Machine Learning Introduction

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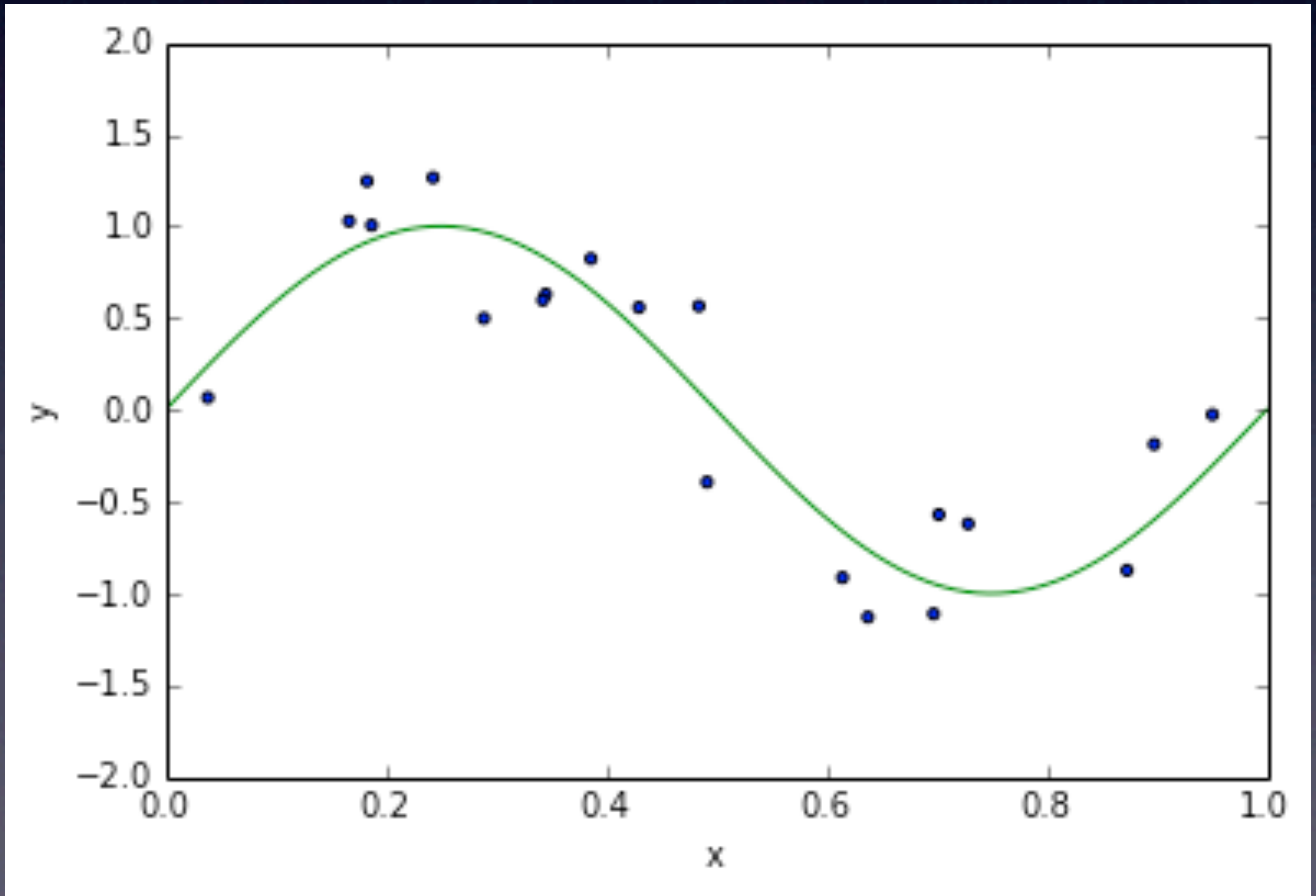
Example Data

20 datapoints for
sinusoid + gaussian noise: y=f(x)

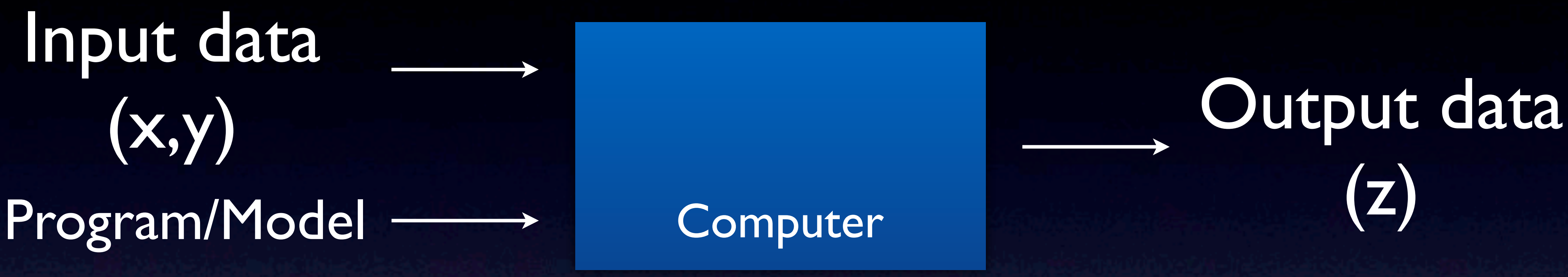


Definitions/Conventions

- Unknown function $z=f(x,y)$ (including noise)
- Function is sampled at various data points: $(x1,y1) = z1$, $(x2,y2)=z2$, $(x3,y3)=z3$, etc...
- x, y are called features (aka variables)
- z is called the response (aka target, label)
- data points #1, 2, 3, etc... are called samples (aka observations)

What is ML?

"Standard Programming"

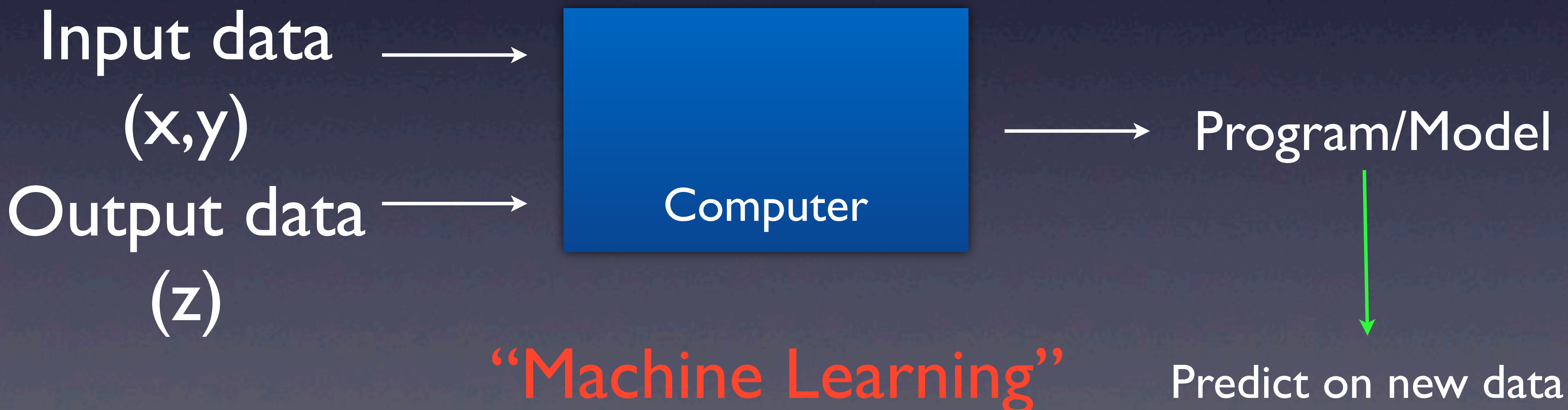


Input data
(x,y)

Program/Model

Computer

Output data
(z)



Input data
(x,y)

Output data
(z)

Computer

Program/Model

Predict on new data

"Machine Learning"
(Supervised)

Definitions/Conventions

- Unsupervised learning: categorize/characterize/find trends in arbitrary dataset (e.g.: clustering in x,y plane, in the absence of z)
- Supervised learning: predict after learning from a set of example datapoints: z=f(x,y)
- Regression: supervised learning with continuous, ordered response (e.g. 0-1000)
- Classification: supervised learning with categorical response (e.g. yes/no, black/white)

A variety of algorithms

Supervised Regression

- Simple and multiple linear regression
- Decision tree, random forest
- Artificial Neural networks
- Nearest neighbor methods (e.g., k-NN or k-Nearest Neighbors)
- ...

Supervised Two-class & Multi-class Classification

- Logistic regression and multinomial regression
- Artificial Neural networks
- Decision tree, random forest
- SVM (support vector machine)
- Bayesian classifiers (e.g., Naive Bayes)
- Nearest neighbor methods (e.g., k-NN or k-Nearest Neighbors)
- ....

Unsupervised

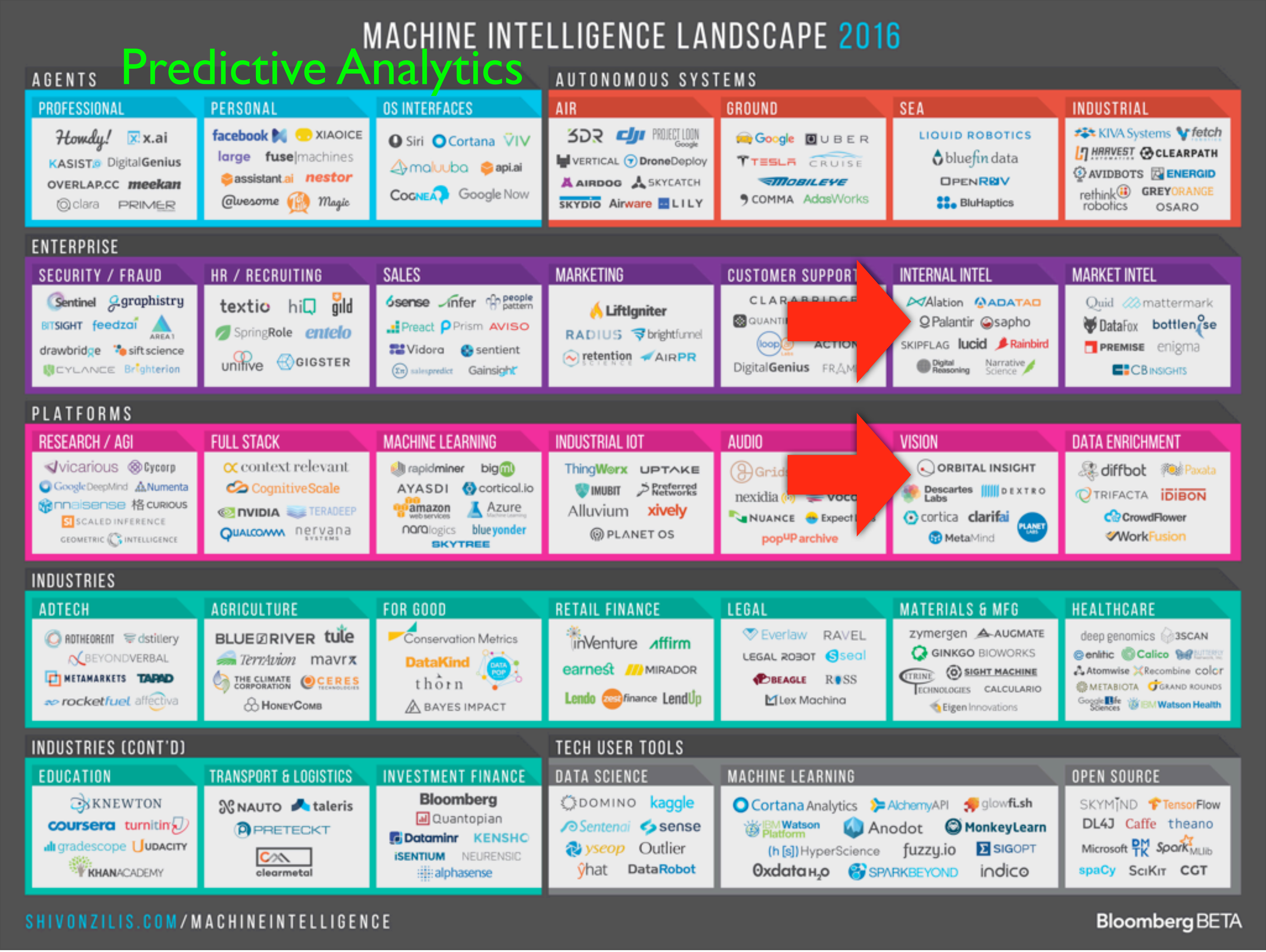
- K-means clustering
- PCA (principal component analysis)
- ...

ML project: general steps

- Data selection and pre-processing
- Data splitting (cross-validation)
- Feature selection (remove) and feature engineering (add)
- Model selection & optimization
- Deployment/Prediction phase

General Workshop Goals

- Learn about various steps in a ML project
- Learn about various algorithms available
- Use scikit-learn platform
- Practice!
- Solve new science problems!?



MACHINE INTELLIGENCE LANDSCAPE 2016

Predictive Analytics

AGENTS

PROFESSIONAL
Howdy!, x.ai, KASISTO, DigitalGenius, OVERLAP.CC, meekan, clara, PRIMER

PERSONAL
facebook M, XIAOICE, large, fuse|machines, assistant.ai, nestor, @wesome, Magic

OS INTERFACES
Siri, Cortana, VIV, maluuba, api.ai, COGNEA, Google Now

AUTONOMOUS SYSTEMS

AIR
3DR, dji, PROJECT LOON Google, VERTICAL, DroneDeploy, AIRDOG, SKYCATCH, SKYDIO, Airware, LILY

GROUND
Google, UBER, TESLA, CRUISE, MOBILEYE, COMMA, AdasWorks

SEA
LIQUID ROBOTICS, bluefin data, OPENROV, BluHaptics

INDUSTRIAL
KIVA Systems, fetch, HARVEST AUTOMATION, CLEARPATH, AVIDBOTS, ENERGID, rethink robotics, GREYORANGE, OSARO

ENTERPRISE

SECURITY / FRAUD
Sentinel, graphistry, BITSIGHT, feedzai, AREA 1, drawbridge, sift science, CYLANCE, Brighterion

HR / RECRUITING
textio, hiQ, gild, SpringRole, entelo, unitive, GIGSTER

SALES
6sense, infer, people pattern, Preact, Prism, AVISO, Vidora, sentient, salespredict, Gainsight

MARKETING
LiftIgniter, RADIUS, brightfunnel, retention science, AIRPR

CUSTOMER SUPPORT
CLARABRIDGE, QUANTI, loop, ACTION, DigitalGenius, FRAM

INTERNAL INTEL
Alation, ADATAO, Palantir, sapho, SKIPFLAG, lucid, Rainbird, Digital Reasoning, Narrative Science

MARKET INTEL
Quid, mattermark, DataFox, bottlenose, PREMISE, enigma, CB INSIGHTS

PLATFORMS

RESEARCH / AGI
vicarious, Cycorp, Google DeepMind, Numenta, nnaisense, CURIOUS, SCALED INFERENCE, GEOMETRIC INTELLIGENCE

FULL STACK
context relevant, CognitiveScale, NVIDIA, TERADEEP, QUALCOMM, nervana systems

MACHINE LEARNING
rapidminer, bigml, AYASDI, cortical.io, amazon web services, Azure Machine Learning, nara logics, blue yonder, SKYTREE

INDUSTRIAL IOT
ThingWorx, UPTAKE, IMUBIT, Preferred Networks, Alluvium, xively, PLANET OS

AUDIO
Grid, nexidia, voco, NUANCE, Expect L, popUp archive

VISION
ORBITAL INSIGHT, Descartes Labs, DEXTRO, cortica, clarifai, MetaMind, PLANET LABS

DATA ENRICHMENT
diffbot, Paxata, TRIFACTA, iDIBON, CrowdFlower, WorkFusion

INDUSTRIES

ADTECH
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BLUE RIVER, tule, TerrAvion, mavrx, THE CLIMATE CORPORATION, CERES, HoneyComb

FOR GOOD
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zymergen, AUGMATE, GINKGO BIOWORKS, CITRINE TECHNOLOGIES, SIGHT MACHINE, CALCULARIO, Eigen Innovations

HEALTHCARE
deep genomics, 3SCAN, enlitic, Calico, BUTTERFLY, Atomwise, Recombine, color, METABIOTA, GRAND ROUNDS, Google Life Sciences, IBM Watson Health

INDUSTRIES (CONT'D)

EDUCATION
KNEWTON, coursera, turnitin, gradescope, UDACITY, KHANACADEMY

TRANSPORT & LOGISTICS
NAUTO, taleris, PRETECKT, clearmetal

INVESTMENT FINANCE
Bloomberg, Quantopian, Dataminr, KENSHO, iSENTIUM, NEURENSIC, alphasense

TECH USER TOOLS

DATA SCIENCE
DOMINO, kaggle, Sentenai, sense, yseop, Outlier, yhat, DataRobot

MACHINE LEARNING
Cortana Analytics, AlchemyAPI, glowfi.sh, IBM Watson Platform, Anodot, MonkeyLearn, (h[s]) HyperScience, fuzzy.io, SIGOPT, 0xdata H2O, SPARKBEYOND, indico

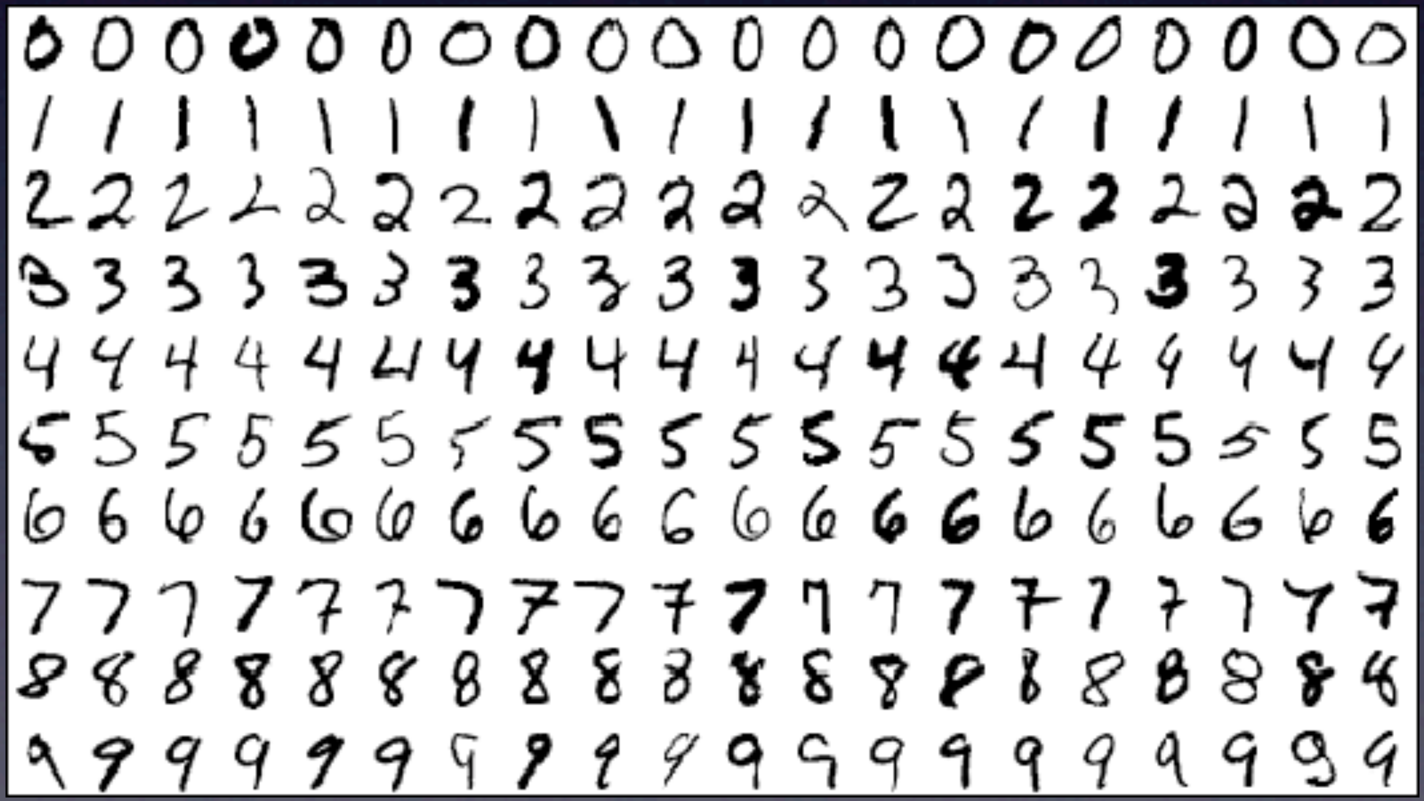
OPEN SOURCE
SKYMIND, TensorFlow, DL4J, Caffe, theano, Microsoft DMTK, Spark MLlib, spaCy, SciKit, CGT

SHIVONZILIS.COM/MACHINEINTELLIGENCE

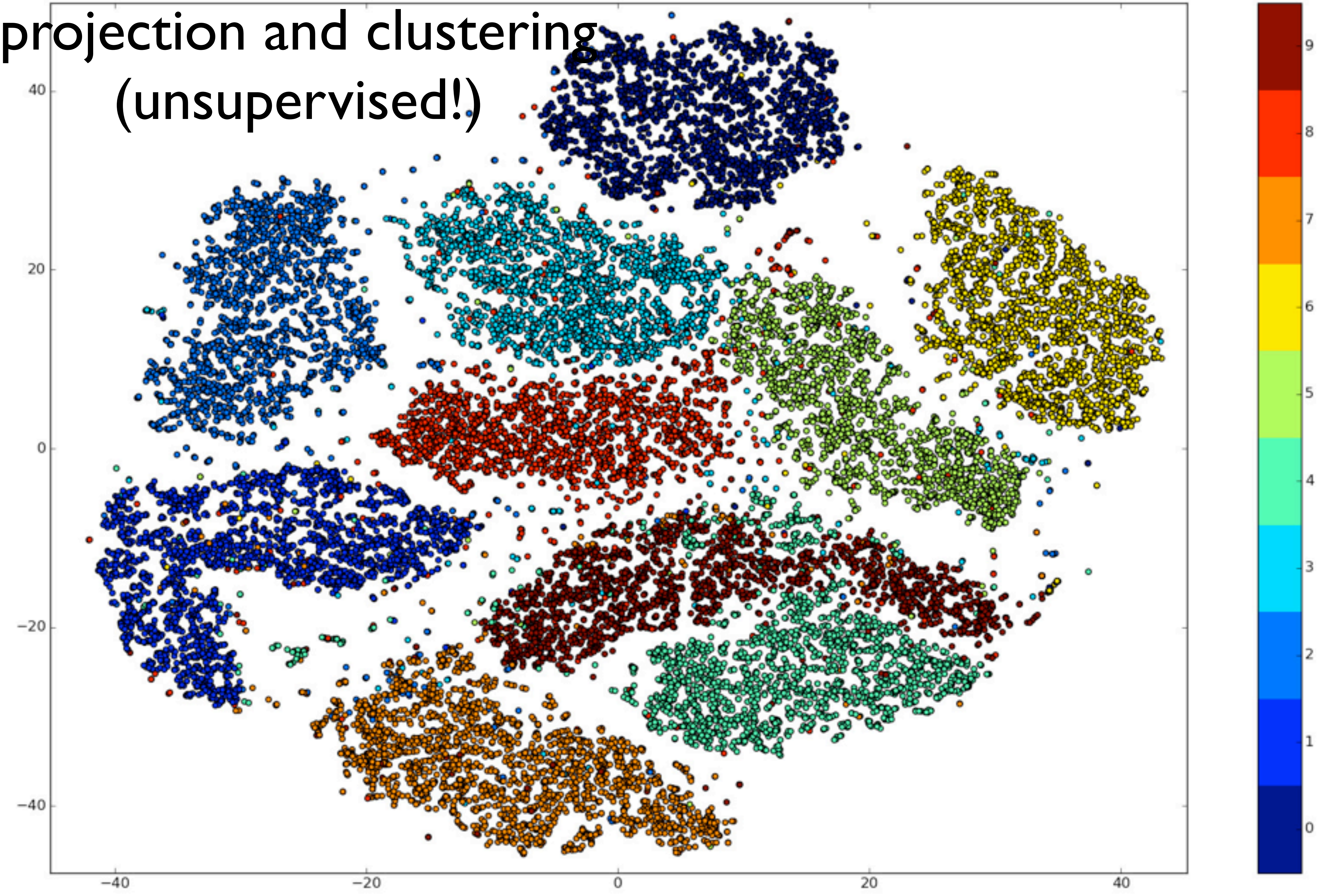
Bloomberg BETA

State-of-the-Art

MNIST data: hand-written digits
(10-class classification)



t-SNE algorithm: 2D projection and clustering (unsupervised!)



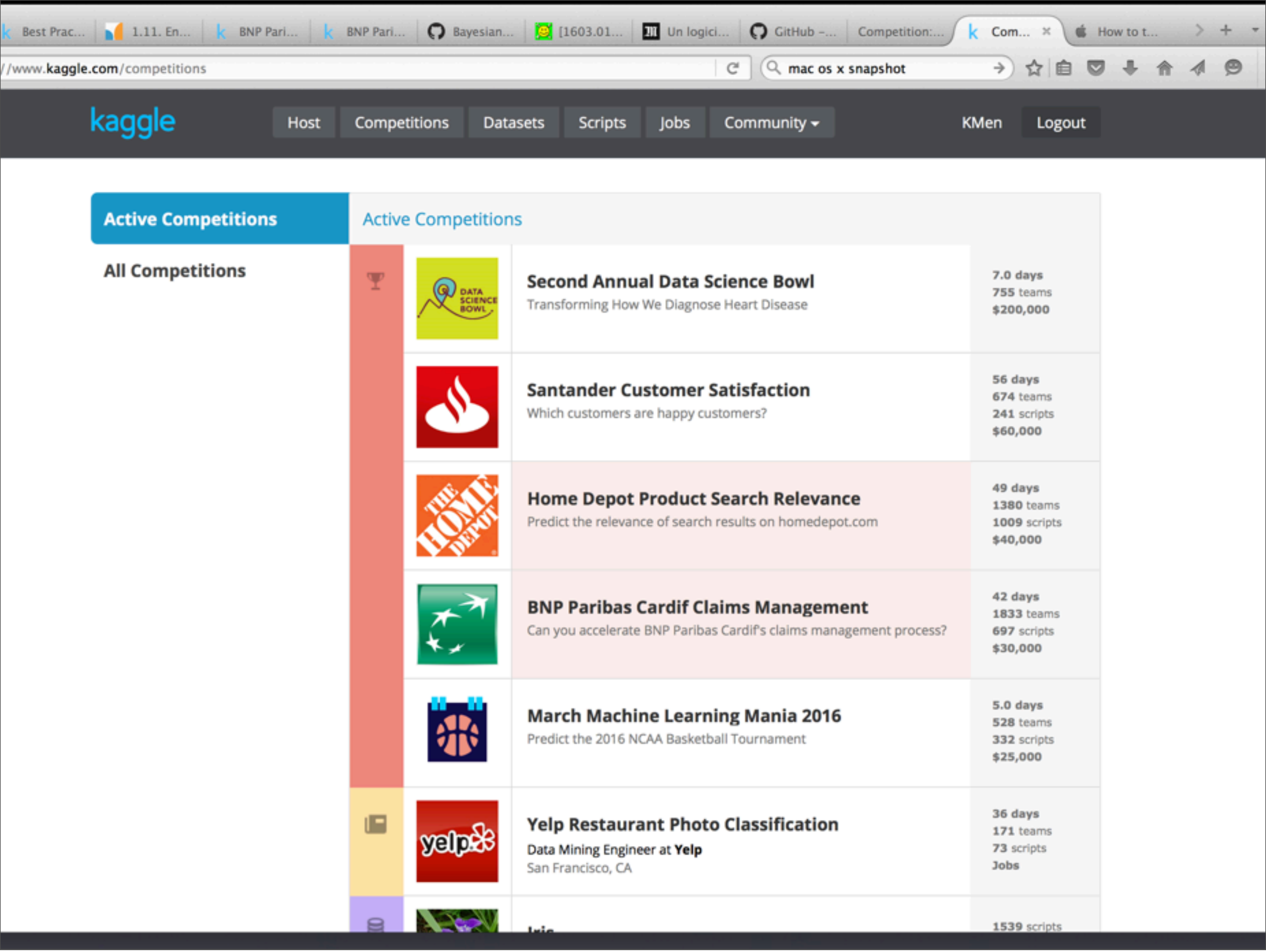
Deep Learning

ML in practice

- It is unclear what constitutes the best ML solution on a given problem
- Data science competitions provide useful comparisons (+ near-optimal solutions)
- Competition & collaboration both help

Kaggle: ML training camp

- Dataset & ML Competition Host
- Competitions: company provides data, crowd builds ML models, predict on “unseen/unlabeled” test data, best predictive model wins $$$
- Company gets crowd-sourced, near-optimal ML solution for their specific data science problem
- ~500,000 kagglers, typically ~500-3000 participate in a given competition
- Key issues: feature engineering, overfitting, ML algorithms (choice + optimization)

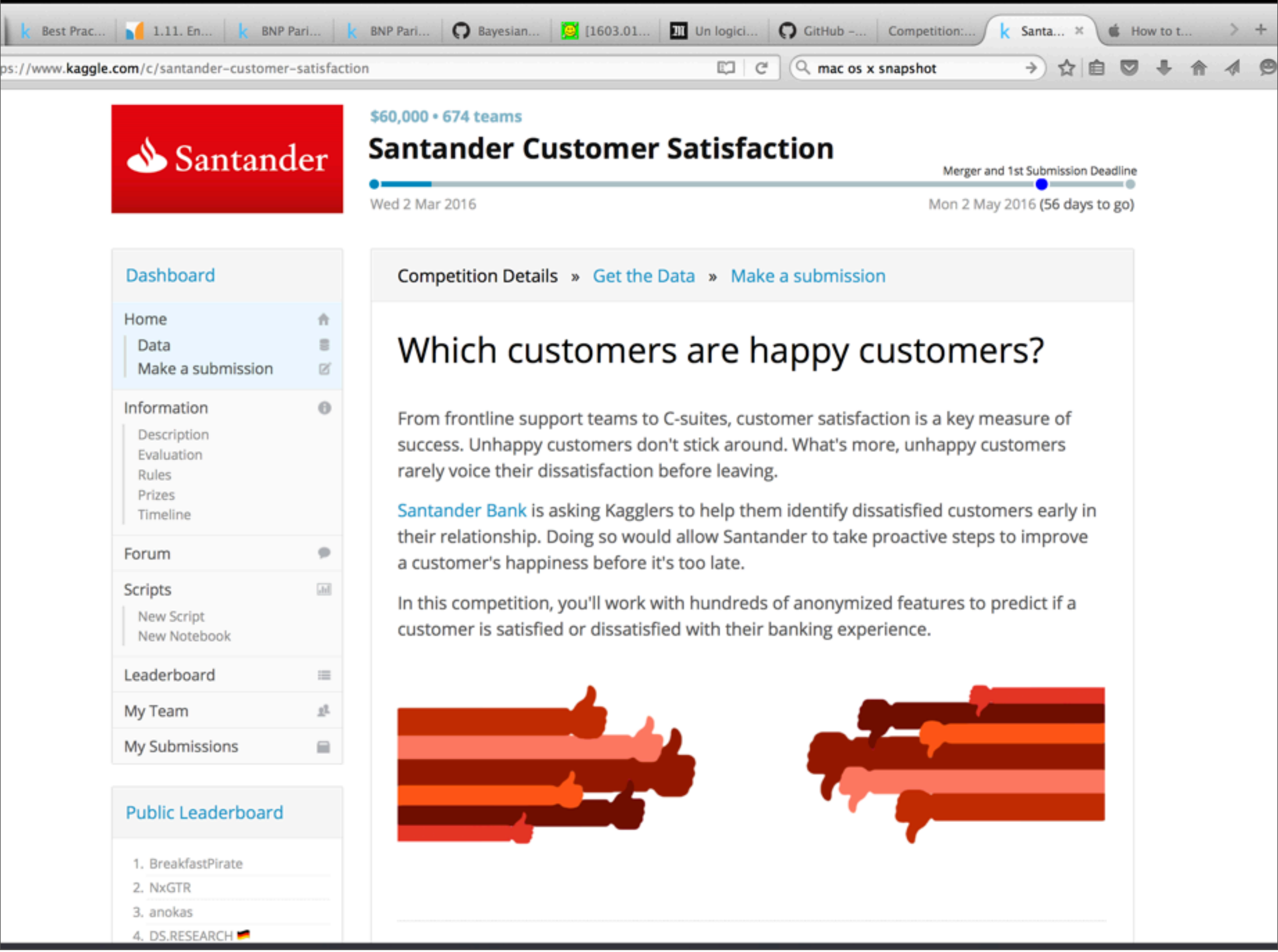


Active Competitions

All Competitions

Active Competitions

	Second Annual Data Science Bowl Transforming How We Diagnose Heart Disease	7.0 days 755 teams $200,000
	Santander Customer Satisfaction Which customers are happy customers?	56 days 674 teams 241 scripts $60,000
	Home Depot Product Search Relevance Predict the relevance of search results on homedepot.com	49 days 1380 teams 1009 scripts $40,000
	BNP Paribas Cardif Claims Management Can you accelerate BNP Paribas Cardif's claims management process?	42 days 1833 teams 697 scripts $30,000
	March Machine Learning Mania 2016 Predict the 2016 NCAA Basketball Tournament	5.0 days 528 teams 332 scripts $25,000
	Yelp Restaurant Photo Classification Data Mining Engineer at **Yelp** San Francisco, CA	36 days 171 teams 73 scripts Jobs
	Iris	1539 scripts



Santander

$60,000 • 674 teams

Santander Customer Satisfaction

Merger and 1st Submission Deadline

Wed 2 Mar 2016

Mon 2 May 2016 (56 days to go)

Dashboard

- Home
  - Data
  - Make a submission
- Information
  - Description
  - Evaluation
  - Rules
  - Prizes
  - Timeline
- Forum
- Scripts
  - New Script
  - New Notebook
- Leaderboard
- My Team
- My Submissions

Public Leaderboard

1. BreakfastPirate
2. NxGTR
3. anokas
4. DS.RESEARCH 🇩🇪

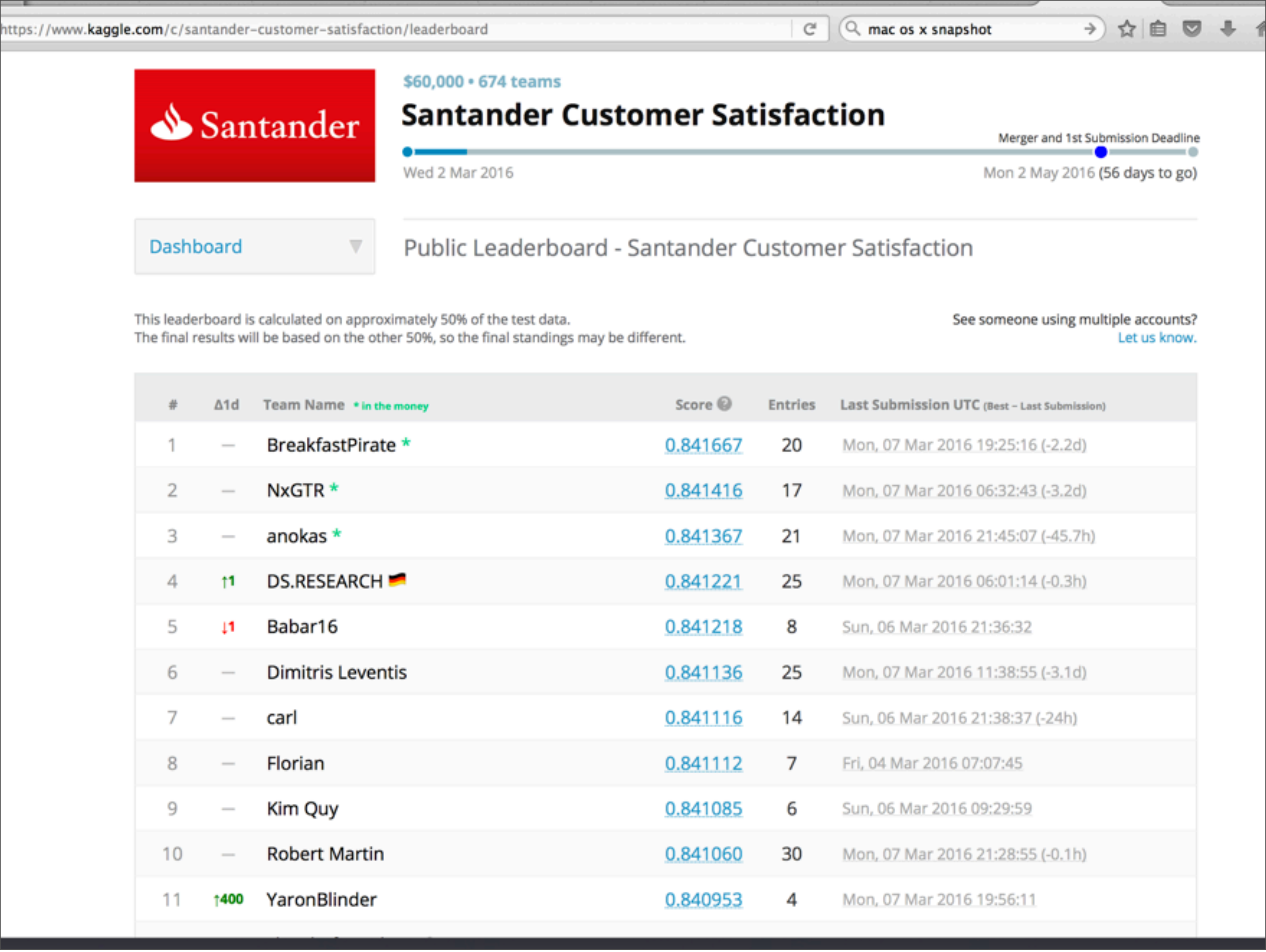
Competition Details » Get the Data » Make a submission

Which customers are happy customers?

From frontline support teams to C-suites, customer satisfaction is a key measure of success. Unhappy customers don't stick around. What's more, unhappy customers rarely voice their dissatisfaction before leaving.

Santander Bank is asking Kagglers to help them identify dissatisfied customers early in their relationship. Doing so would allow Santander to take proactive steps to improve a customer's happiness before it's too late.

In this competition, you'll work with hundreds of anonymized features to predict if a customer is satisfied or dissatisfied with their banking experience.



https://www.kaggle.com/c/santander-customer-satisfaction/leaderboard
mac os x snapshot
Santander
Dashboard

$60,000 • 674 teams

Santander Customer Satisfaction

Merger and 1st Submission Deadline

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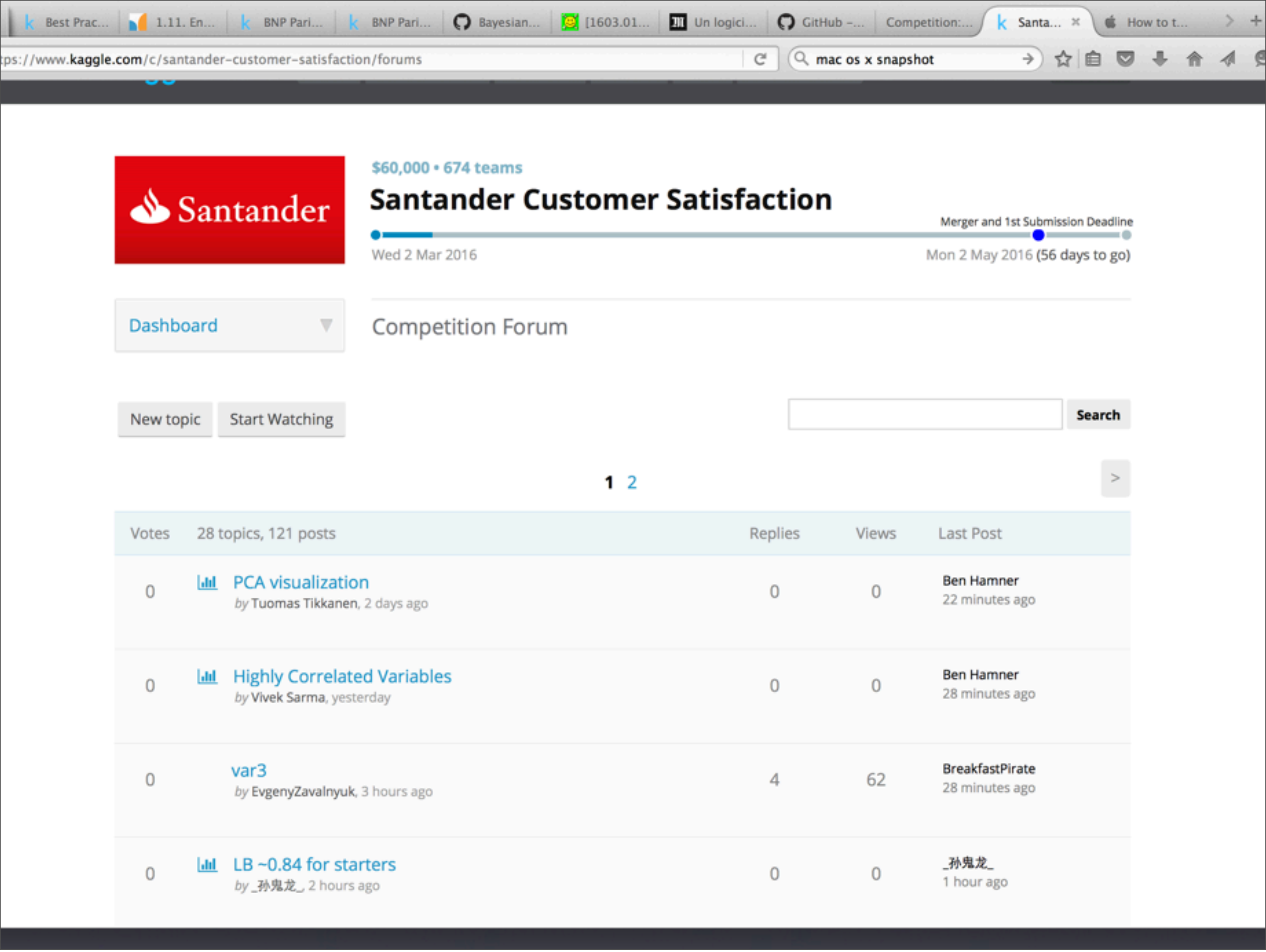
Public Leaderboard - Santander Customer Satisfaction

This leaderboard is calculated on approximately 50% of the test data.
The final results will be based on the other 50%, so the final standings may be different.

See someone using multiple accounts?
Let us know.

#	Δ1d	Team Name * in the money	Score	Entries	Last Submission UTC (Best – Last Submission)
1	—	BreakfastPirate *	0.841667	20	Mon, 07 Mar 2016 19:25:16 (-2.2d)
2	—	NxGTR *	0.841416	17	Mon, 07 Mar 2016 06:32:43 (-3.2d)
3	—	anokas *	0.841367	21	Mon, 07 Mar 2016 21:45:07 (-45.7h)
4	↑1	DS.RESEARCH 🇩🇪	0.841221	25	Mon, 07 Mar 2016 06:01:14 (-0.3h)
5	↓1	Babar16	0.841218	8	Sun, 06 Mar 2016 21:36:32
6	—	Dimitris Leventis	0.841136	25	Mon, 07 Mar 2016 11:38:55 (-3.1d)
7	—	carl	0.841116	14	Sun, 06 Mar 2016 21:38:37 (-24h)
8	—	Florian	0.841112	7	Fri, 04 Mar 2016 07:07:45
9	—	Kim Quy	0.841085	6	Sun, 06 Mar 2016 09:29:59
10	—	Robert Martin	0.841060	30	Mon, 07 Mar 2016 21:28:55 (-0.1h)
11	↑400	YaronBlinder	0.840953	4	Mon, 07 Mar 2016 19:56:11



$60,000 • 674 teams

Santander Customer Satisfaction

Merger and 1st Submission Deadline

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Dashboard ▼

Competition Forum

New topic Start Watching

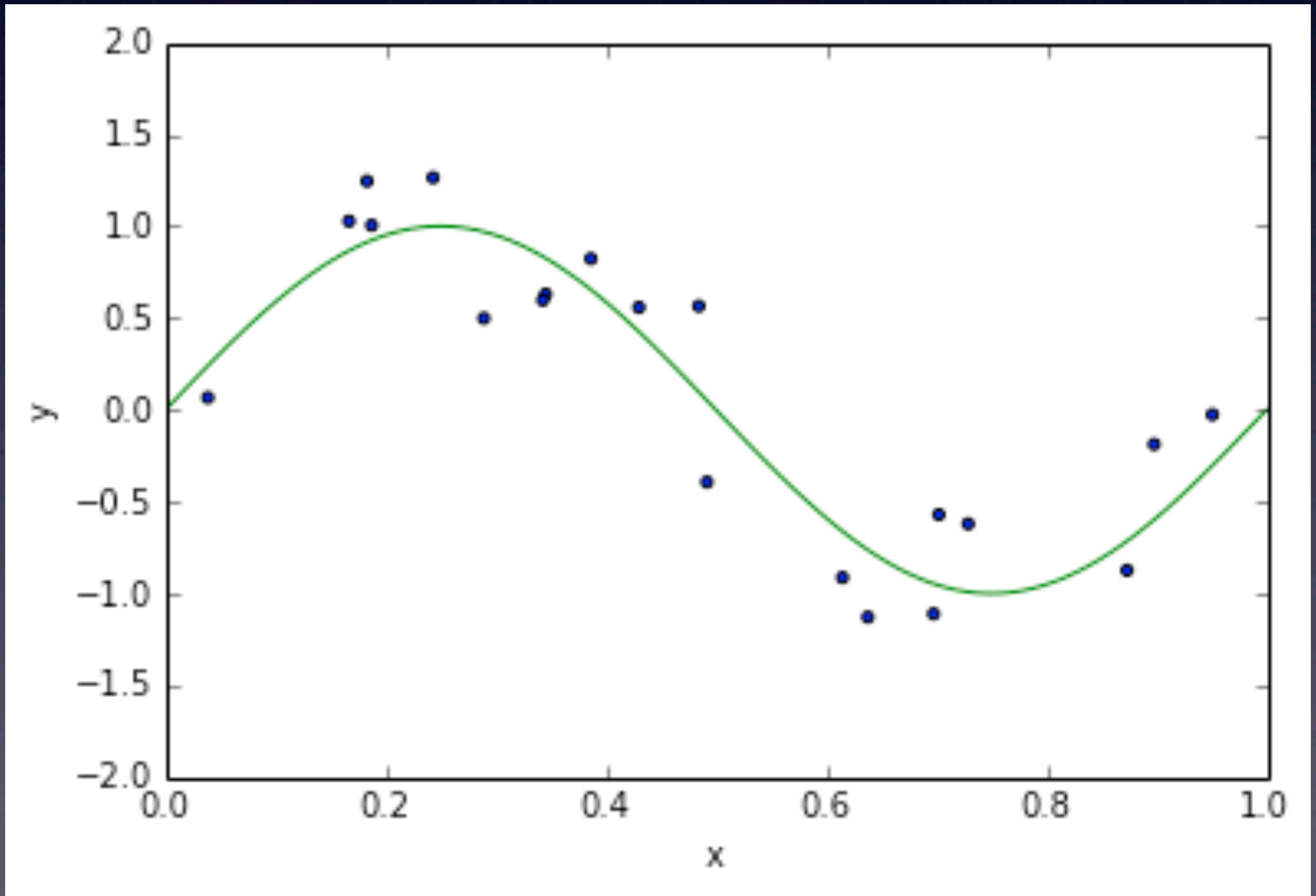
Search

1 2 >

Votes	28 topics, 121 posts	Replies	Views	Last Post
0	PCA visualization *by* Tuomas Tikkanen, 2 days ago	0	0	Ben Hamner 22 minutes ago
0	Highly Correlated Variables *by* Vivek Sarma, yesterday	0	0	Ben Hamner 28 minutes ago
0	var3 *by* EvgenyZavalnyuk, 3 hours ago	4	62	BreakfastPirate 28 minutes ago
0	LB ~0.84 for starters *by* _孙鬼龙_, 2 hours ago	0	0	_孙鬼龙_ 1 hour ago

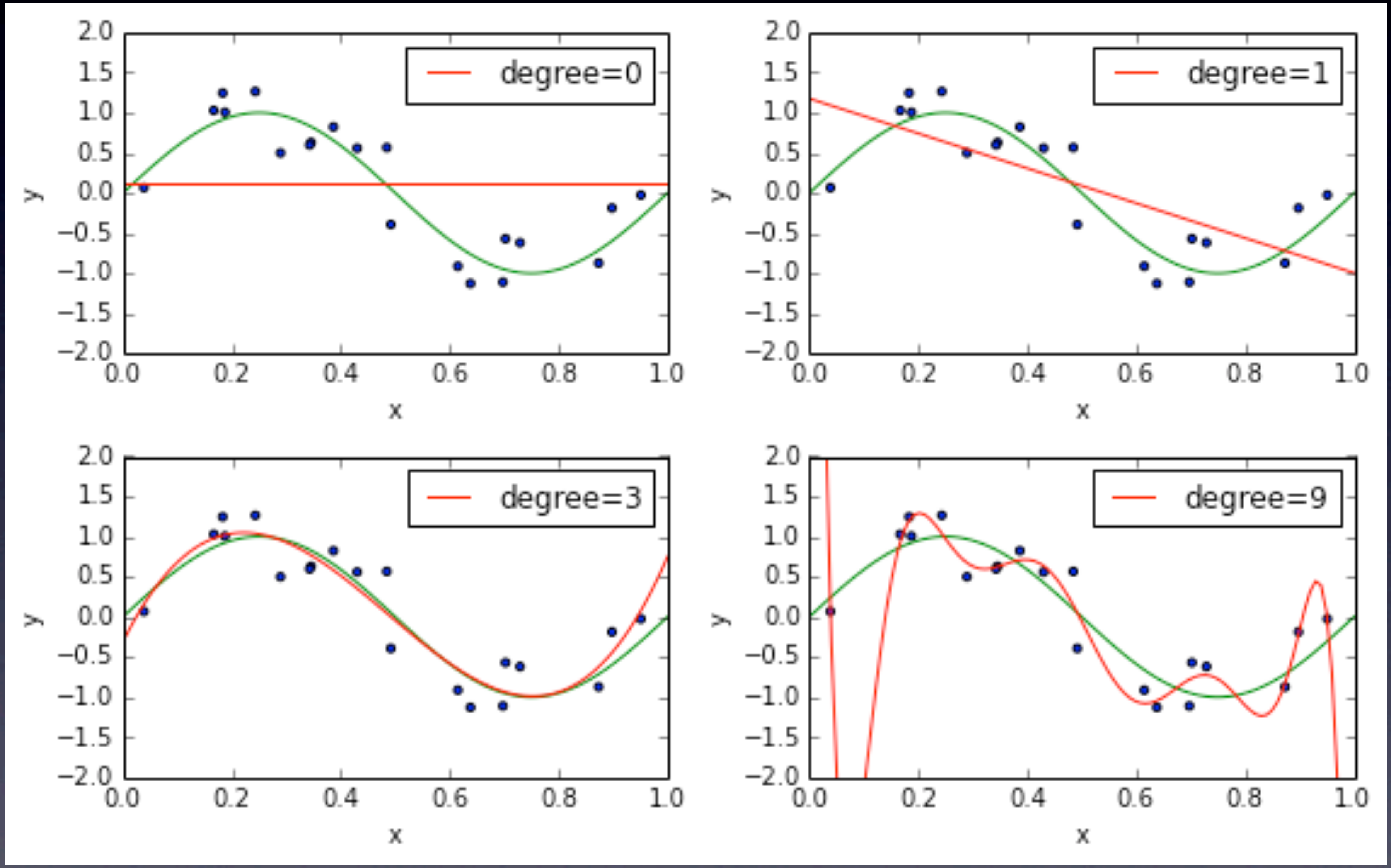
Synthetic Data

Generate 20 samples from sinusoid + gaussian noise: y=f(x)



Fitting choices

Best fit polynomials of various degrees (minimizing the squared residuals)

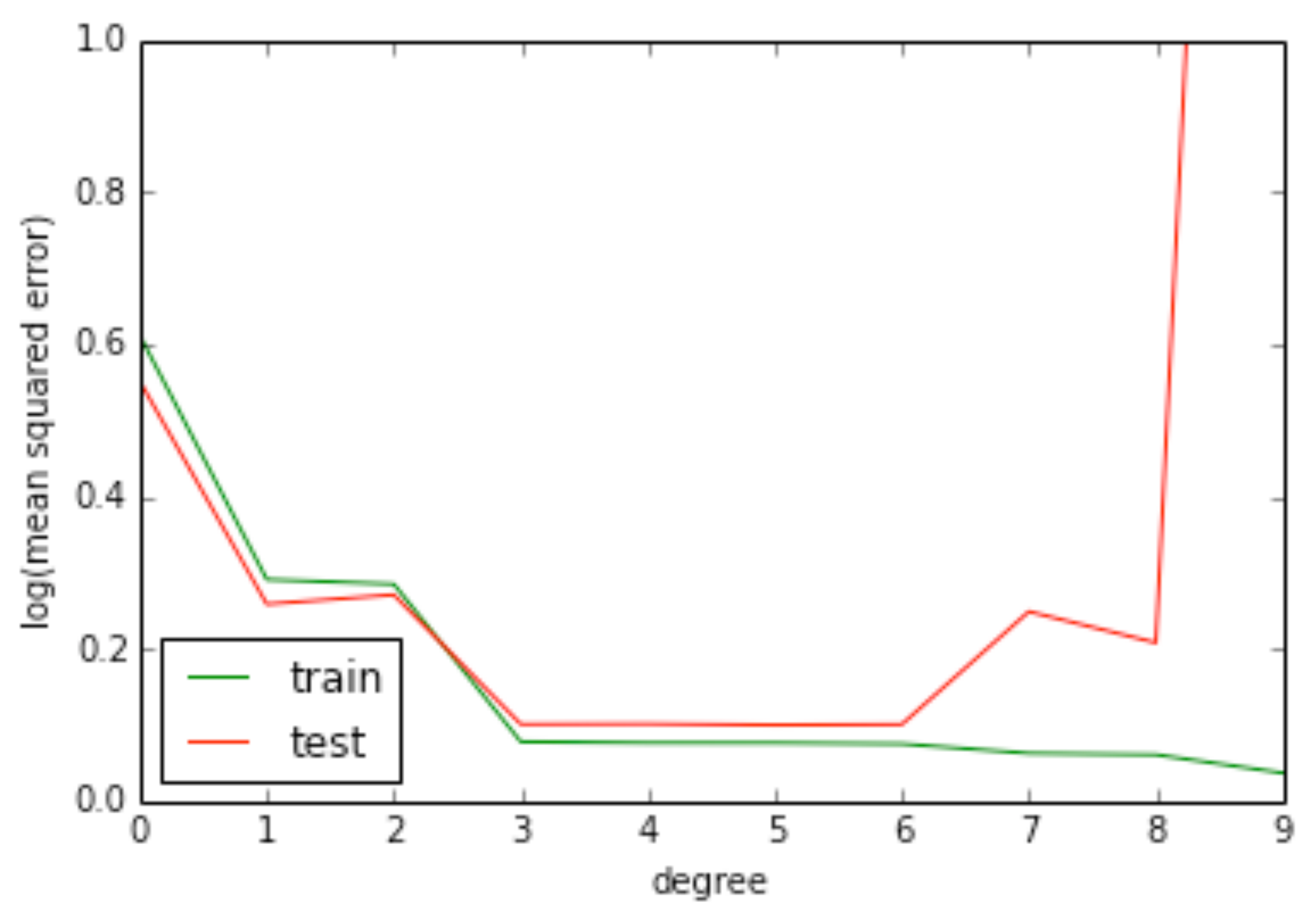


Good?

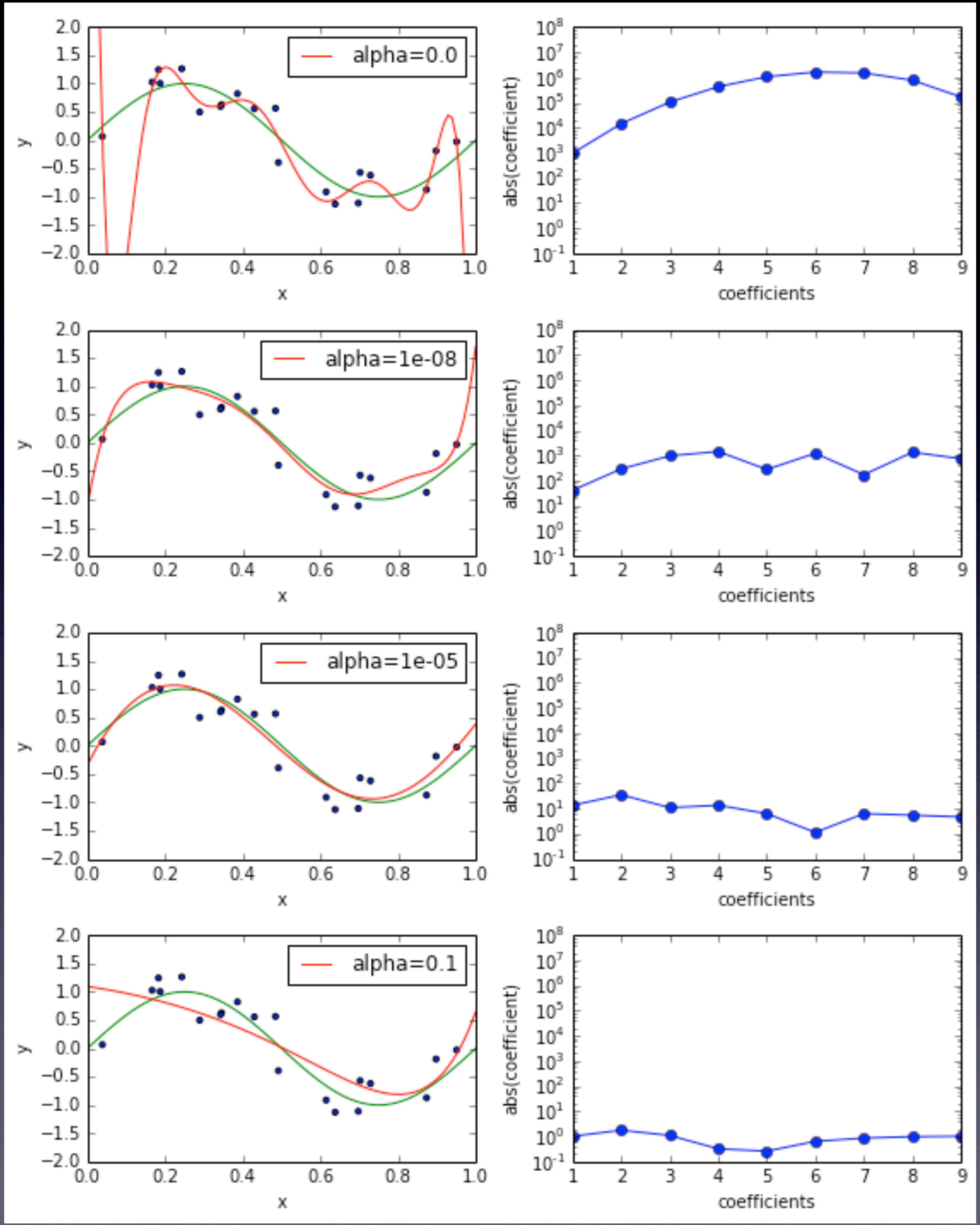
Fits the noise?
“Overfitting”

Train-Test Split

Split data points in train (say 2/3) and test (1/3)



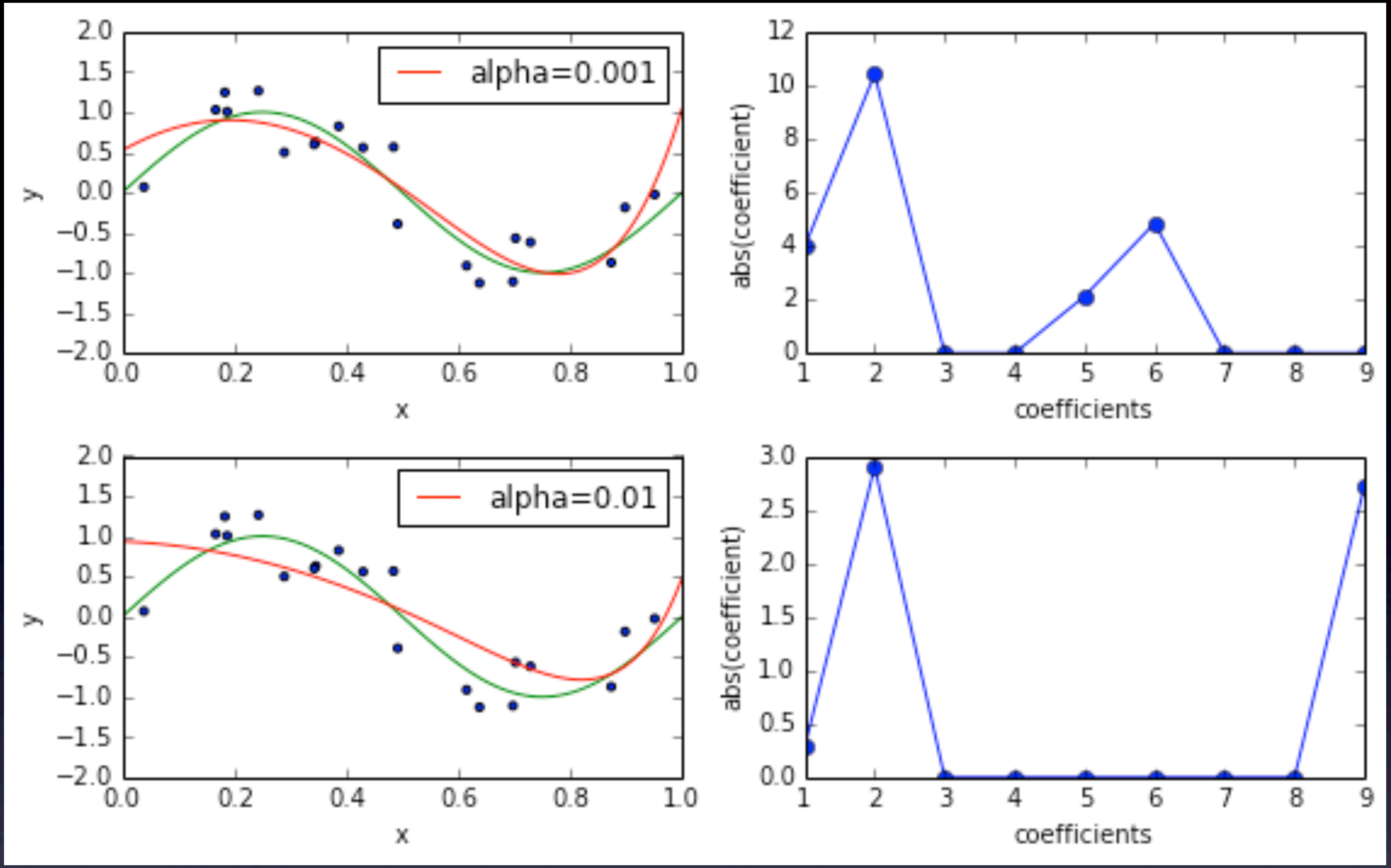
Fit/Learn/Train on train set, predict on test set (mean squared error). Best model will "generalize" best on the test data (rather than "fitting the noise" in the train data)



Strategy I:
limit complexity

Strategy 2:
regularization.

Damp coefficients of polynomial fit. Adjust free parameter with train/test validation.



Sparse regularization: zero-out coefficients preferentially (only 3-4 non-zero).

Again train/test validation required for model evaluation.

A kind of automated feature selection!

Topics for Day-1 Workshop

- Scikit-Learn
- Overfitting
- K-NN/Linear Regression
- Cross-Validation
- Plan long-term ML projects