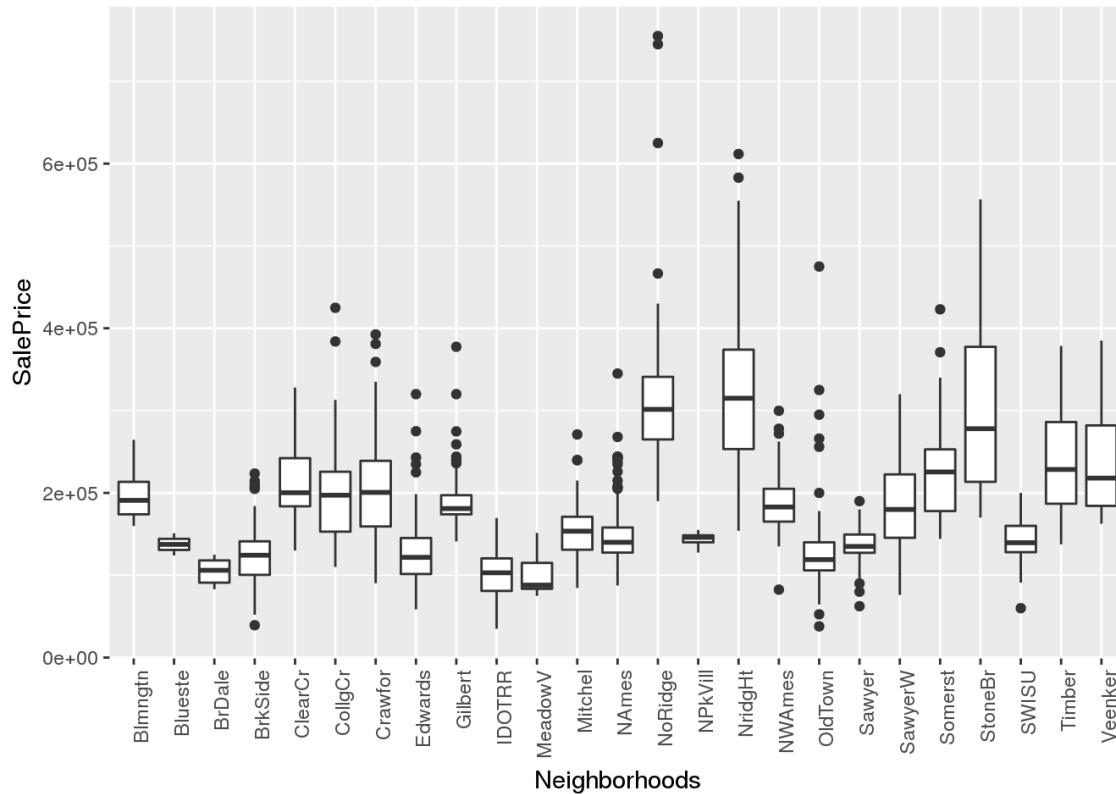
Variable	Importance
0_CV_TE_item_nbr_0	1.00
5_ClusterDist_10.item_nbr_store_nbr_0	0.50
25_date_get_day_in_month_x	0.48
1_CV_TE_store_nbr_0	0.28
25_date_get_day_in_year_y	0.28
31_NumToCatTE_item_nbr_store_nbr_0	0.22
28_Freq_item_nbr	0.20
5_ClusterDist_10.item_nbr_store_nbr_1	0.19
29_Freq_item_nbr_store_nbr	0.18
4_store_nbr	0.16
5_ClusterDist_10.item_nbr_store_nbr_3	0.11
25_date_get_weekday_in_week_x	0.10
25_date_get_day_in_year_x	0.10
19_ClusterDist_6.item_nbr_store_nbr_5	0.07

EXPERIMENT SUMMARY

Experiment: 7bf05b, 2017-12-20 18:26
Settings: 4/2/1, seed=1201534438, GPUs disabled
Train data: train.csv (2500000, 6)
Test data: test.csv (3370464, 5)
Target column: unit_sales (regression)
System specs: 24 GB RAM, 16 CPU cores, 0/0 GPU
Recipe: AutoDL (20 iterations, 4 individuals)
Validation scheme: random, 1 internal holdout
Feature engineering: 296 features tested (83 selected)
Timing:
Data preparation: 137.05 secs
Model parameter tuning: 17.69 secs (1 models trained)
Feature engineering: 3659.07 secs (44 models trained)
Final model training: 812.11 secs (1 models trained)
Score on train (internal holdout): RMSE = 16.27623 (iteration 1)
Score on train (internal holdout): RMSE = 15.59097 (final model)
Score on test (external holdout): RMSE = N/A

Concurso precios de alquileres (Kaggle)

- Página del concurso. Tutoriales. Kernels y Foro



Conclusiones

- En muy poco tiempo (¿este año?) vamos a tener herramientas comerciales de Machine Learning Automatizado como DriverlessAI
- Inicialmente su uso tendrá sentido en determinados escenarios
- La herramienta H2O (gratuita) tiene mucho sentido, por su capacidad de escalar, sus distintas interfaces y sus posibilidades de paralelización
- AutoML tiene aún mucho camino que recorrer

Meetup de R de Madrid

- Página de meetup ([link](#))
- Página del grupo con vídeos y presentaciones ([link](#))



The slide features a dark background with a red circular graphic on the right. At the top left is the logo for 'Comunidad R Hispano'. Below it, the title 'GRUPO DE USUARIOS DE R DE MADRID' is displayed. The slide contains the following information:

- Fecha:** Jueves 8 de marzo
- Lugar:** THE CUBE - Rufino González 25
- Hora:** 7:00pm - 8:30pm
- Acceso:** Libre
- Cómo llegar:** Metro Suanzes
- Programa:** (Cervezas: En el mismo TheCube)
- Más detalles en:** <http://madrid.r-es.org>

Presentaciones:

- Francisco Rodriguez: "Análisis NLP de textos en esperanto".
- Carlos Ortega: "Deep LeaRning for Cancer Immunotherapy".

Nuestros patrocinadores:

kabel **R consortium** **UNED MÁSTER EN BIG DATA Y DATA SCIENCE**

<http://madrid.r-es.org/>



The Big Bang Theory @bigbangtheory · 6 h

In loving memory of Stephen Hawking. It was an honor to have him on The #BigBangTheory. Thank you for inspiring us and the world.

Traducir del inglés



460



20K



46K



<https://twitter.com/bigbangtheory/status/973789142780964864>

ML Automatizado / <https://github.com/santiagomota>



GRACIAS

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