Data Science for the Rest of Us

Brandon Rohrer, Senior Data Scientist

Welcome to the webinar!
We'll start in a minute.

If you…

are wondering whether to hire a data scientist,
are thinking about becoming a data scientist,
want to surprise and impress your data scientist co-workers,
have a loved one that is a data scientist,

… I wrote this presentation for you.

TL;DR

Data science isn't magic,
but there are tricks
and secrets.

You can’t use just any data.

Recipe

Crispy crust
Marinara sauce
Fresh mozzarella
Thick cut pepperoni
Fresh tomato

Recipe

Data that is

- Relevant
- Connected
- Accurate
- Enough

and a Sharp Question

Irrelevant data

Price of milk ($/gal)	Red Sox batting avg.	Blood alcohol content (%)
3.79	.304	.03
3.45	.320	.09
4.06	.259	.01
3.89	.298	.05
4.12	.332	.13
3.92	.270	.06
3.23	.294	.10

Relevant data

Body mass (kg)	Margaritas	Blood alcohol content (%)
103	3	.03
67	5	.09
87	1	.01
52	2	.05
73	5	.13
79	3	.06
110	7	.10

[data points] [rows] [samples] [features] [columns] [attributes] [table] [database]

Irrelevant data

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103	3	.03
67	5	.09
87	1	.01
52	2	.05
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[data points] [rows] [samples] [features] [columns] [attributes] [table] [database]

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[data points] [rows] [samples] [features] [columns] [attributes] [table] [database]

Disconnected data

Grill temperature (F)	Weight of beef patty (lb)	Burger rating (out of 10)
	.33	8.2
	.24	5.6
550		7.8
725	.45	9.4
600		8.2
625		6.8
	.49	4.2

Connected data

Grill temperature (F)	Weight of beef patty (lb)	Burger rating (out of 10)
575	.33	8.2
550	.24	5.6
550	.69	7.8
725	.45	9.4
600	.57	8.2
625	.36	6.8
550	.49	4.2

[missing values]

Disconnected data

Grill temperature (F)	Weight of beef patty (lb)	Burger rating (out of 10)
	.33	8.2
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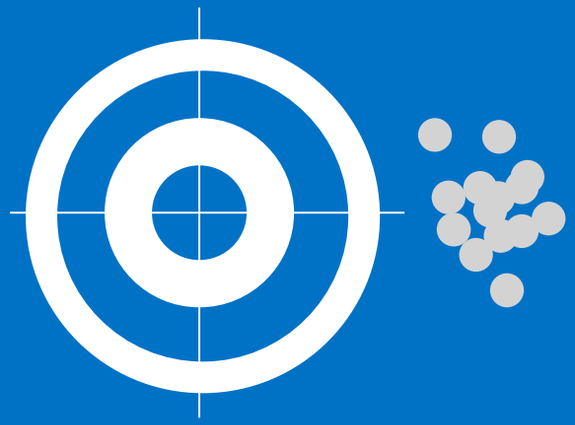
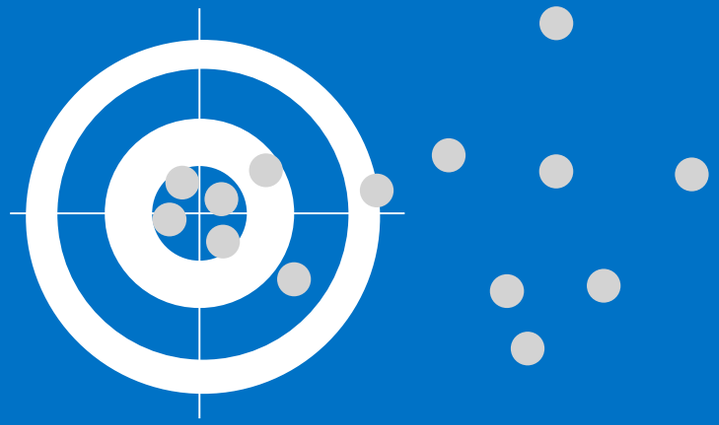
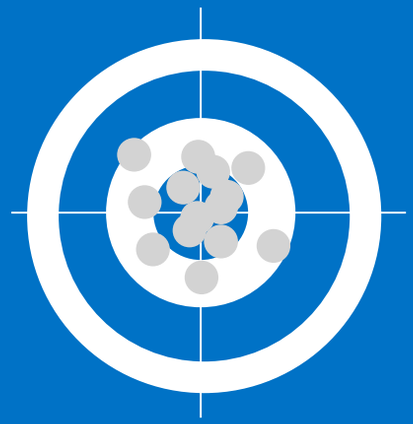
[missing values]

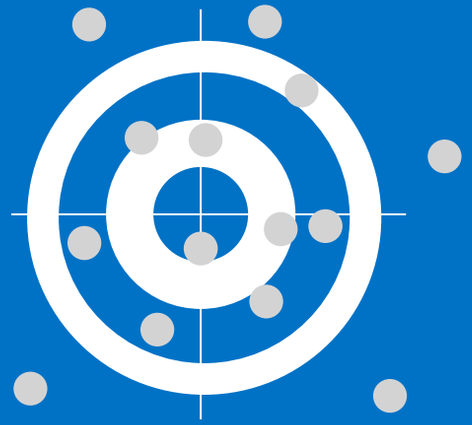
Inaccurate data





Accurate data





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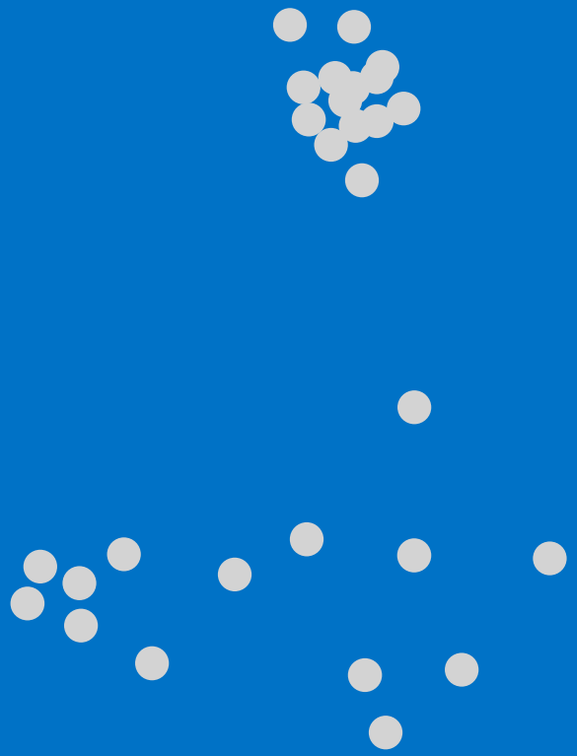
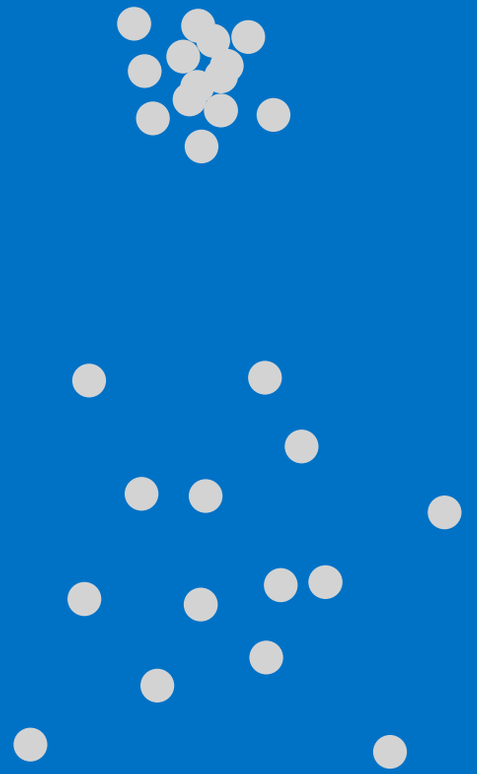
Inaccurate data



Accurate data



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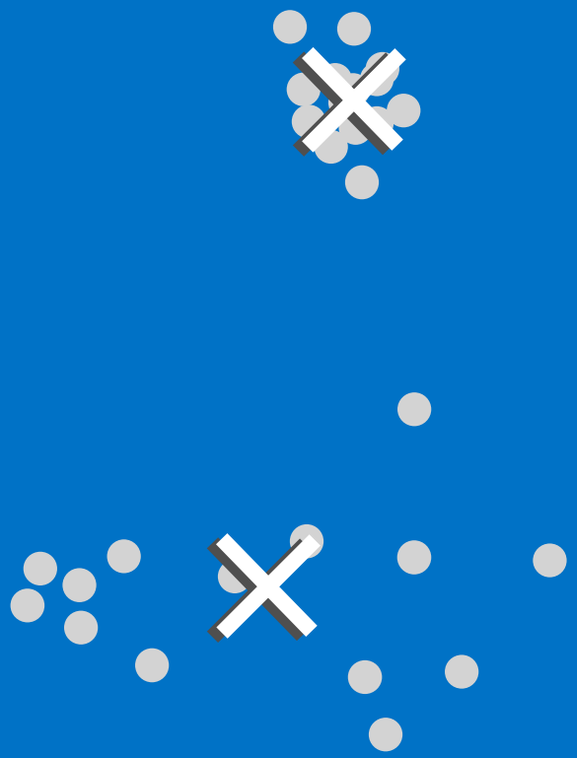

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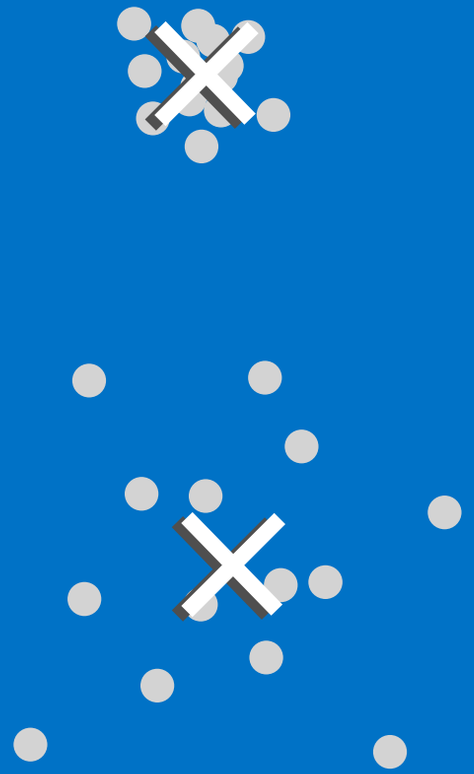

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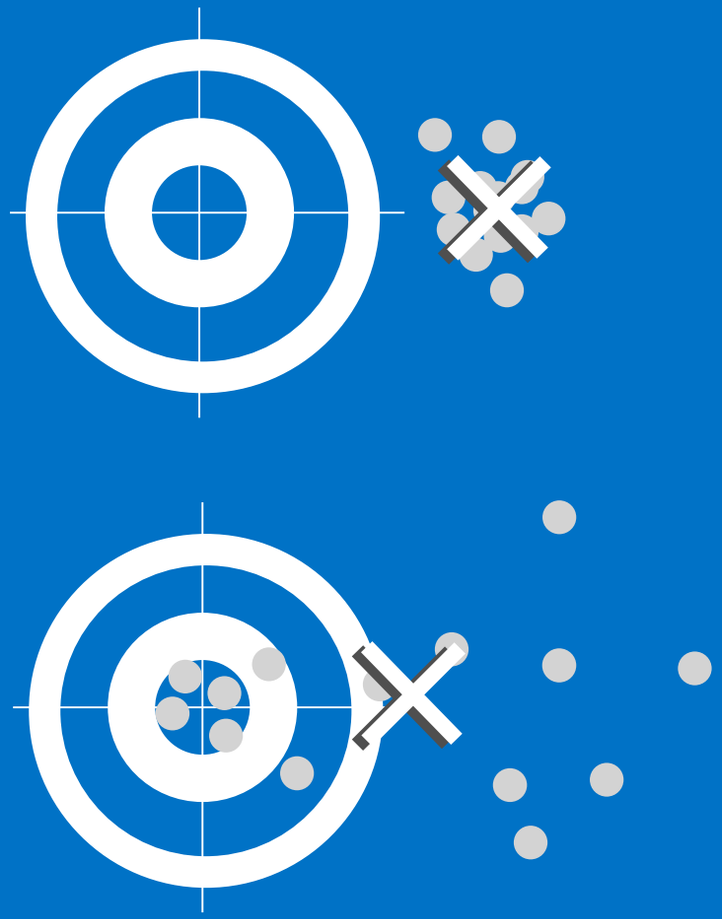

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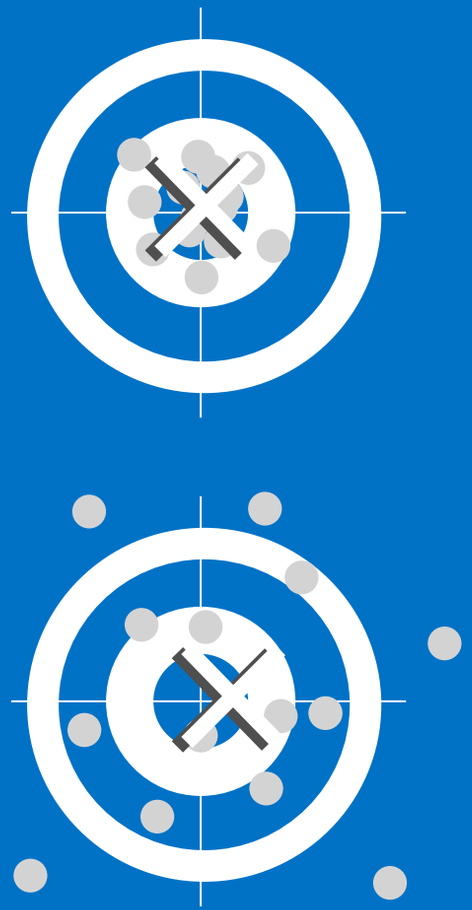
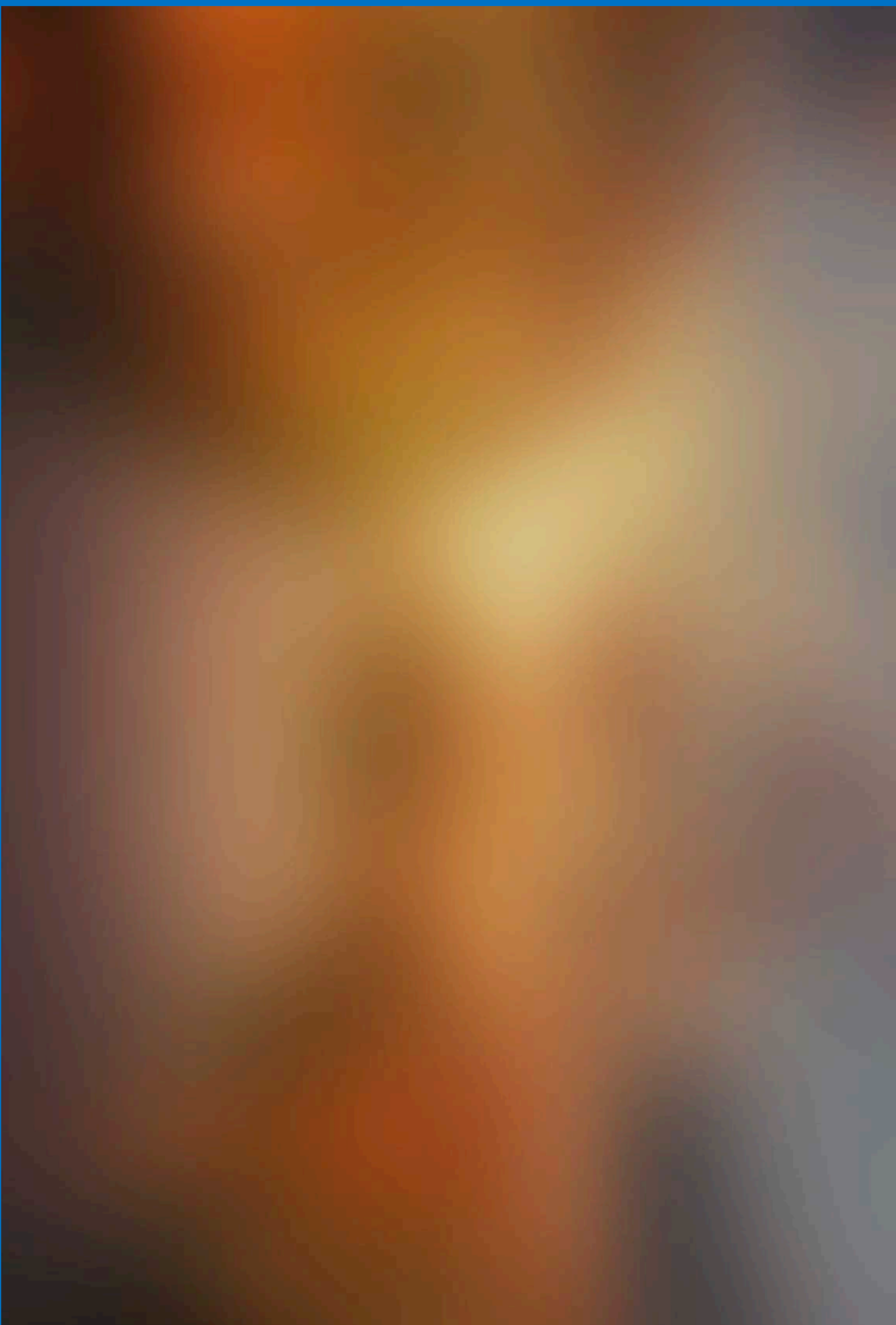
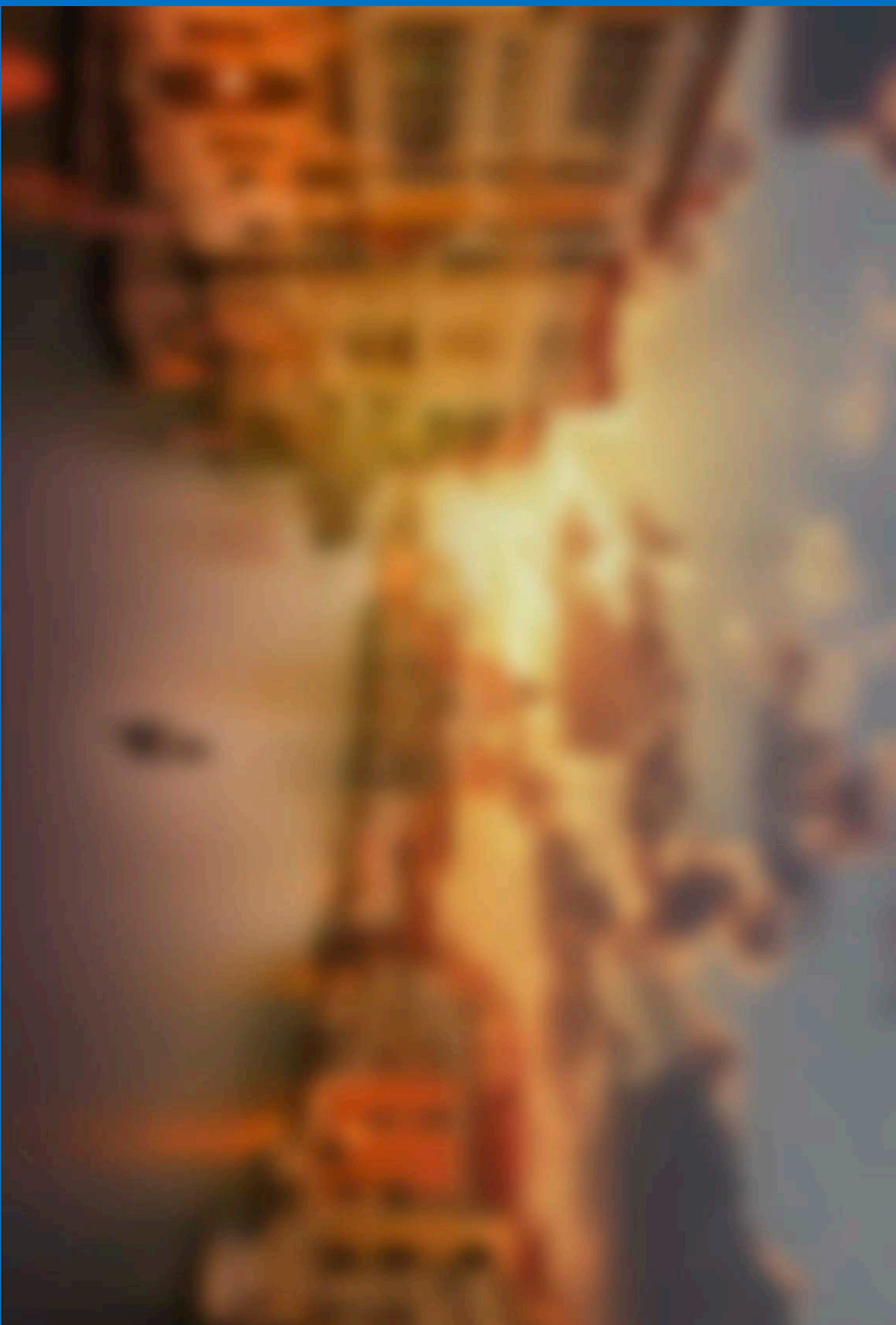


Not enough data

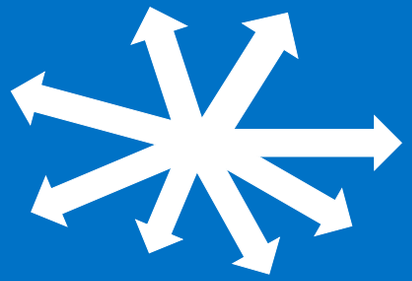


Barely enough data



Enough data

Vague questions vs. Sharp questions



Can't be answered with a name or a number

What can my data tell me about my business?

What should I do?

How can I increase my profits?

Can be answered with a name or a number.

How many Model Q Gizmos will I sell in Montreal during the third quarter?

Which car in my fleet is going to fail first?

Turn your data into a picture.

Mystery data

Two features
Four classes
1600 data points

[feature] [class] [histogram] [visualization]

rows 1600 columns 3

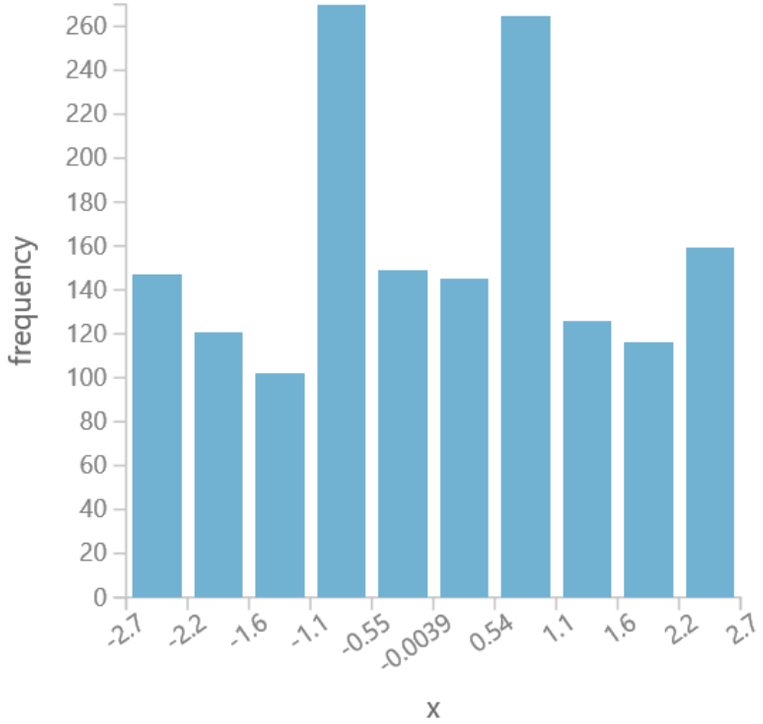
view as

x	y	l
0.756759	-1.373646	S
-1.071171	0.934892	L
0.301784	-1.447297	S
-0.071593	2.472344	C
0.470462	-1.388383	S
0.544586	-1.359058	S
0.689908	-1.280118	S
-0.317403	-1.500969	S
2.268651	0.537407	C
1.111744	-1.283004	S
-0.032994	-1.350037	S
-0.597814	-1.441323	S
1.141835	-2.325779	C
0.114728	-1.605493	S

x

Histogram

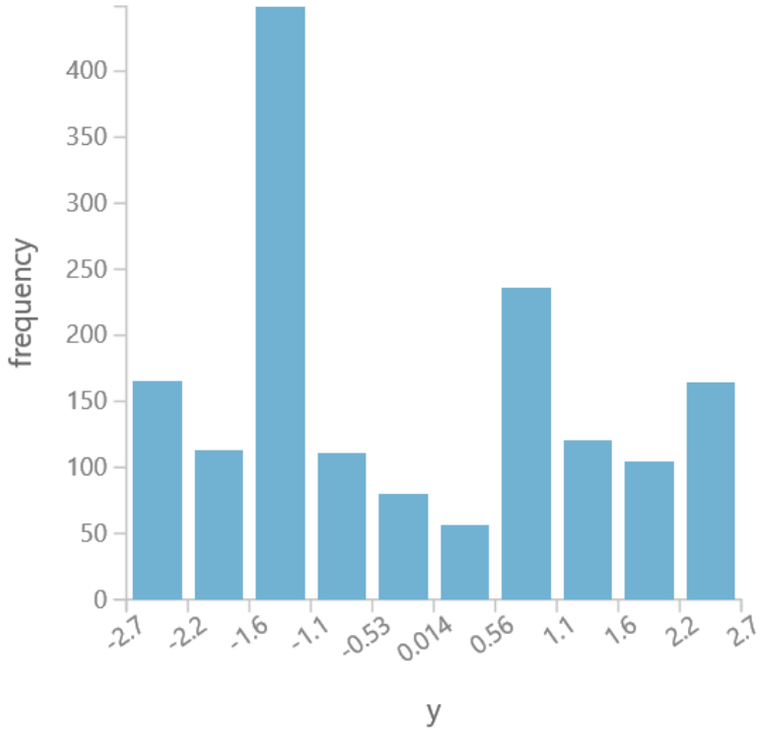
compare to None



y

Histogram

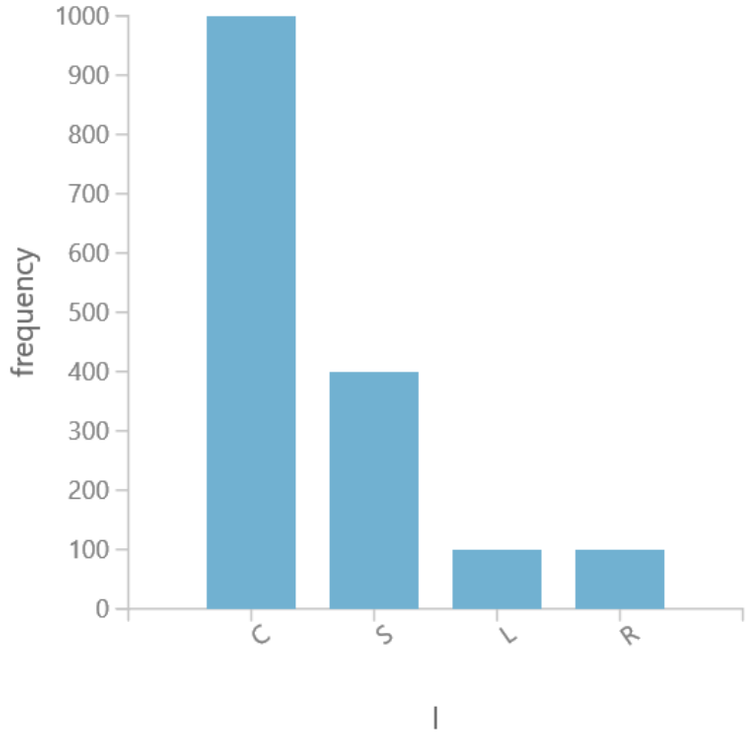
compare to None



l

Histogram

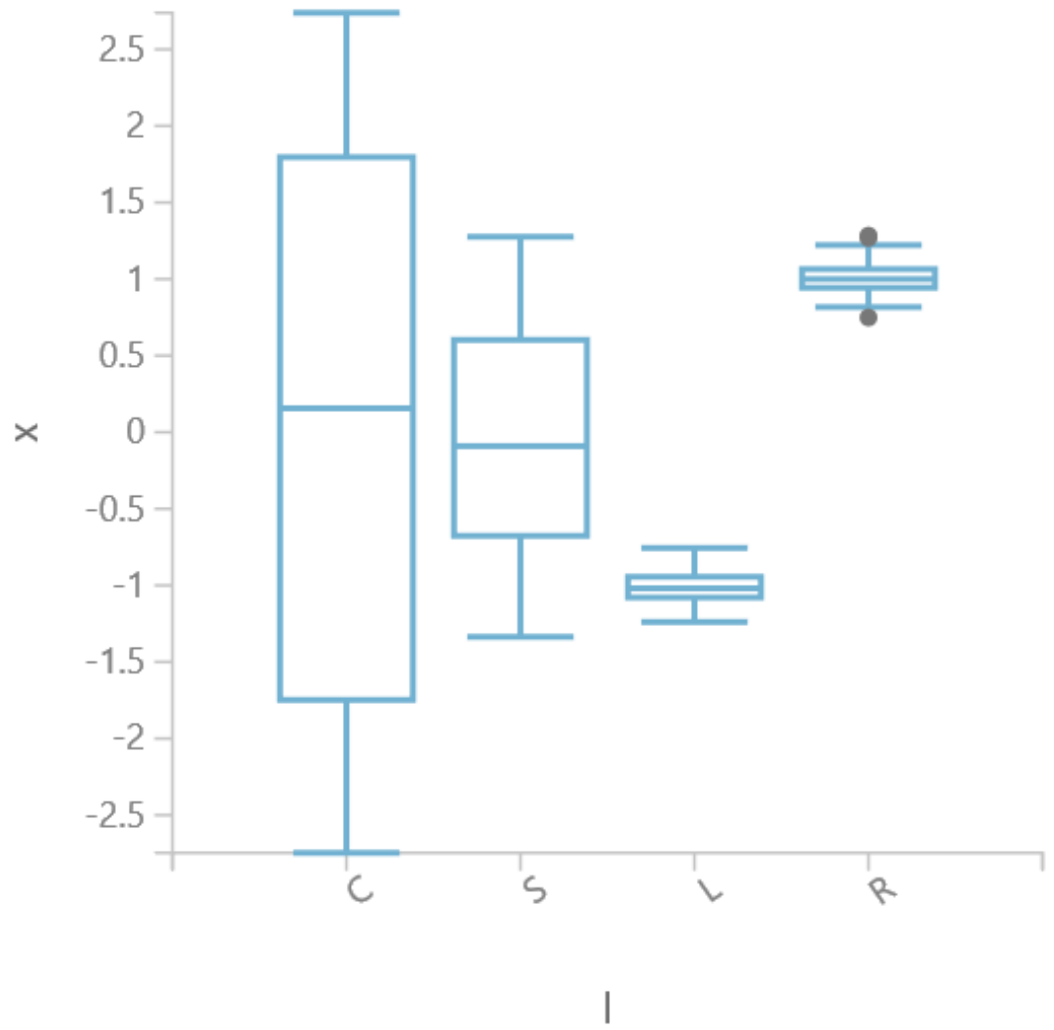
compare to None



x

MultiboxPlot

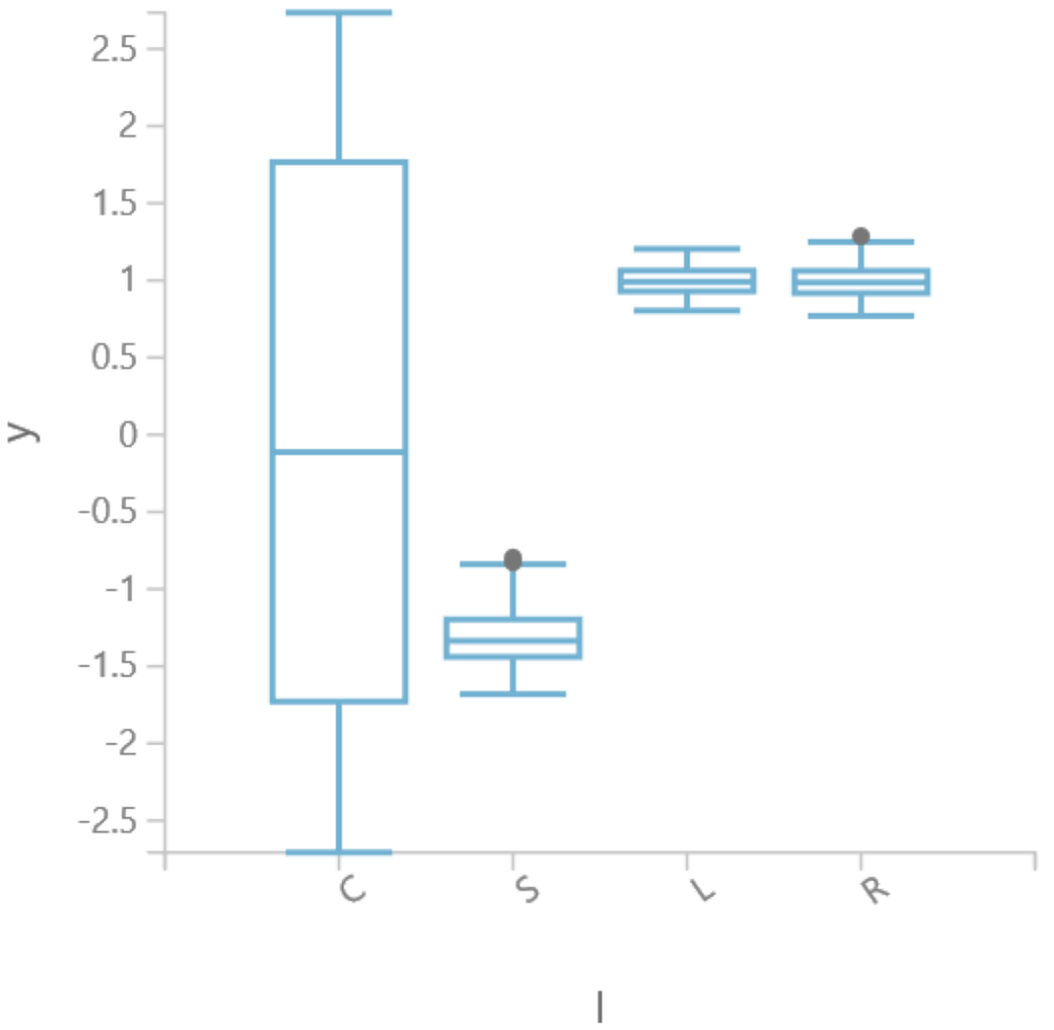
compare to l

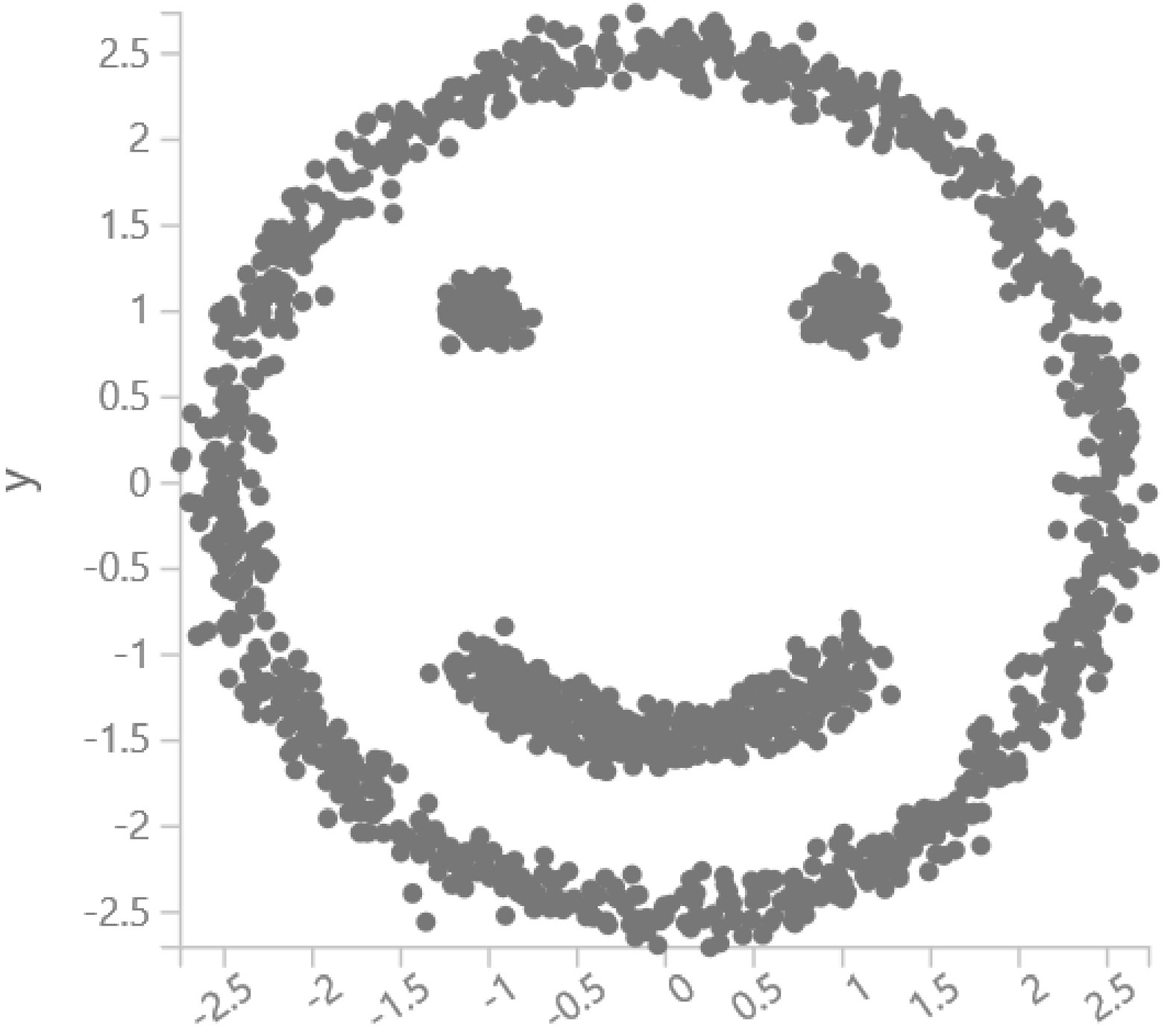


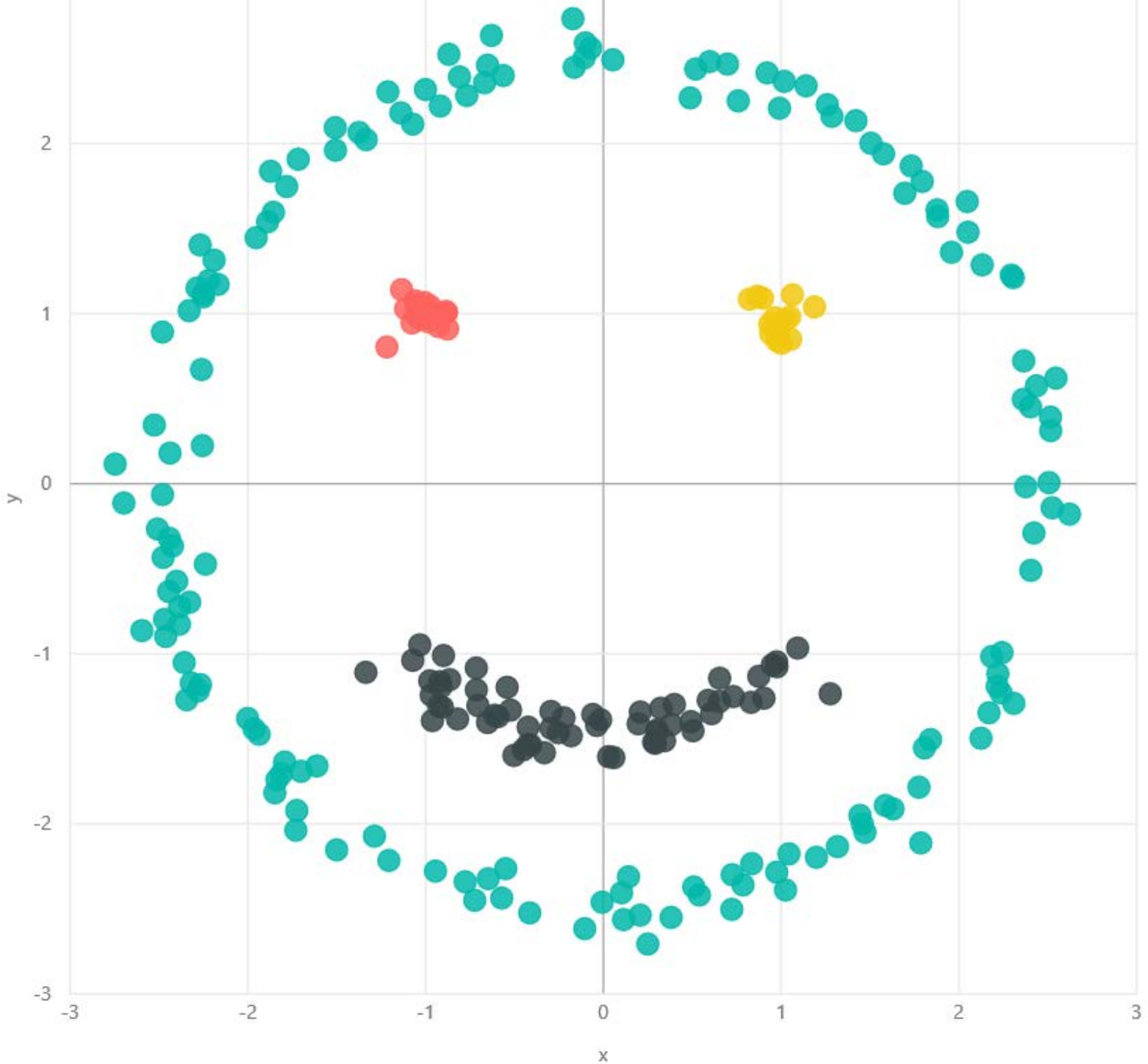
y

MultiboxPlot

compare to l




y
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5


2
1
0
-1
-2
-3
y
-3
-2
-1
0
1
2
3
x

rows 1600

columns 3

x	y	l
0.756759	-1.373646	S
-1.071171	0.934892	L
0.301784	-1.447297	S
-0.071593	2.472344	C
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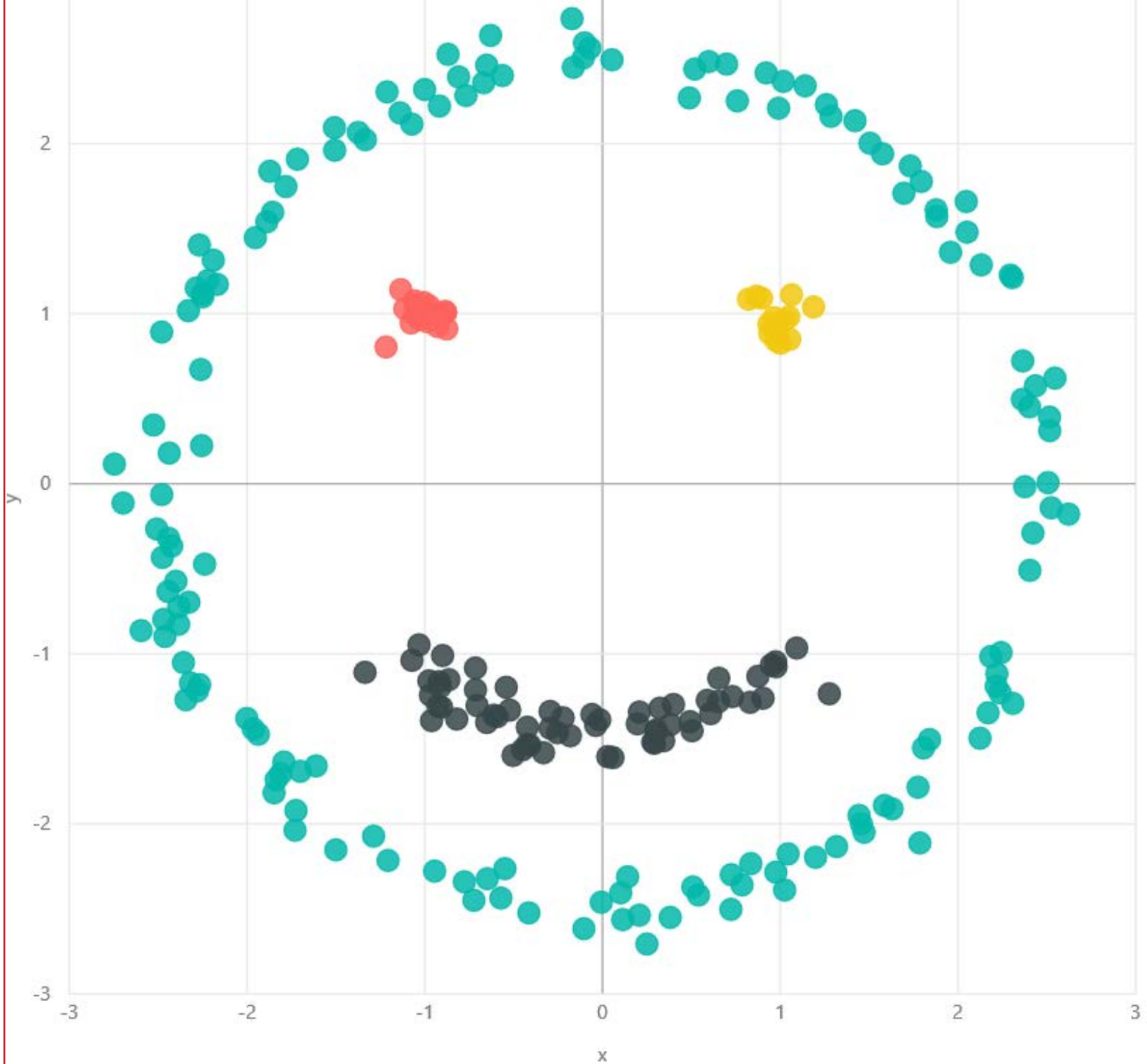
-0.317403	-1.500969	S
2.268651	0.537407	C
1.111744	-1.283004	S
-0.032994	-1.350037	S
-0.597814	-1.441323	S
1.141835	-2.325779	C
0.114728	-1.605493	S
-0.961781	-1.3926	S



Data science can only answer five questions.

1. How much / how many?
2. Which category?
3. Which groups?
4. Is it weird?
5. Which action?

[algorithm]

How much / how many?

What will the temperature be next Tuesday?

What will my fourth quarter sales in Portugal be?

How many new followers will I get next week?

[regression]

Which category?

Is this an image of a cat or a dog?

Which aircraft is causing this radar signature?

What is the topic of this news article?

[classification]

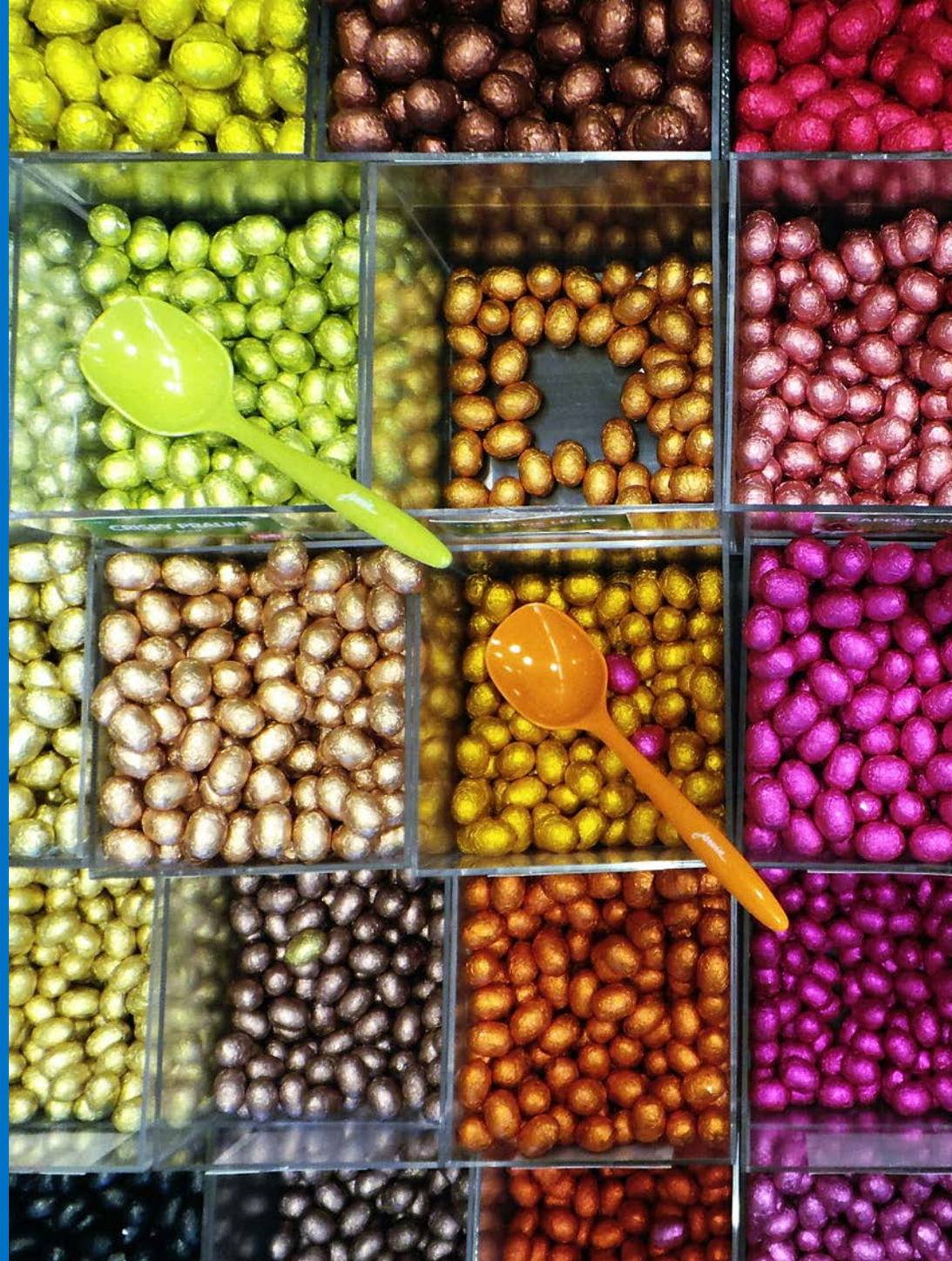
Which groups?

Which shoppers have similar tastes in produce?

Which viewers like the same kind of movies?

What is a natural way to break these documents into five topic groups?

[clustering] [recommendation]



Is this weird?

Is this pressure reading unusual?

Is this internet message typical?

Is this combination of purchases very different from what this customer has made in the past?

[anomaly detection]

Which action?

Should I raise or lower the temperature?

Should I vacuum the living room again or stay plugged in to my charging station?

Should I brake or accelerate in response to that yellow light?

[reinforcement learning]

Machine learning is simple.

Машинное
обучение
не действительно
сложной,
но
оно
иностранный
язык.

Machine
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isn’t actually
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language

язык

язык

yazeek

я	з	ы	к
ya	z	ee	k

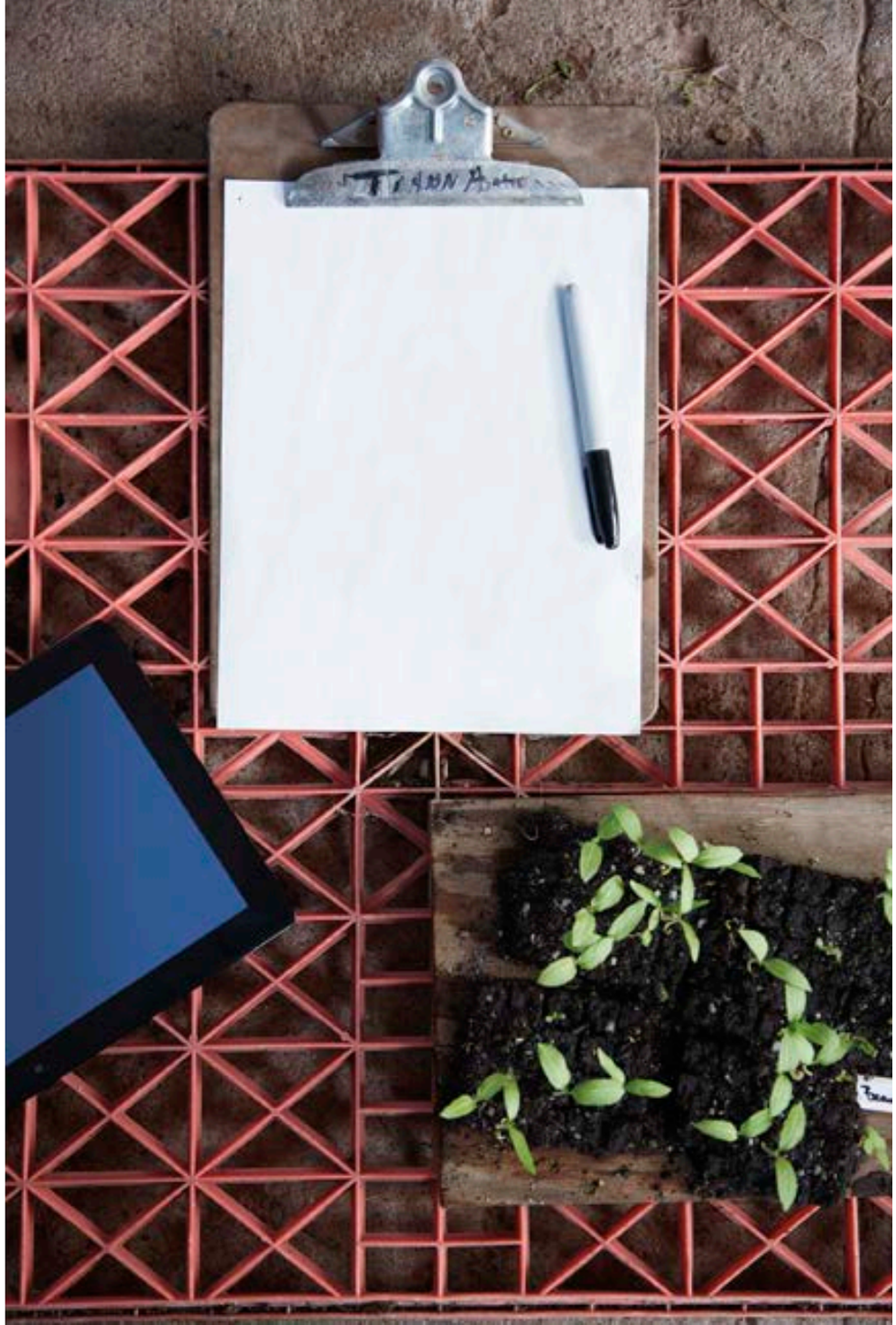
я

уа

Diamonds

Diamonds

carats	price
1.01	$7,366
.49	985
.31	544
1.51	9,140
.37	493
.73	3,011
1.53	11,413
.56	1,814
.41	876
.74	2,690
.63	1,991
.6	4,172
2.06	11,764
1.1	4,682
1.32	6,171
2.02	15,996
.34	695



Diamonds

[number line]
[axis]

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[axes]
[units]

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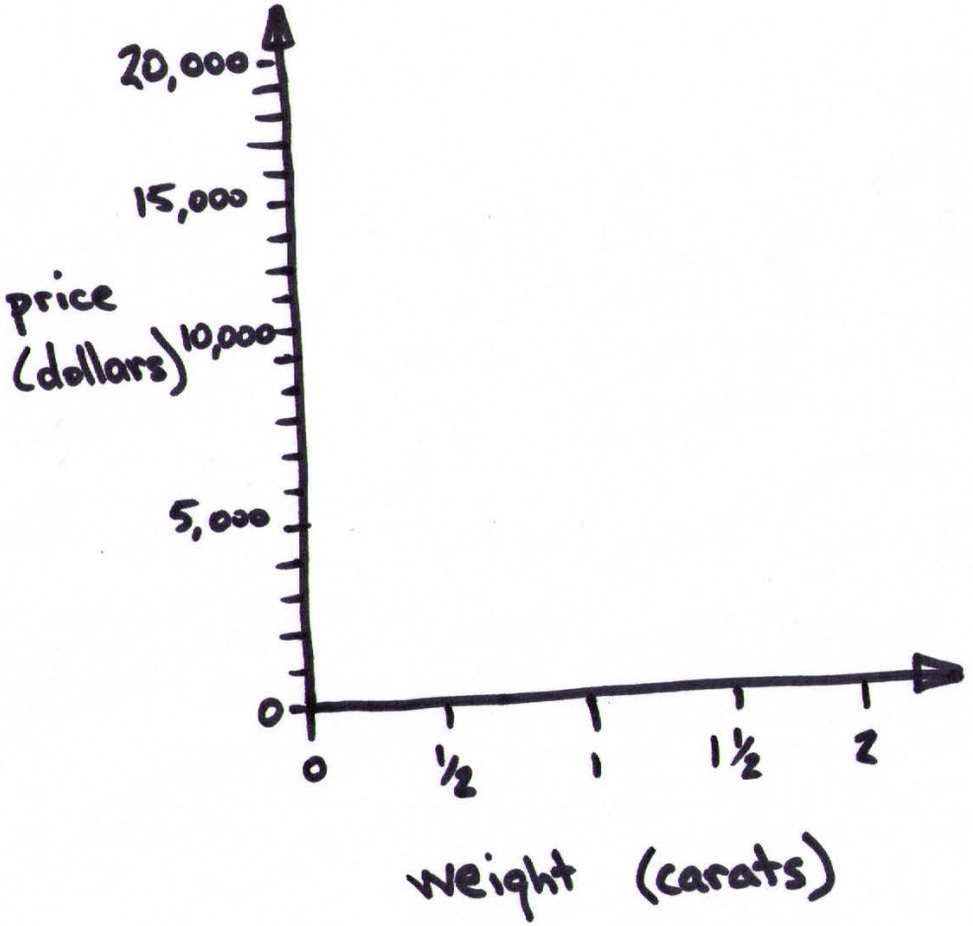

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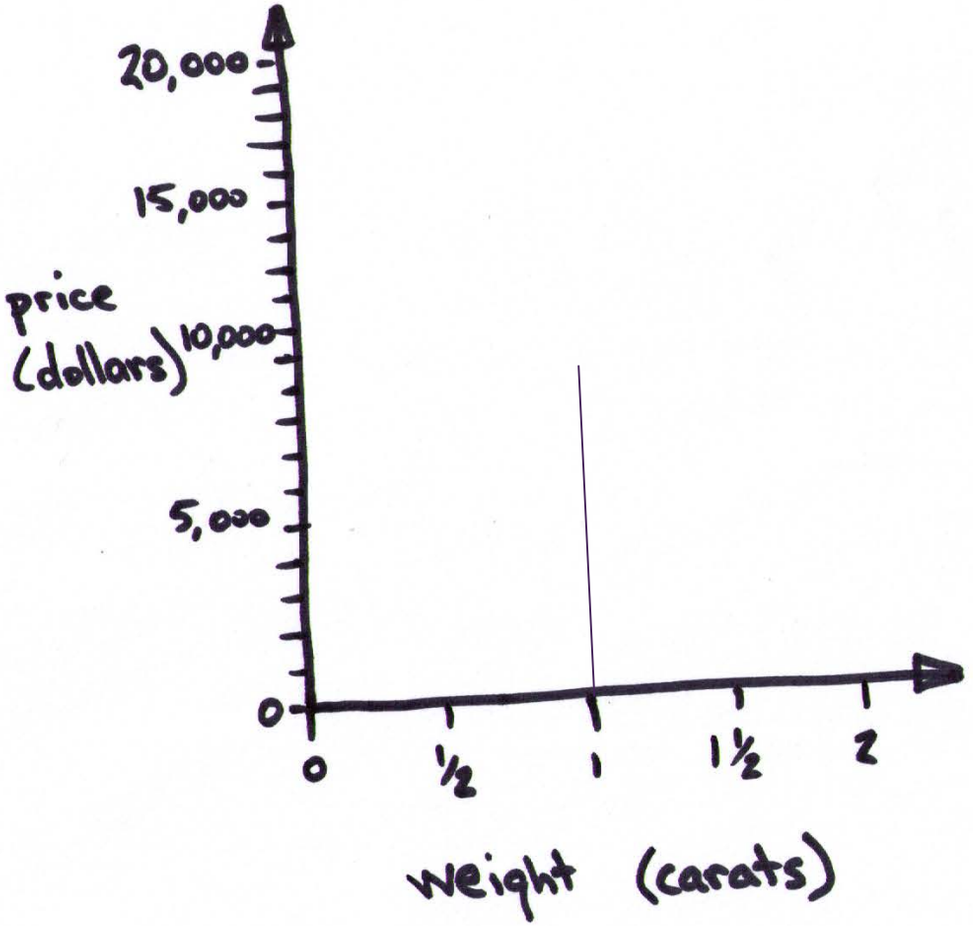

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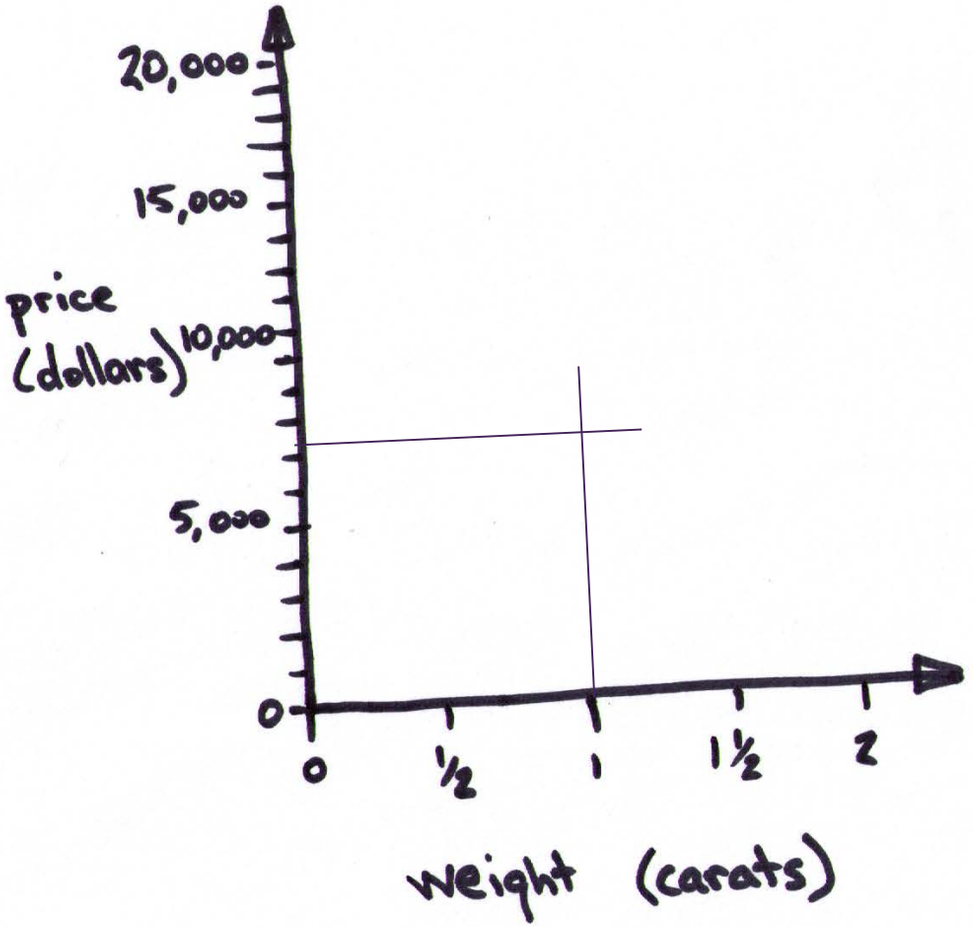

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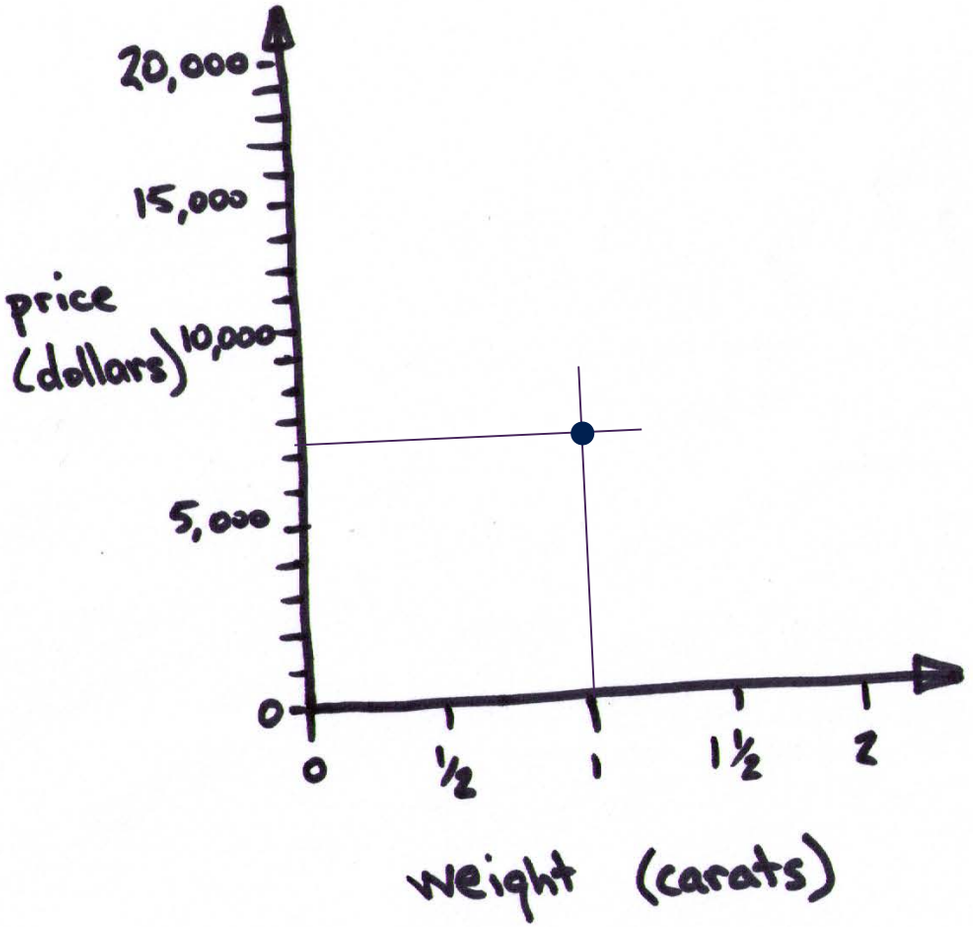

Diamonds

[plot]
[scatter plot]

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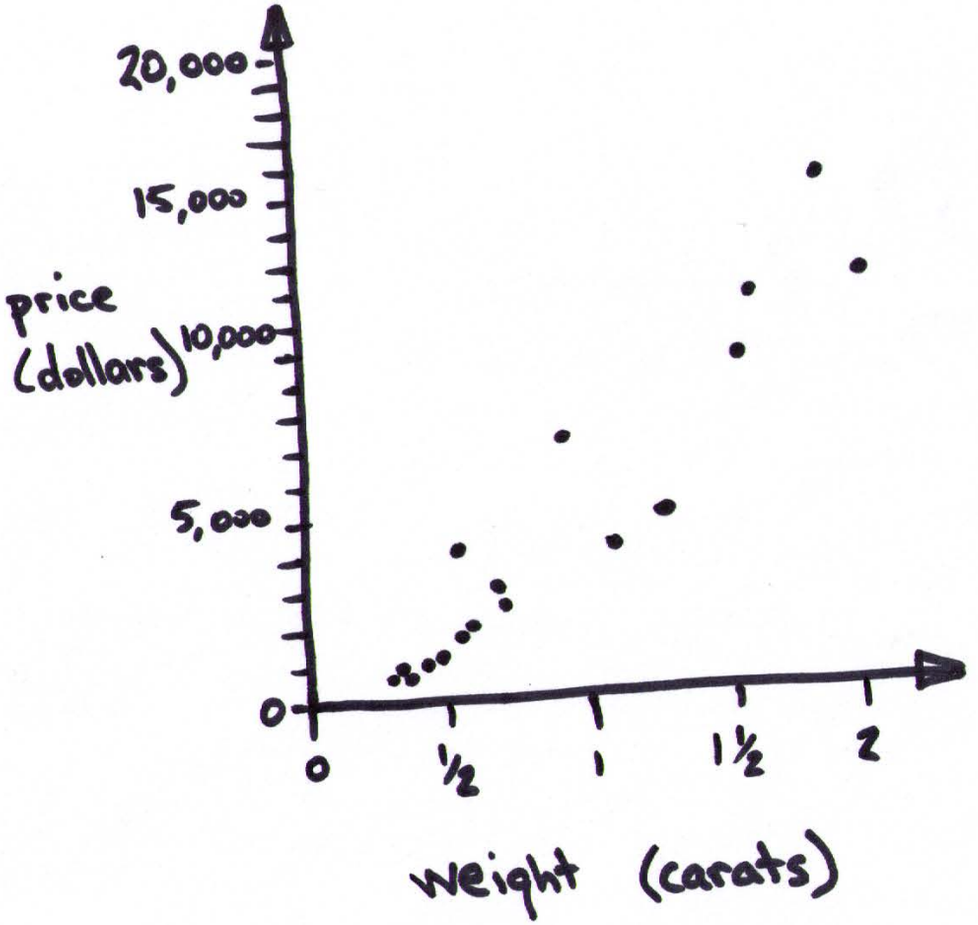

Diamonds

[modeling]
[linear regression]
[variance]
[noise]

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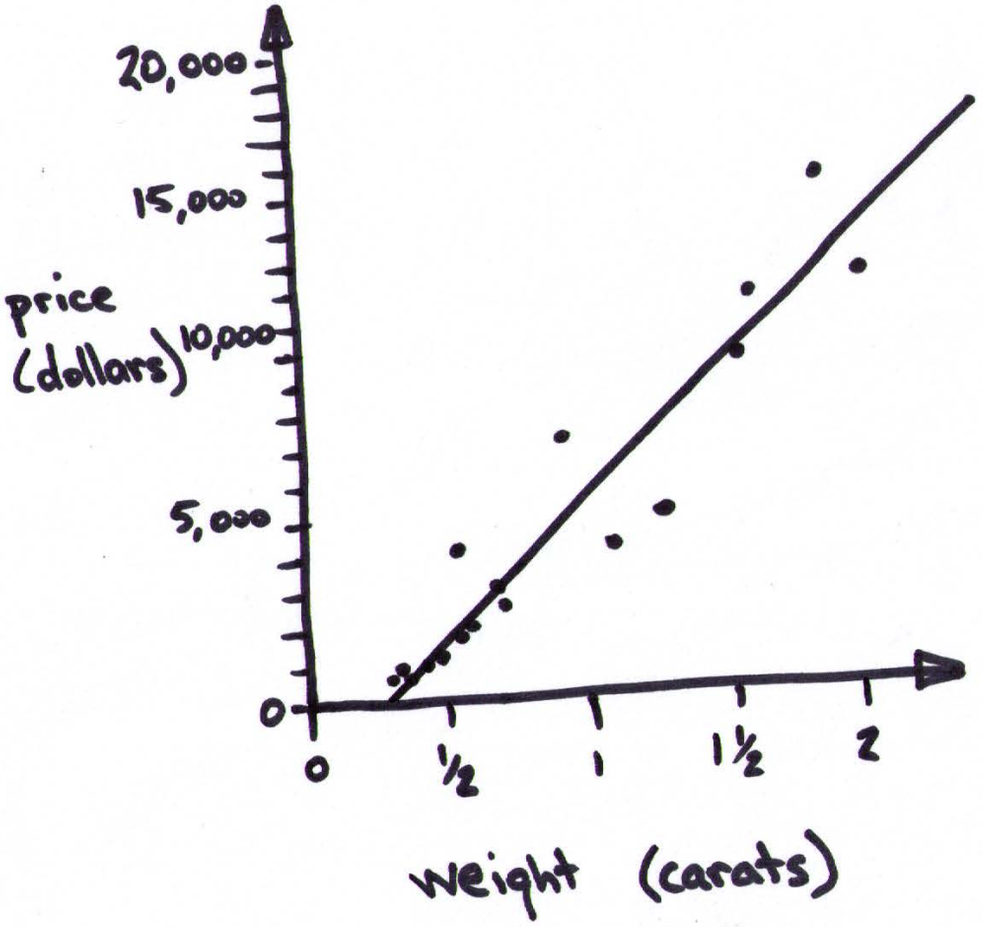
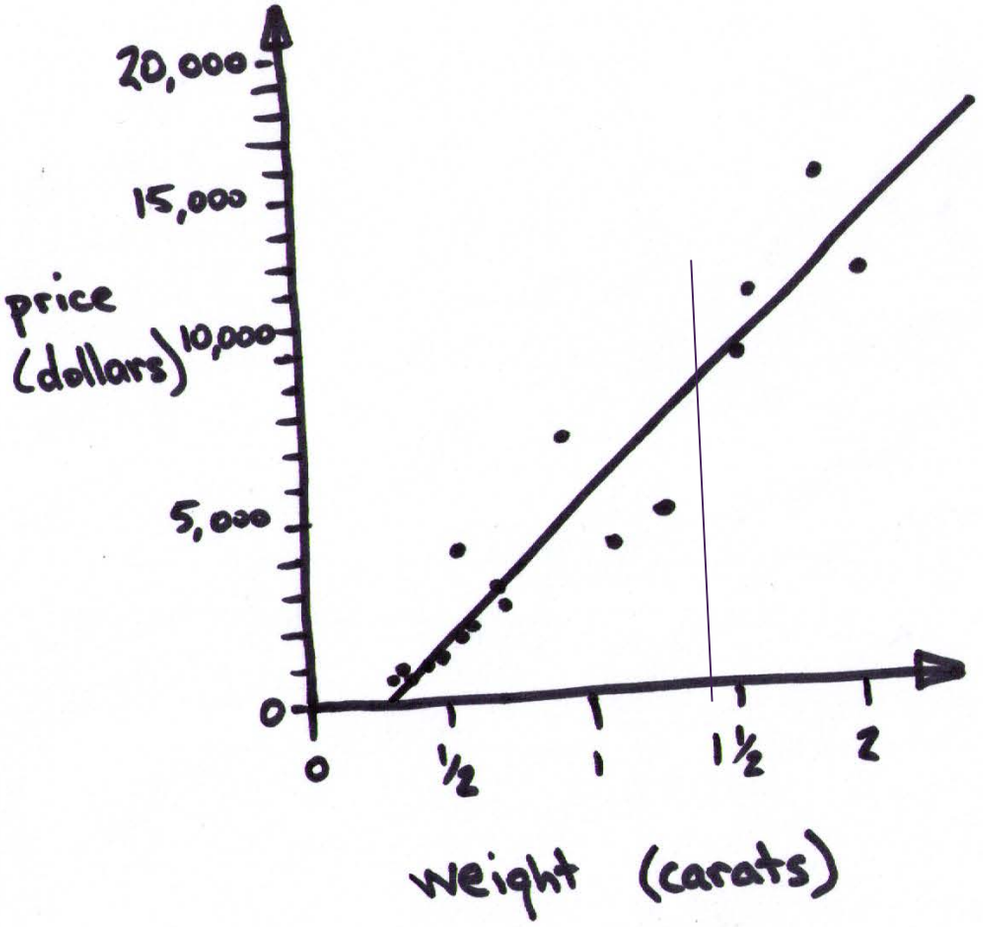


Diamonds

carats	price
1.01	$7,366
.49	985
.31	544
1.51	9,140
.37	493
.73	3,011
1.53	11,413
.56	1,814
.41	876
.74	2,690
.63	1,991
.6	4,172
2.06	11,764
1.1	4,682
1.32	6,171
2.02	15,996
.34	695



Diamonds

[prediction]

carats	price
1.01	$7,366
.49	985
.31	544
1.51	9,140
.37	493
.73	3,011
1.53	11,413
.56	1,814
.41	876
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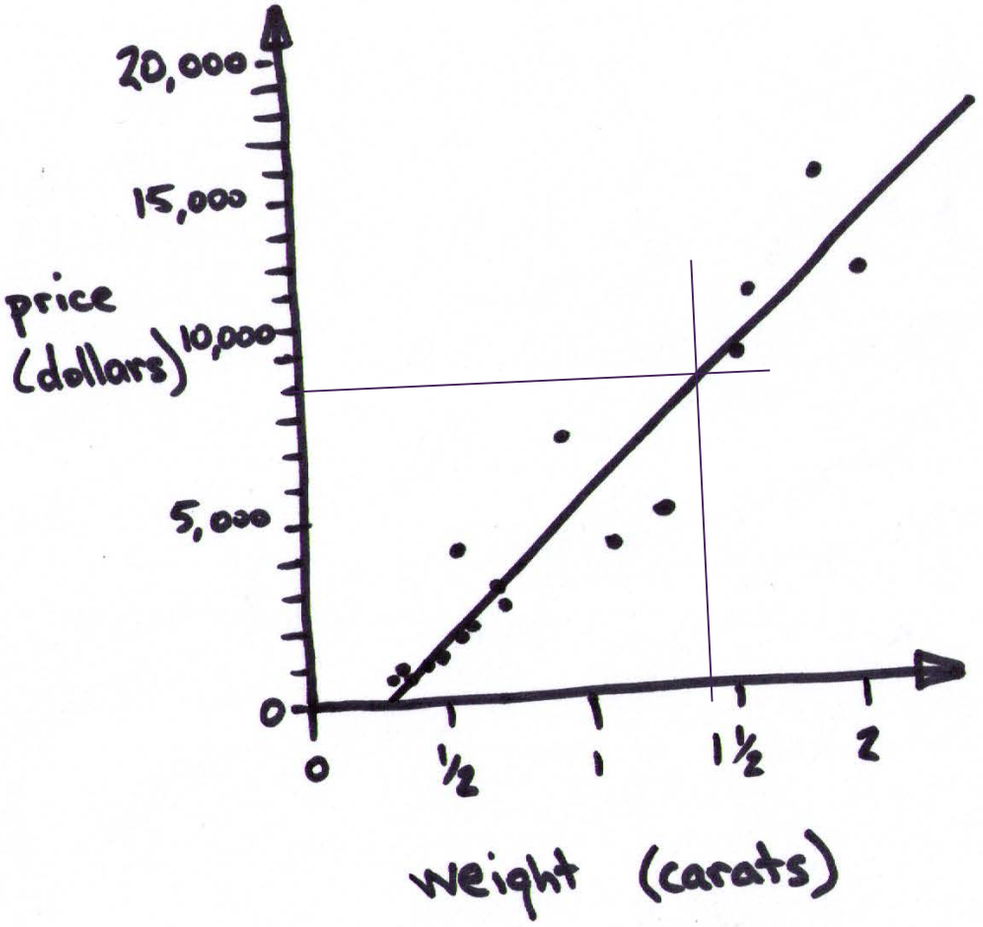

Diamonds

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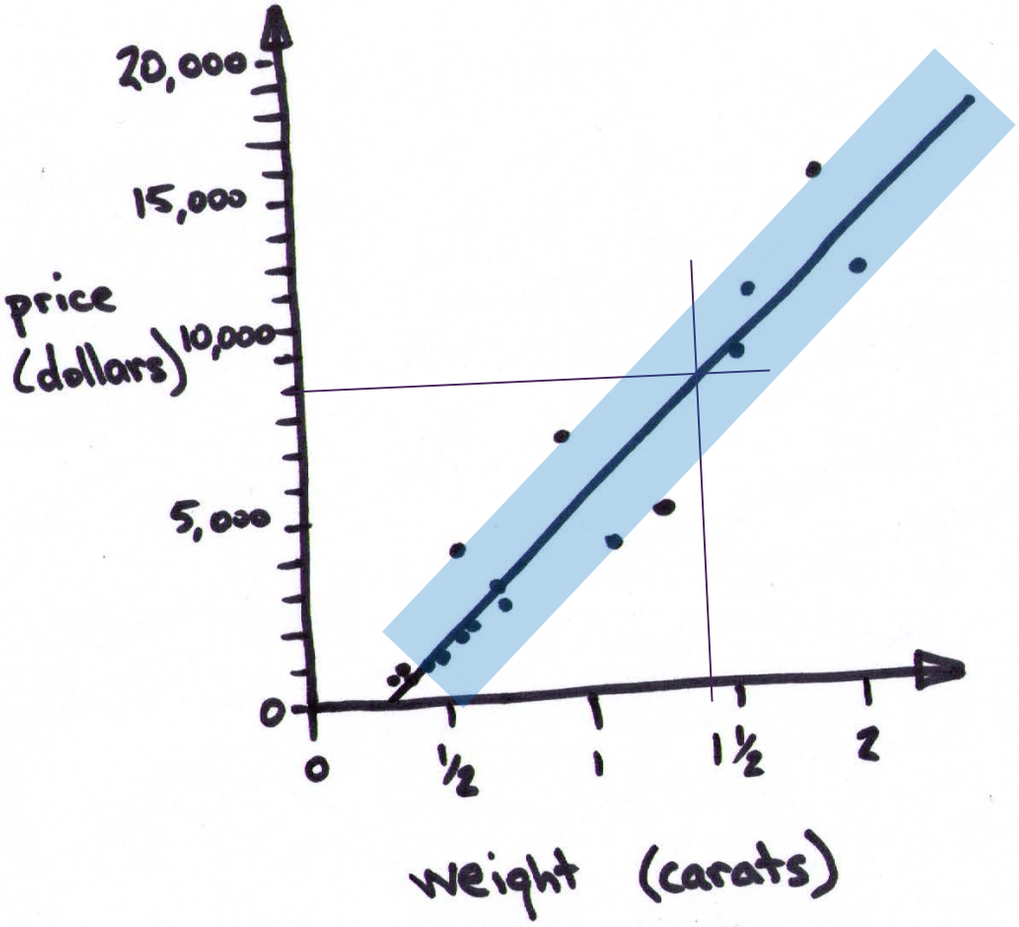

Diamonds

[confidence interval]

carats	price
1.01	$7,366
.49	985
.31	544
1.51	9,140
.37	493
.73	3,011
1.53	11,413
.56	1,814
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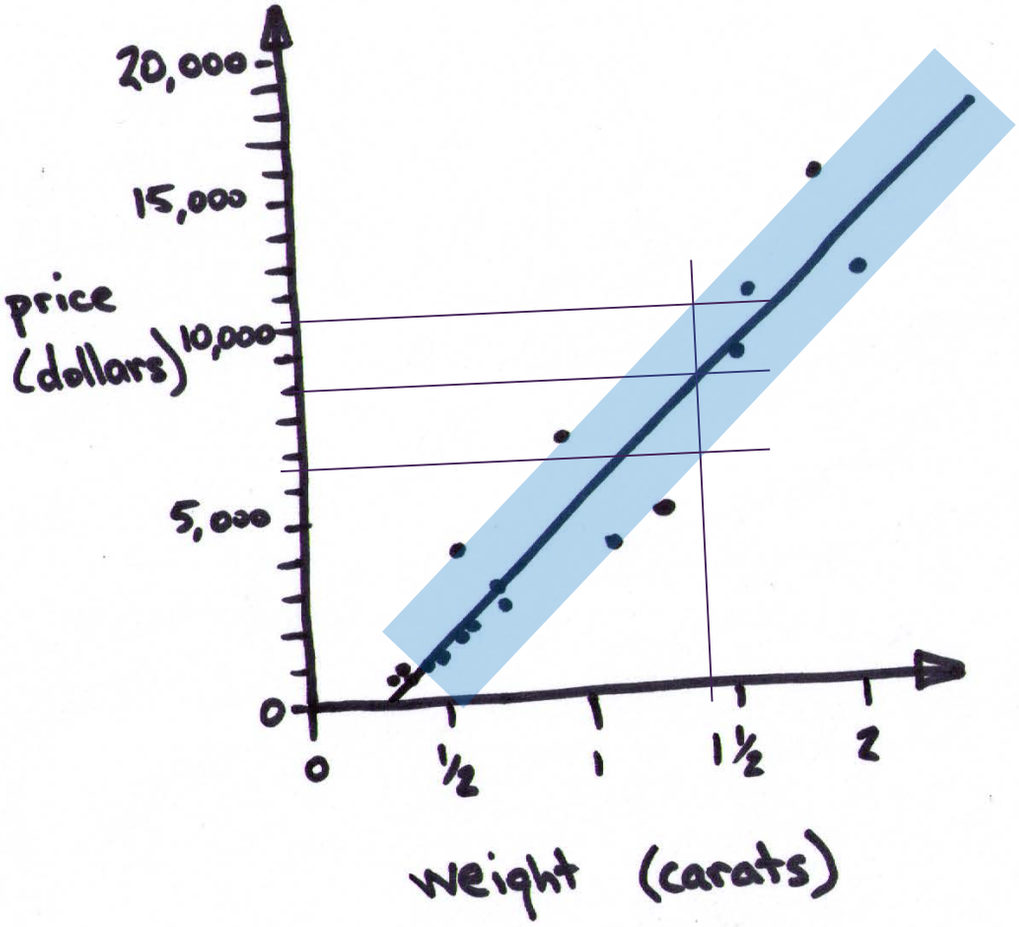


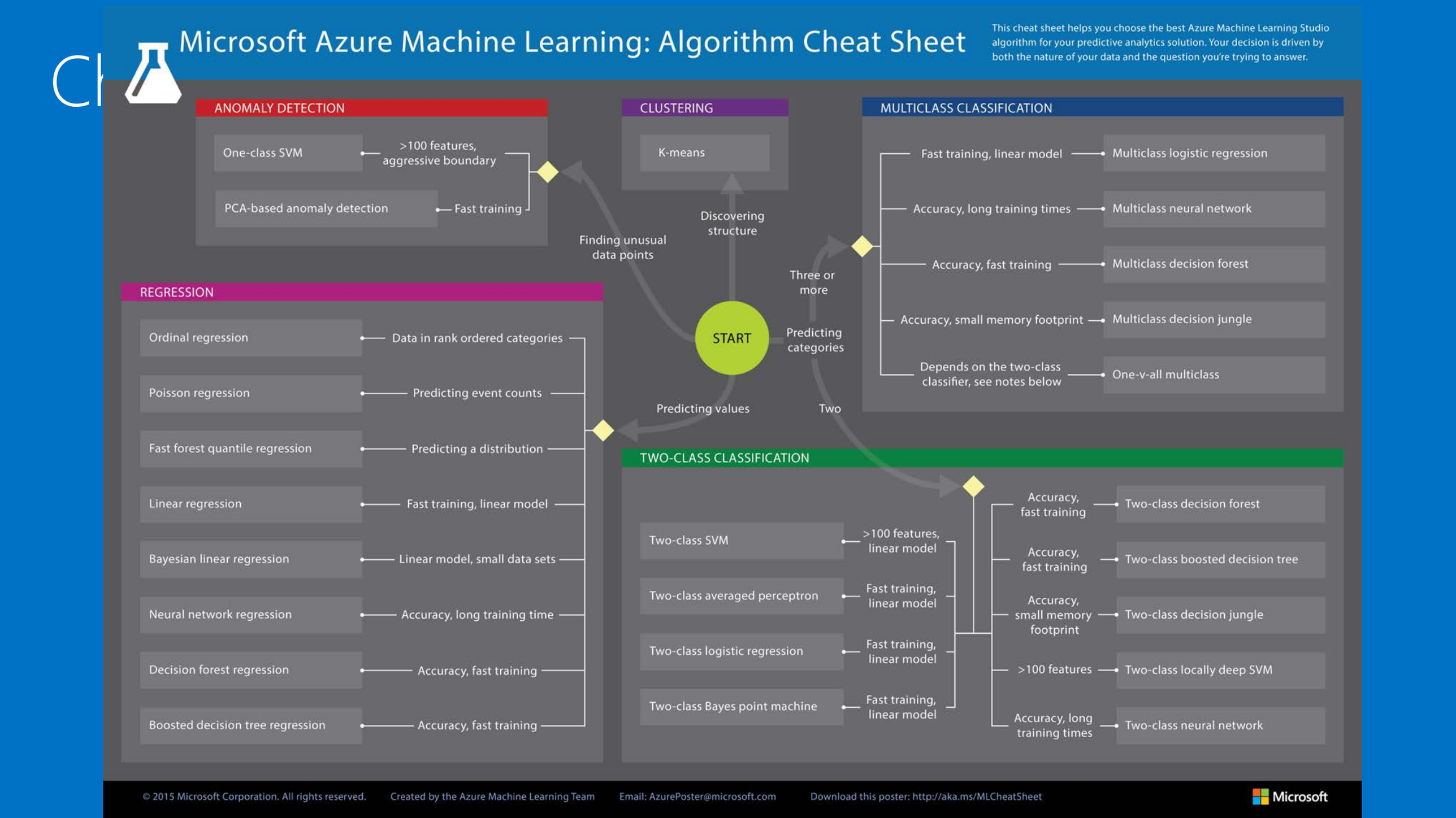
Congratulations!

We built a machine learning model.
We used linear regression.
We made a prediction, complete with a confidence interval.
(We didn't need math or computers.)

There are lots of right ways to do it.

Microsoft Azure Machine Learning: Algorithm Cheat Sheet

This cheat sheet helps you choose the best Azure Machine Learning Studio algorithm for your predictive analytics solution. Your decision is driven by both the nature of your data and the question you're trying to answer.



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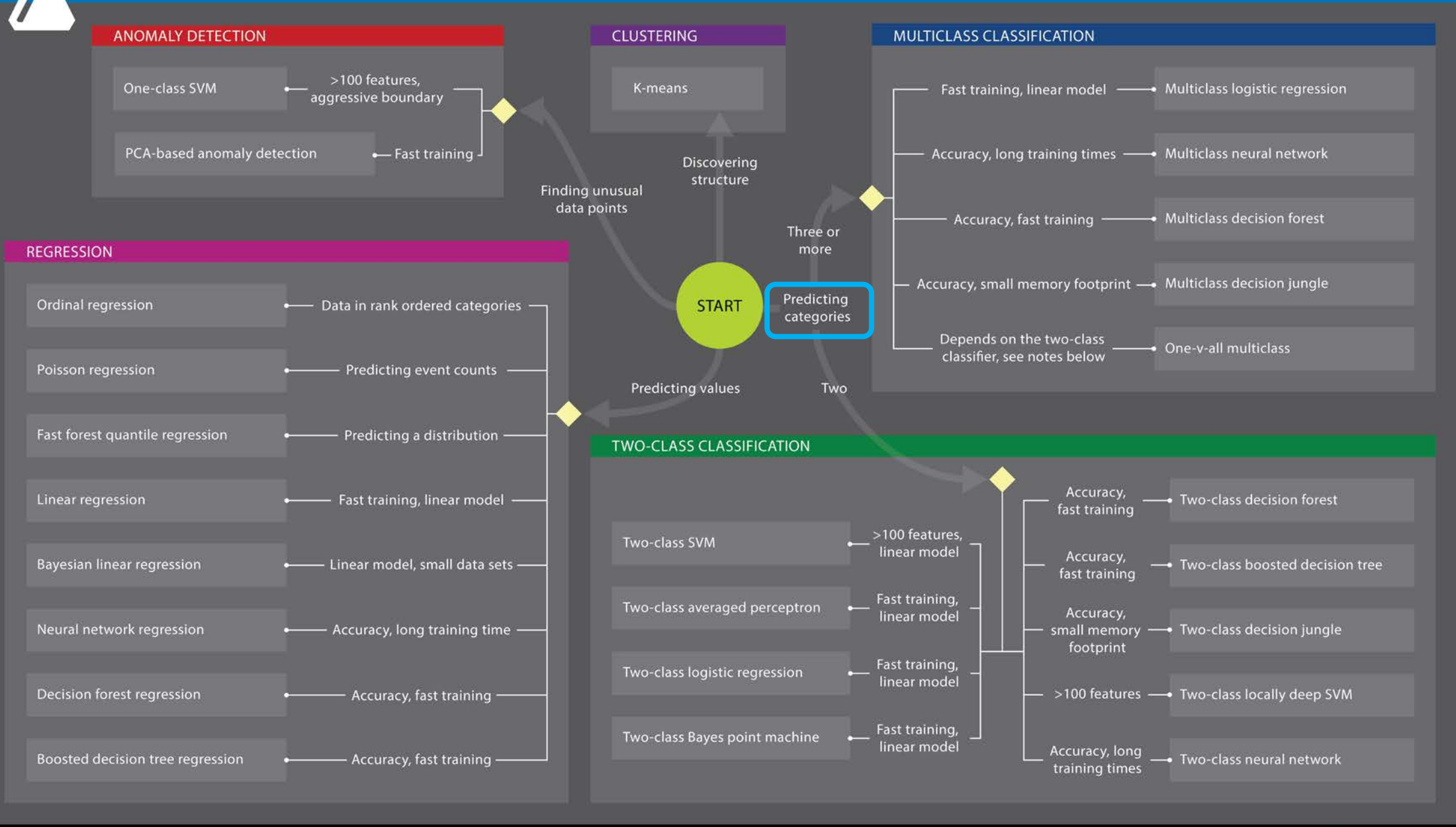

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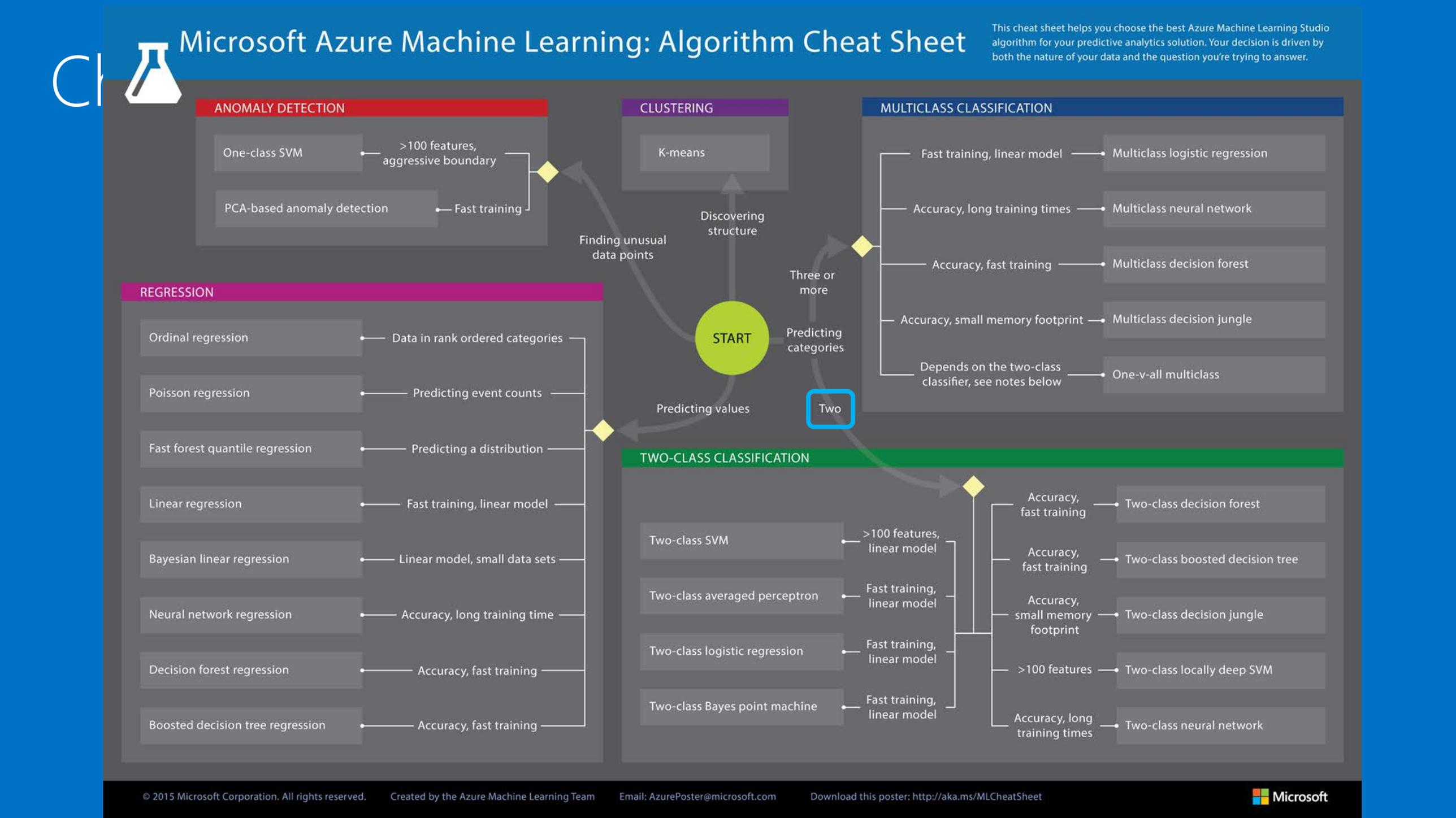

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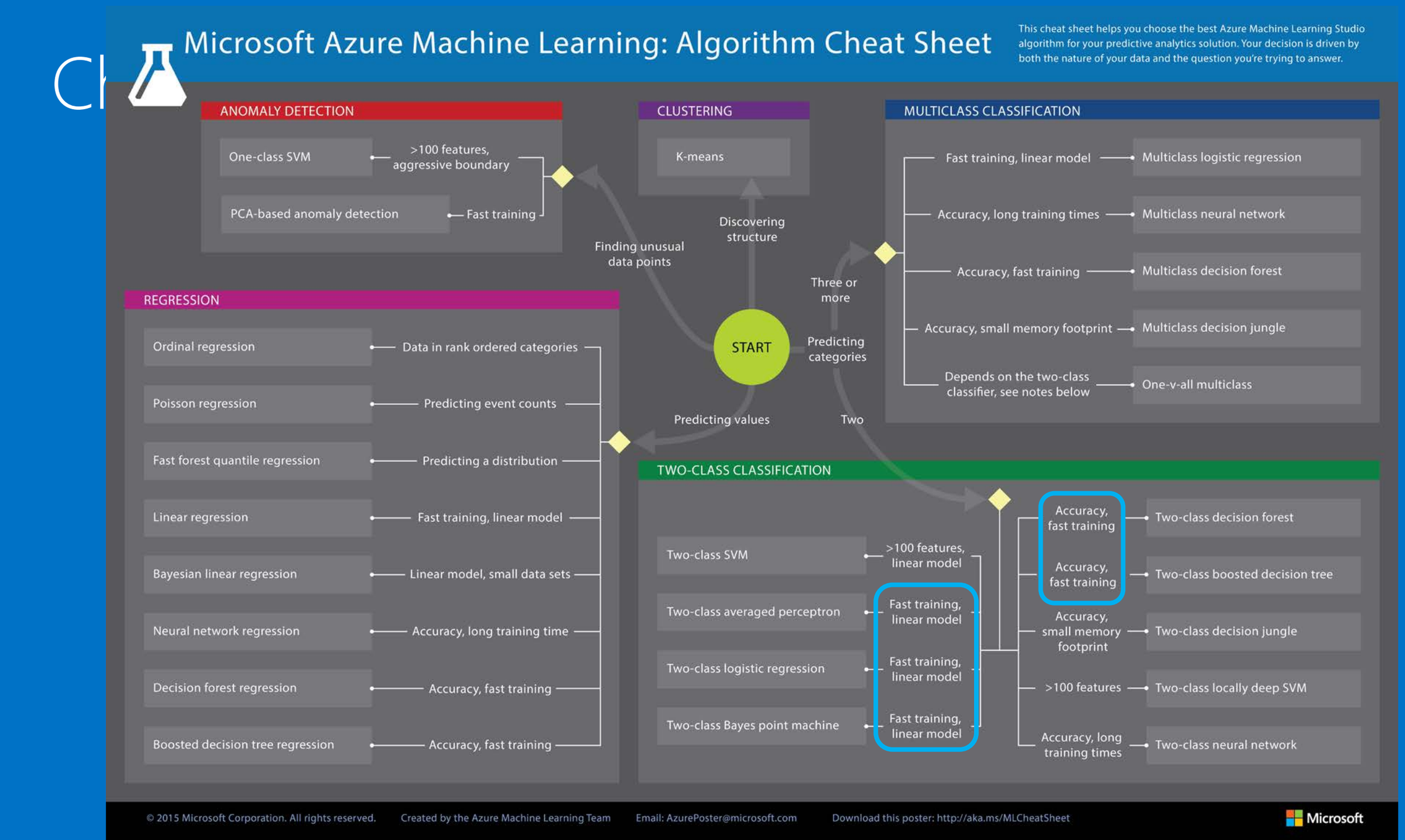

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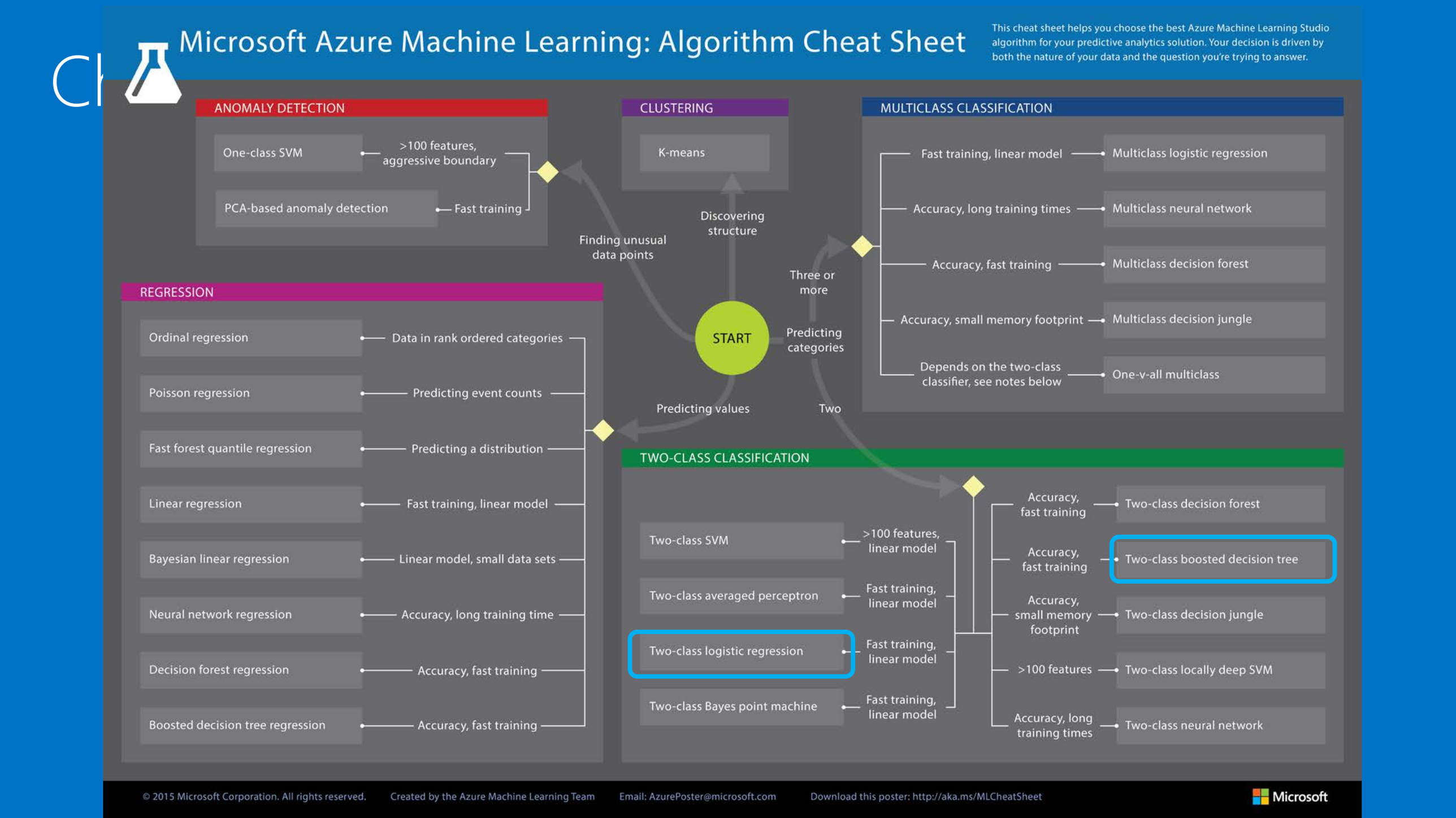

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You can make other people do your work for you.

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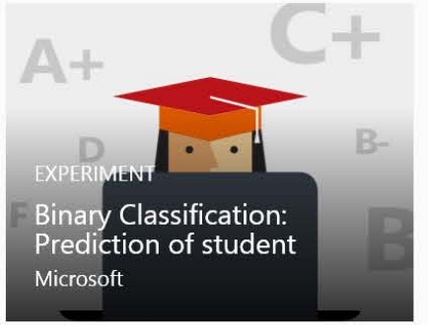

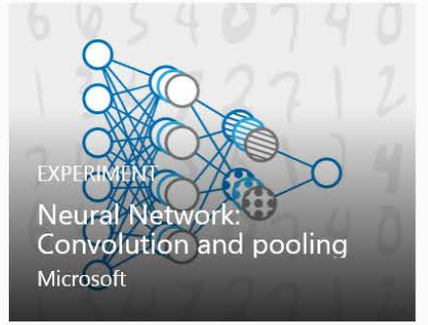

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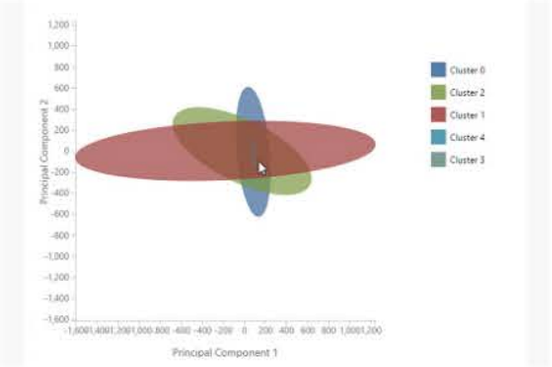
Clustering sweep: diabetes dataset



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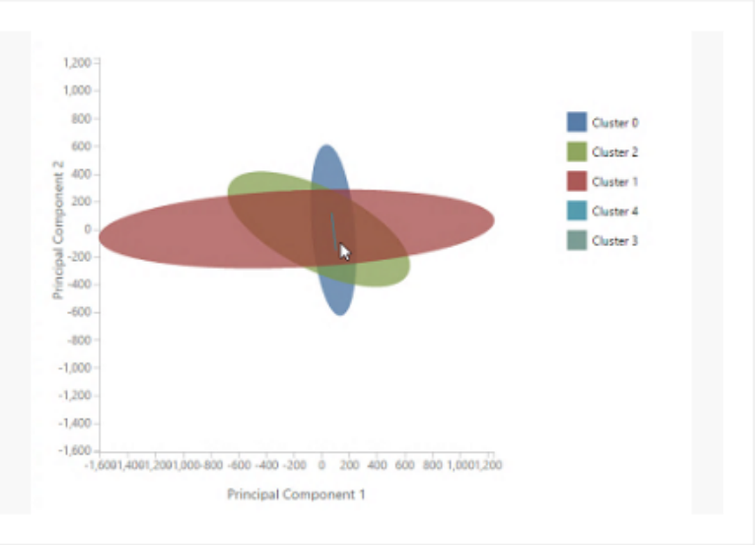
Jeannine Takaki • published on October 28, 2015



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ALGORITHMS

K-Means Clustering

Summary

This experiment demonstrates how to use the new Sweep Clustering module to select the best number of centroids and optimize other parameters

Description

Summary

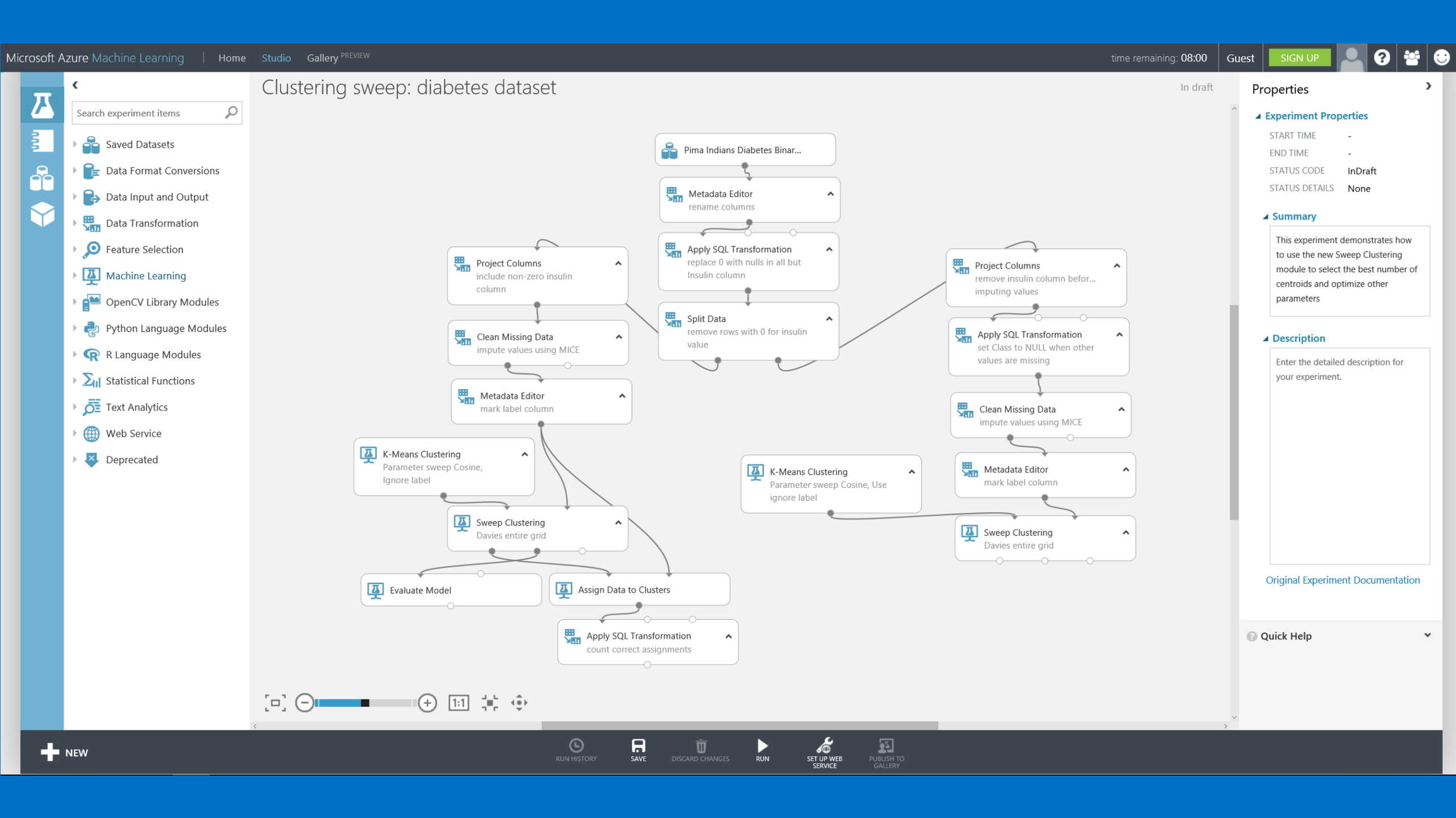
This experiment uses a parameter sweep with the K-means clustering algorithm to select the best number of clusters and the best initial centroid, based on a clustering metric you select. In the experiment, the original dataset is divided into two parts, to handle missing data and to compare the effect of variables on clustering. The results of the models are compared using a principal components graph. The experiment also demonstrates how you can use the Sweep Clustering module to fill in values for a label column.

Understanding the Data

The dataset contains 768 rows, from a larger dataset that studies the incidence of diabetes among different populations.

The following clinical values are included, which are often used in diagnosing diabetes.

Triceps skin fold measurements (TSF) and **body mass index (BMI)** are thought to be correlated with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Guest
SIGN UP
Clustering sweep: diabetes dataset
In draft
Search experiment items
Saved Datasets
Data Format Conversions
Data Input and Output
Data Transformation
Feature Selection
Machine Learning
OpenCV Library Modules
Python Language Modules
R Language Modules
Statistical Functions
Text Analytics
Web Service
Deprecated
Pima Indians Diabetes Binar...
Metadata Editor
rename columns
Apply SQL Transformation
replace 0 with nulls in all but Insulin column
Project Columns
include non-zero insulin column
Split Data
remove rows with 0 for insulin value
Clean Missing Data
impute values using MICE
Metadata Editor
mark label column
K-Means Clustering
Parameter sweep Cosine, Ignore label
Sweep Clustering
Davies entire grid
Evaluate Model
Assign Data to Clusters
Apply SQL Transformation
count correct assignments
Project Columns
remove insulin column befor... imputing values
Apply SQL Transformation
set Class to NULL when other values are missing
Clean Missing Data
impute values using MICE
Metadata Editor
mark label column
K-Means Clustering
Parameter sweep Cosine, Use ignore label
Sweep Clustering
Davies entire grid
1:1
Properties
Experiment Properties
START TIME -
END TIME -
STATUS CODE InDraft
STATUS DETAILS None
Summary
This experiment demonstrates how to use the new Sweep Clustering module to select the best number of centroids and optimize other parameters
Description
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Original Experiment Documentation
Quick Help
NEW
RUN HISTORY
SAVE
DISCARD CHANGES
RUN
SET UP WEB SERVICE
PUBLISH TO GALLERY

EXPERIMENT

Methods for handling missing values

Brandon Rohrer • published on September 28, 2015

edit

Summary

This experiment illustrates a variety methods for handling missing data on a sample data set.

Description

Real world data is usually missing values, which trip up a lot of machine learning algorithms. There are lots of tricks for dealing with these, but you have to be careful. The way in which you fill them can change the result dramatically. Being explicit and thoughtful about how you handle missing values will get you the very best results.

I've illustrated a large handful of approaches to missing values here in a fake data set. The data shows a group of employees, some of their personal data, and some data regarding an upcoming office party. In every case, knowing what the data means is the most important part of handling it well.

Column 0	age	years_seniority	income	parking_space	attending_party	entree	pets	emergency_contact
Tony	48	27		1	5	shrimp		Pepper
Donald	67	25	86	10	2	beef		Jane
Henry	69	21	95	6	1	chicken	62	Janet
Janet	62	21	110	3	1	beef		Henry
Nick		17		4				
Bruce	37	14	63		1	veggie		NA
Steve	83		77	7	1	chicken		n/a
Clint	27	9	118	9		shrimp	3	None
Wanda	19	7	52	2	2	shrimp		empty
Natasha	26	4	162	5	3			-
Carol		3	127	11	1	veggie	1	""
Mandy	44	2	68	8	1	chicken		null

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Secrets of data science revealed

Secrets of data science revealed

1. You can’t use just any data.

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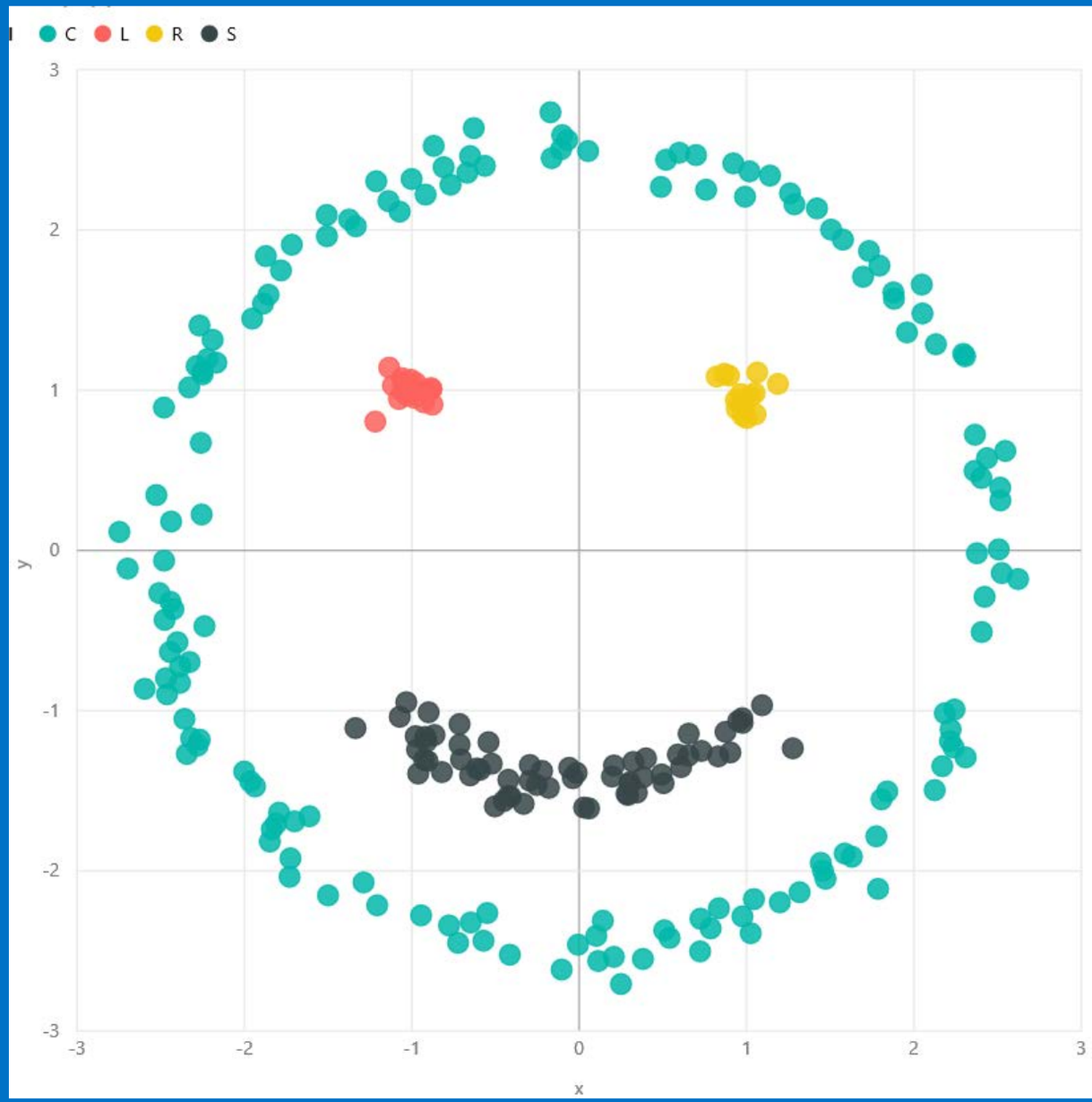
1. You can’t use just any data.
2. Turn your data into a picture.



Secrets of data science revealed

1. You can’t use just any data.
2. Turn your data into a picture.
3. Data science can only answer five questions.

Secrets of data science revealed

1. You can’t use just any data.
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3. Data science can only answer five questions.
4. Machine learning is simple.

Secrets of data science revealed

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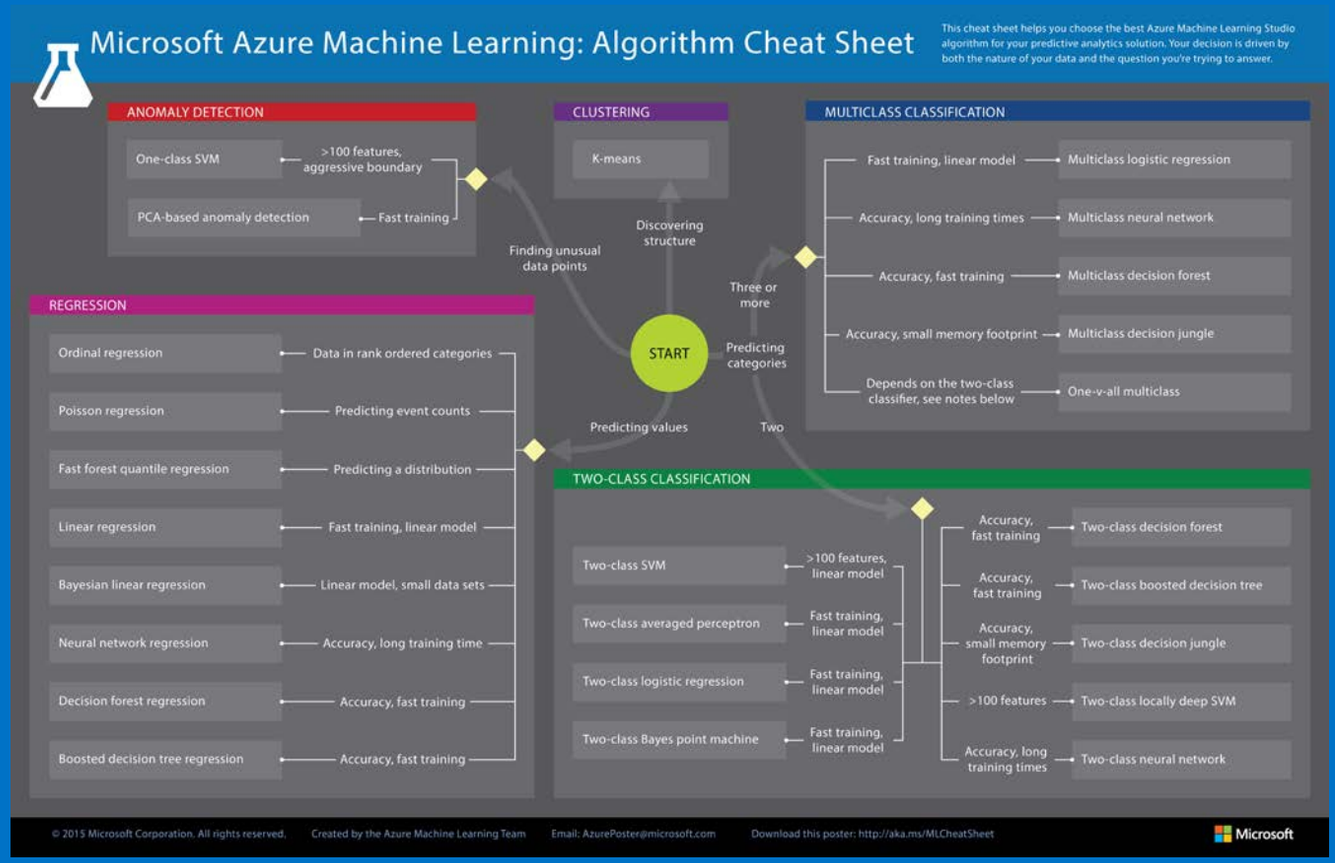
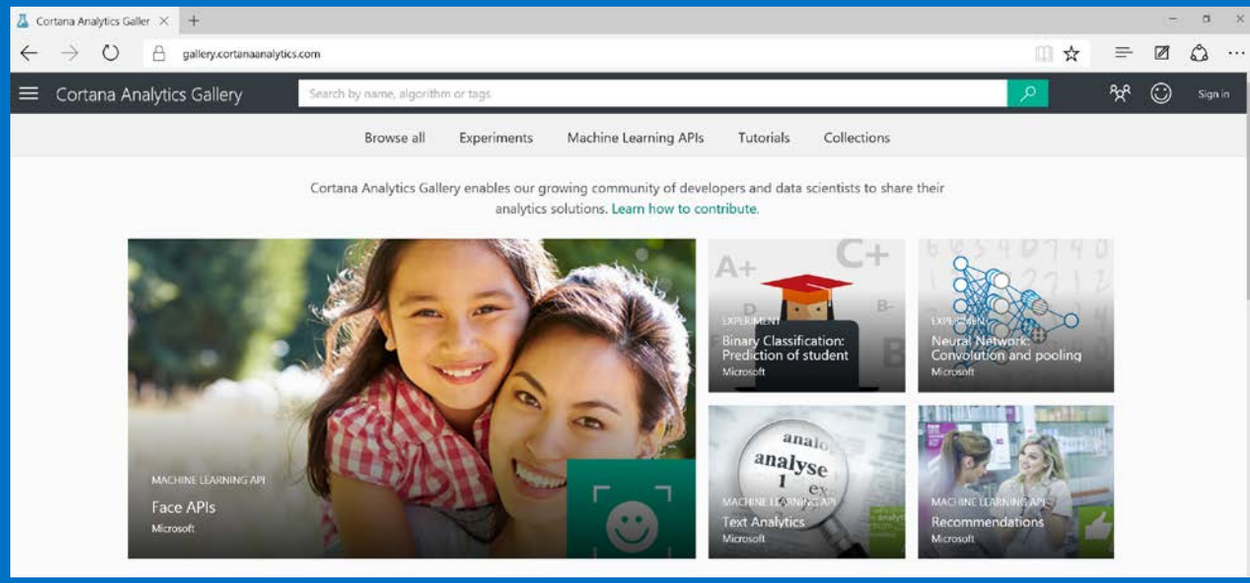
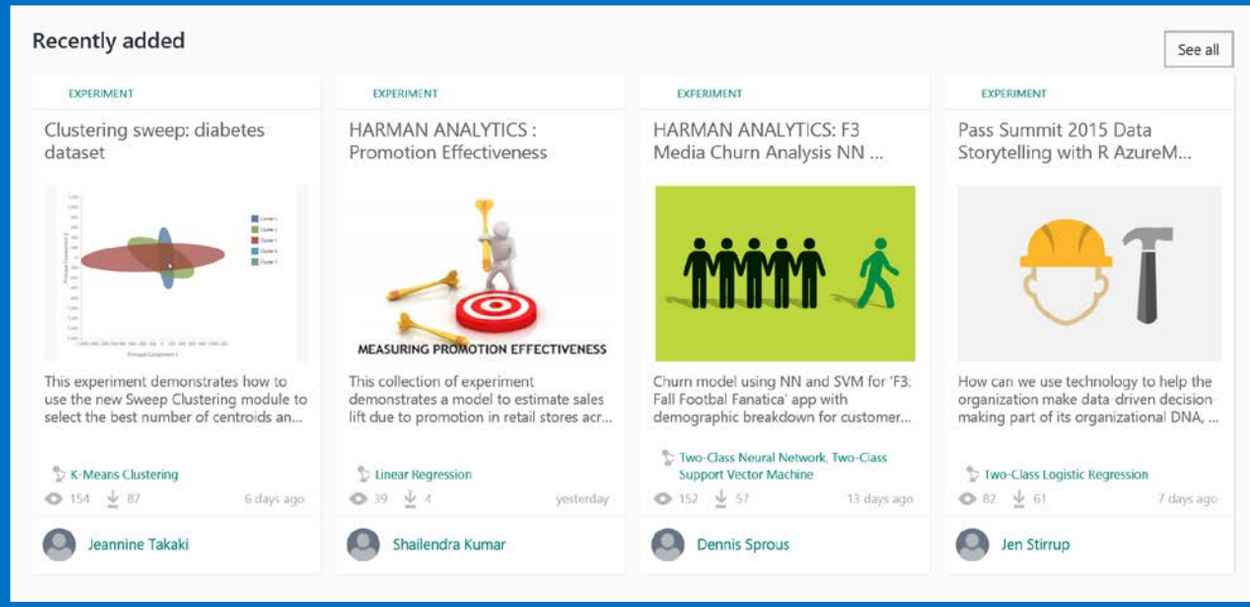
4. Machine learning is simple.
5. There are lots of right ways to do it.



Secrets of data science revealed

1. You can’t use just any data.
2. Turn your data into a picture.
3. Data science can only answer five questions.
4. Machine learning is simple.
5. There are lots of right ways to do it.
6. You can make other people do your work for you.





Resources

1. You can't use just any data.	http://blogs.technet.com/b/machinelearning/archive/2015/08/26/what-can-data-science-do-for-me.aspx
2. Turn your data into a picture.	https://gallery.cortanaanalytics.com/Experiment/Data-exploration-through-visualization-1
3. Data science can only answer five questions.	http://blogs.technet.com/b/machinelearning/archive/2015/08/27/what-types-of-questions-can-data-science-answer.aspx http://blogs.technet.com/b/machinelearning/archive/2015/09/01/which-algorithm-family-can-answer-my-question.aspx
4. Machine learning is simple.	Unfortunately, you will have to learn math and a computer language to do this one.
5. There are lots of right ways to do it.	https://azure.microsoft.com/en-us/documentation/articles/machine-learning-algorithm-cheat-sheet/ https://azure.microsoft.com/en-us/documentation/articles/machine-learning-algorithm-choice/
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Thanks for listening!

Thoughts to share? Questions?
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Special thanks to Diane Rohrer for image and layout design.

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