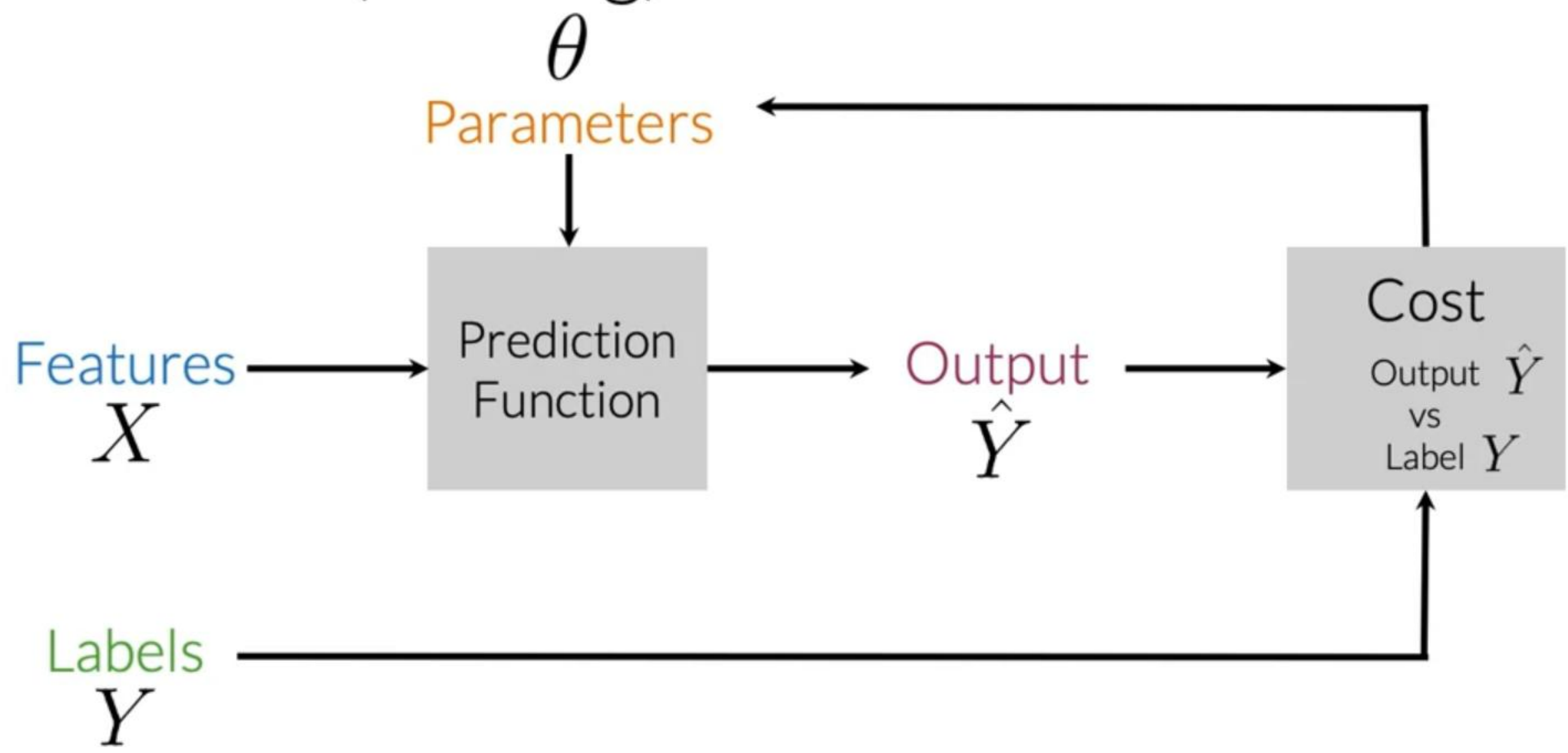
Supervised ML (training)



Sentiment analysis

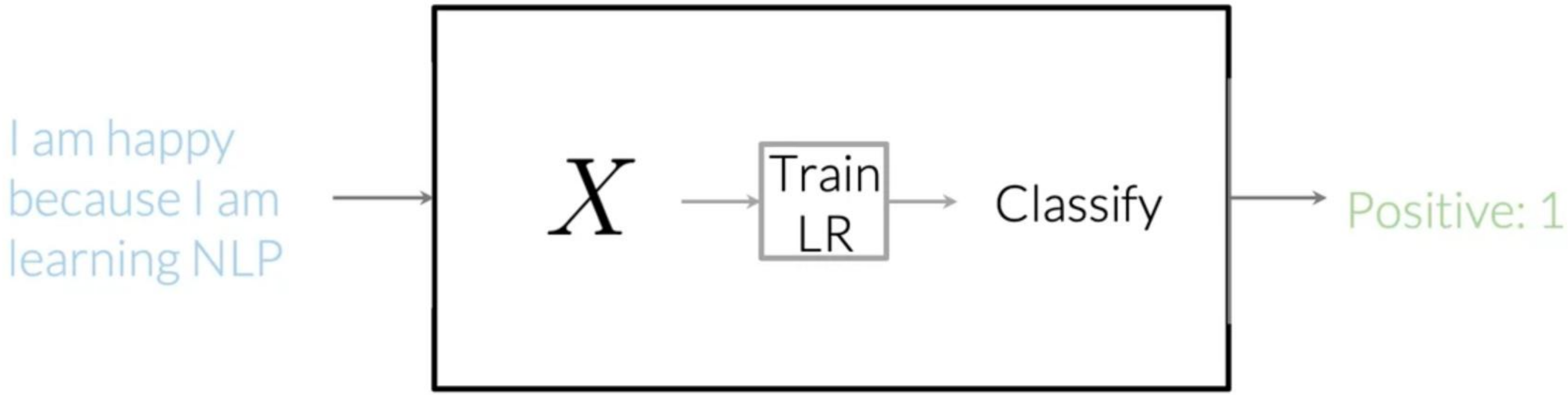
Tweet: I am happy because I am learning NLP

Positive: 1

Negative: 0

Logistic regression

Sentiment analysis



Problems with sparse representations

I am happy because I am learning NLP

All zeros!

$[1, 1, 1, 1, 1, 1, \ldots, 0, \ldots, 0, 0, 0]$

$1 \longleftrightarrow |V|$

$$[\theta_0, \theta_1, \theta_2, \ldots, \theta_n]$$

$$n = |V|$$

1. Large training time
2. Large prediction time

Vocabulary

Tweets:
[tweet_1, tweet_2, ..., tweet_m] →

I am happy because I am learning NLP
...
...
...
I hated the movie

$V =$

[I, am, happy, because, learning, NLP, ... hated, the, movie]

Feature extraction

I am happy because I am learning NLP

[I ,	am,	happy,	because,	learning,	NLP,	...	hated,	the,	movie]
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
[1,	1,	1,	1,	1,	1,	...	0,	0,	0]

A lot of zeros! That's a sparse representation.

Positive and negative counts

Corpus

I am happy because I am learning NLP

I am happy

I am sad, I am not learning NLP

I am sad

Vocabulary
I
am
happy
because
learning
NLP
sad
not

Positive and negative counts

Positive tweets

I am happy because I am learning NLP

I am happy

Vocabulary	PosFreq (1)
I	3
am	3
happy	2
because	1
learning	1
NLP	1
sad	0
not	0

Positive and negative counts

Vocabulary	NegFreq (0)
I	3
am	3
happy	0
because	0
learning	1
NLP	1
sad	2
not	1

Negative tweets

I am sad, I am not learning NLP
I am sad

Word frequency in classes

Vocabulary	PosFreq (1)	NegFreq (0)
I	3	3
am	3	3
happy	2	0
because	1	0
learning	1	1
NLP	1	1
sad	0	1
not	0	1

freqs: dictionary mapping from (word, class) to frequency

Feature extraction

freqs: dictionary mapping from (word, class) to frequency

$$X_m = [1, \sum_w freqs(w, 1), \sum_w freqs(w, 0)]$$

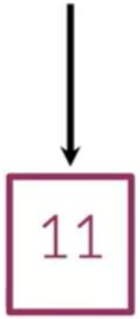
- X_m → Features of tweet m
- 1 → Bias
- $\sum_w freqs(w, 1)$ → Sum Pos. Frequencies
- $\sum_w freqs(w, 0)$ → Sum Neg. Frequencies

Feature extraction

Vocabulary	NegFreq (0)
I	3
am	3
happy	0
because	0
learning	1
NLP	1
sad	2
not	1

I am sad, I am not learning NLP

$$X_m = [1, \sum_w freqs(w, 1), \sum_w freqs(w, 0)]$$



Feature extraction

I am sad, I am not learning NLP

$$X_m = [1, \sum_w freqs(w,1), \sum_w freqs(w,0)]$$

$$\downarrow$$

$$X_m = [1, 8, 11]$$

Preprocessing: stop words and punctuation

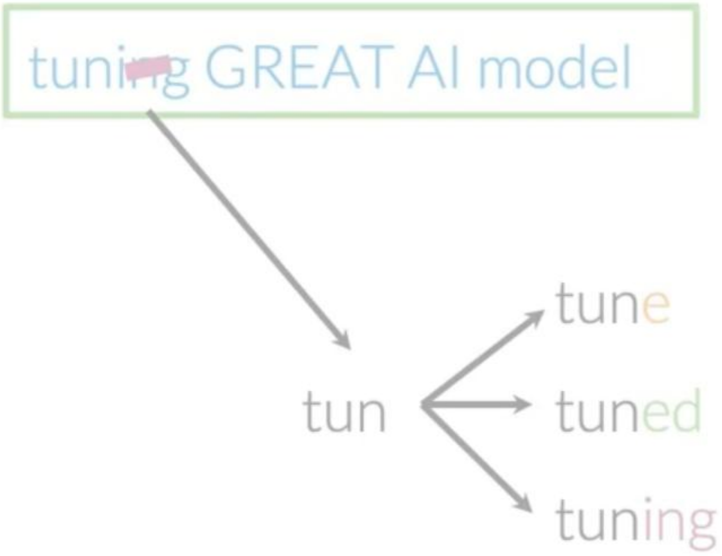
@YMourri @AndrewYNg tuning GREAT AI model https://deeplearning.ai~~!!!~~

@YMourri @AndrewYNg tuning GREAT AI model https://deeplearning.ai

Stop words
and
is
a
at
has
for
of

Punctuation
,
.
:
!
“
‘

Preprocessing: Stemming and lowercasing



Preprocessed tweet:
[tun, great, ai, model]

General overview

I am Happy Because i am learning NLP @deeplearning

↓ Preprocessing

[happy, learn, nlp]

↓ Feature Extraction

Bias ← [1, 4, 2] → Sum negative frequencies

↓

Sum positive frequencies

General overview

I am Happy Because i am learning NLP @deeplearning

I am sad not learning NLP

...

I am sad :(

→

[happy, learn, nlp]

[sad, not, learn, nlp]

...

[sad]

→

[[1, 40, 20],
[1, 20, 50],
...
[1, 5, 35]]

General overview

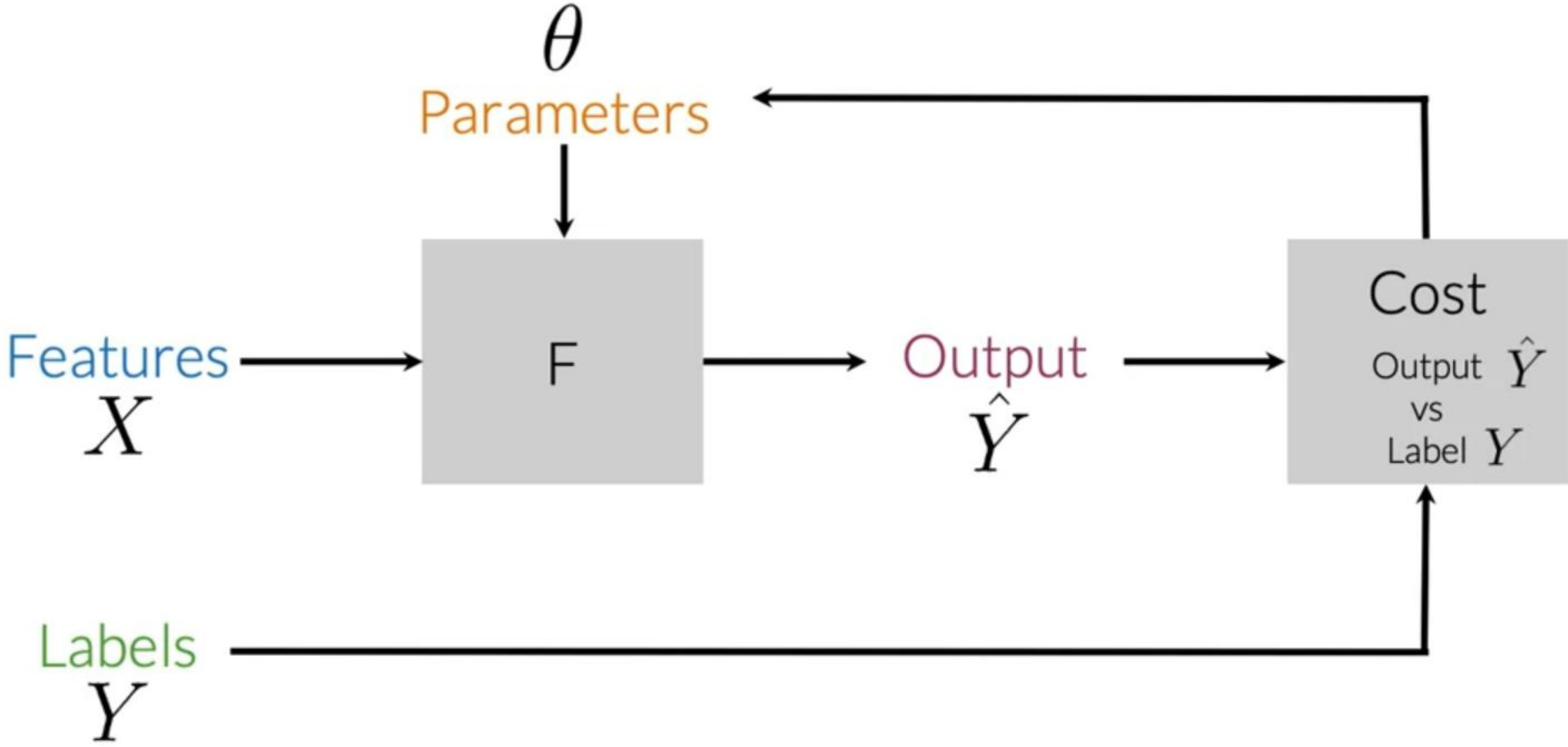
$$\begin{bmatrix} 1 & X_1^{(1)} & X_2^{(1)} \\ 1 & X_1^{(2)} & X_2^{(2)} \\ \vdots & \vdots & \vdots \\ 1 & X_1^{(m)} & X_2^{(m)} \end{bmatrix} \longleftrightarrow$$

[[1, 40, 20]
[1, 20, 50],
...
[1, 5, 35]]

General Implementation

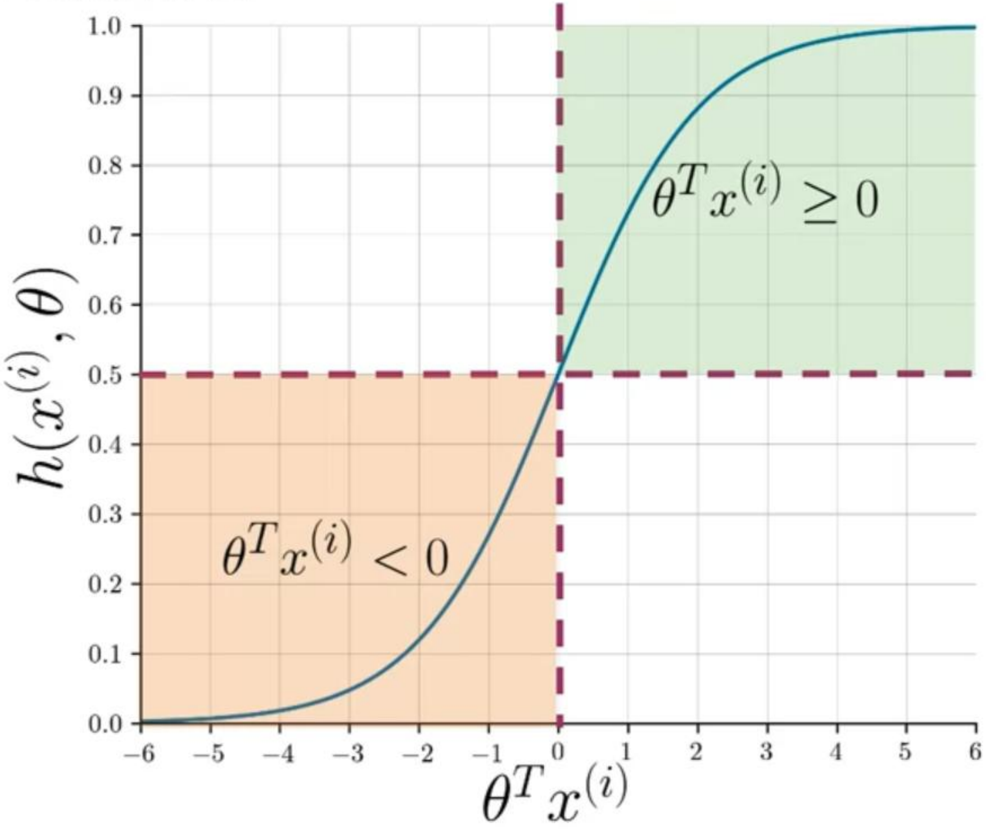
```
freqs = build_freqs(tweets,labels) #Build frequencies dictionary

X = np.zeros((m,3)) #Initialize matrix X

for i in range(m): #For every tweet

        p_tweet = process_tweet(tweets[i]) #Process tweet

    X[i,:] = extract_features(p_tweet,freqs) #Extract Features
```

Overview of logistic regression



Overview of logistic regression

$$h(x^{(i)}, \theta) = \frac{1}{1 + e^{-\theta^T x^{(i)}}}$$



Overview of logistic regression

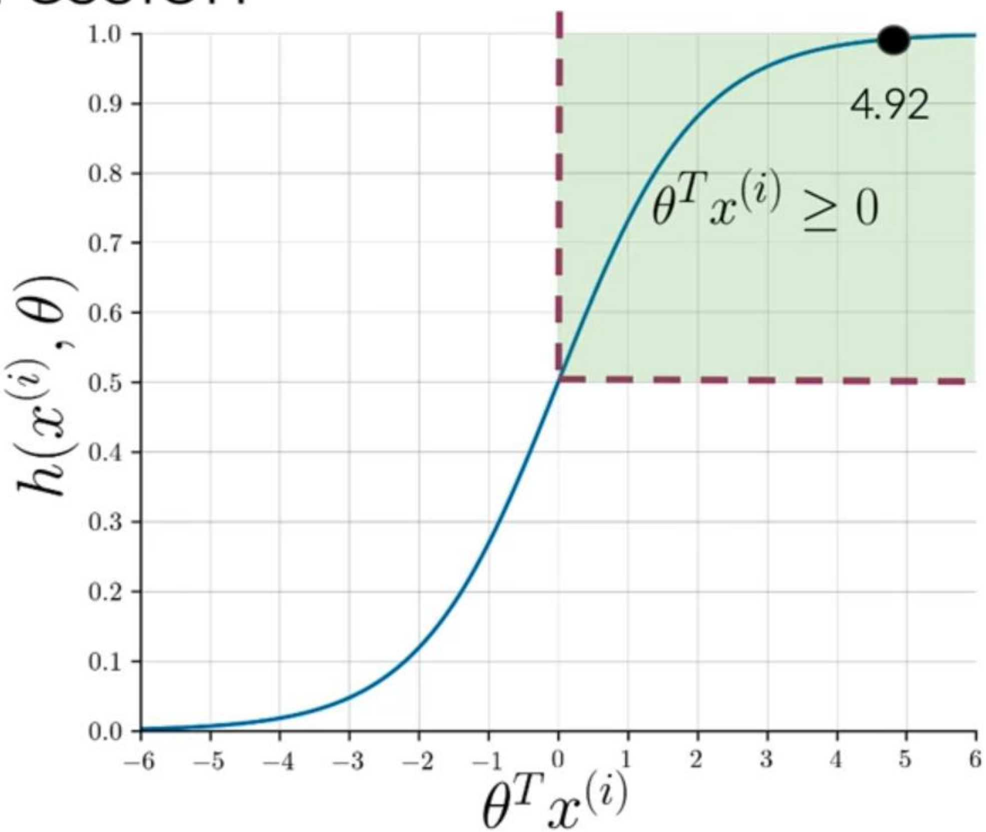
@YMourri and
@AndrewYNg are tuning a
GREAT AI model

↓

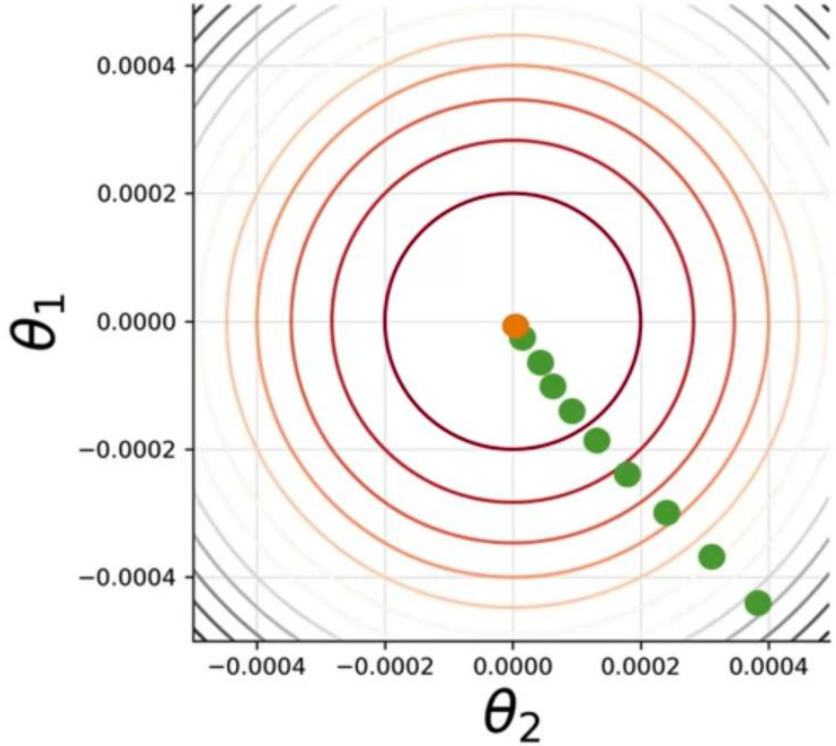
[tun, ai, great, model]

↓

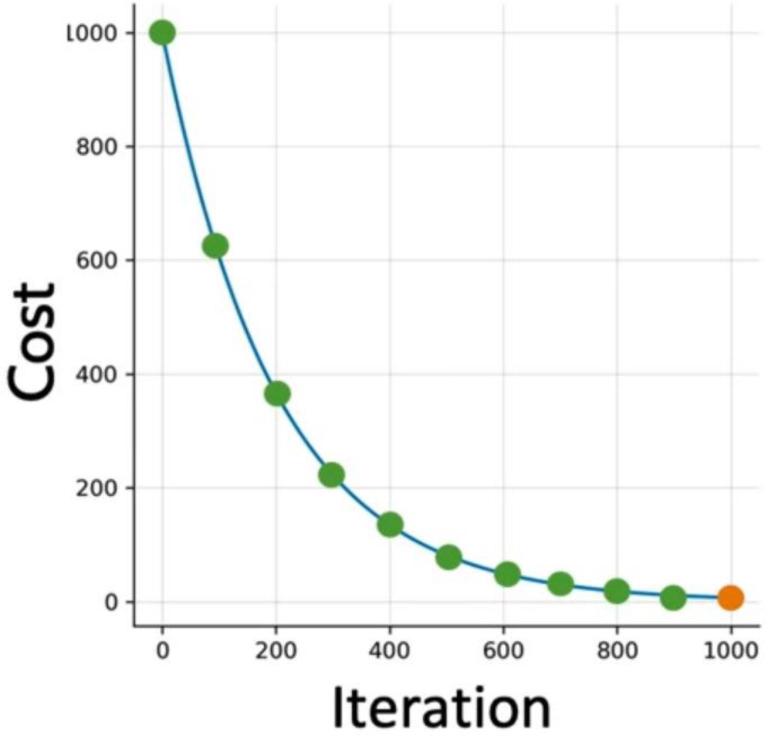
$$x^{(i)} = \begin{bmatrix} 1 \\ 3476 \\ 245 \end{bmatrix} \quad \theta = \begin{bmatrix} 0.00003 \\ 0.00150 \\ -0.00120 \end{bmatrix}$$



Training LR

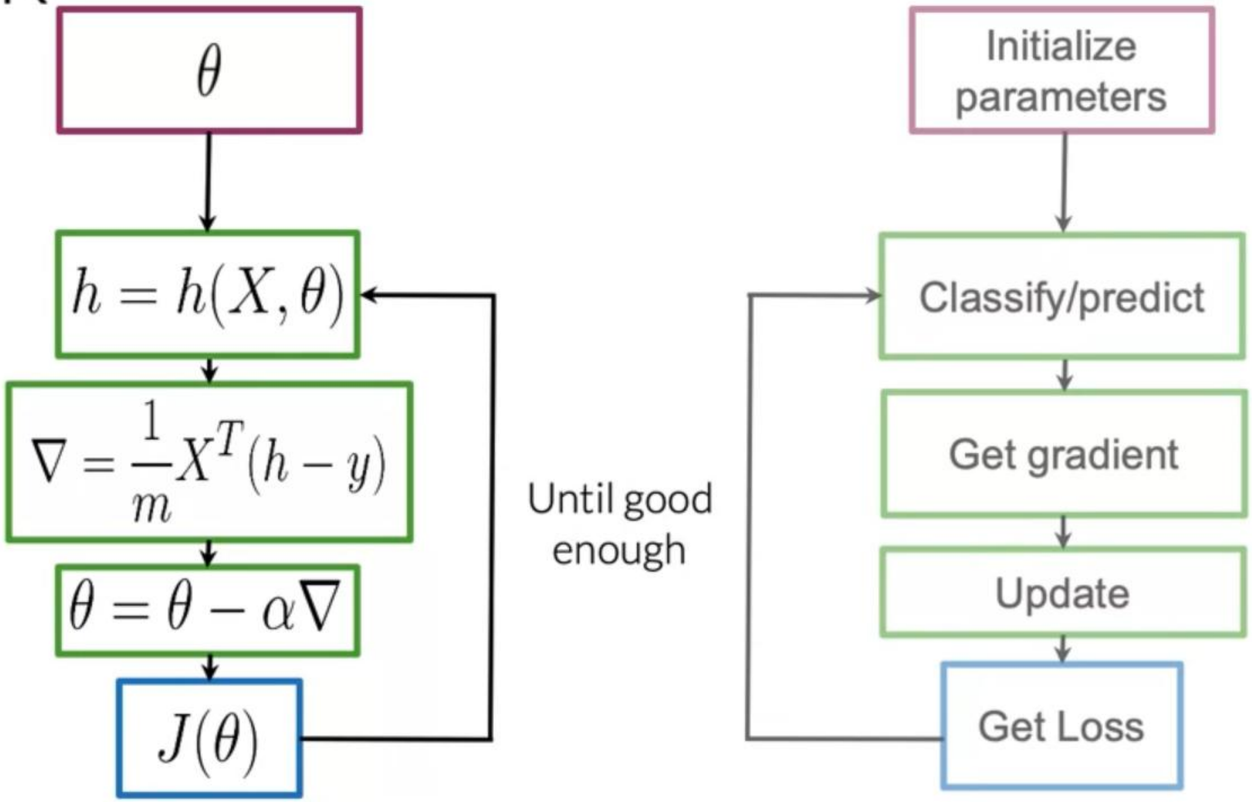


0.0004
0.0002
0.0000
−0.0002
−0.0004
θ_1
−0.0004
−0.0002
0.0000
0.0002
0.0004
θ_2



Cost
1000
800
600
400
200
0
0
200
400
600
800
1000
Iteration

Training LR



θ
$h = h(X, \theta)$
$\nabla = \frac{1}{m} X^T (h - y)$
$\theta = \theta - \alpha \nabla$
$J(\theta)$
Until good enough
Initialize parameters
Classify/predict
Get gradient
Update
Get Loss

Testing logistic regression

- $X_{val}\ Y_{val}\ \theta$

$$h(X_{val}, \theta)$$

$$pred = h(X_{val}, \theta) \geq 0.5$$

$$\begin{bmatrix} 0.3 \\ 0.8 \\ 0.5 \\ \vdots \\ h_m \end{bmatrix} \geq 0.5 = \begin{bmatrix} 0.3 \geq 0.5 \\ 0.8 \geq 0.5 \\ \underline{0.5 \geq 0.5} \\ \vdots \\ pred_m \geq 0.5 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ \underline{1} \\ \vdots \\ pred_m \end{bmatrix}$$

Testing logistic regression

- $X_{val}\ Y_{val}\ \theta$

$$h(X_{val}, \theta)$$

$$pred = h(X_{val}, \theta) \geq 0.5$$

$$\sum_{i=1}^{m} \frac{(pred^{(i)} == y_{val}^{(i)})}{m}$$

$$\begin{bmatrix} \underline{0} \\ 1 \\ 1 \\ \vdots \\ pred_m \end{bmatrix} == \begin{bmatrix} \underline{0} \\ 0 \\ 1 \\ \vdots \\ Y_{val_m} \end{bmatrix}$$

$$\begin{bmatrix} \underline{1} \\ 0 \\ 1 \\ \vdots \\ pred_m == Y_{val_m} \end{bmatrix}$$

Testing logistic regression

$$Y_{val} = \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \\ 1 \end{bmatrix} \quad pred = \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} \quad (Y_{val} == pred) = \begin{bmatrix} 1 \\ 1 \\ 0 \\ 1 \\ 1 \end{bmatrix}$$

$$\text{accuracy} = \frac{4}{5} = 0.8$$

Cost function for logistic regression

$$J(\theta) = -\frac{1}{m}\sum_{i=1}^{m}\left[y^{(i)}\log h(x^{(i)},\theta) + (1-y^{(i)})\log(1-h(x^{(i)},\theta))\right]$$