

Introduction to Machine Learning and Artificial Intelligence

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Silicon Valley Code Camp
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Machine Learning

Traditional Software Development

Traditional Software Development

Convert **inches** to **cm**

Traditional Software Development

Convert **inches** to **cm**

Input:

Output:

Traditional Software Development

Convert to **cm**

Input: **inches**

Output:

Traditional Software Development

Input: **inches**

Relationship: **cm** =

Output:

Traditional Software Development

Input: **inches**

Relationship: **cm** = **inches** * 2.54

Output:

Traditional Software Development

Input: **inches**

Relationship: **cm** = **inches** * 2.54

Output: **cm**

Traditional Software Development

Traditional Software Development

Convert a **number** to its **absolute value**

Traditional Software Development

Convert a **number** to its **absolute value**

Input:

Output:

Traditional Software Development

Convert a to its **absolute value**

Input: **number**

Output:

Traditional Software Development

Convert a **number** to its **absolute value**

Input: **number**

Rules:

Output:

Traditional Software Development

Input: **number**

Rules:

abs. value

Output:

Traditional Software Development

Input: **number**

Rules:

if **number** >= 0: **abs. value** = **number**

Output:

Traditional Software Development

Input: **number**

Rules:

```
if number >= 0: abs. value = number
else: abs. value = number * -1
```

Output:

Traditional Software Development

Input: **number**

Rules:

if **number** >= 0: **abs. value** = **number**
else: **abs. value** = **number** * -1

Output: **abs. value**

Traditional Software Development

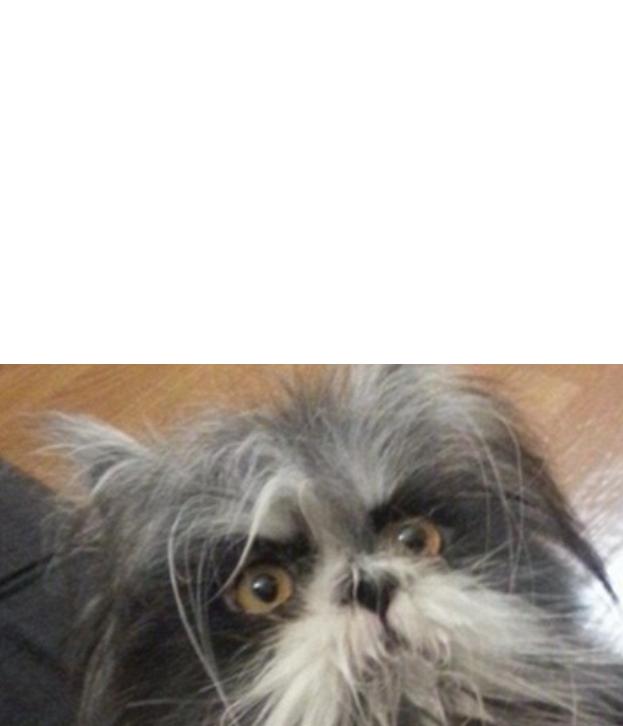
Traditional Software Development







© Twitter



Traditional Software Development

Input:



Rules:

Output:

Traditional Software Development

Input:



Rules:

rule 1
rule 2
rule 3 ...

Output:

Traditional Software Development

Input:



Rules:

rule 1

rule 2

rule 3 ...

Output: “cat”

Machine Learning

Machine Learning

Input	144	181	200	317	800
Output					

Machine Learning

Input	144	181	200	317	800
Output	256	219	200	?	-400

Machine Learning

Input	144	181	200	317	800
Output	256	219	200	83	-400

Output = 400 - Input

Input	144	181	200	317	800
Output	256	219	200	83	-400

Machine Learning

Input: [144, 181, 200 800]

Machine Learning

Input: [144, 181, 200 800]

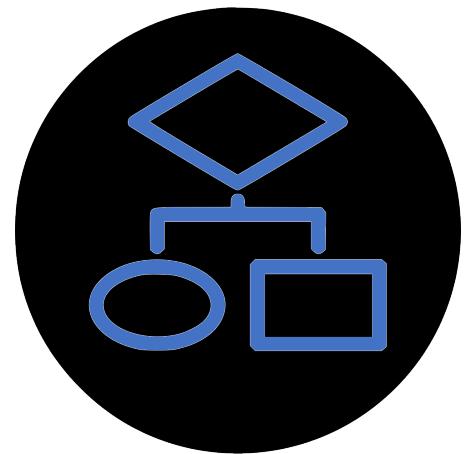
Output: [256, 219, 200, -400]

Machine Learning

Input: [144, 181, 200 800]

Relationship: ?

Output: [256, 219, 200, -400]



=

Common ML Algorithms

Linear Regression

Logistic Regression

Naïve Bayes

Support Vector Machine

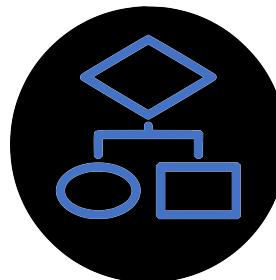
Decision Tree

K-Nearest Neighbor

Machine Learning

Input: [144, 181, 200 800]

Relationship:



Output: [256, 219, 200, -400]

Machine Learning

Input: [144, 181, 200 800]

Relationship: 400 - input

Output: [256, 219, 200, -400]

Machine Learning

Input: [144, 181, 200 800]

Relationship: 400 - input ← Model

Output: [256, 219, 200, -400]

Machine Learning

ML Model

400 - Input

Machine Learning

ML Model

New input: 317 → 400 - Input

Machine Learning

ML Model

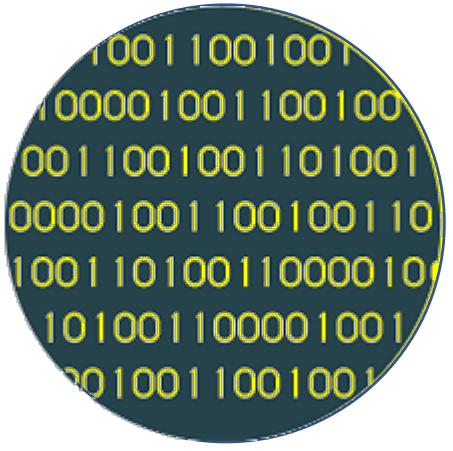
New input: 317 → 400 - Input → output: 83

$$\hat{f}(X)$$

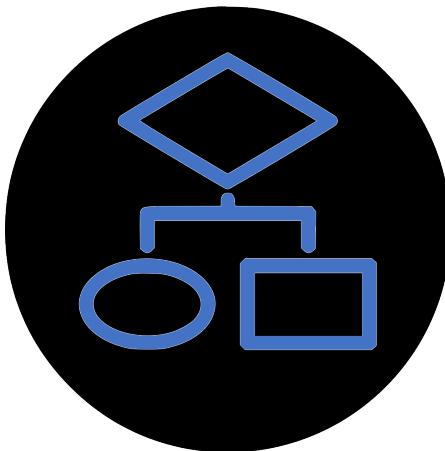
The Prediction

$$\hat{y} = \hat{f}(X)$$

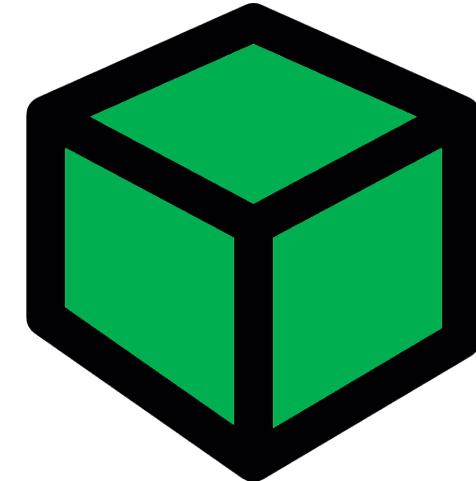
output input



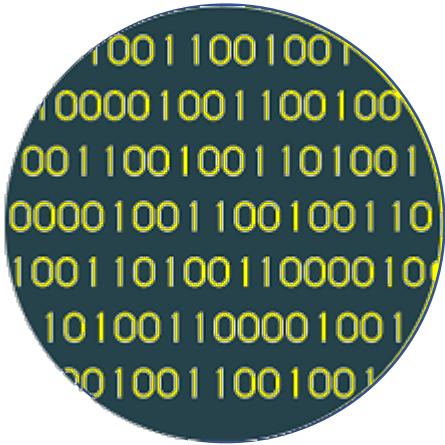
DATA



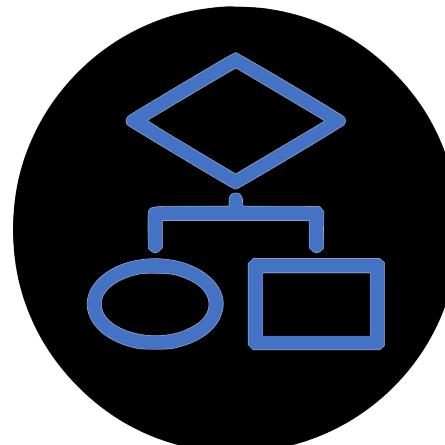
ALGORITHM



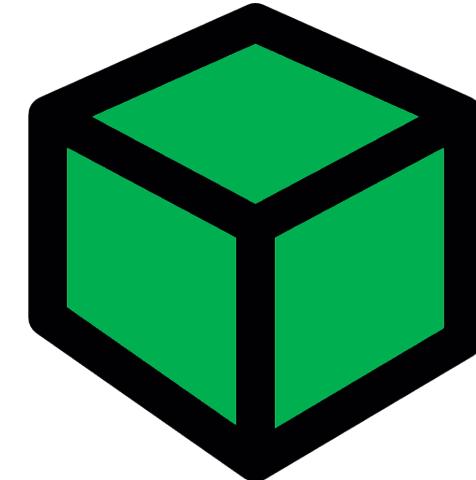
MODEL



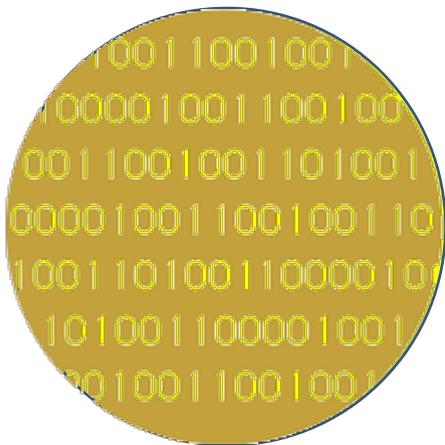
DATA



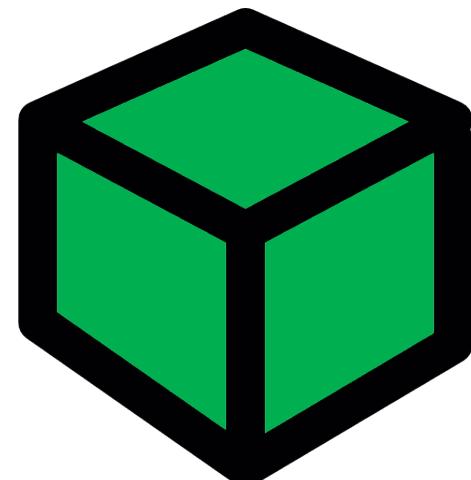
ALGORITHM



MODEL



NEW DATA



MODEL



PREDICTIONS

Machine Learning

Input: [ ,  ,  , ]

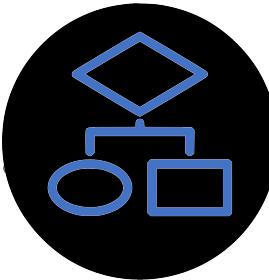
Relationship:

Output: [“cat”, “dog”, “dog”, “cat”]

Machine Learning

Input: [ ,  ,  , ]

Relationship



Output: [“cat”, “dog”, “dog”, “cat”]

Machine Learning

Instead of programming a computer,
you give a computer **examples** and
it **learns** what you want.

Why ML Now?

Why ML Now?

- Increasing availability of data

Why ML Now?

- Increasing availability of data
- Sophistication of ML algorithms

Why ML Now?

- Increasing availability of data
- Sophistication of ML algorithms
- Increasing power and availability of computing hardware and software

Types of Machine Learning

Supervised

Unsupervised



Music

Song	Artist	Genre	Liked
Breathing Light	Frameworks	Alternative Rock	Yes
Superior	Silver Maple	Pop	No
Icicle	AK	Pop	No
Jazzin	Flap Jack	R&B	Yes
The Way You Do	Schlomo	R&B	Yes
Mirror Maru	Cashmere	Rock	Yes
Never Too Far	Sorrow	Pop	No



Music

Features →
(X)

Song	Artist	Genre	Liked
Breathing Light	Frameworks	Alternative Rock	Yes
Superior	Silver Maple	Pop	No
Icicle	AK	Pop	No
Jazzin	Flap Jack	R&B	Yes
The Way You Do	Schlomo	R&B	Yes
Mirror Maru	Cashmere	Rock	Yes
Never Too Far	Sorrow	Pop	No



Music

Song	Artist	Genre	Liked
Breathing Light	Frameworks	Alternative Rock	Yes
Superior	Silver Maple	Pop	No
Icicle	AK	Pop	No
Jazzin	Flap Jack	R&B	Yes
The Way You Do	Schlomo	R&B	Yes
Mirror Maru	Cashmere	Rock	Yes
Never Too Far	Sorrow	Pop	No

← Target
(y)



Music

Song	Artist	Genre	Liked
Breathing Light	Frameworks	Alternative Rock	Yes
Superior	Silver Maple	Pop	No
Icicle	AK	Pop	No
Jazzin	Flap Jack	R&B	Yes
The Way You Do	Schlomo	R&B	Yes
Mirror Maru	Cashmere	Rock	Yes
Never Too Far	Sorrow	Pop	No

← Labels

Supervised

Features	Label
	Yes
	No
	No
	Yes
	Yes
	Yes
	No

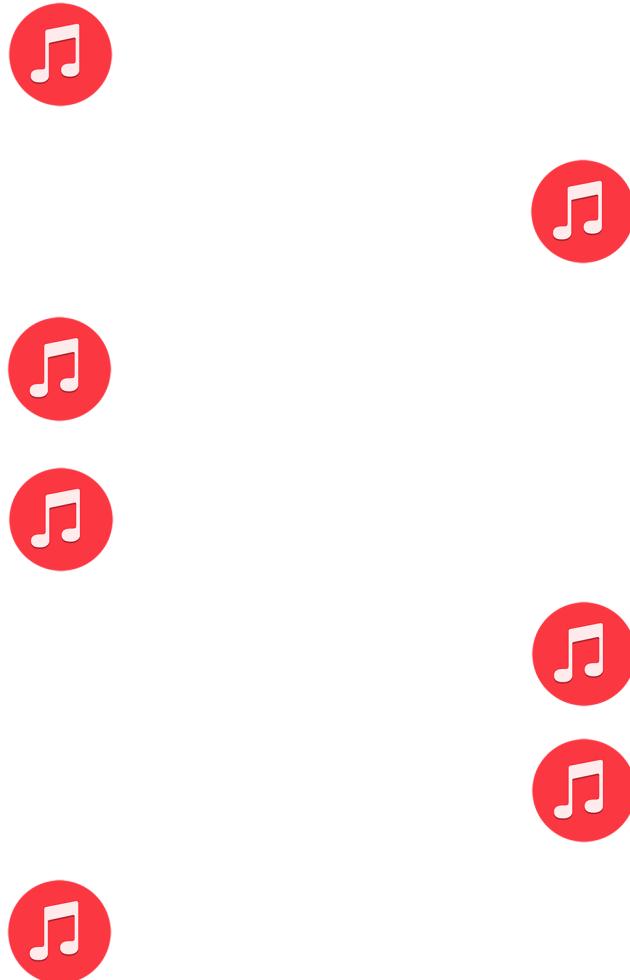
Unsupervised

Features	Label
	
	
	
	
	
	
	
	

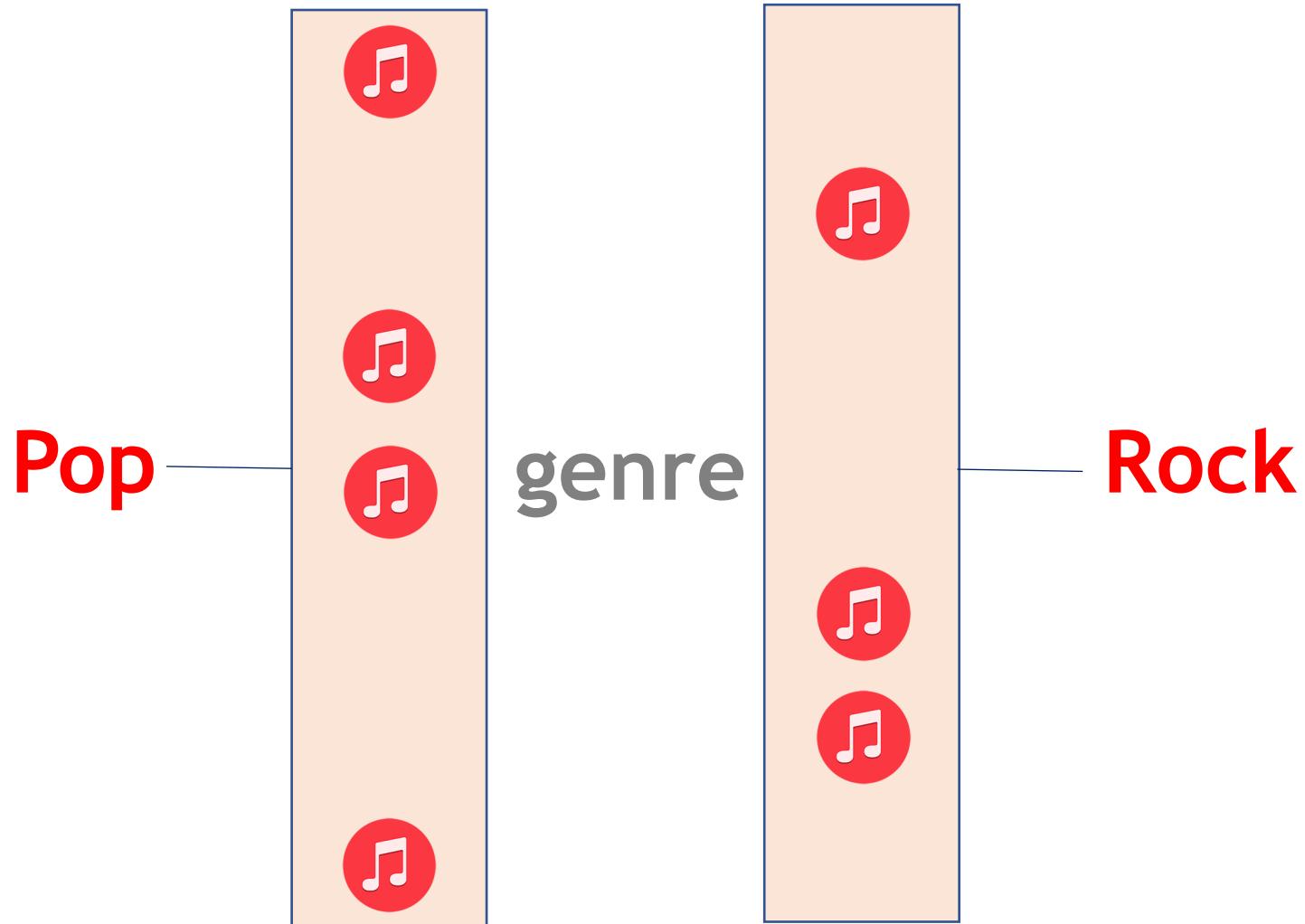
Clustering



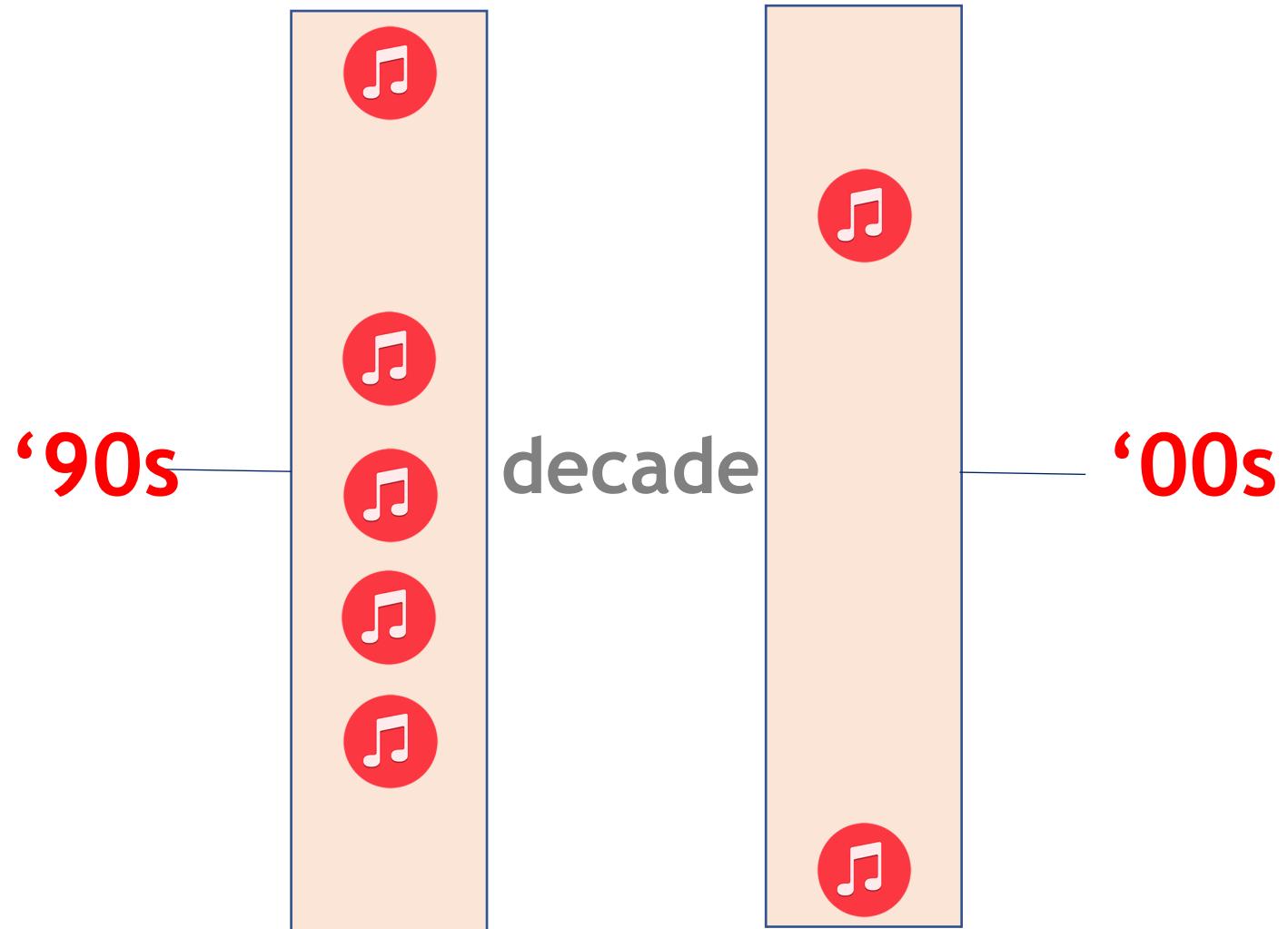
Clustering



Clustering



Clustering



Supervised

Regression

Classification

Unsupervised

Clustering

Data

The best data has 3 qualities:

- Clean
- Coverage
- Complete

The best data has 3 qualities:

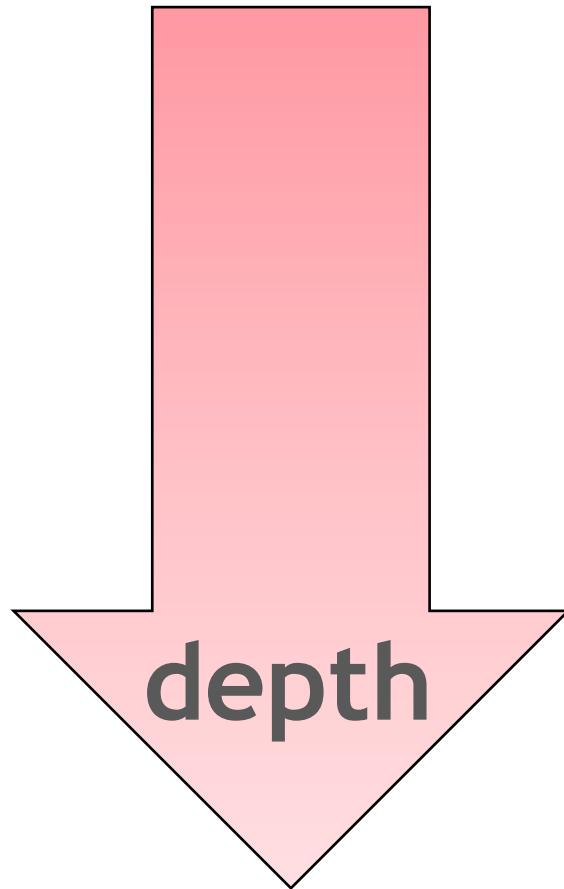
Feature 1	Feature 2	Feature 3	Feature 4
Male	200	1	Yes
Female	316	3	No
F	190	1	No
Male	244		Yes
Male	128	2	Yes
Male		3	Yes
Female	302	2	No

Clean

Feature 1	Feature 2	Feature 3	Feature 4
Male	200	1	Yes
Female	316	3	No
F	190	1	No
Male	244	13	Yes
Male	128	2	Yes
Male		3	Yes
Female	302	2	No

Coverage

Feature 1	Feature 2	Feature 3	Feature 4
Male	200	1	Yes
Female	316	3	No
F	190	1	No
Male	244		Yes
Male	128	2	Yes
Male		3	Yes
Female	302	2	No



Machine Learning

$$y = 2x$$

Input	1	2								
Output	2	4								

Machine Learning

Input	1		3		5		7		9	
Output	2		10		26		50		82	

$$y = x^2 + 1$$

Input	1		3		5		7		9	
Output	2		10		26		50		82	

Machine Learning

Input	2	4	6	8	10
Output	4	16	36	64	100

$$y = x^2$$

Input	2	4	6	8	10
Output	4	16	36	64	100

Machine Learning

Input	1	2	3	4	5	6	7	8	9	10
Output	2	4	10	16	26	36	50	64	82	100

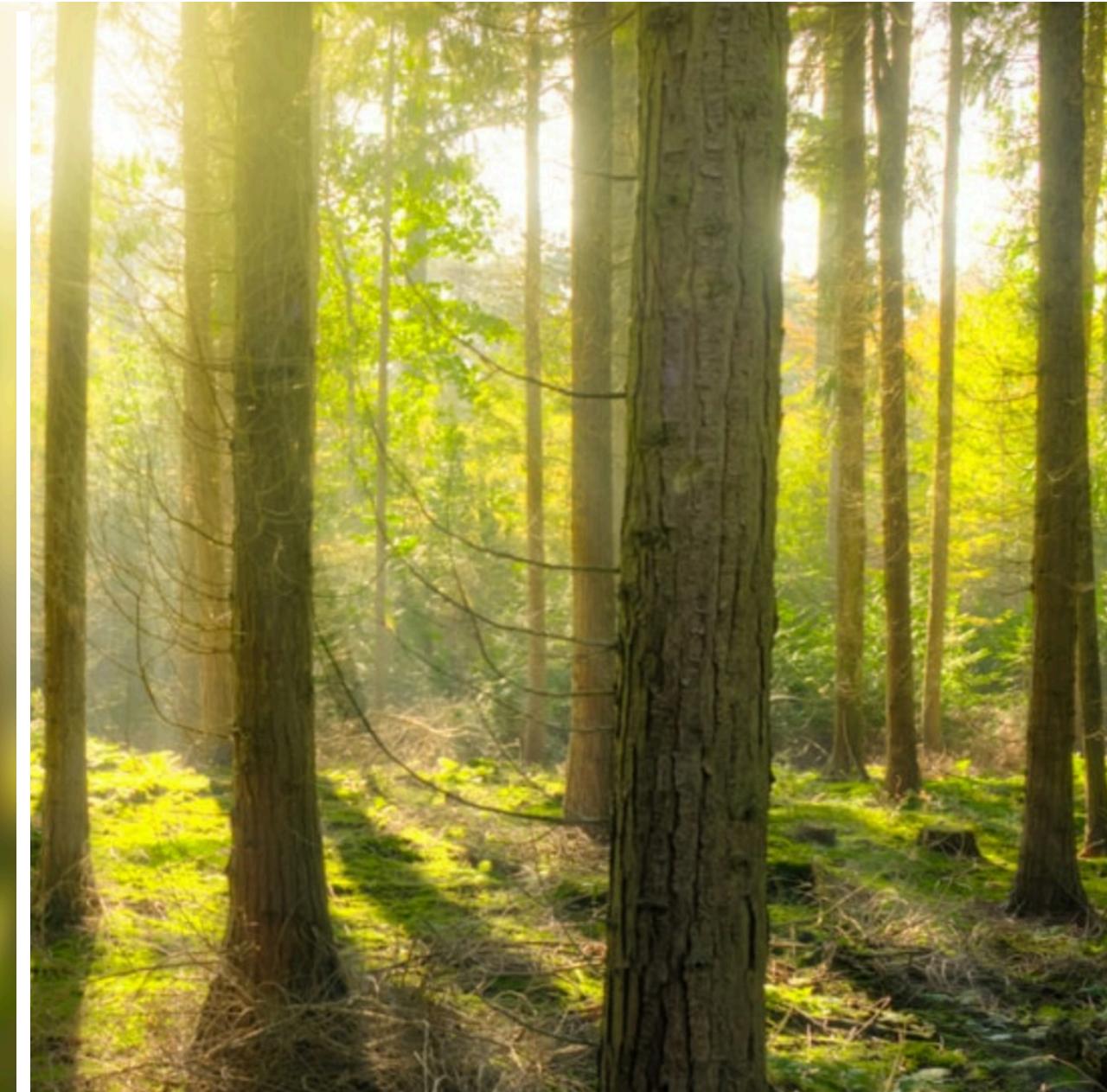
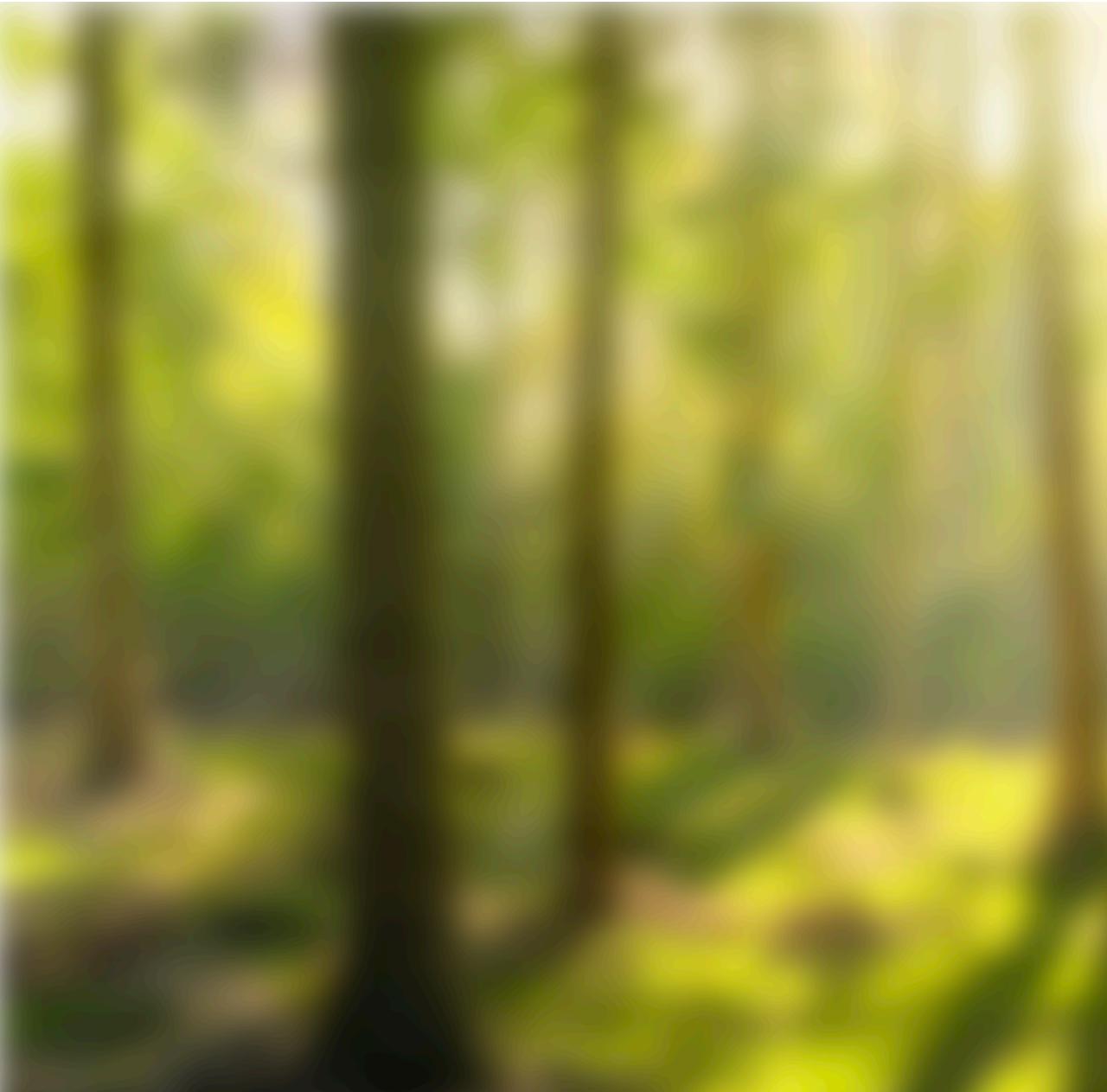
$$y = x^2 + (x \% 2)$$

Input	1	2	3	4	5	6	7	8	9	10
Output	2	4	10	16	26	36	50	64	82	100

Complete

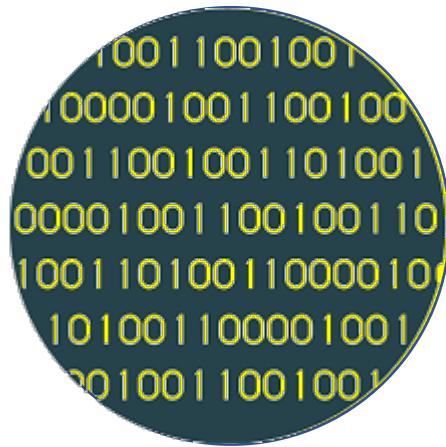
breadth

Feature 1	Feature 2	Feature 3	Feature 4
Male	200	1	Yes
Female	316	3	No
F	190	1	No
Male	244		Yes
Male	128	2	Yes
Male		3	Yes
Female	302	2	No

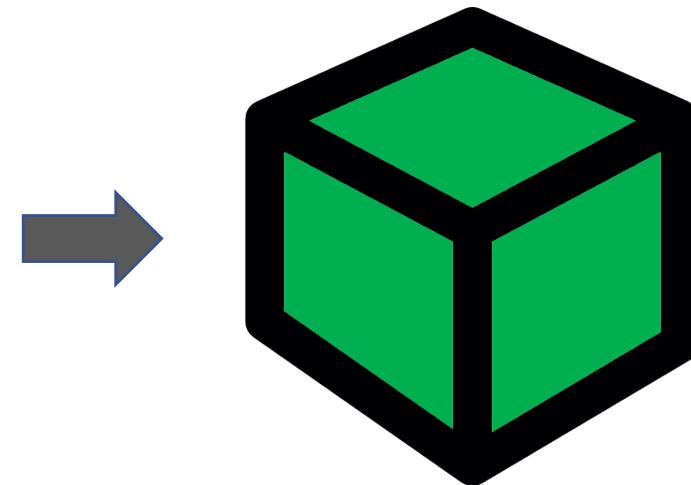


Model Training

Model Training

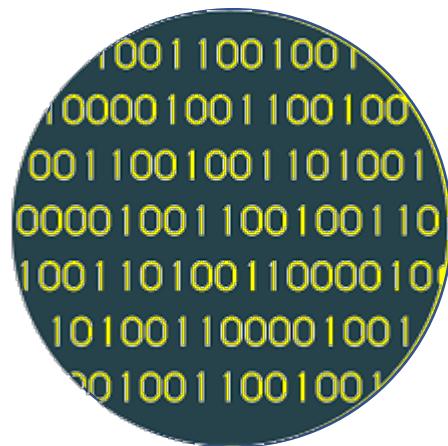


DATA

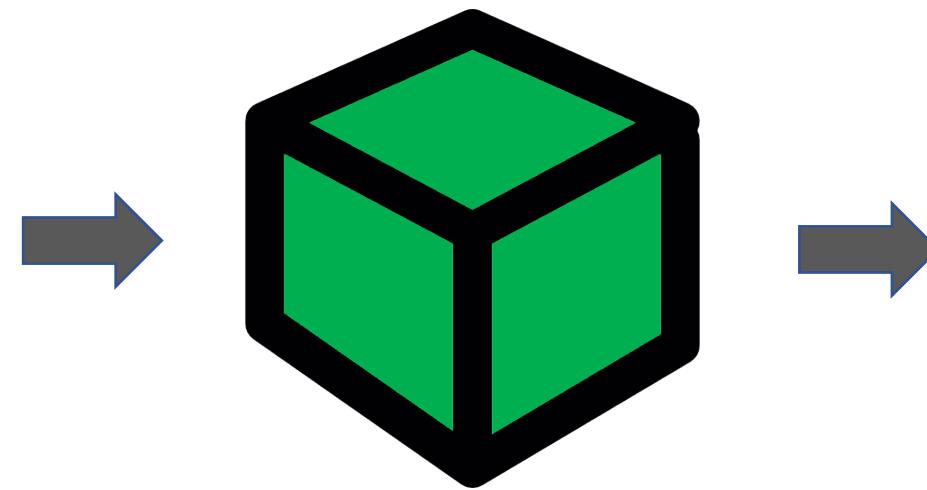


MODEL

Model Training



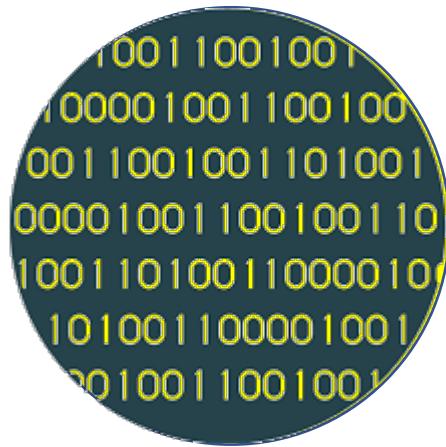
DATA



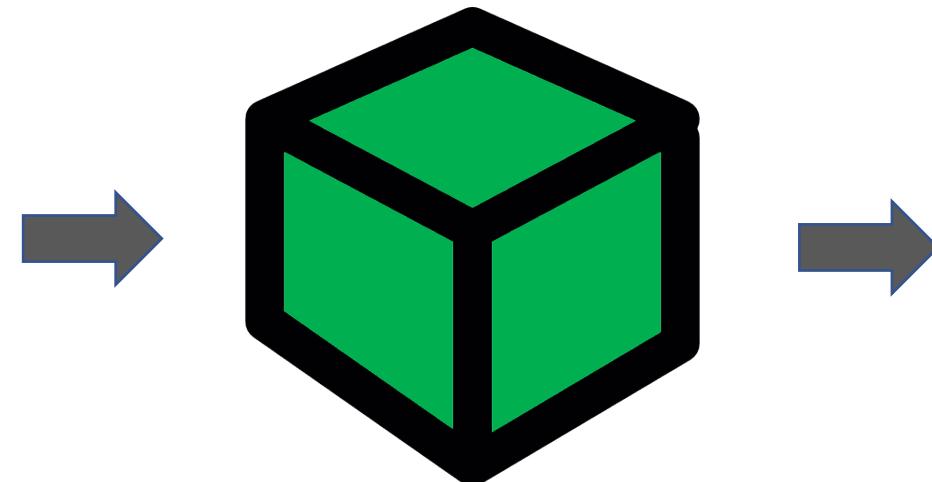
MODEL

Prediction
0
1
0
0
1
0

Model Training



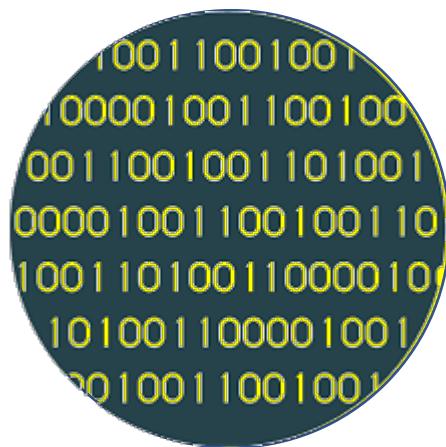
DATA



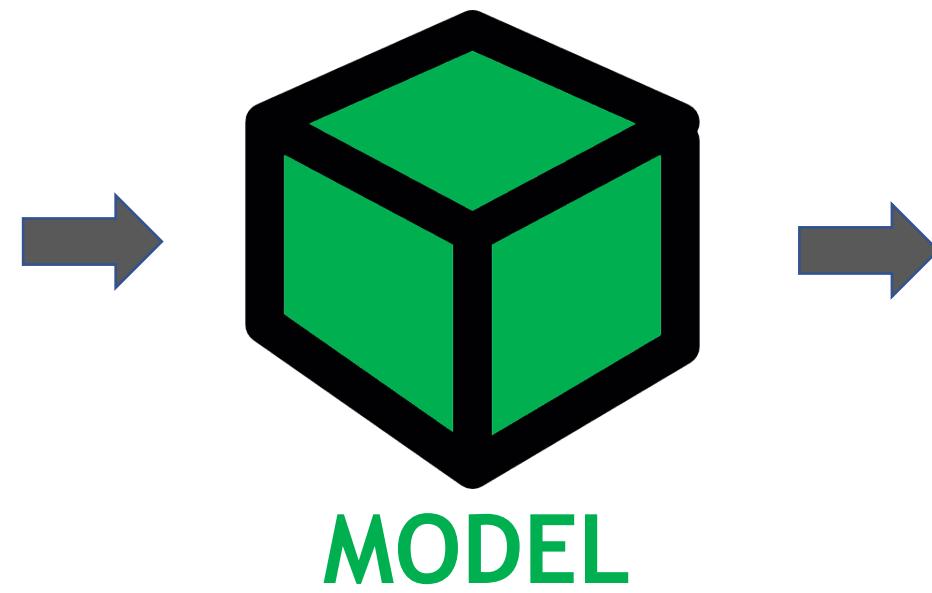
MODEL

Prediction	Label
0	1
1	1
0	0
0	1
1	0
0	0

Model Training

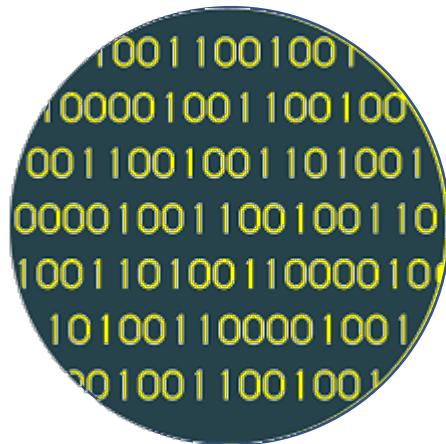


DATA



Prediction	Label
0	1
1	1
0	0
0	1
1	0
0	0

Model Training



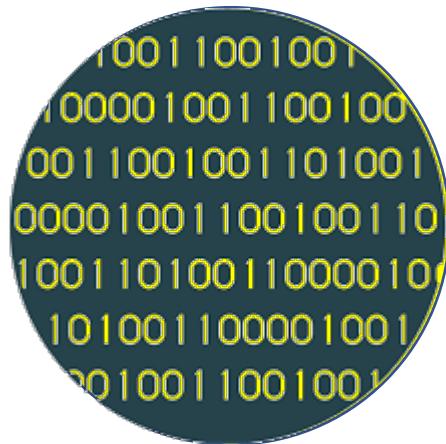
DATA



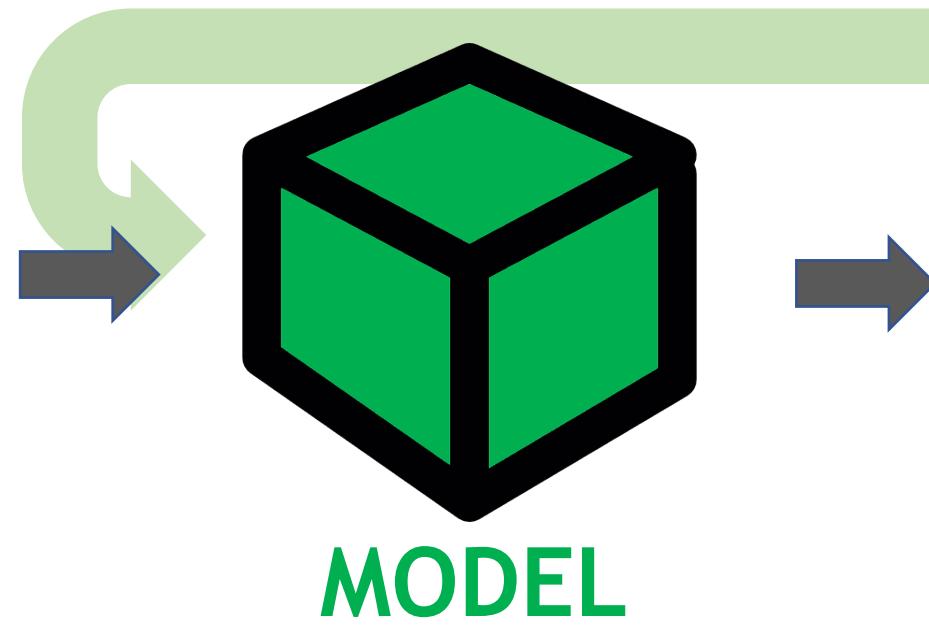
MODEL

Prediction	Label
0	1
1	1
0	0
0	1
1	0
0	0

Model Training

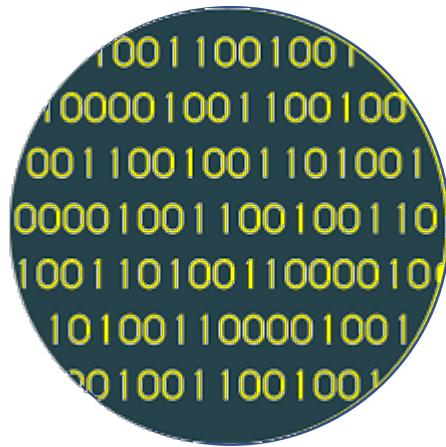


DATA

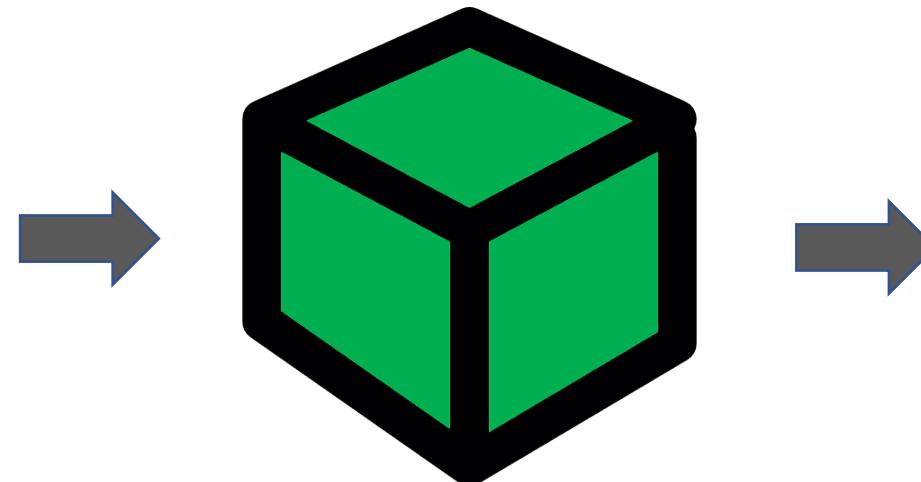


Prediction	Label
1	1
1	1
0	0
1	1
0	0
0	0

Model Training



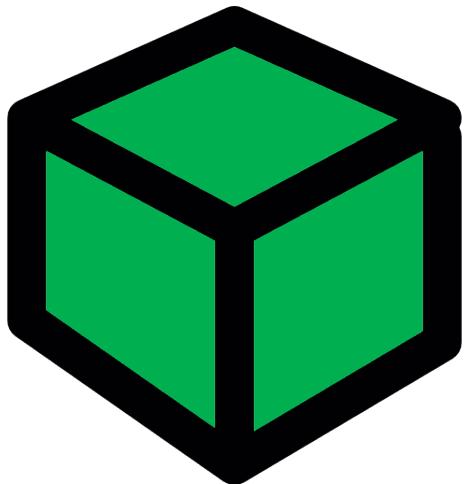
DATA



MODEL

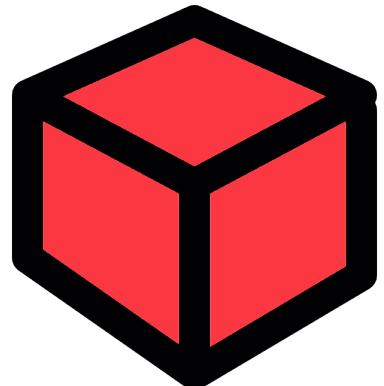
Prediction	Label
1	1
1	1
0	0
1	1
0	0
0	0

Model Training

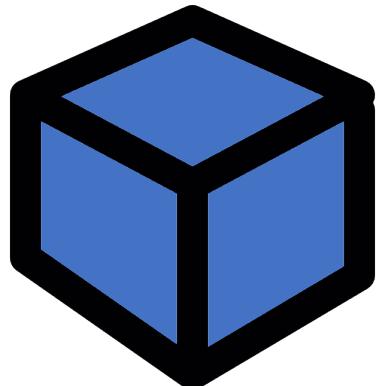


TRAINED MODEL

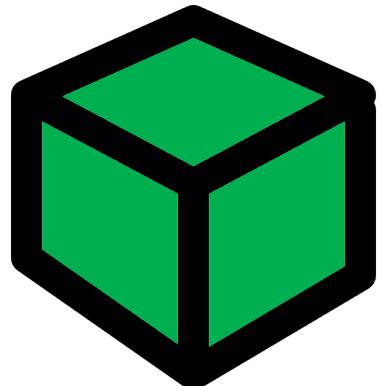
Model Training



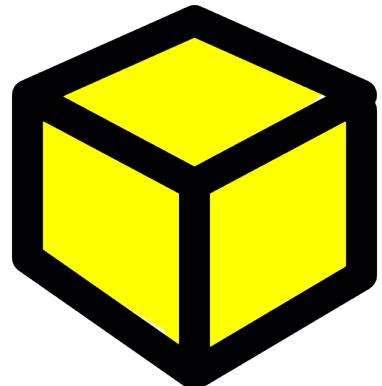
MODEL



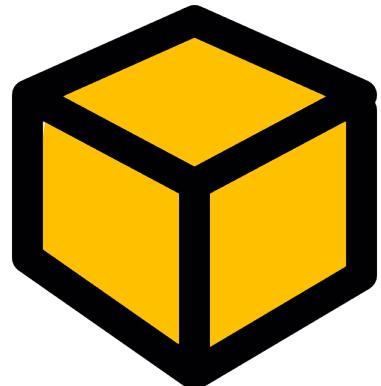
MODEL



MODEL

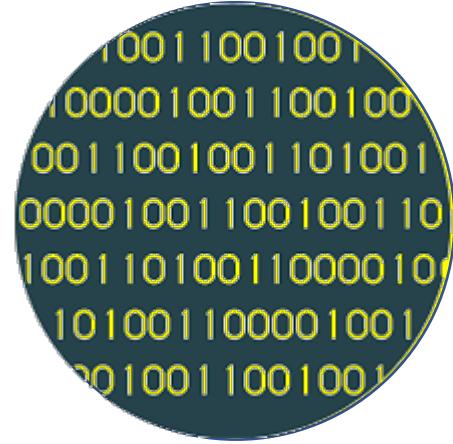


MODEL



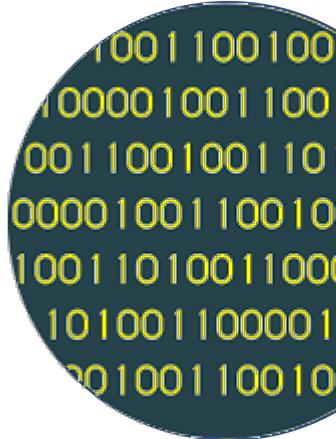
MODEL

Evaluate the Model

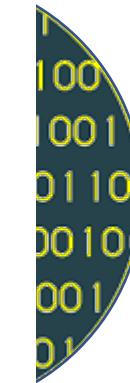


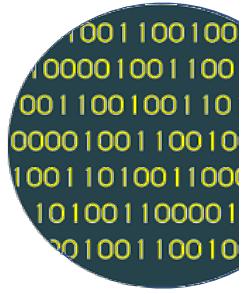
Evaluate the Model

Training Data

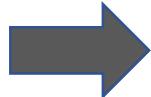


Test Data

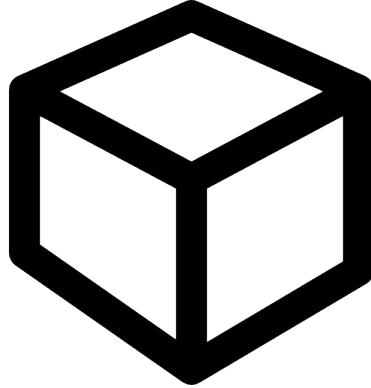


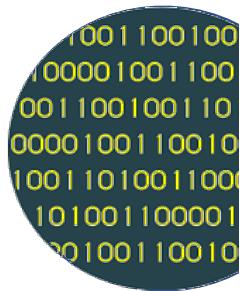


1001100100
00001001100
001100100110
0000100110010
10011010011000
101001100001
00100110010

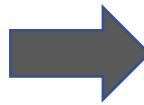


Train

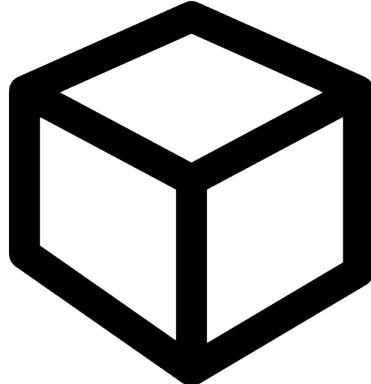




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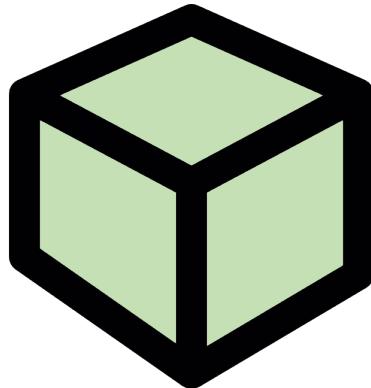
Train

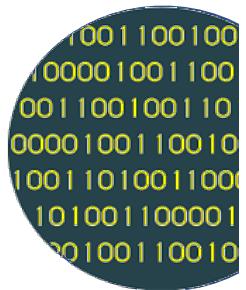


100
1001
0110
0010
001
01

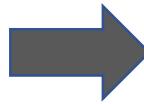


Test

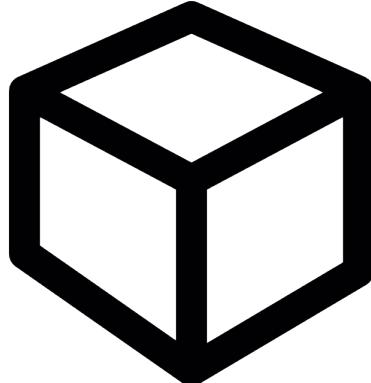




1001100100
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101001100001
00100110010



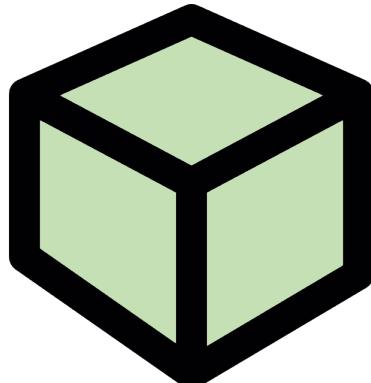
Train



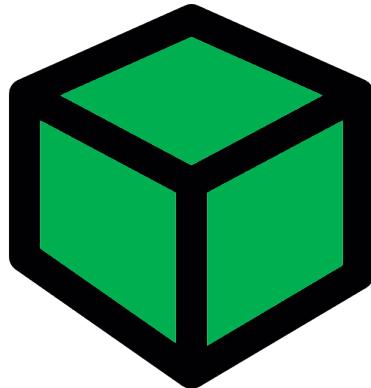
100
1001
0110
0010
001
01



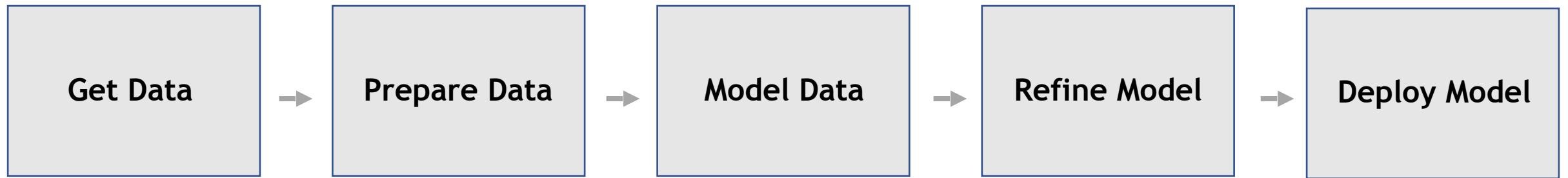
Test



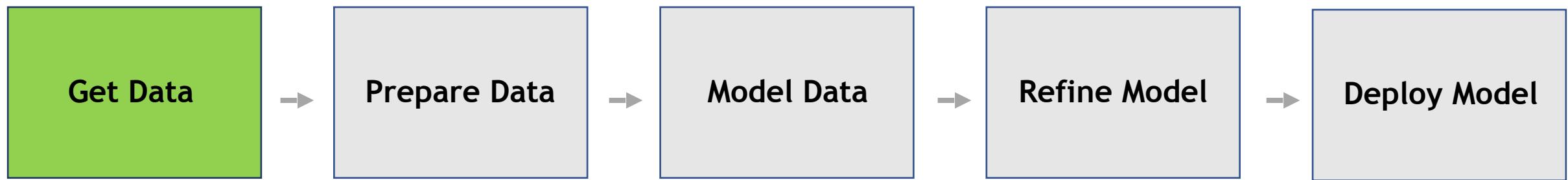
Deploy



ML Process

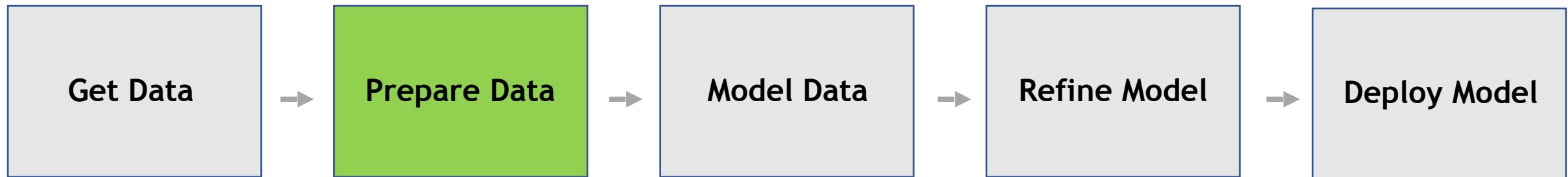


ML Process



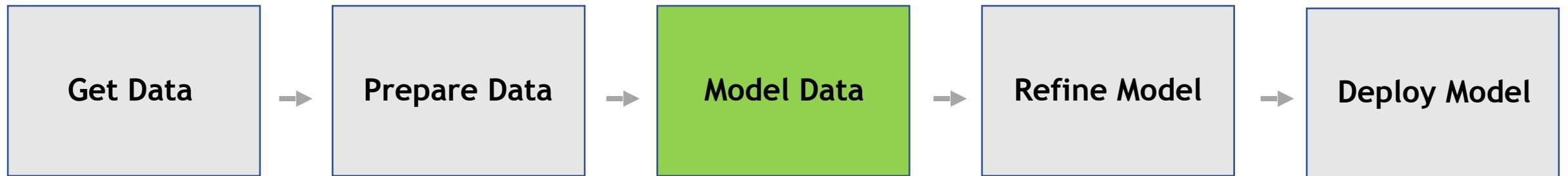
What data should you use?
Is it labeled?

ML Process



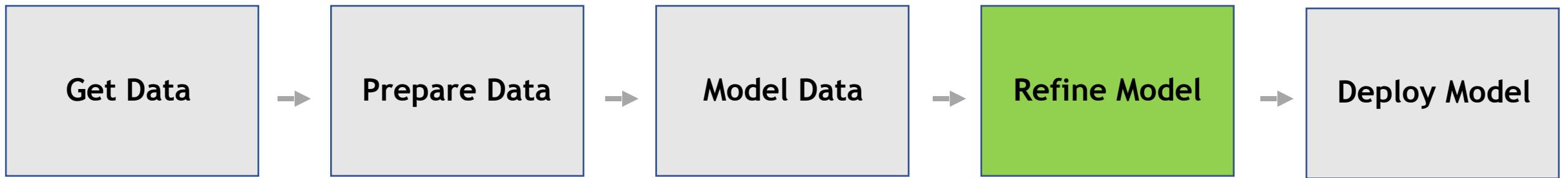
Is your data **complete, **clean**, does it have **coverage**?**

ML Process



Which algorithms should you use?

ML Process



What level of
performance is sufficient?

ML Process

