

UNIT 2

MACHINE LEARNING

CONCEPTS

Content Curated by Pollux M. Rey

FOR THIS UNIT...

01

What is Machine Learning?

02

Types of Machine Learning

03

Supervised Learning

04

Unsupervised Learning

Content Curated by Pollux M. Rey

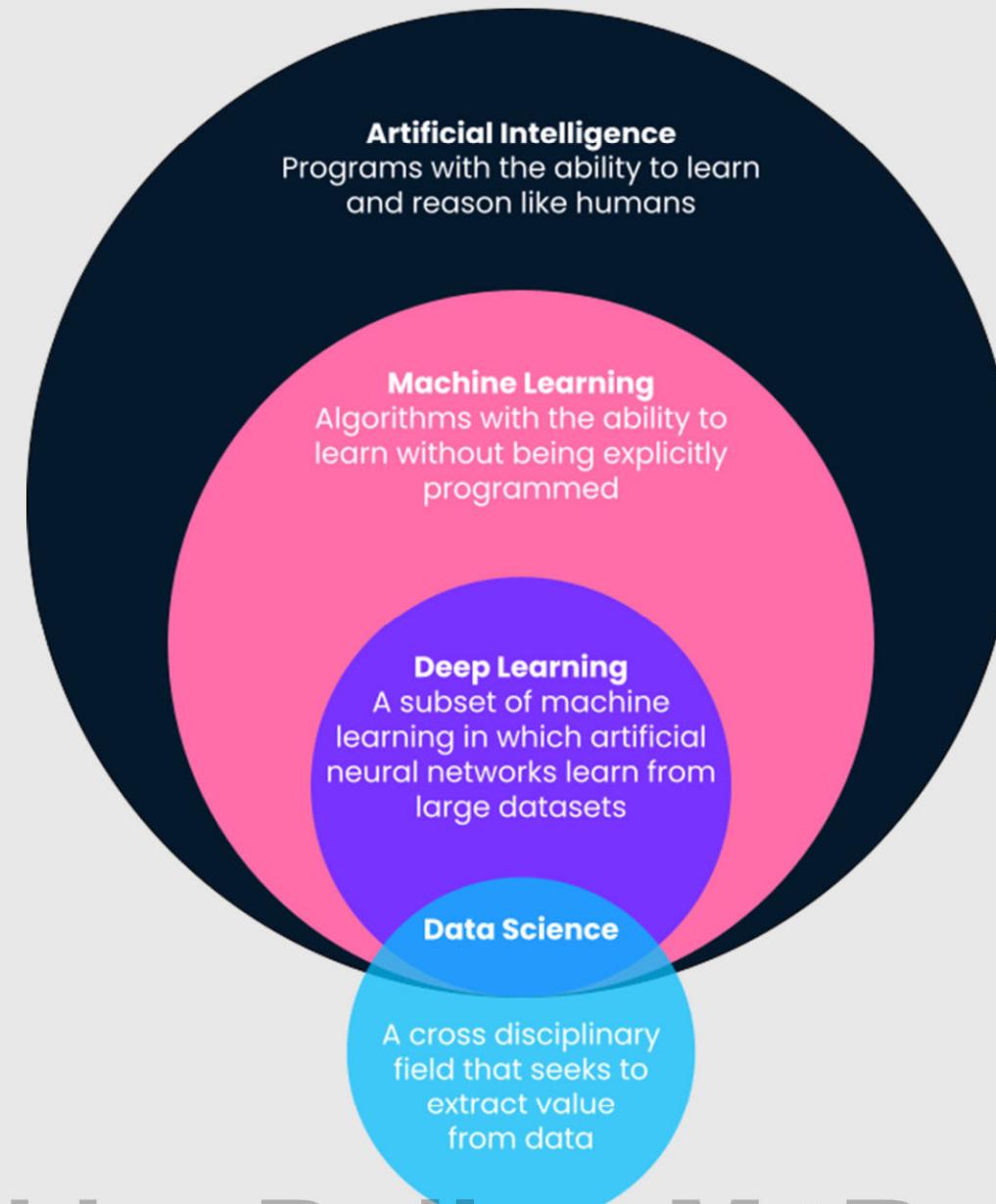
FOR THIS UNIT...

05

Machine Learning Process

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AI vs. ML vs. DL vs. Data Science



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<https://www.datacamp.com/blog/what-is-machine-learning>
<https://towardsdatascience.com/data-science-vs-artificial-intelligence-vs-machine-learning-vs-deep-learning-9fadd8bda583>

What is Machine Learning?

Machine learning enables computers to learn from data and make decisions or predictions without being explicitly programmed to do so.

Traditional Programming vs. ML

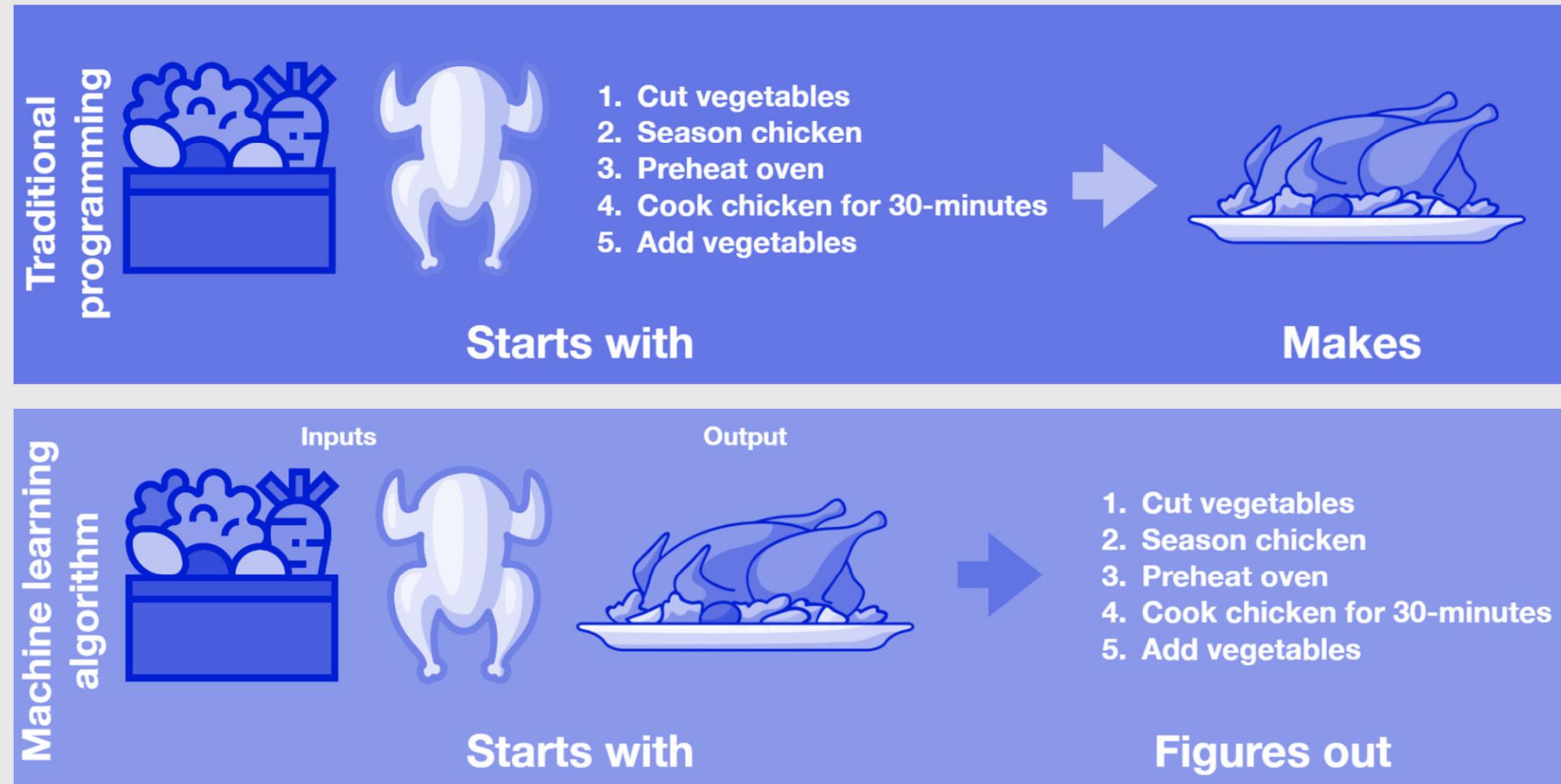
Traditional Programming

A computer follows a set of predefined instructions to perform a task.

Machine Learning

The computer uses given data to figure out how to perform a given task.

Traditional Programming vs. ML



What is Machine Learning?

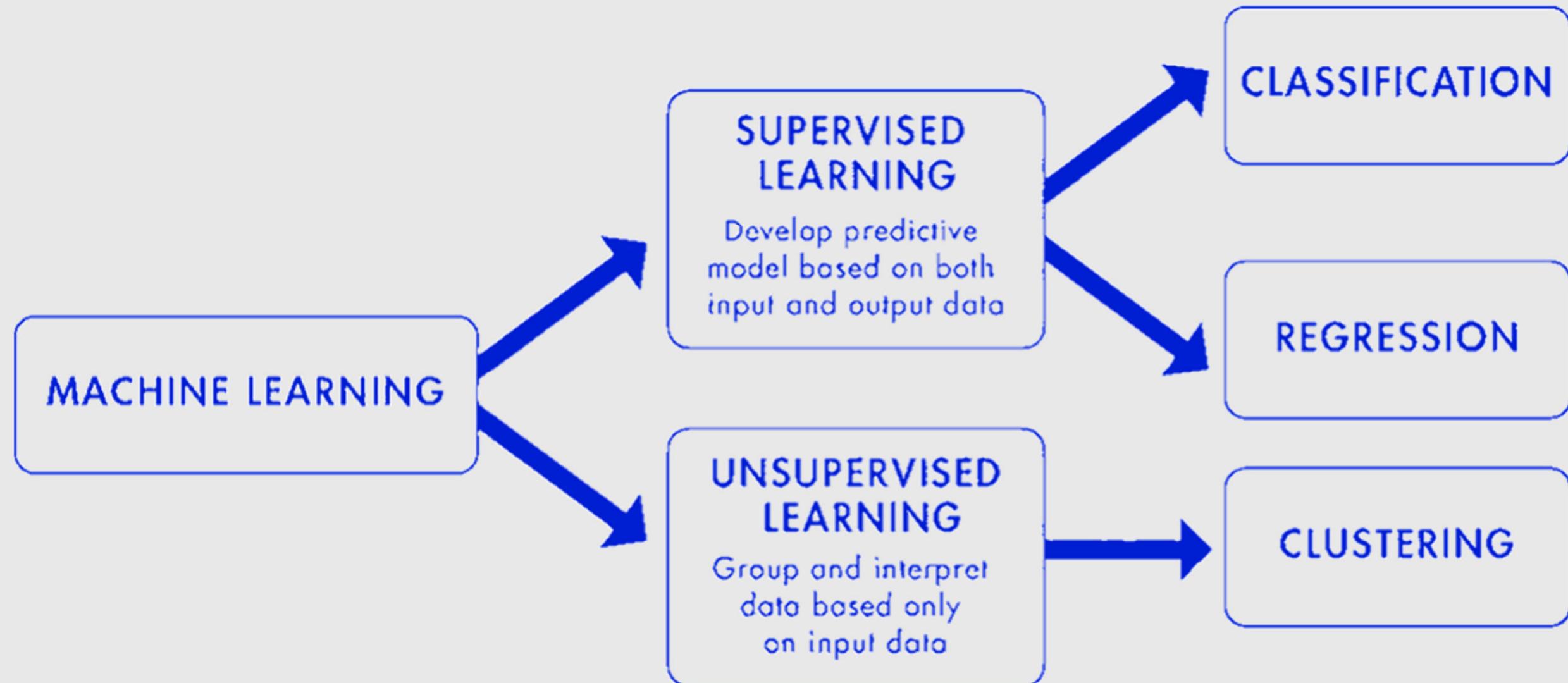
our ability to learn and get better at

**WHAT IS
MACHINE LEARNING?**

Content Curated by Pollux M. Rev

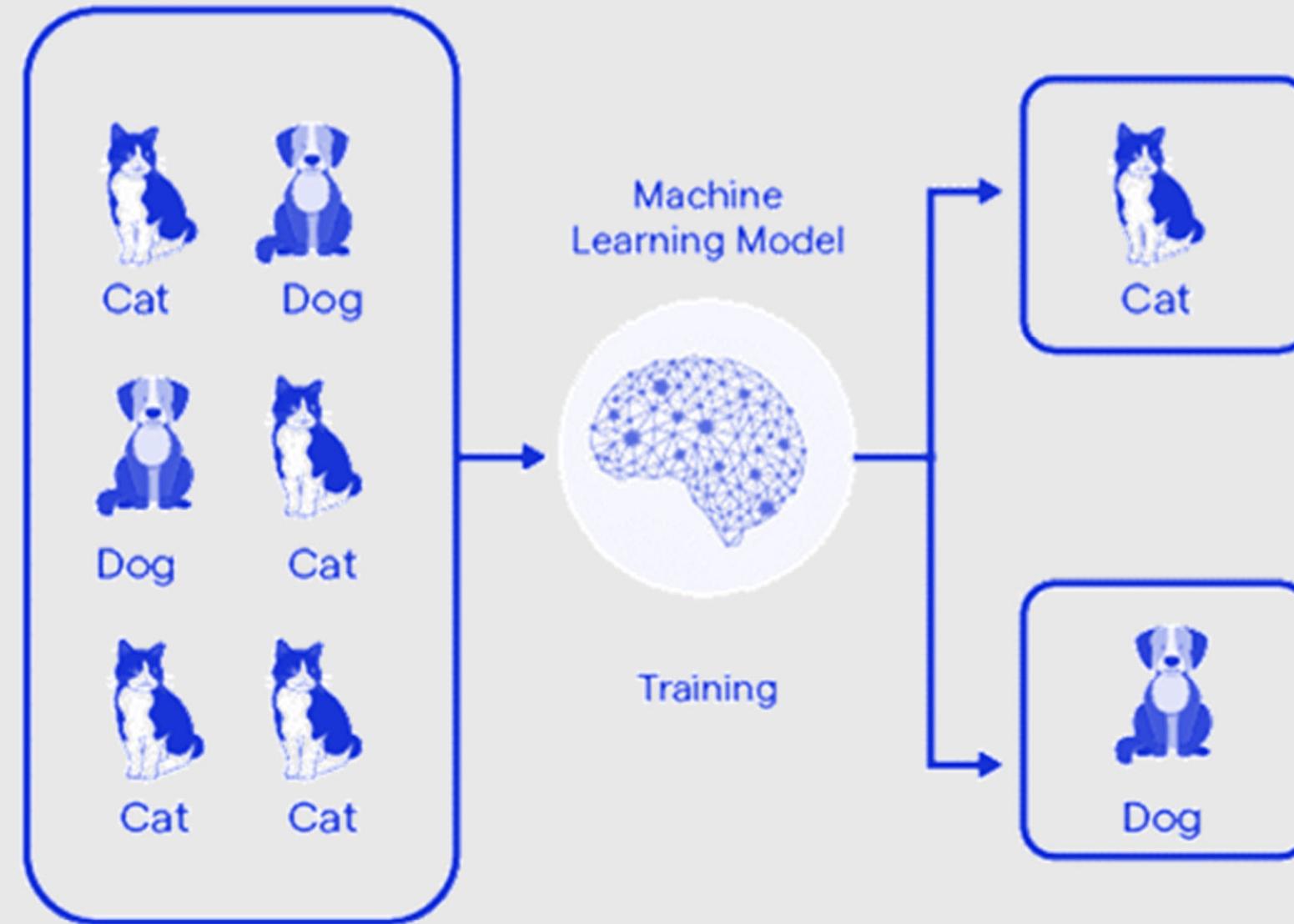
https://www.youtube.com/watch?v=f_uwKZIAeM0

Types of Machine Learning



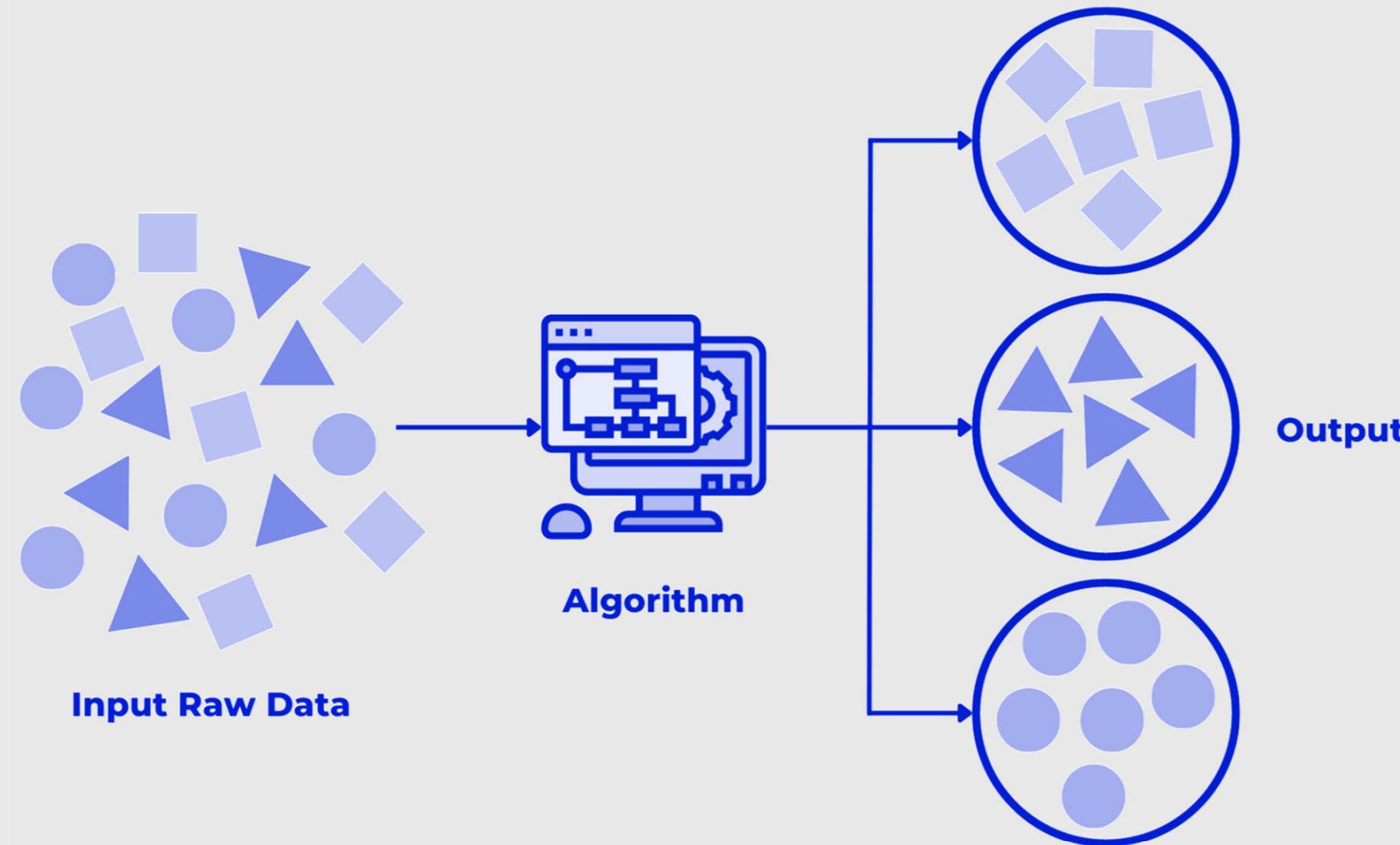
Supervised Learning

Model is trained on a **labeled** dataset



Unsupervised Learning

Model is
trained on
an **unlabeled**
dataset



Supervised Learning

This could be anything from a **category label** to a real-valued number.

Sepal Length (cm)	Sepal Width (cm)	Petal Length (cm)	Petal Width (cm)	Species
5.1	3.5	1.4	0.2	Iris-setosa
4.9	3	1.4	0.2	Iris-setosa
7	3.2	4.7	1.4	Iris-versicolor
6.4	3.2	4.5	1.5	Iris-versicolor
6.3	3.3	6	2.5	Iris-virginica
5.8	2.7	5.1	1.9	Iris-virginica

Supervised Learning

This could be anything from a category label to a real-valued number.

Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
79545.46	5.682861	7.009188	4.09	23086.8	1059034
79248.64	6.0029	6.730821	3.09	40173.07	1505891
61287.07	5.86589	8.512727	5.13	36882.16	1058988
63345.24	7.188236	5.586729	3.26	34310.24	1260617
59982.2	5.040555	7.839388	4.23	26354.11	630943.5

Supervised Learning

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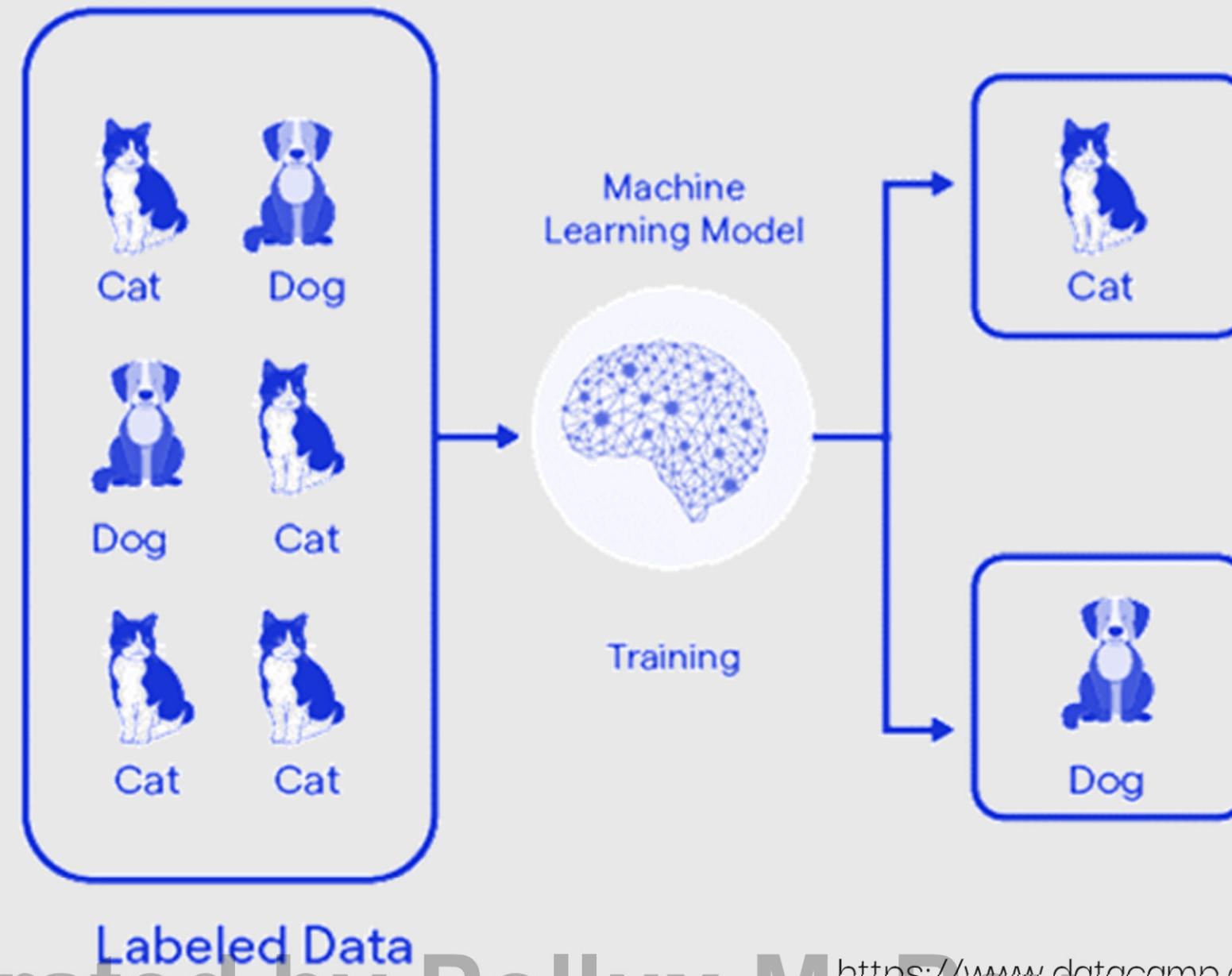
Features: values that a supervised model uses to predict the label

Supervised Learning

Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
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59982.2	5.040555	7.839388	4.23	26354.11	630943.5

Label: The "answer," or the value we want the model to predict

Supervised Learning



The model learns a mapping between the input (features) and the output (label) during the training process.

Supervised Learning - Activity

Feature	Mammals	Birds	Reptiles
Body Covering	Fur or hair	Feathers	Scales
Babies	Mostly live birth	Egg-laying	Mostly egg-laying

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Supervised Learning - Activity



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<https://www.blueridgehumane.org/puppy-vs-grown-dog/>

Supervised Learning - Activity



Mammal

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<https://www.blueridgehumane.org/puppy-vs-grown-dog/>

Supervised Learning - Activity



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<https://www.istockphoto.com/photo/nile-crocodile-gm1200909172-344158057>

Supervised Learning - Activity



Reptile

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<https://www.istockphoto.com/photo/nile-crocodile-gm1200909172-344158057>

Supervised Learning - Activity



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<https://www.neurofog.ca/6-Things-I-Learned-From-My-Parrot-1205055.html>

Supervised Learning - Activity



Bird

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<https://www.neurofog.ca/6-Things-I-Learned-From-My-Parrot-1205055.html>

Supervised Learning - Activity



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

Supervised Learning - Activity



Mammal

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

Supervised Learning - Activity



ECHIDNA: Egg-laying mammal living in Australia and New Guinea

Content Curated by Pollux M. Rev

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

Types of Supervised Learning

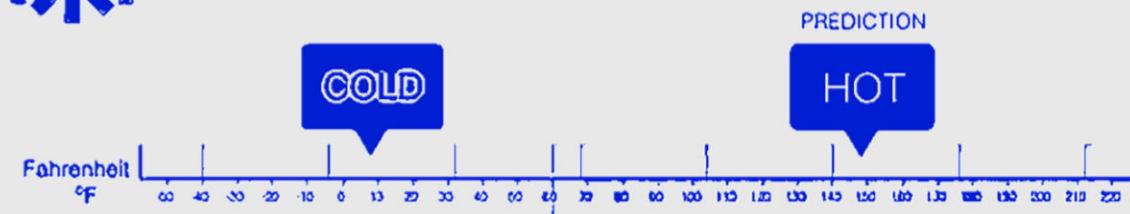
Classification

Used to predict
a categorical label



Classification

Will it be Cold or Hot tomorrow?



Regression

Used to predict
a real or continuous value

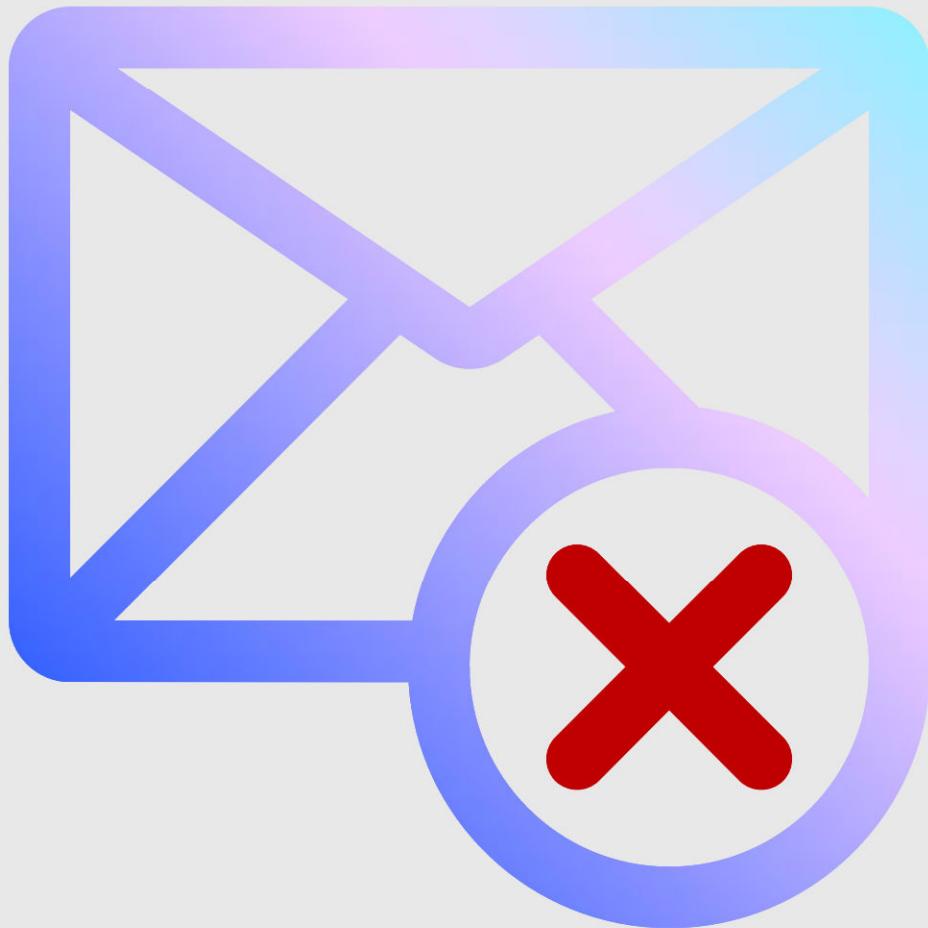


Regression

What is the temperature going to
be tomorrow?



Classification Example

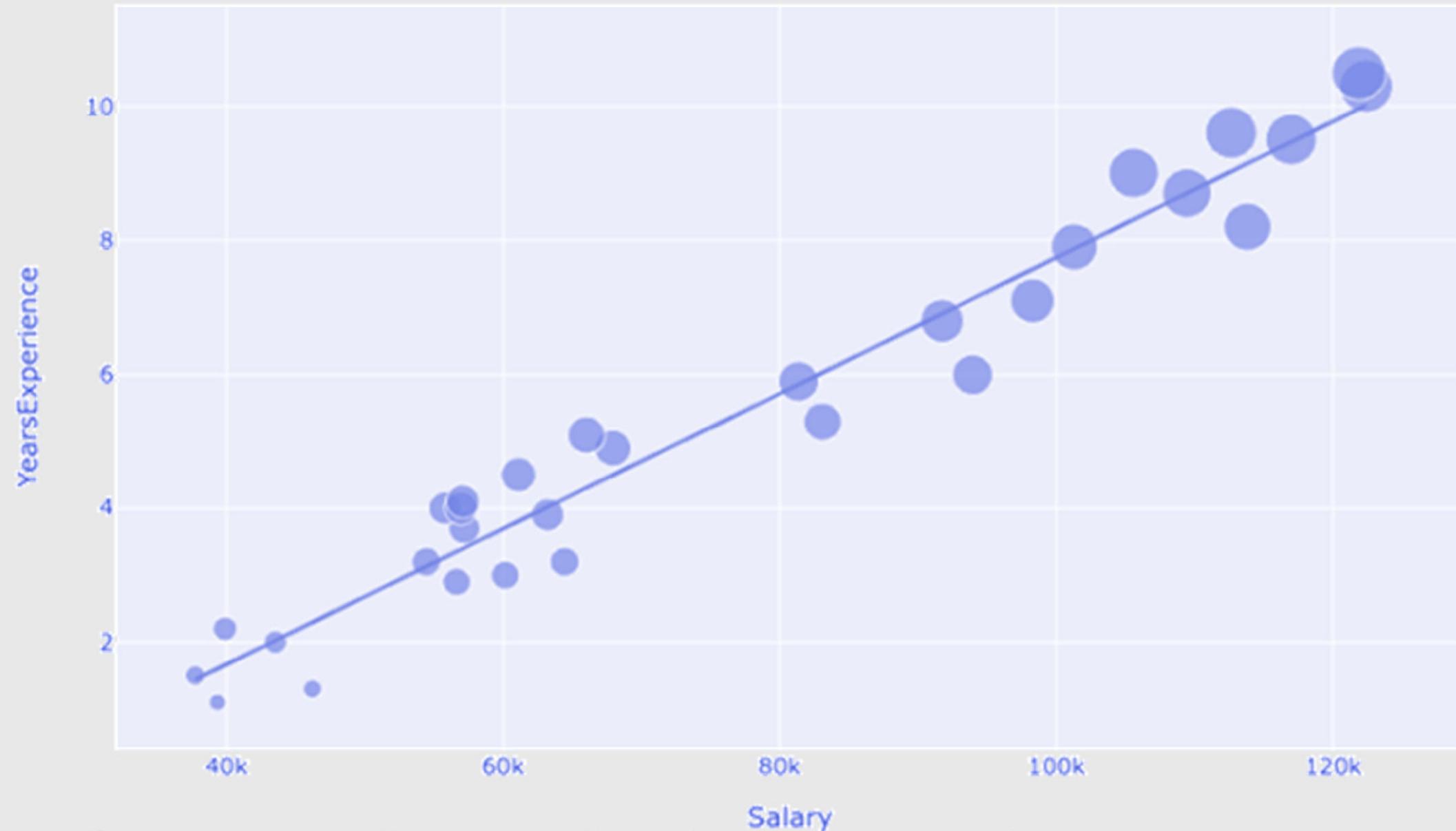


Spam



Not Spam

Regression Example

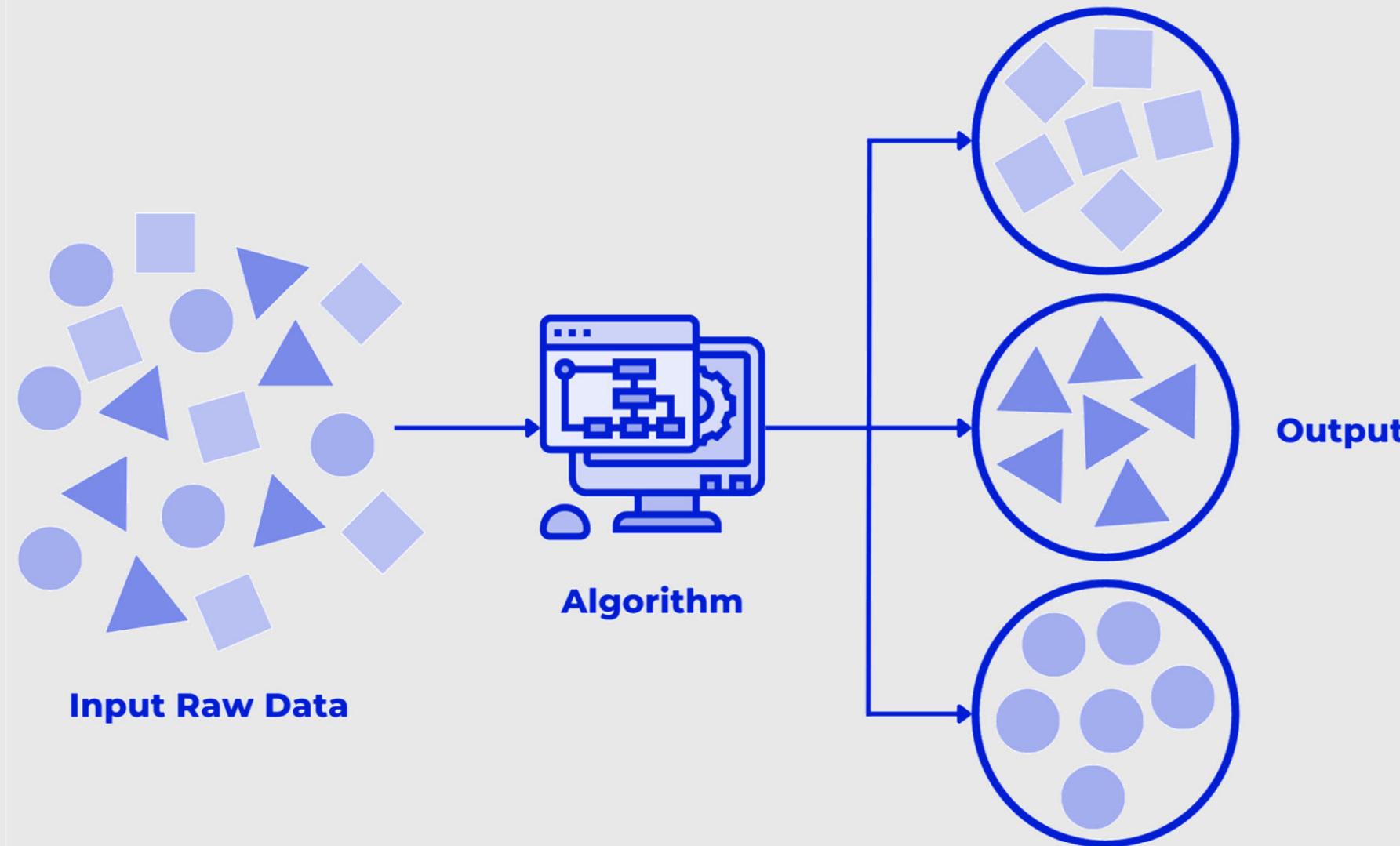


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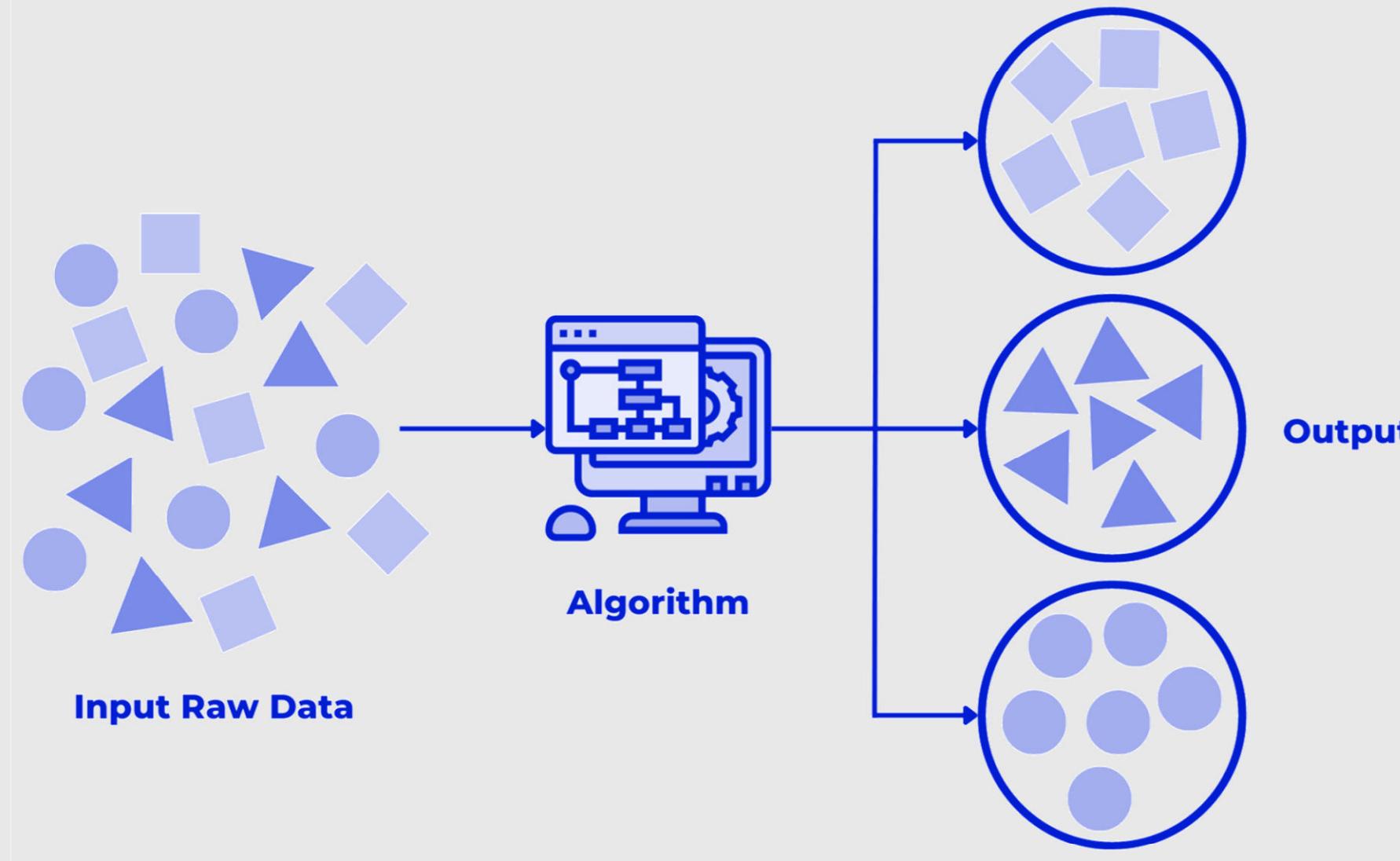
<https://cloud.google.com/discover/what-is-supervised-learning>
<https://thecleverprogrammer.com/2022/10/31/salary-prediction-with-machine-learning/>

Unsupervised Learning

Model is
trained on
an **unlabeled**
dataset



Unsupervised Learning



The model is left to find patterns and relationships in the data on its own.

Unsupervised Learning

Company	Clients	Rate of Return	Sales	Years
A	150	15.4	50400200	18
B	144	11.3	42100650	15
C	120	9.9	39440420	12
D	110	12.5	36500520	16
E	100	9.7	40650005	10
F	99	15.2	45665230	12

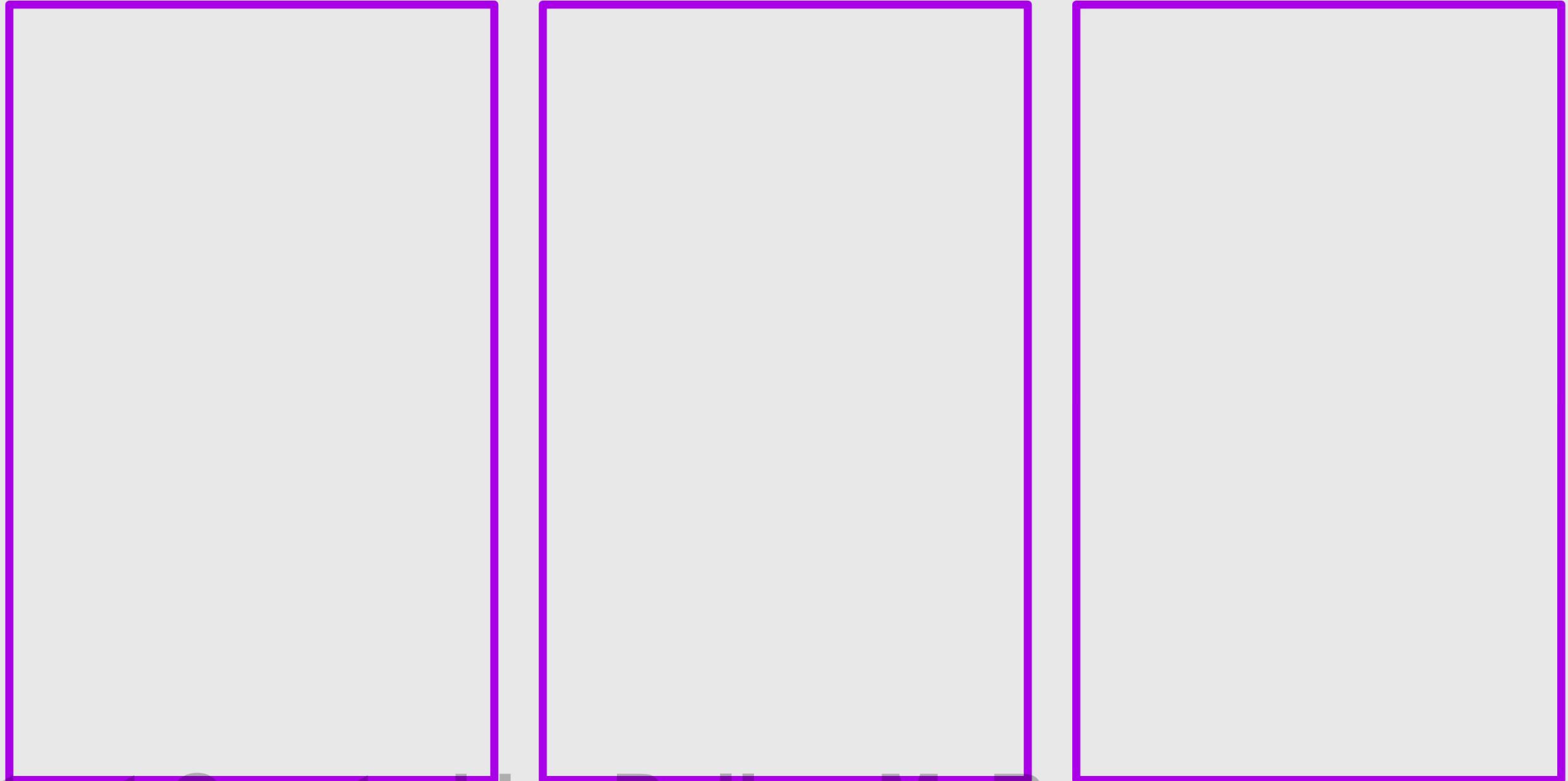
Features

Unsupervised Learning - Activity



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Unsupervised Learning - Activity



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Unsupervised Learning - Activity



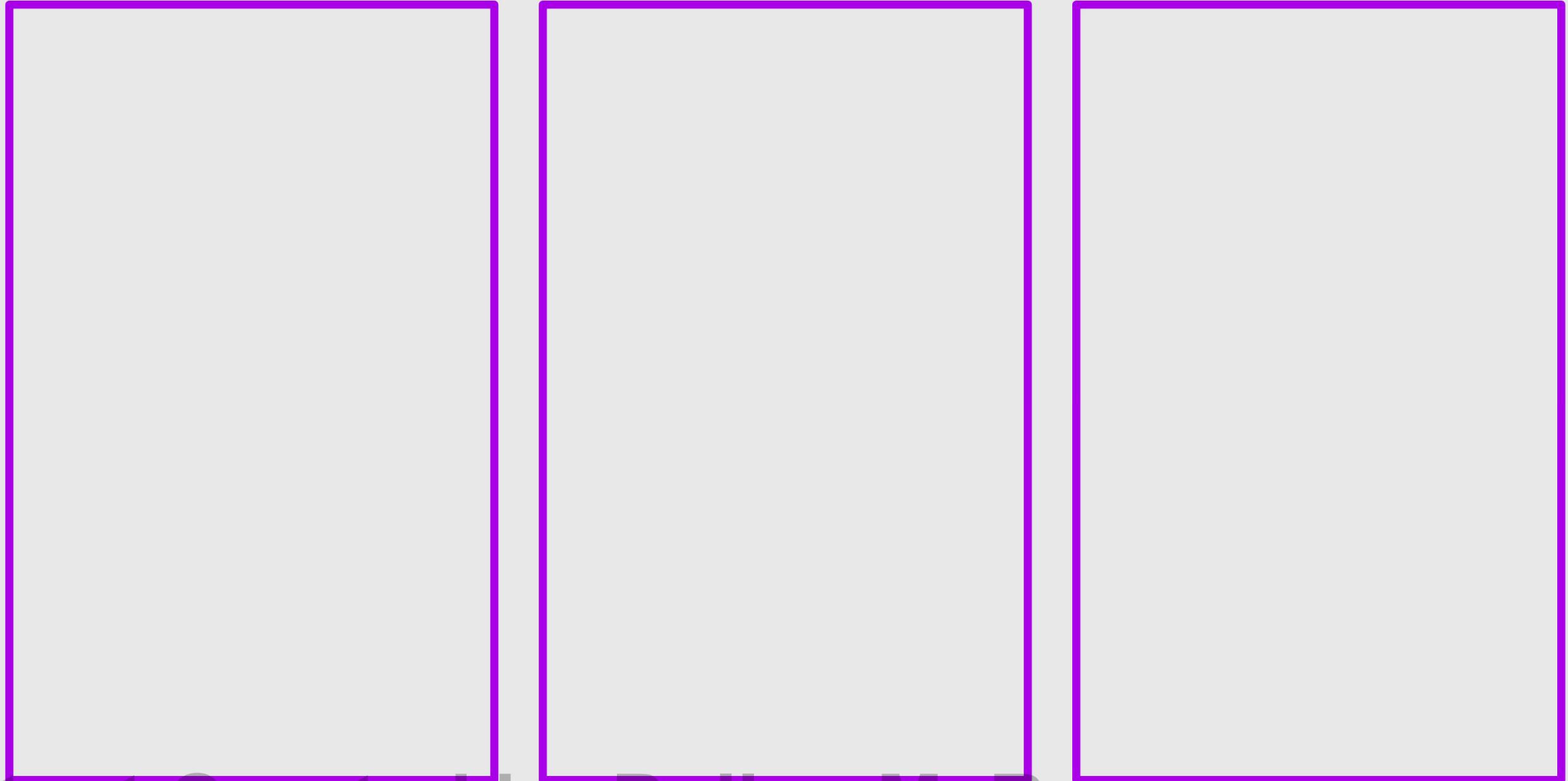
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Unsupervised Learning - Activity



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Unsupervised Learning - Activity



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Unsupervised Learning - Activity



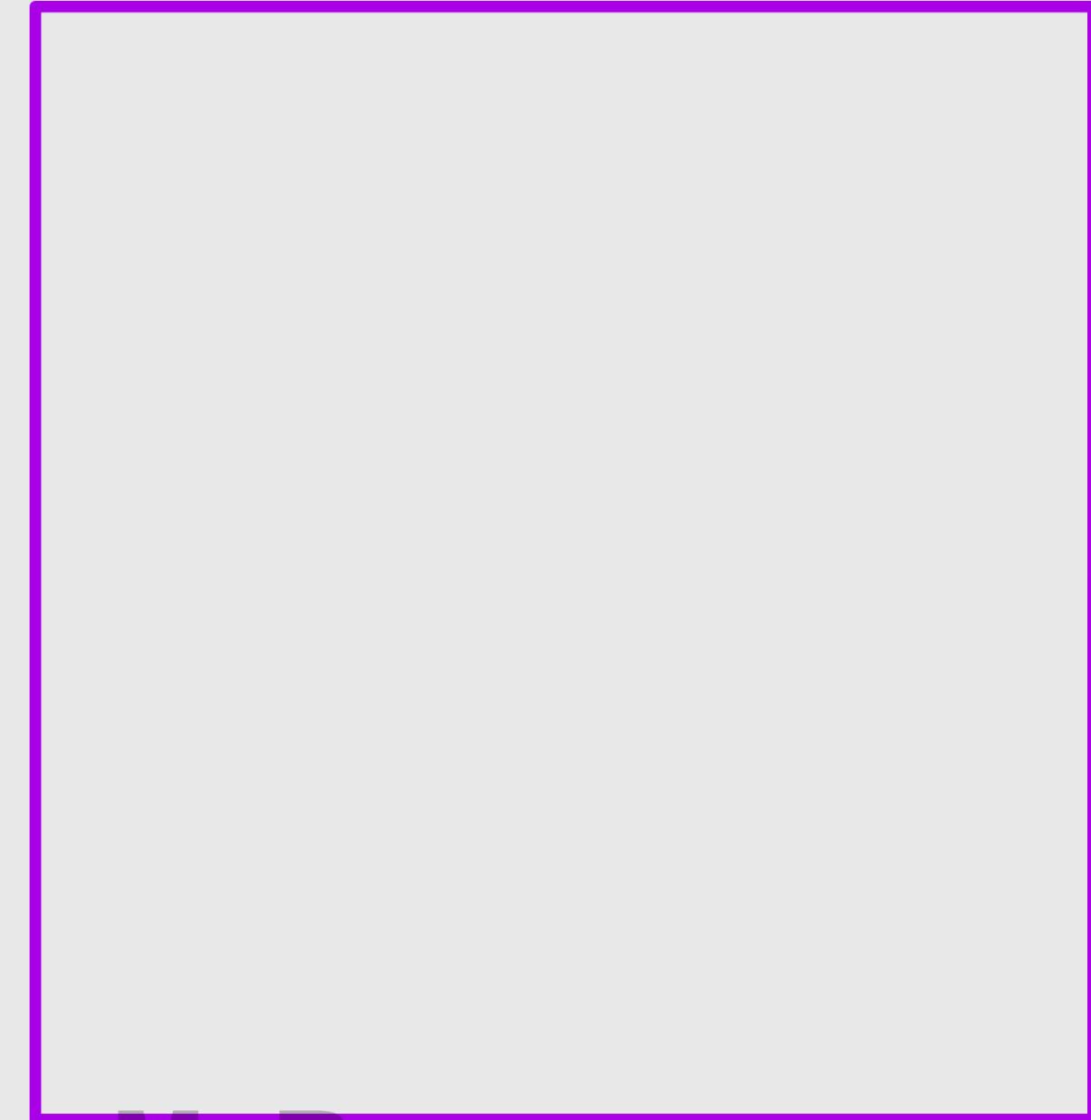
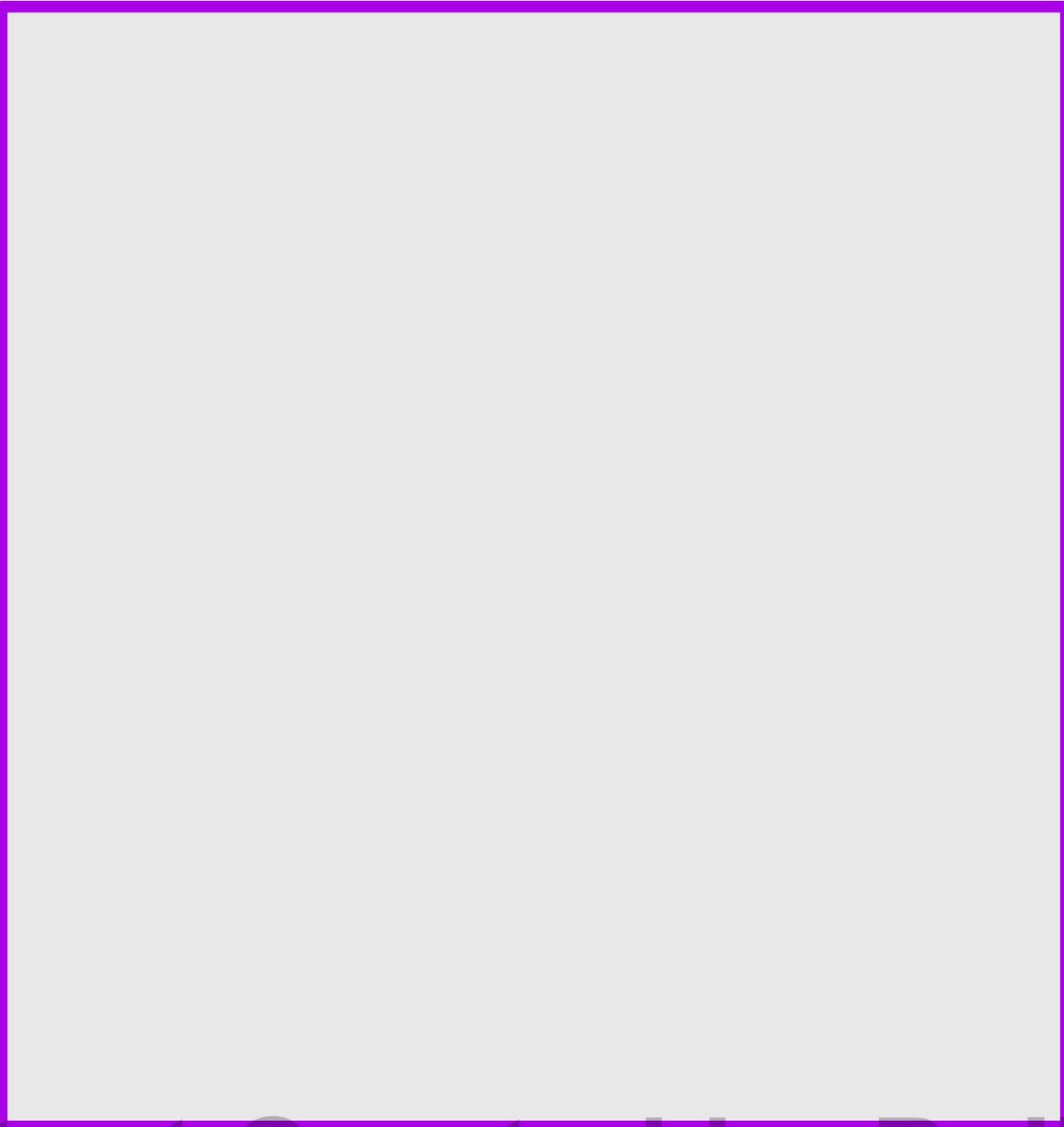
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Unsupervised Learning - Activity



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Unsupervised Learning - Activity



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Unsupervised Learning - Activity

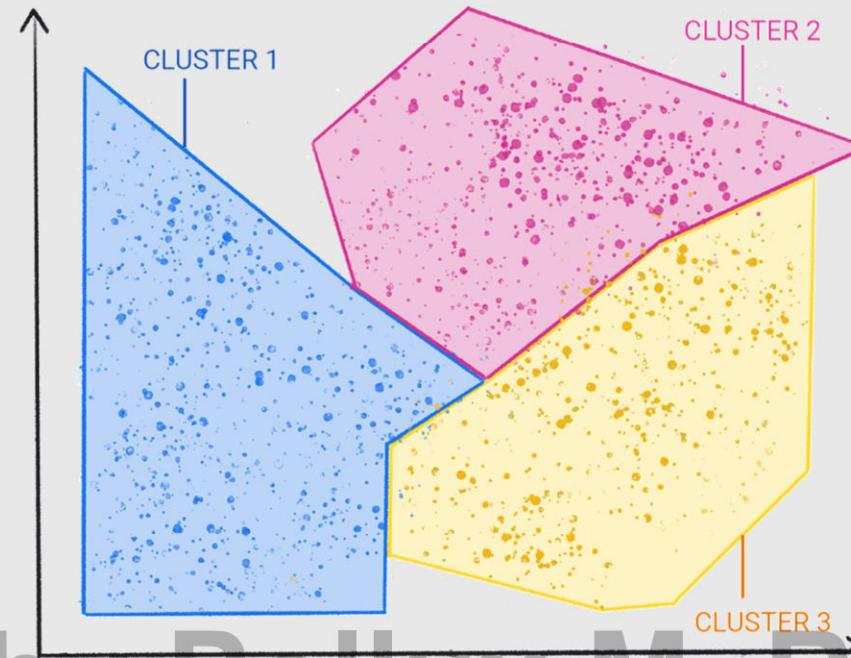


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Type of Unsupervised Learning

Clustering

Used to break down into clusters
based on similarities and differences



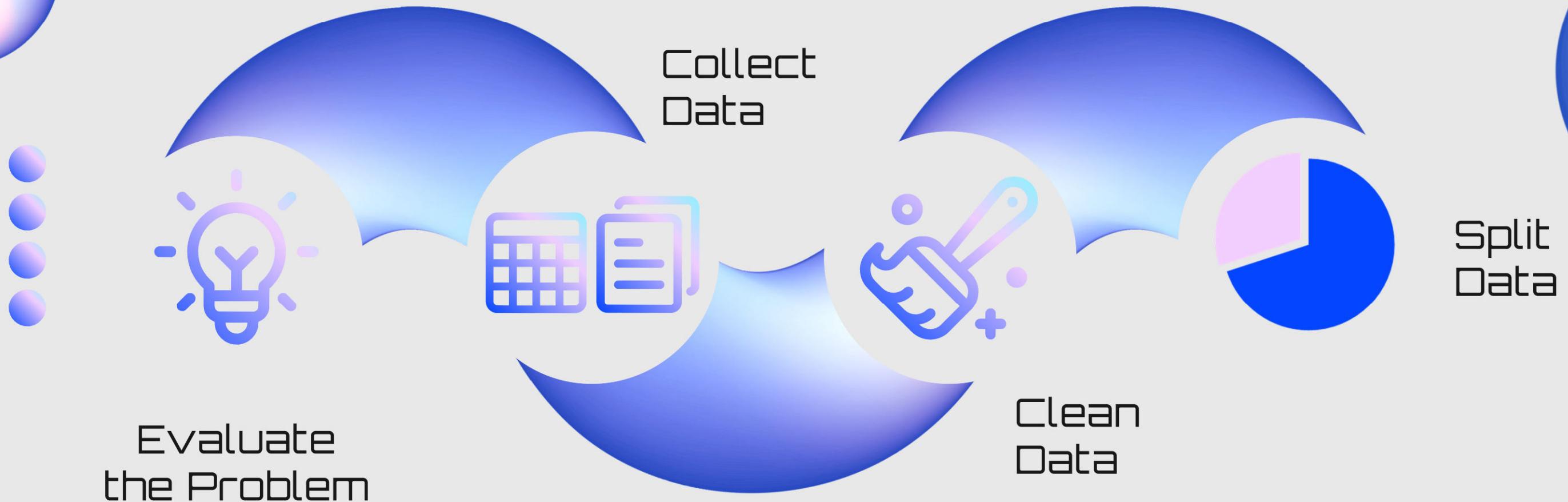
Clustering

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<https://cloud.google.com/discover/what-is-unsupervised-learning>

How to build a machine learning model?

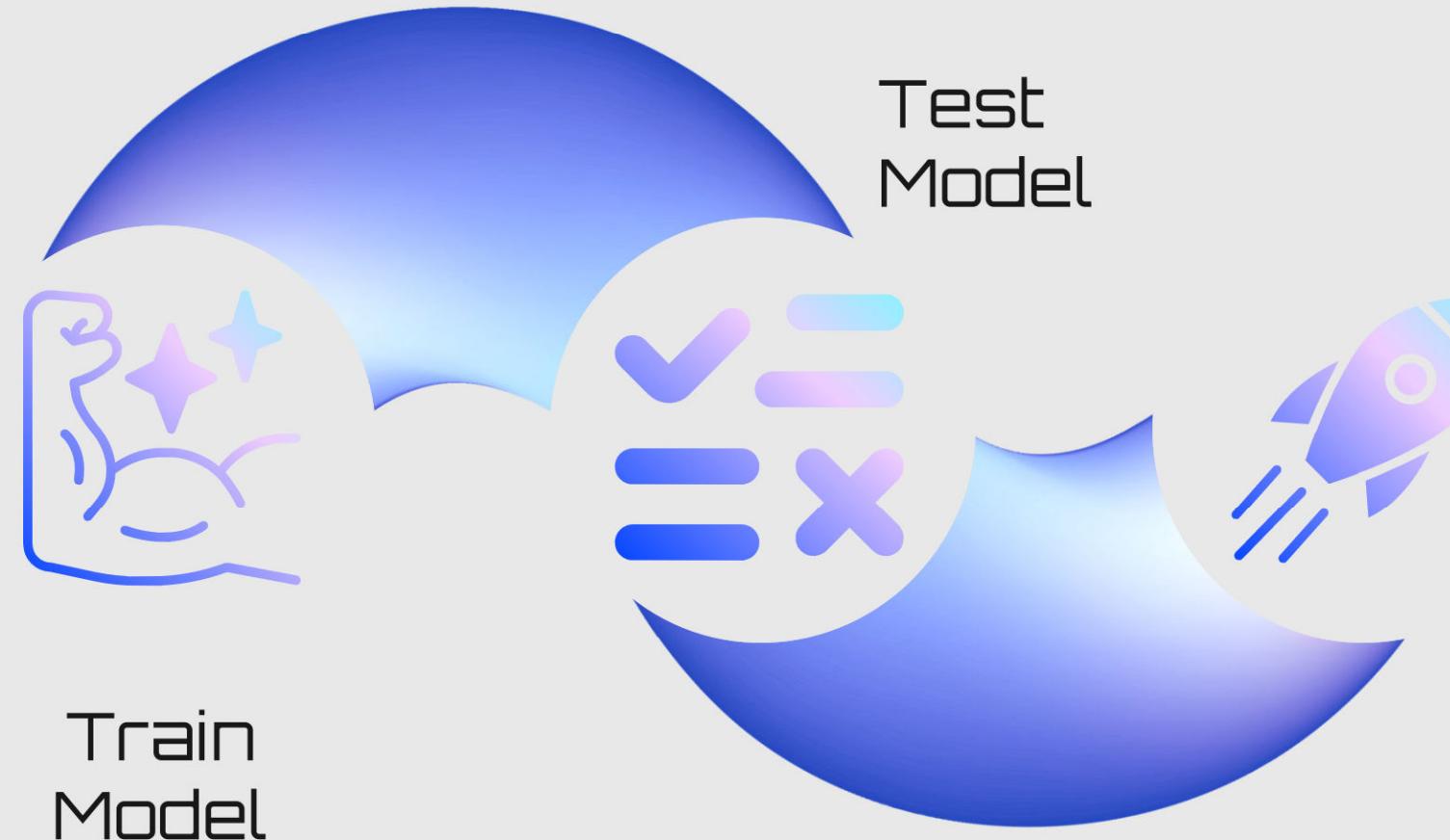


<https://cloud.google.com/ai-platform/docs/ml-solutions-overview>

<https://www.codingdojo.com/blog/machine-learning-workflow>

<https://ml-ops.org/content/end-to-end-ml-workflow>

How to build a machine learning model?



<https://cloud.google.com/ai-platform/docs/ml-solutions-overview>

<https://www.codingdojo.com/blog/machine-learning-workflow>

<https://ml-ops.org/content/end-to-end-ml-workflow>

How to build a machine learning model?

Evaluate the Problem

Ask yourself the following questions:

1. Do you have a well-defined problem to solve?
2. Is ML the best solution for the problem?
3. How can you measure the model's success?



<https://cloud.google.com/ai-platform/docs/ml-solutions-overview>

<https://www.datacamp.com/blog/a-beginner-s-guide-to-the-machine-learning-workflow>

<https://www.codingdojo.com/blog/machine-learning-workflow>

How to build a machine learning model?

Collect Data

Gather data that is relevant to the problem.



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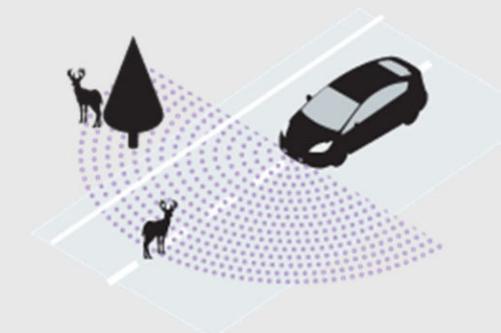
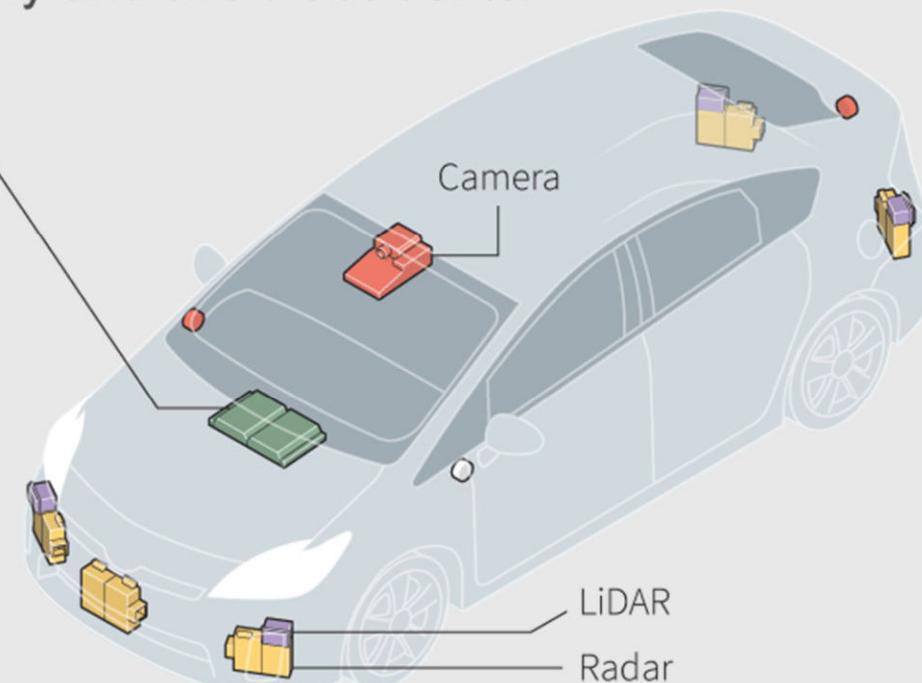
How to build a machine learning model?

How self-driving cars see the road

Autonomous vehicles rely on a host of sensors to plot their trajectory and avoid accidents.

- **Multi-domain controller**

Manages inputs from camera, radar, and LiDAR. With mapping and navigation data, it can confirm decisions in multiple ways.



- **Camera**

Takes images of the road that are interpreted by a computer. Limited by what the camera can “see”.

- **Radar**

Radio waves are sent out and bounced off objects. Can work in all weather but cannot differentiate objects.

- **LiDAR**

Light pulses are sent out and reflected off objects. Can define lines on the road and works in the dark.

How to build a machine learning model?

The data to be used could be...

Structured

Fits neatly into
data tables

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Label
3.5	5	25	4	Cat
6	10	40	15	Dog
2	4	22	3.5	Cat
7.5	12	45	20	Dog
4	6	28	4.5	Cat
6.5	11	38	18	Dog
1.5	4.5	20	3	Cat
8	12.5	50	25	Dog
2.5	5.5	23	3.8	Cat
7	11	42	19	Dog

How to build a machine learning model?

The data to be used
could be...

Unstructured

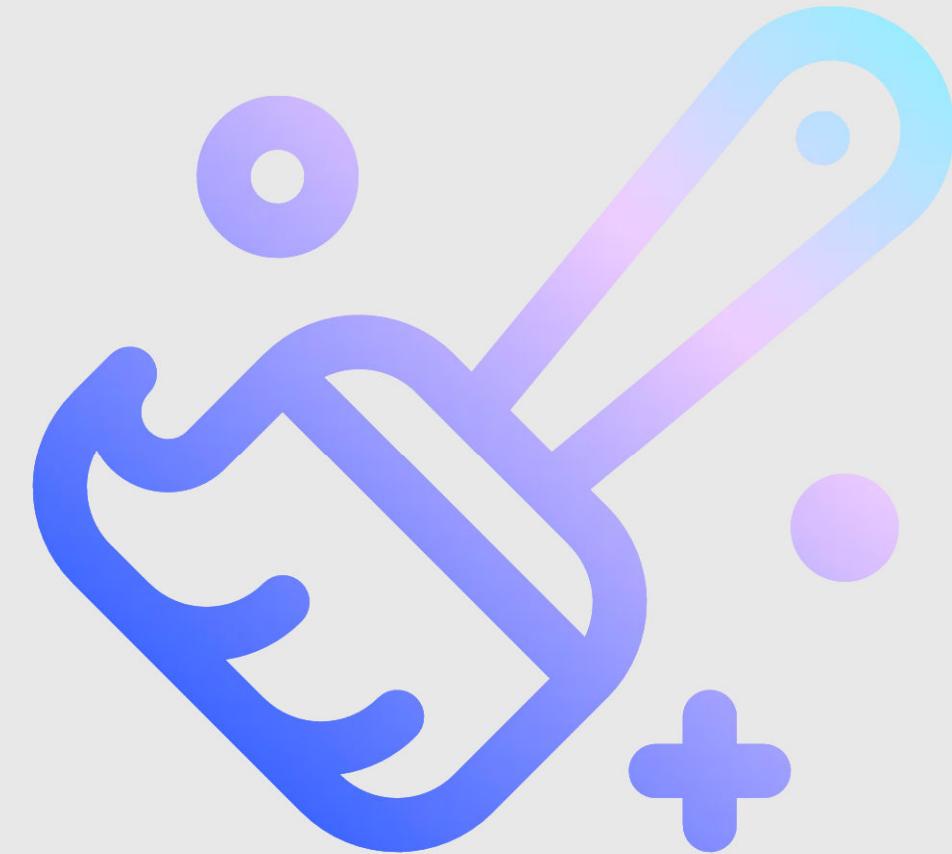
Does not fit neatly into
data tables
due to its nature



How to build a machine learning model?

Clean Data

Transform raw data into clean,
tidy data for training
the machine learning model.



<https://cloud.google.com/ai-platform/docs/ml-solutions-overview>

<https://www.datacamp.com/blog/a-beginner-s-guide-to-the-machine-learning-workflow>

<https://www.codingdojo.com/blog/machine-learning-workflow>

Data Cleaning - Activity

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
6	10	40	15	Striped	Dog
2	4	22	3.5	Spotted	Cat
7.5	12	45	20	Solid	Dog
4	6	28		Striped	Cat
6.5	11	38	18	Solid	Dog
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Data Cleaning - Activity

Duplicate Rows

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
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Data Cleaning - Activity

Duplicate Rows

Remove duplicates

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
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Data Cleaning - Activity

Missing Data

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
6	10	40	15	Striped	Dog
2	4	22	3.5	Spotted	Cat
7.5	12	45	20	Solid	Dog
4	6	28		Striped	Cat
6.5	11	38	18	Solid	Dog
1.5	4.5	20	3	Spotted	Cat
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Data Cleaning - Activity

Missing Data
Impute with
measures of
centrality such as
median or mean

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
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4	6	28	12.4	Striped	Cat
6.5	11	38	18	Solid	Dog
1.5	4.5	20	3	Spotted	Cat
8	12.5	50	25	Striped	Dog
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How to build a machine learning model?

Clean Data

Also, machine learning models typically require numerical input, so ordinal and categorical data must be converted into numeric features.



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8	12.5	50	25	Striped	Dog
2.5	5.5	23	3.8	Solid	Cat
7	11	42	19	Spotted	Dog

Data Cleaning - Activity

Categorical
Data
w/o Ranking

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
6	10	40	15	Striped	Dog
2	4	22	3.5	Spotted	Cat
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8	12.5	50	25	Striped	Dog
2.5	5.5	23	3.8	Solid	Cat
7	11	42	19	Spotted	Dog

Data Cleaning - Activity

Categorical
Data
w/o Ranking
Perform
one-hot-encoding

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
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7.5	12	45	20	Solid	Dog
4	6	28	12.4	Striped	Cat
6.5	11	38	18	Solid	Dog
1.5	4.5	20	3	Spotted	Cat
8	12.5	50	25	Striped	Dog
2.5	5.5	23	3.8	Solid	Cat
7	11	42	19	Spotted	Dog

Data Cleaning - Activity

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Coat Pattern	Label
3.5	5	25	4	Solid	Cat
6	10	40	15	Striped	Dog
2	4	22	3.5	Spotted	Cat
7.5	12	45	20	Solid	Dog
4	6	28	12.4	Striped	Cat
6.5	11	38	18	Solid	Dog
1.5	4.5	20	3	Spotted	Cat
8	12.5	50	25	Striped	Dog
2.5	5.5	23	3.8	Solid	Cat
7	11	42	19	Spotted	Dog

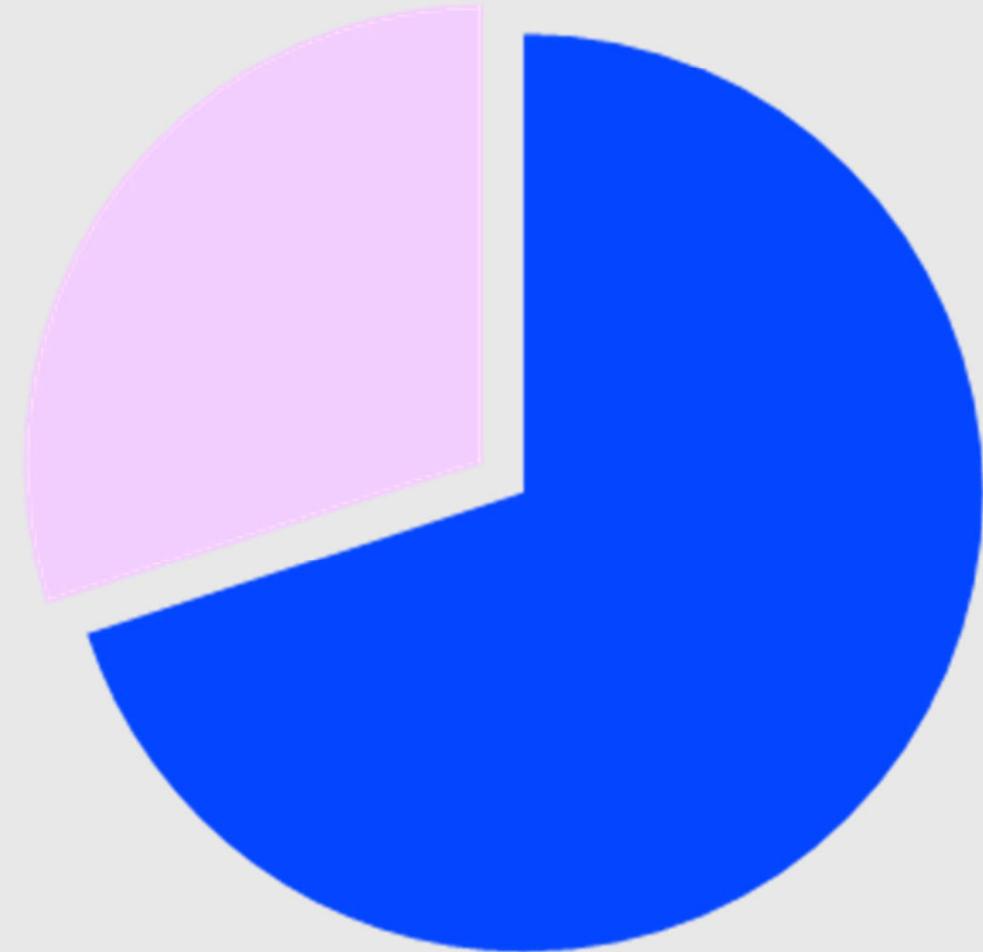
Data Cleaning - Activity

Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Solid Coat Pattern	Striped Coat Pattern	Spotted Coat Pattern	Label
3.5	5	25	4	1	0	0	Cat
6	10	40	15	0	1	0	Dog
2	4	22	3.5	0	0	0	Cat
7.5	12	45	20	1	0	0	Dog
4	6	28	12.4	0	1	0	Cat
6.5	11	38	18	1	0	0	Dog
1.5	4.5	20	3	0	0	0	Cat
8	12.5	50	25	0	1	0	Dog
2.5	5.5	23	3.8	1	0	0	Cat
7	11	42	19	0	0	0	Dog

How to build a machine learning model?

Split Data

Randomly divide the records in the dataset into a training set and a testing set.

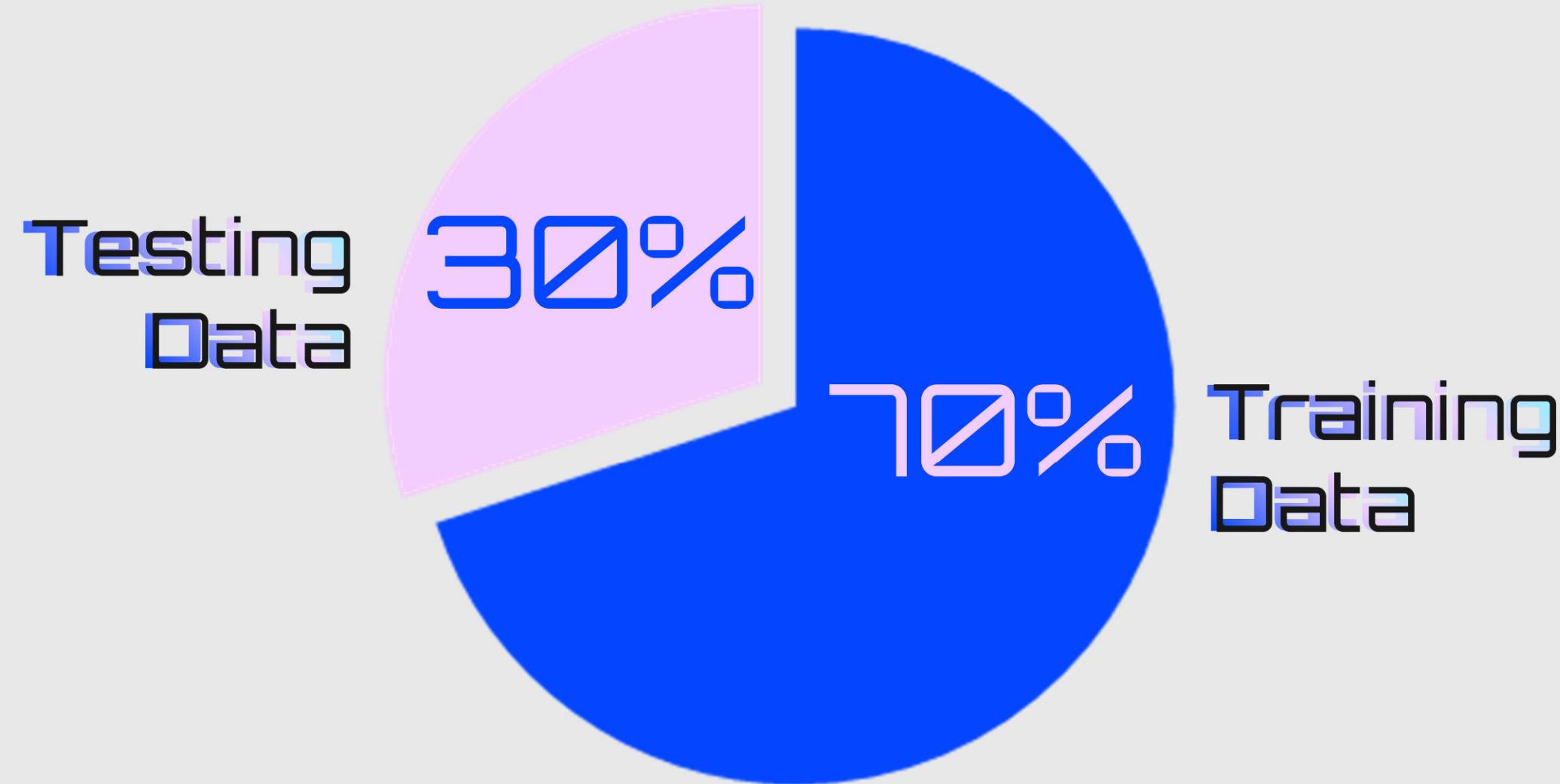


<https://cloud.google.com/ai-platform/docs/ml-solutions-overview>

<https://www.datacamp.com/blog/a-beginner-s-guide-to-the-machine-learning-workflow>

<https://www.codingdojo.com/blog/machine-learning-workflow>

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Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Solid Coat Pattern	Striped Coat Pattern	Spotted Coat Pattern	Label
3.5	5	25	4	1	0	0	Cat
6	10	40	15	0	1	0	Dog
2	4	22	3.5	0	0	1	Cat
7.5	12	45	20	1	0	0	Dog
4	6	28	12.4	0	1	0	Cat
6.5	11	38	18	1	0	0	Dog
1.5	4.5	20	3	0	0	1	Cat
8	12.5	50	25	0	1	0	Dog
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How to build a machine learning model?

	Fur Length (cm)	Ear Size (cm)	Tail Length (cm)	Weight (kg)	Solid Coat Pattern	Striped Coat Pattern	Spotted Coat Pattern	Label
Training Data	3.5	5	25	4	1	0	0	0 Cat
	6	10	40	15	0	1	0	0 Dog
	2	4	22	3.5	0	0	0	1 Cat
	7.5	12	45	20	1	0	0	0 Dog
Testing Data	4	6	28	12.4	0	1	0	0 Cat
	6.5	11	38	18	1	0	0	0 Dog
	1.5	4.5	20	3	0	0	0	1 Cat
	8	12.5	50	25	0	1	0	0 Dog
	2.5	5.5	23	3.8	1	0	0	0 Cat
	7	11	42	19	0	0	0	1 Dog

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How to build a machine learning model?

 MLU-EXPLAIN

[Introduction](#)

The Split

Train Set

Model

Validation Set

Test Set

Summary

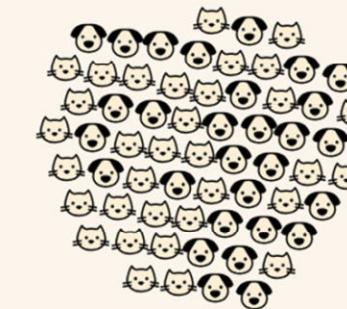
The Importance of Data Splitting

By [Jared Wilber](#) & Brent Werness

In most supervised machine learning tasks, best practice recommends to split your data into three independent sets: a **training set**, a **testing set**, and a **validation set**.

To learn why, let's pretend that we have a dataset of two types of pets:

Cats:  Dogs: 



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<https://mlu-explain.github.io/train-test-validation/>

How to build a machine learning model?

Train Model

Fit model to the training set.

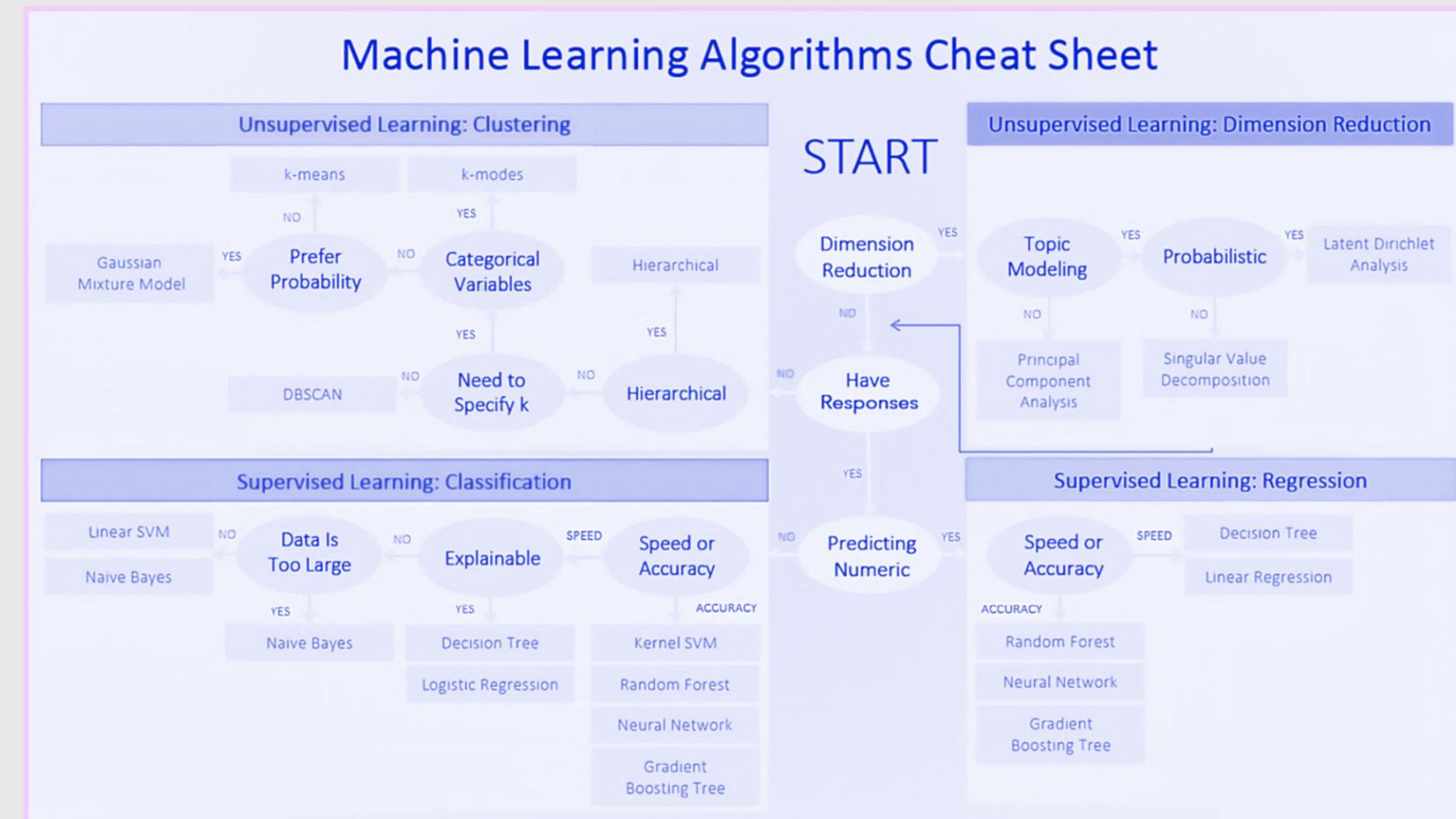


<https://cloud.google.com/ai-platform/docs/ml-solutions-overview>

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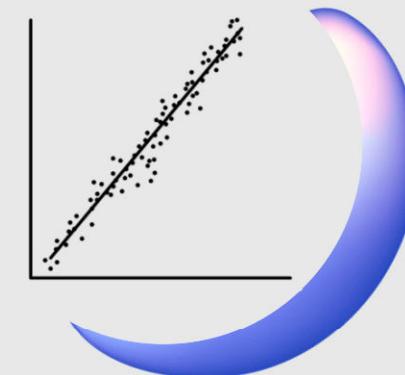
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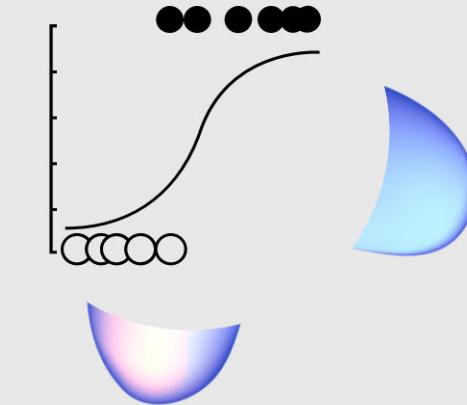
<https://blogs.sas.com/content/subconsciousmusings/2020/12/09/machine-learning-algorithm-use>

COURSE OUTLINE



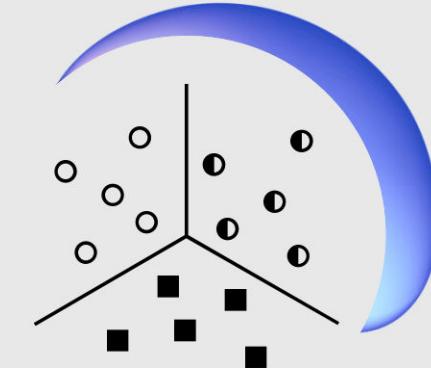
03

LINEAR
REGRESSION



04

LOGISTIC
REGRESSION
(CLASSIFICATION)



05

K-MEANS
CLUSTERING

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How to build a machine learning model?

Test Model

Calculate performance metrics on the testing set such as accuracy, recall and precision.



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How to build a machine learning model?

Deploy Model

Embed the model in dashboards or applications.

Continuously iterate and update it post-deployment to improve performance.



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How to build a machine learning model?

[MUSIC PLAYING]

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<https://www.youtube.com/watch?v=nKW8Ndu7Mjw>

THANK YOU!

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