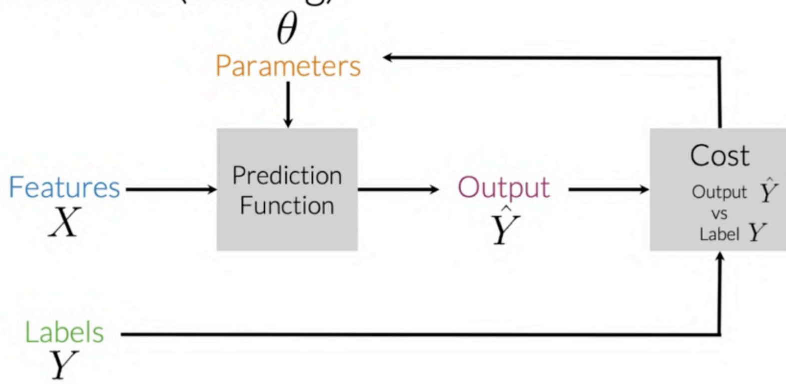
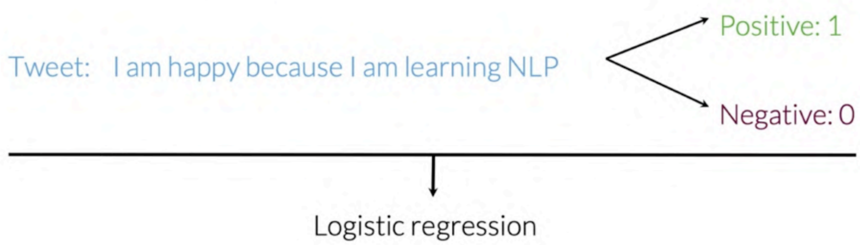
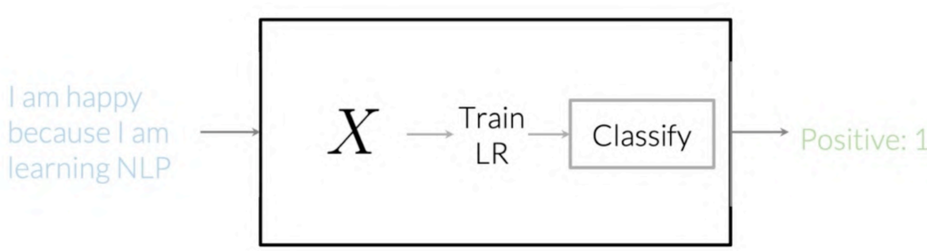
Supervised ML (training)



Sentiment analysis



Sentiment analysis



Vocabulary

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

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

$V =$ Unique Words

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

Feature extraction

Number of features the size of the vocabulary

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.

Problems with sparse representations

I am happy because I am learning NLP

[1 , 1 , 1 , 1 , 1 , 1 , ... , 0 , ... , 0 , 0 , 0] → All zeros!

$1 \longleftrightarrow |V|$

$[\theta_0, \theta_1, \theta_2, \ldots, \theta_n]$ →
1. Large training time
2. Large prediction time

$n = |V|$

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	Negative tweets
I am happy because I am learning NLP	I am sad, I am not learning NLP
I am happy	I am sad

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

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

$$\underbrace{X_m}_{\text{Features of tweet m}} = [\underbrace{1}_{\text{Bias}}, \underbrace{\sum_w freqs(w, 1)}_{\text{Sum Pos. Frequencies}}, \underbrace{\sum_w freqs(w, 0)}_{\text{Sum Neg. Frequencies}}]$$

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

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

8

$\boxed{11}$

Using Posfreq

Feature extraction

I am sad, I am not learning NLP

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

[1, 8, 11]

Preprocessing: stop words and punctuation

@YMourri ~~and~~ @AndrewYNg ~~are~~ tuning ~~a~~ GREAT AI model ~~at~~ https://deeplearning.ai!!!

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

Stop words
and
is
are
at
has
for
a

Punctuation
,
.
:
!
"
'

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
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of

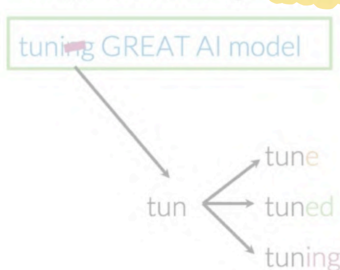
Punctuation
,
.
:
!
“
‘

Preprocessing: Handles and URLs

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

tuning GREAT AI model

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 positive frequencies

General overview

Multiple tweets

I am Happy Because i am learning NLP @deeplearning → [happy, learn, nlp] → [[1, 40, 20],

I am sad not learning NLP → [sad, not, learn, nlp] → [1, 20, 50],

... → ... → ...

I am sad :(→ [sad] → [1, 5, 35]]

General overview

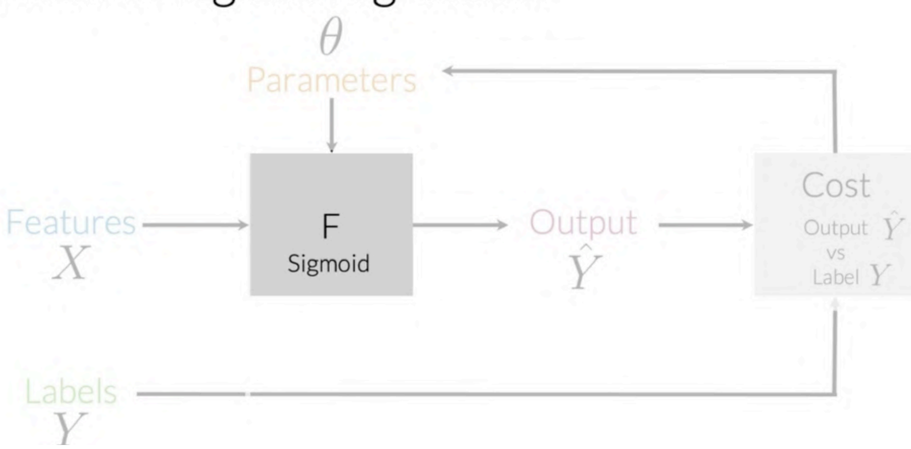
features for each tweet

$$\begin{bmatrix} \boxed{1 \quad X_1^{(1)} \quad X_2^{(1)}} \\ 1 \quad X_1^{(2)} \quad X_2^{(2)} \\ \vdots \quad \vdots \quad \vdots \\ 1 \quad X_1^{(m)} \quad X_2^{(m)} \end{bmatrix} \longleftrightarrow \begin{matrix} [\boxed{[1, 40, 20]} \\ [1, 20, 50], \\ \dots \\ [1, 5, 35]] \end{matrix}$$

General Implementation

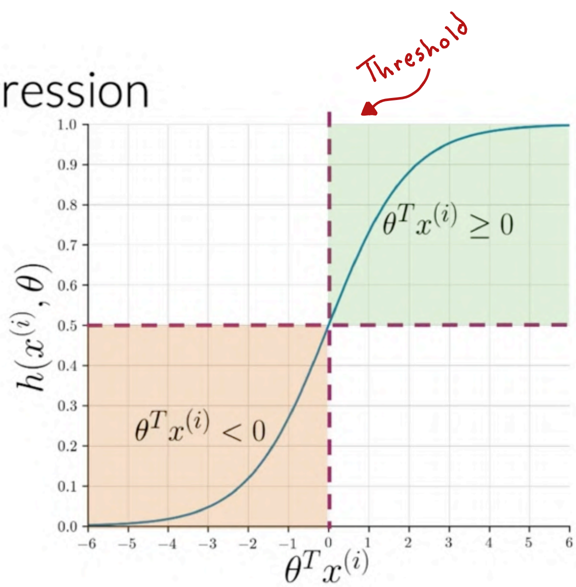
```
freqs = build_freqs(tweets,labels) #Build frequencies dictionary
X = np.zeros((m,3)) #Initialize matrix X
for i in range(m): #For every tweet
        p_tweet = process_tweet(tweets[i]) #Process tweet
    X[i,:] = extract_features(p_tweet,freqs) #Extract Features
```

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]

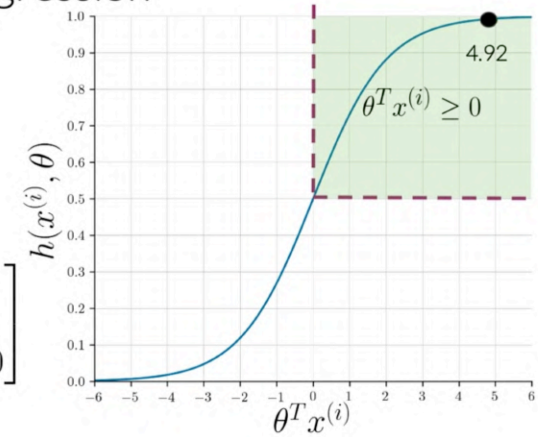
↓

bias

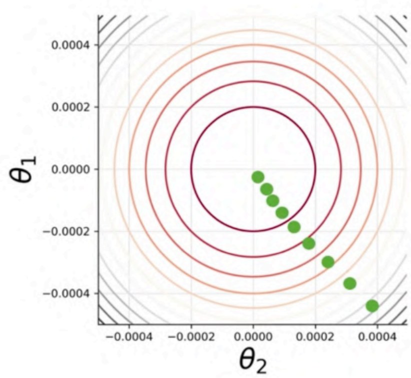
$$x^{(i)} = \begin{bmatrix} 1 \\ 3476 \\ 245 \end{bmatrix} \quad \theta = \begin{bmatrix} 0.00003 \\ 0.00150 \\ -0.00120 \end{bmatrix}$$

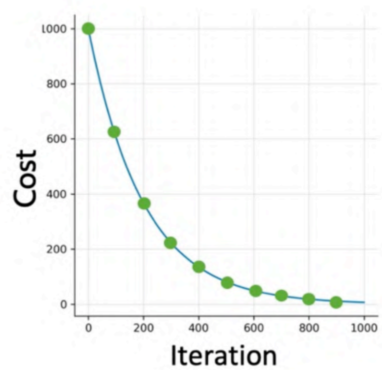
sum of pos freq

sum of neg freq

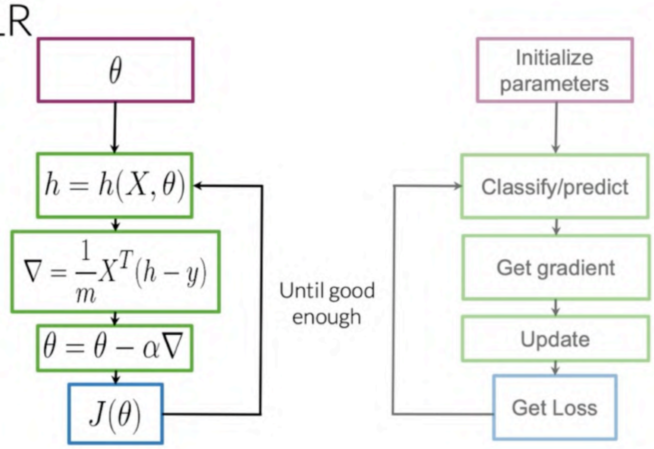


Training LR





Training LR

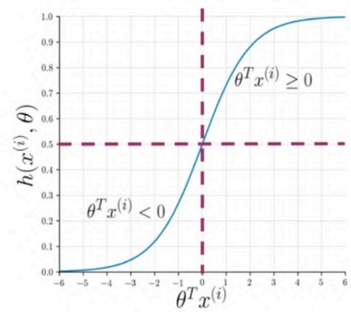


Testing logistic regression

- X_{val} Y_{val} θ

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

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



Testing logistic regression

- X_{val} Y_{val} θ

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

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

boolean
T or F

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

Testing logistic regression

- X_{val} Y_{val} θ

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

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

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

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

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

Testing logistic regression

- X_{val} Y_{val} θ

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

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

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

Testing logistic regression

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

Sum of vector comparisons

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

— 1 Number of

Cost function for logistic regression

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

$y^{(i)}$	$h(x^{(i)}, \theta)$	
0	any	0
1	0.99	~0
1	~0	-inf

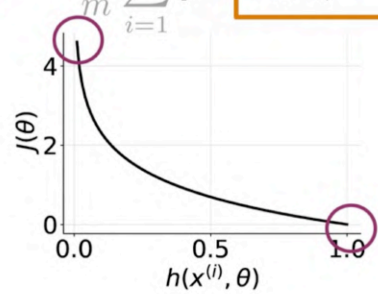
Cost function for logistic regression

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

$y^{(i)}$	$h(x^{(i)},\theta)$	
1	any	0
0	0.01	~0
0	~1	-Inf

Cost function for logistic regression

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



Cost function for logistic regression

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