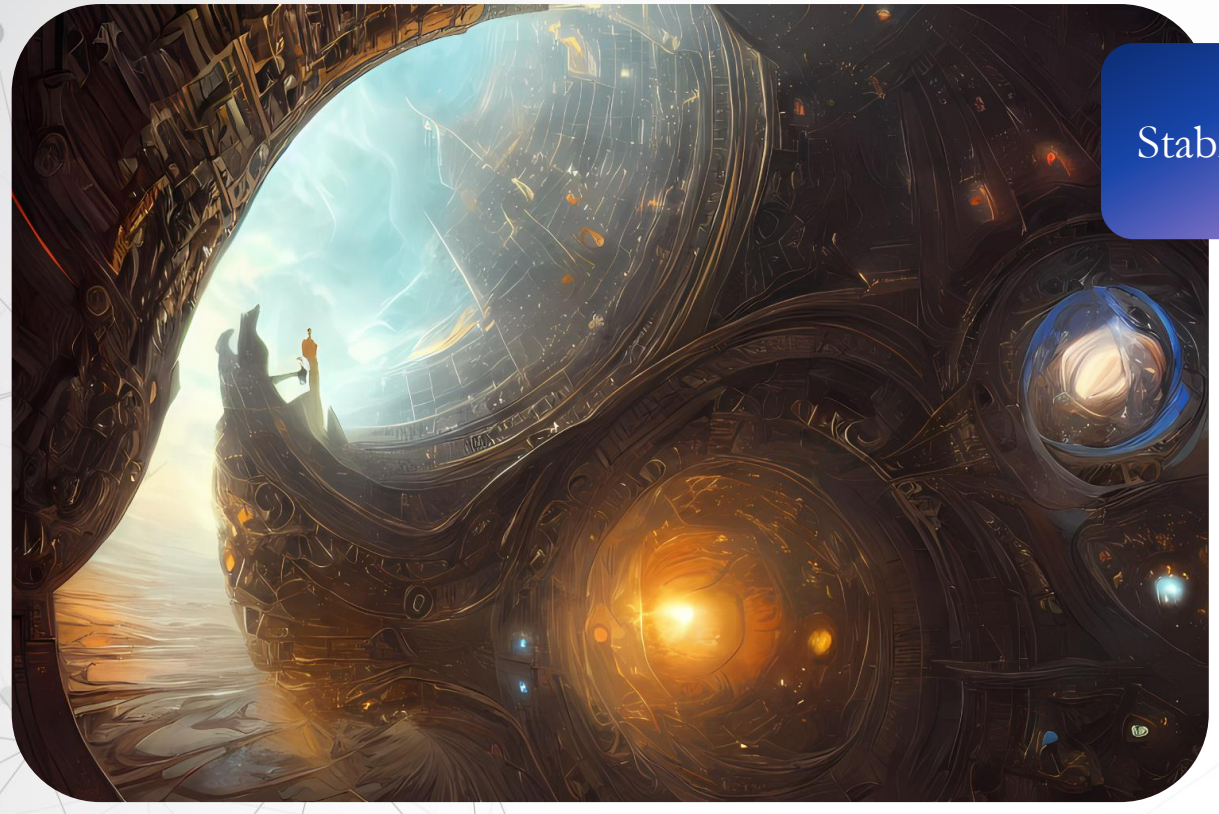
MLDL-I
Machine Learning and Deep Learning - I



Stable Diffusion

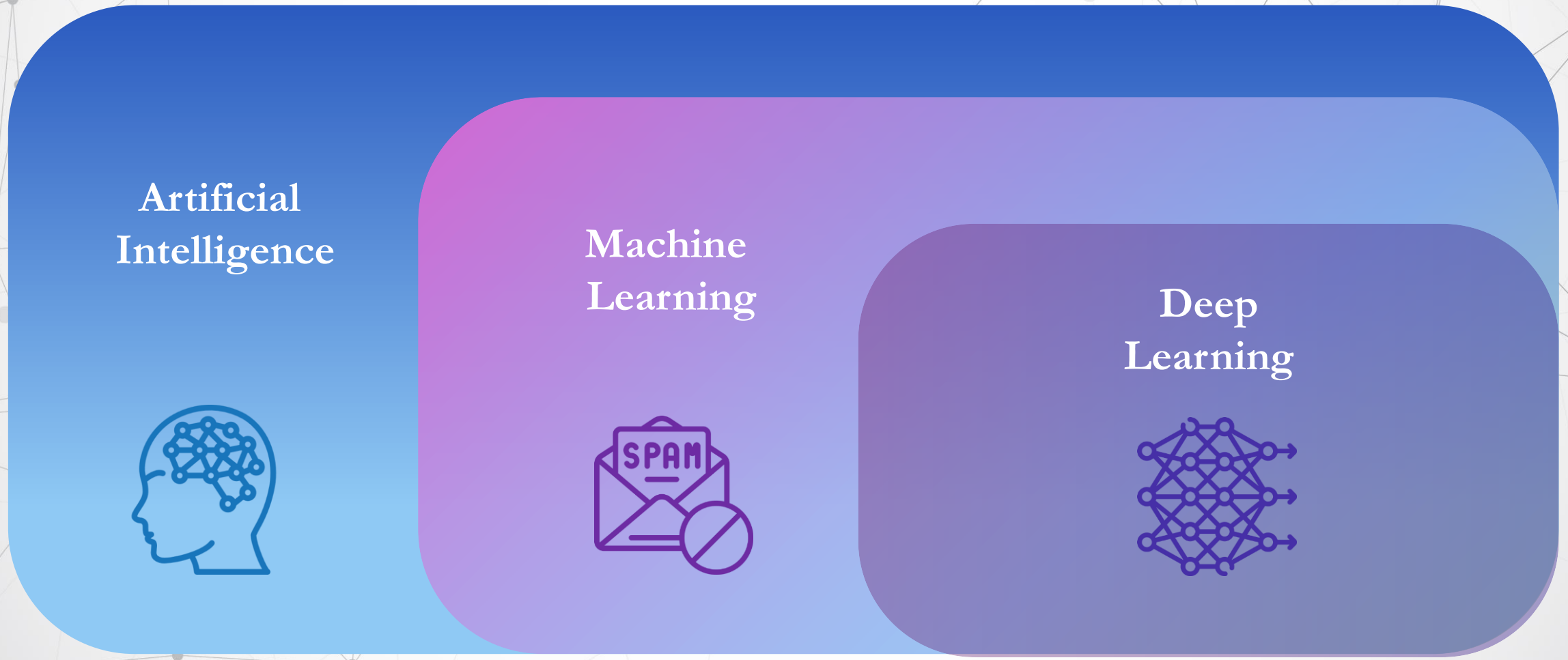
M

Tell me how ChatGPT works.

ChatGPT is a large language model that uses deep learning techniques to generate human-like text. It is based on the GPT (Generative Pre-trained Transformer) architecture, which uses a transformer neural network to process and generate text. The model is pre-trained on a massive dataset of text, such as books, articles, and websites, so it can understand the patterns and structure of natural language. When given a prompt or a starting point, the model uses this pre-trained knowledge to generate text that continues the given input in a coherent and natural way.

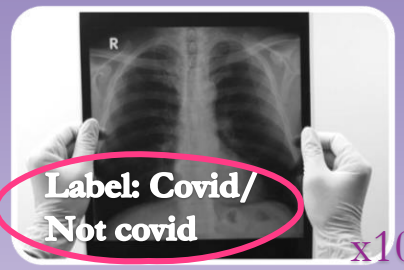
ChatGPT

Artificial Intelligence, Machine Learning, and Deep Learning



Supervised Learning: An Overview

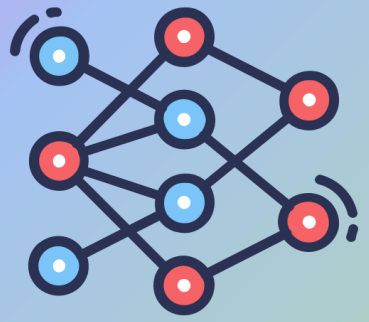
Data



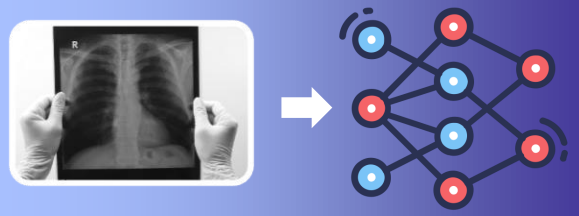
x10000

Rooms	Bathroom	BuildingArea	Price
2	1.0	NaN	1480000.0
2	1.0	79.0	1035000.0
3	2.0	150.0	1465000.0
3	2.0	NaN	850000.0

Training



Inference



Covid	Not Covid
6% Probability	94% Probability

Rooms	Bathroom	BuildingArea
4	2.0	NaN

Price
124500

The Data: Features and Labels

Rooms	Bathroom	BuildingArea	Price
2	1.0	NaN	1480000.0
2	1.0	79.0	1035000.0
3	2.0	150.0	1465000.0
3	2.0	NaN	850000.0

2 1.0 79.0

1035000.0

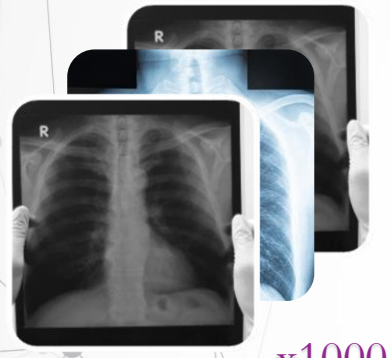
Cat or Dog?

Has Tail?
Has Whiskers?

1	0	1	0.7	0.8	1	0

Cat

The Process: Training, Validation, and Testing



x1000

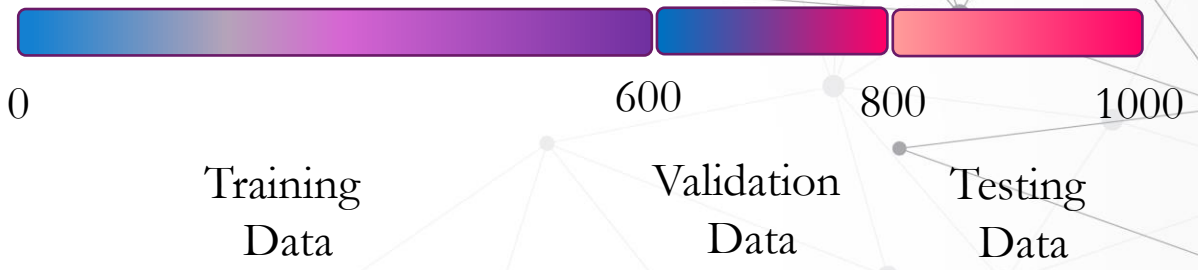
0 Total Data 1000

Covid/
Not Covid

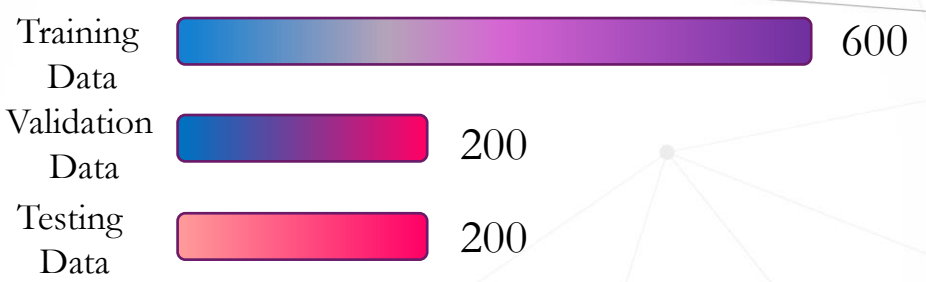
The Process: Training, Validation, and Testing

Covid/
Not Covid

The Process: Training, Validation, and Testing



The Process: Training, Validation, and Testing

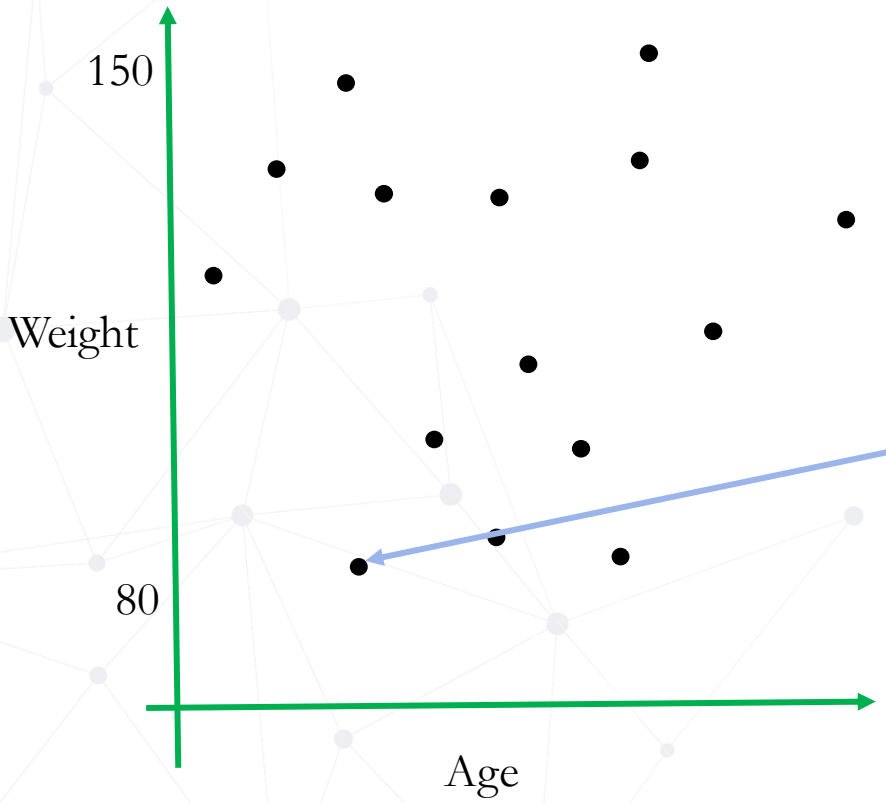


Covid/
Not Covid

Dog vs Horse

Age	Weight	Label
3	150	horse
4	120	horse
2	90	dog
5	200	horse
2	85	dog

Dog vs Horse



Age	Weight	Label
3	150	horse
4	120	horse
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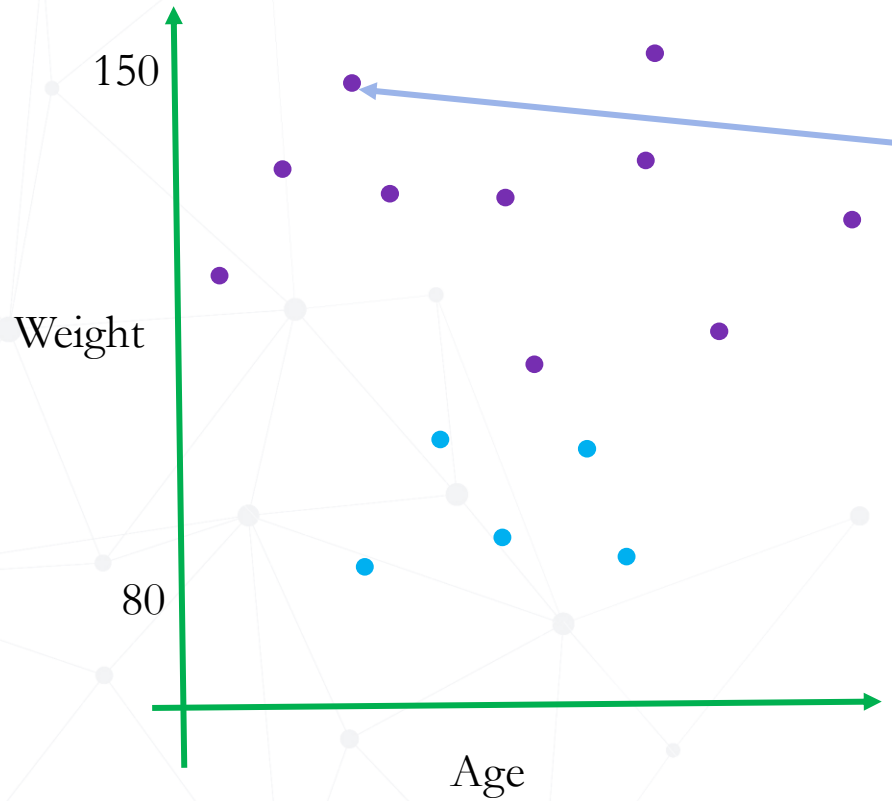
5	200	horse
2	85	dog

Dog vs Horse



Age	Weight	Label
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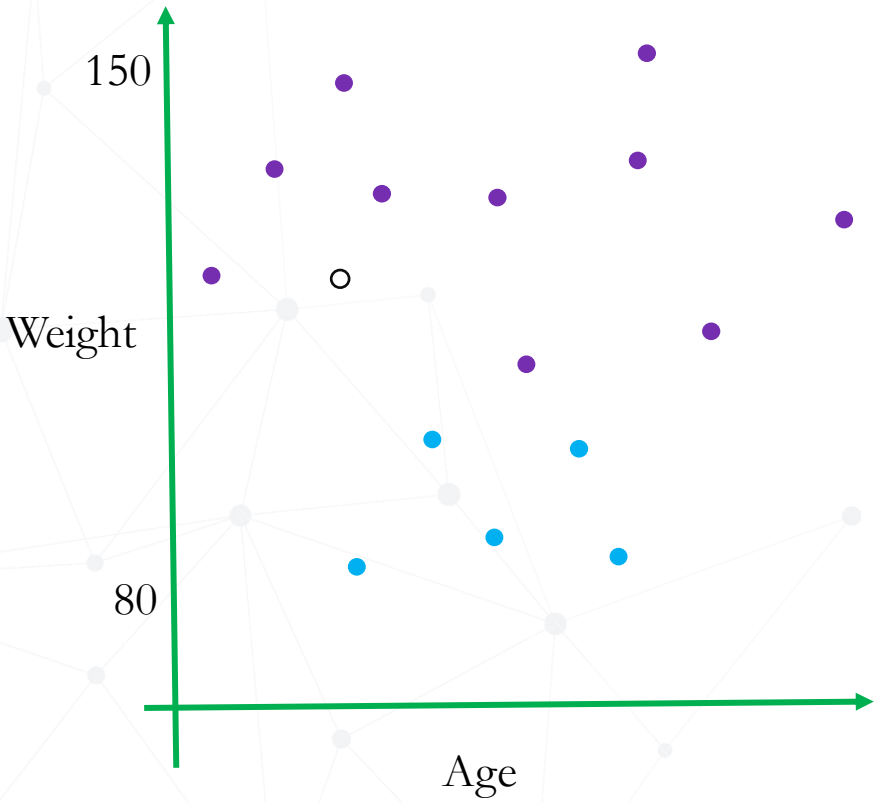
Dog vs Horse



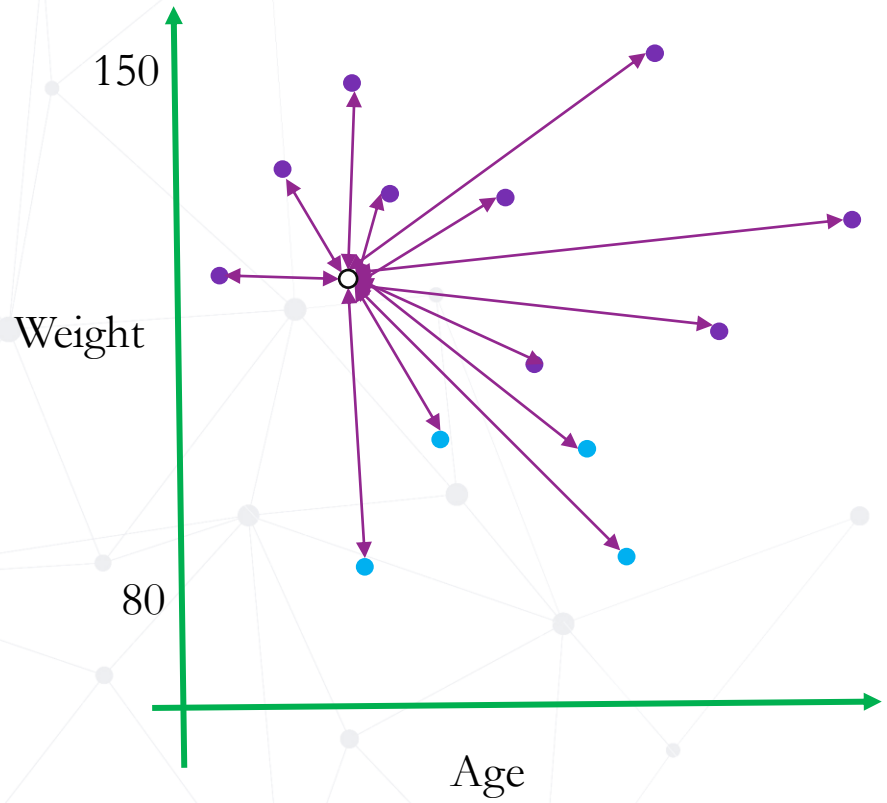
Age	Weight
3	150
4	120
2	90
5	200
2	85

Label
horse
horse
dog
horse
dog

Age	Weight
3	120

?

Dog vs Horse

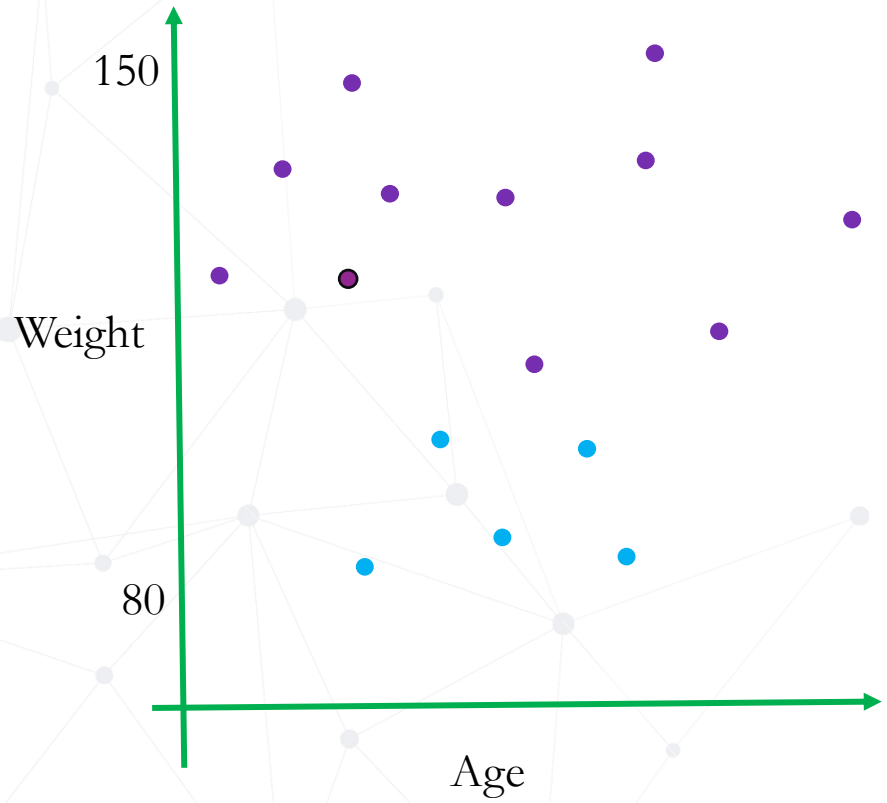


Age	Weight
3	120

?

```
Distance: 1.0, Label: horse
Distance: 30.0, Label: horse
Distance: 30.01666203960727, Label: dog
Distance: 35.014282800023196, Label: dog
Distance: 80.02499609497022, Label: horse
```

Dog vs Horse

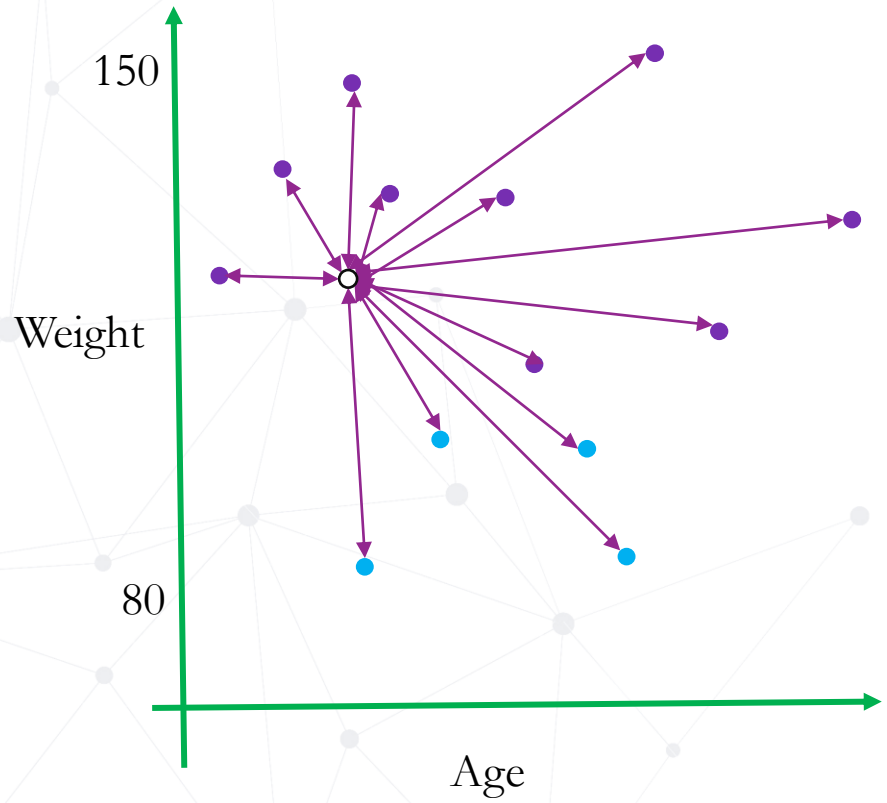


Age	Weight
3	120

```
Distance: 1.0, Label: horse
Distance: 30.0, Label: horse
Distance: 30.01666203960727, Label: dog
Distance: 35.014282800023196, Label: dog
Distance: 80.02499609497022, Label: horse
```

It’s a horse!

Supervised Classification: K Nearest Neighbors (KNN)



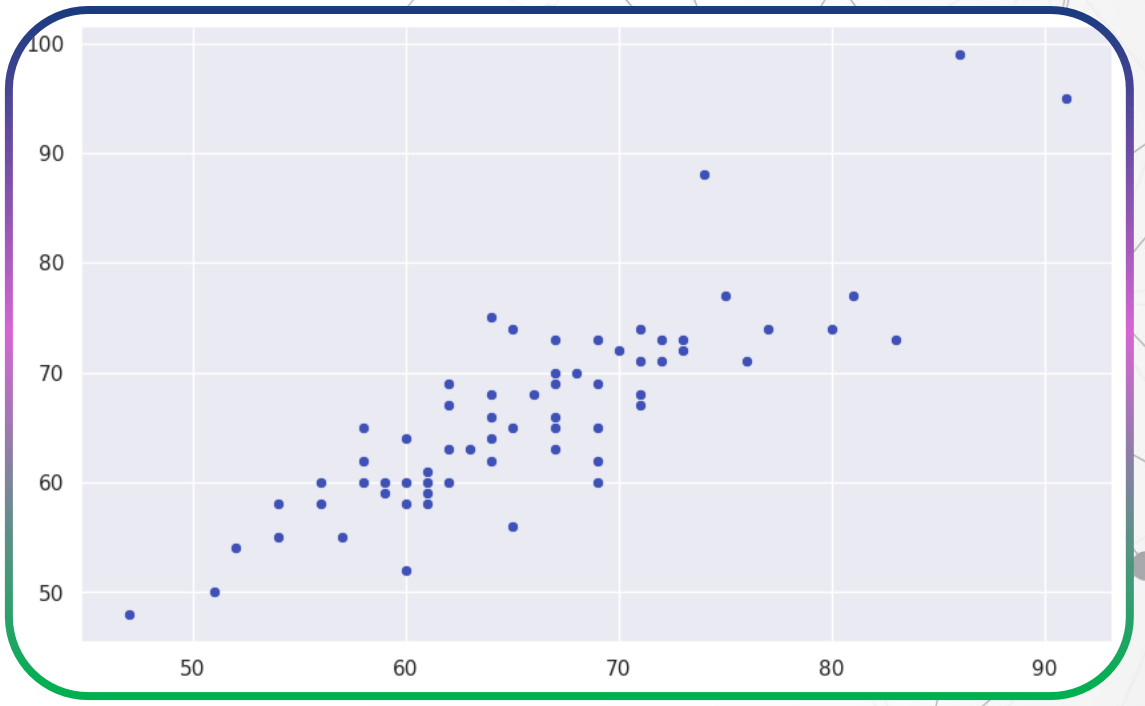
- Calculate Distance Between Points
- Sort the distance

```
Distance: 1.0, Label: horse
Distance: 30.0, Label: horse
Distance: 30.01666203960727, Label: dog
Distance: 35.014282800023196, Label: dog
Distance: 80.02499609497022, Label: horse
```

- Take top k (k is the parameter we can set) values and vote

Supervised Regression: Linear Regression

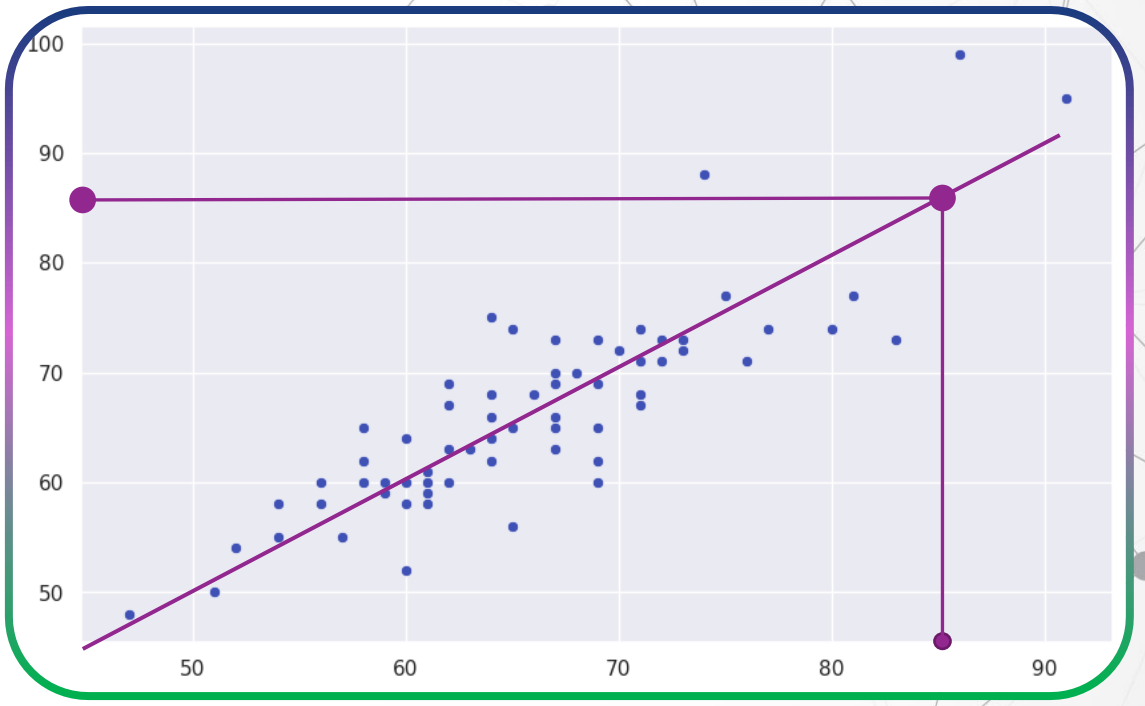
	tmax	tmax_tomorrow
1970-01-01	60.0	52.0
1970-01-02	52.0	52.0
1970-01-03	52.0	53.0
1970-01-04	53.0	52.0
1970-01-05	52.0	50.0



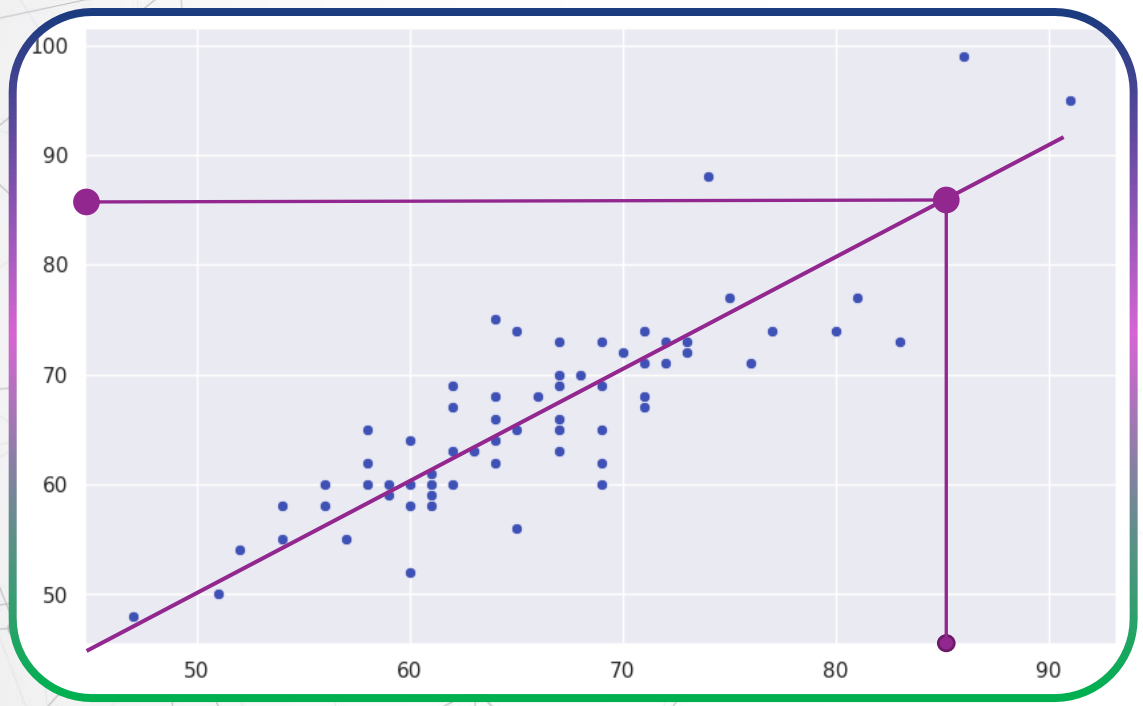
Supervised Regression: Linear Regression

	tmax
1970-01-01	60.0
1970-01-02	52.0
1970-01-03	52.0
1970-01-04	53.0
1970-01-05	52.0

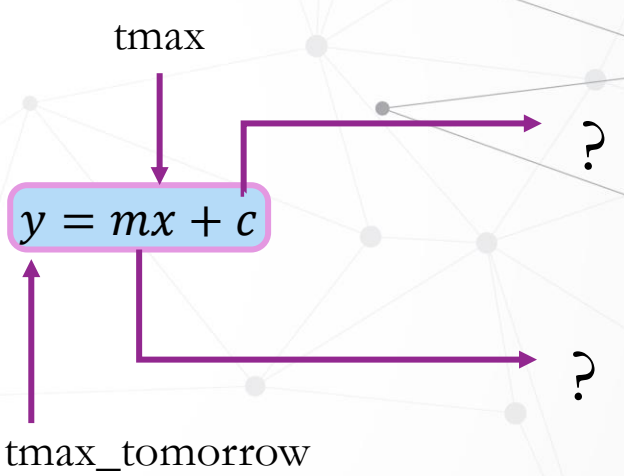
tmax_tomorrow
52.0
52.0
53.0
52.0
50.0



Supervised Regression: Linear Regression



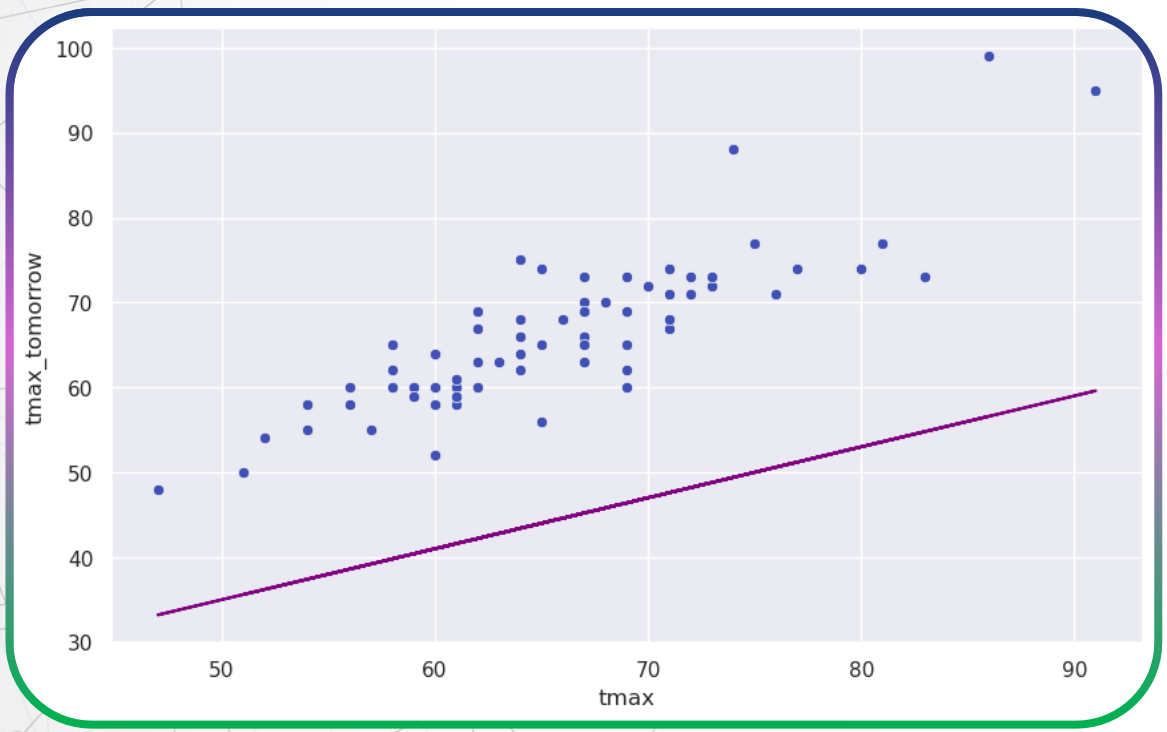
How to get this line?



Lets Play a Guessing Game!

- Initialize Parameters
- Predict Target
- Estimate Error
- Update Parameters
- Repeat

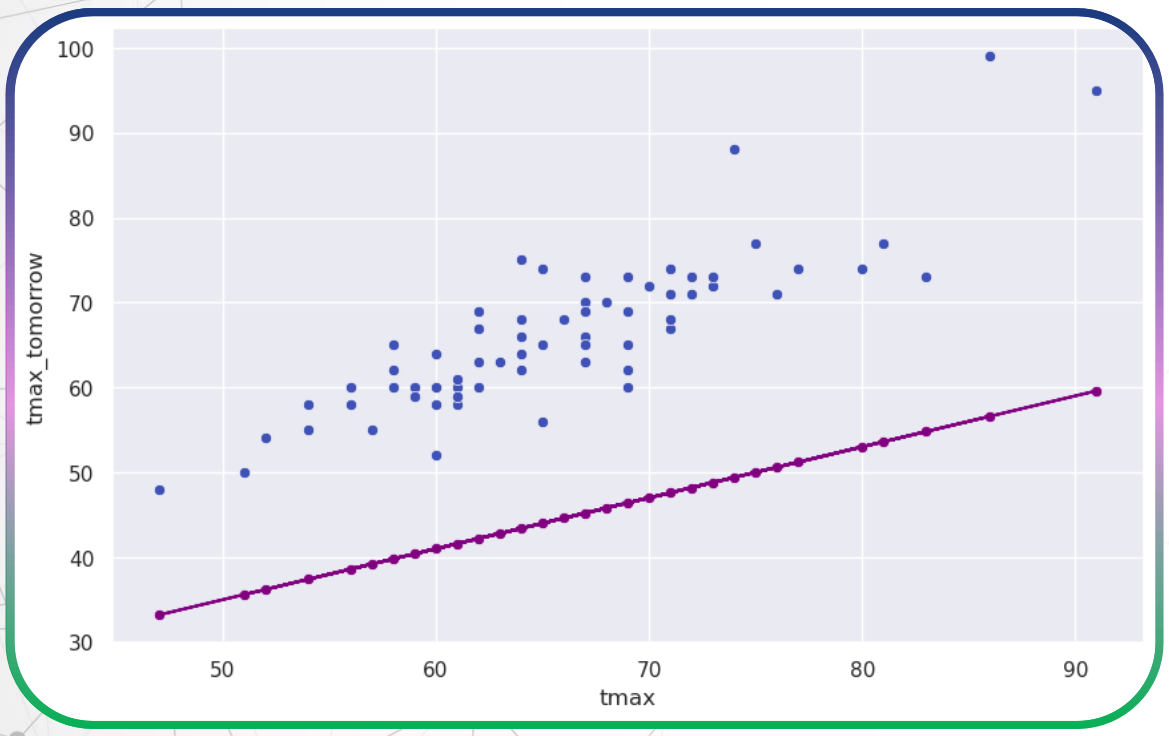
Supervised Regression: Linear Regression



$y = mx + c$

Initialize Parameters
m = 0.6
c = 5

Supervised Regression: Linear Regression



Initialize Parameters

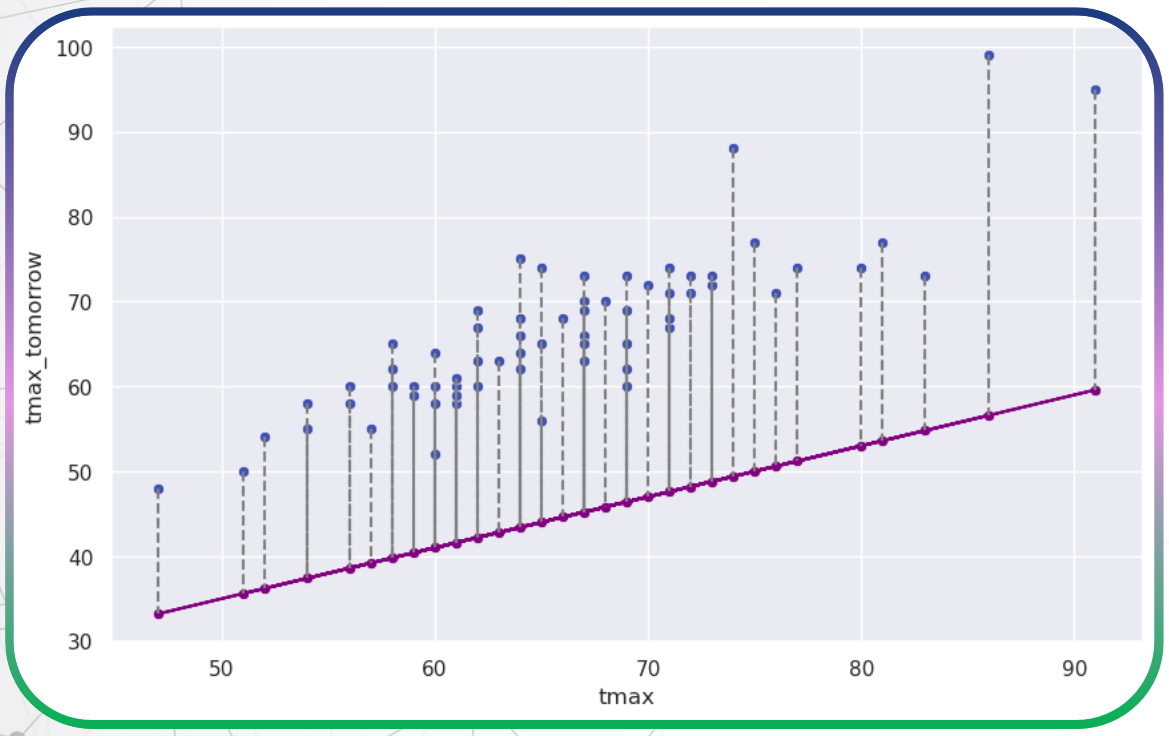
Calculate Prediction

$$\hat{y} = mx + c$$

tmax

tmax_tomorrow (prediction)

Supervised Regression: Linear Regression



Initialize Parameters

Calculate Prediction

$\hat{y} = mx + c$

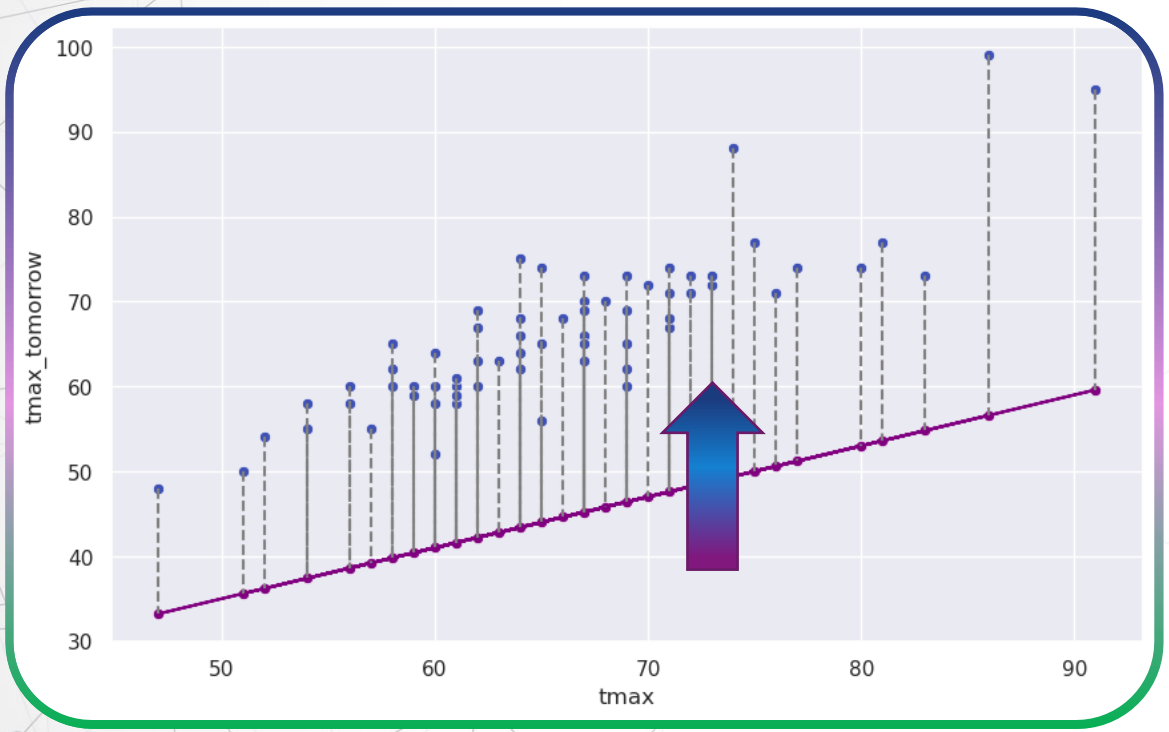
Estimate Error

$J(m, c) = (\hat{y} - y_{actual})^2$

	tmax
1970-01-01	60.0
1970-01-02	52.0
1970-01-03	52.0
1970-01-04	53.0
1970-01-05	52.0

tmax_tomorrow
52.0
52.0
53.0
52.0
50.0

Supervised Regression: Linear Regression



Initialize Parameters

Calculate Prediction

$$\hat{y} = mx + c$$

Estimate Error

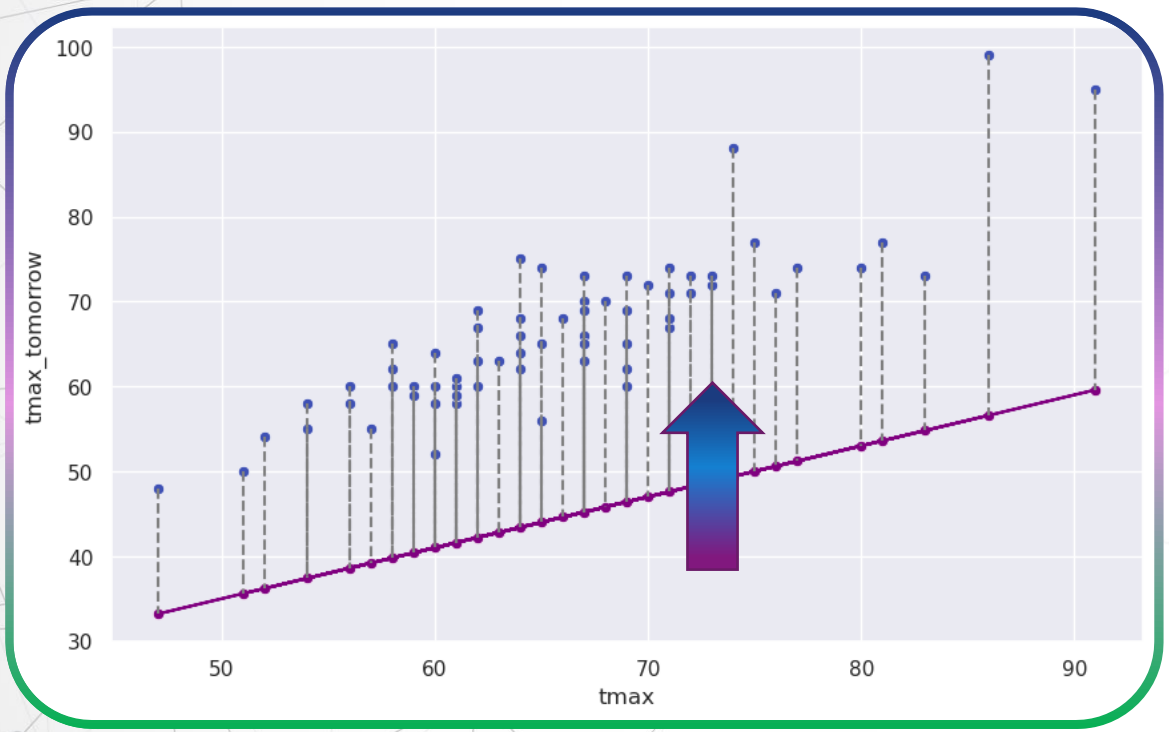
$$J(m,c) = (\hat{y} - y_{actual})^2$$

Update Parameters

$$\frac{\partial J}{\partial m} = (\hat{y} - y) \cdot x$$

$$\frac{\partial J}{\partial c} = (\hat{y} - y)$$

Supervised Regression: Linear Regression



Initialize Parameters

Calculate Prediction

$$\hat{y} = mx + c$$

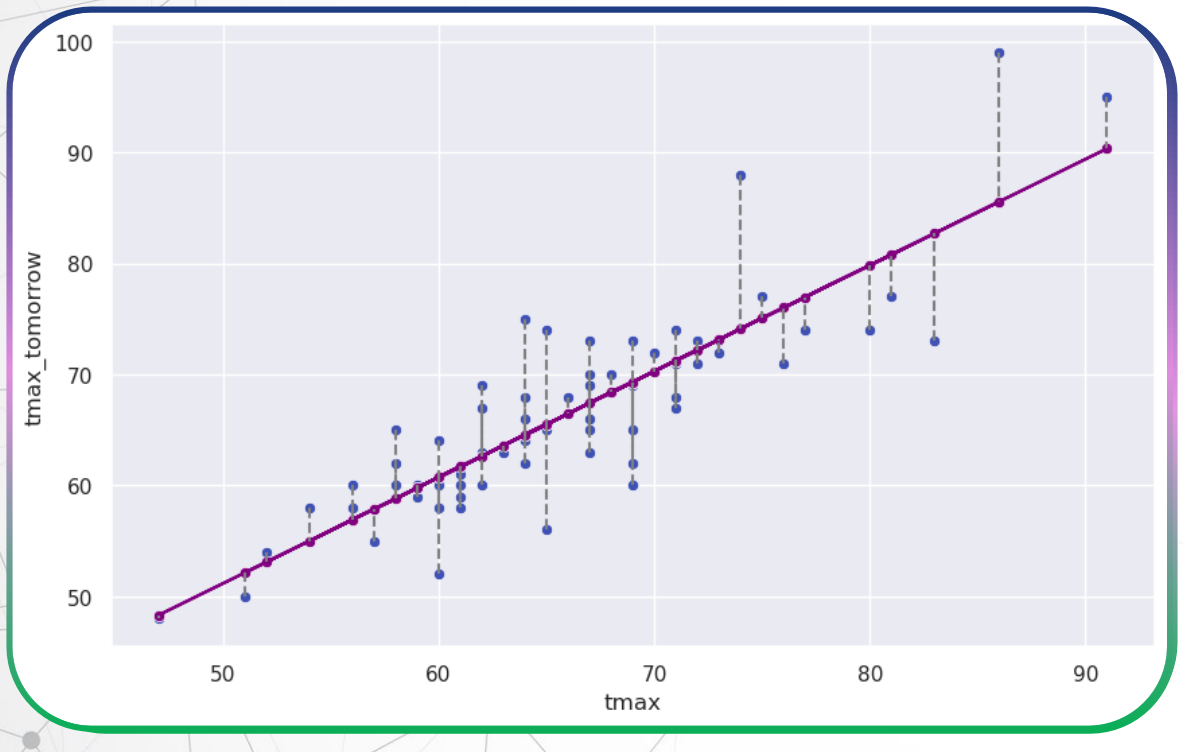
Estimate Error

$$J(m,c) = (\hat{y} - y_{actual})^2$$

Update Parameters

$$m = m - \frac{\partial J}{\partial m} \qquad c = c - \frac{\partial J}{\partial c}$$

Supervised Regression: Linear Regression



Initialize Parameters

Calculate Prediction

$$\hat{y} = mx + c$$

Estimate Error

$$J(m, c) = (\hat{y} - y_{actual})^2$$

Update Parameters

$$m = m - \frac{\partial J}{\partial m} \qquad c = c - \frac{\partial J}{\partial c}$$

Next Steps and Q&A