CIFAR-100 Image Classification

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- Este ejercicio consiste en clasificar imágenes del dataset CIFAR-100 en sus 100 categorías (mutuamente exclusivas), 20 superclases (2 etiquetas).
- Métrica del rendimiento: *multiclass classification accuracy*
- Solución Implementada: Python3 + TFLearn http://tflearn.org
- Escrita “encima” de Tensorflow - nivel de abstracción mayor
- Menos código , mayor claridad.
- La abstracción está basada en capas (o layers)
- Visualización de algunos parametros con o Tensorboard.

Ingestión de Datos

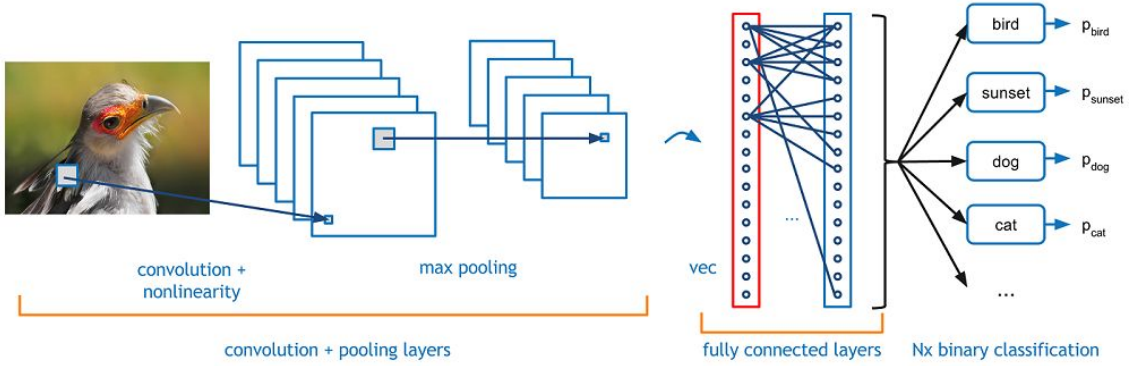
- Download automatico de https://www.cs.toronto.edu/~kriz/cifar.html a dir local
- Cada clase tiene 500 imagenes de training (50k) y 100 de prueba (10k)
- Clasificación relativamente no trivial
- Formato binario (python pickled) -> función decodifica a caracteres normales (unpickle).
- Cada imagen: 32x32x3 pixeles (3 colores RGB) ->matriz de 50,000 x 3072, una imagen por renglón.
- Cada imagen se convierte en un 4d-tensor `[records, channels, width, height]=[-1, 3, 32, 32]`
- One-Shot encoding: Datos categóricos, etiquetas->valores numéricos, ejemplo:

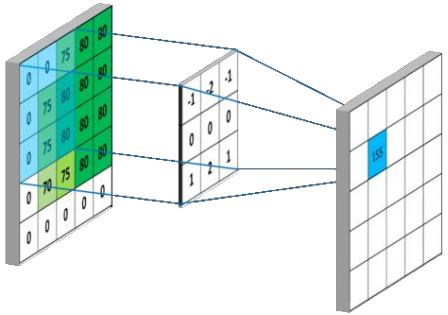
red,	green,	blue
1,	0,	0
0,	1,	0
0,	0,	1

Pre-Proceso de los Datos

- Re-escalamiento alrededor de la media y usando std de *feature values:*
  - Suprimir valores muy grandes → evitar sesgo/distorsión en el aprendizaje i.e. de los gradientes que son retro-propagados en la red
  - Más o menos a la misma escala. *Feature engineering*

- Data augmentation
  - Generar más imágenes de entrenamiento mediante reflexiones y rotaciones al azar (máx 15 grados)
  - Número de imágenes de entrenamiento relativamente pequeño.





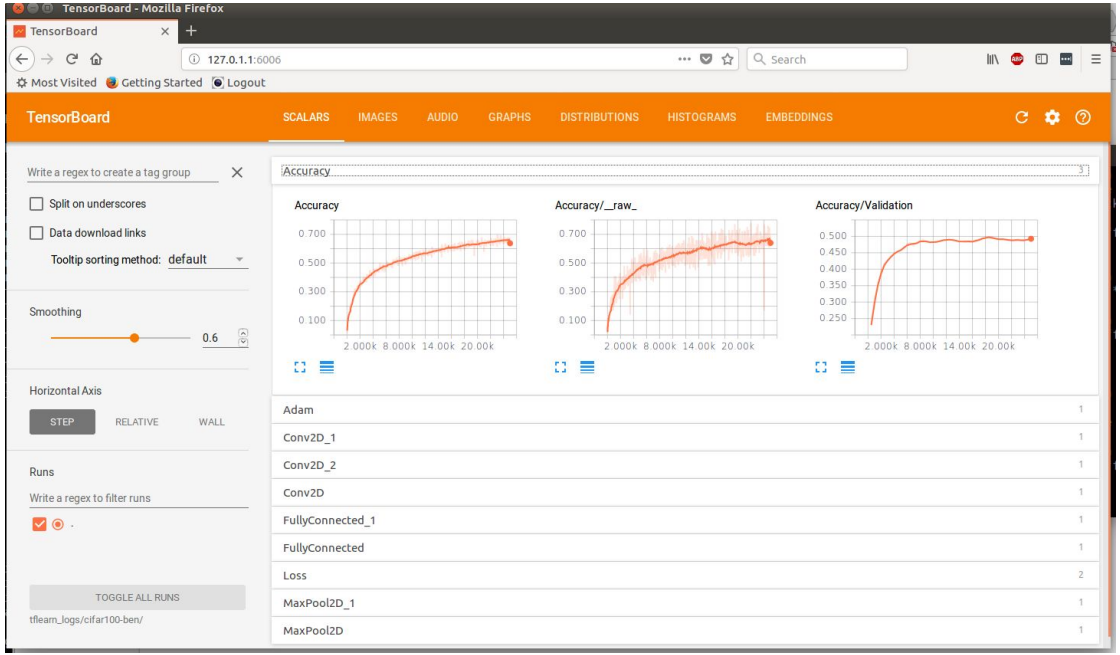
- Modelo de Aprendizaje*:* Convolutional neural network (CNN)
- De facto standard para Image/Clasificación
- 3 capas de convolución: *feature maps (coarser)* , filtros (replicados) de 3x3, stride=1, padding
- Función de activación ReLU (*Rectifier Linear Unit - layer -nonlinearity)*
- 2 capas de *max-pooling* de 2x2 (reduce comp. cost, overfitting)
- 2 capas tipo "*fully connected*", con función de activación softmax.
- El algoritmo de optimización para los pesos es ADAM
- *Dropout* al 50% (apagar nodos de las redes al azar para mitigar *overfitting)*.

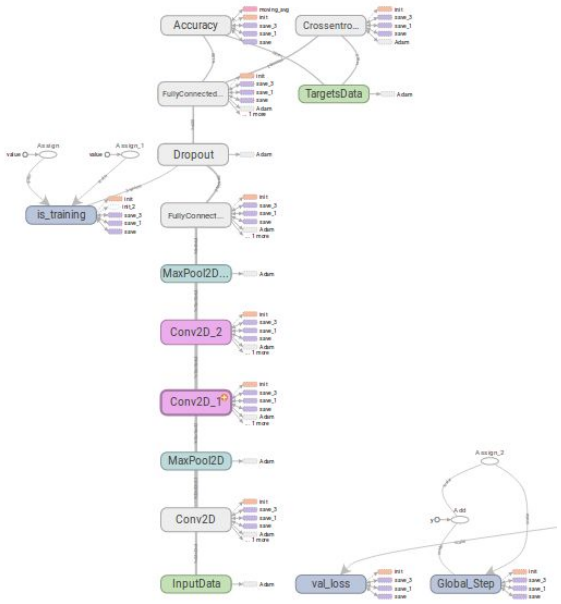
Resultados

- Ejecución:
  - ADAM optimizer (learning rate) es de 0.001.
  - El código se ejecutó por 50 épocas i.e. el dataset entero paso de adelante hacia atrás 50 veces.
  - ~2 horas de ejecución
  - Loss function*: Categorical Cross Entropy*
  - *Multiclass classification accuracy: categorical outcomes*
  - **El valor de la métrica obtenido fue de 0.4927, aproximadamente 49%.**
  - **(On testing data)**

$$Accuracy = \frac{\sum_M tp + tn}{\sum_M tp + tn + fp + fn}$$

Tensorboard





Minería de datos de Twitter para evaluar “sentimiento social”

- Objetivo: utilizar el stream de twitter para identificar tweets positivos o negativos
- El “humor” de la comunicación de tweeter es un ...
  - Reflejo de ritmos biológicos
  - Medida de los mercados bursátiles
  - Analizar “humor” a escalas nacionales o en contextos meteorológicos/desastres.
- **Los tweets representan datos muy sucios y sin estructura**: incompletos, sin texto, sin geo-información, , idioma, codificados en distintos lenguajes y formatos, etc.
- Primer Paso: capturar el stream de twitter usando su API **https://dev.twitter.com/apps**.
- Codificado en *unicode strings* --->API ---> JSON y sea humanamente legible.

Stream de datos

-
```
xpanded_url":"https:\/\/twitter.com\/QnA0304\/status\/992977255918850049\/photo\/1","type":"photo","sizes":{"thumb":{"w":150,"h":150,"resize":"
crop"},"large":{"w":575,"h":360,"resize":"fit"},"small":{"w":575,"h":360,"resize":"fit"},"medium":{"w":575,"h":360,"resize":"fit"}}}]}},"quote_
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```

Implementación de la evaluación de Sentimiento

- Asignamos un sentimiento en base a las palabras del texto del tweet.
- Cada palabra recibirá un score y el sentimiento es la suma de los scores de todas las palabras del tweet.
- Diccionario en inglés ⇨ Restricción a tweets en INGLÉS.
- El score es **cero** si:
  - La palabra no está en el diccionario
  - Tweet en otro idioma (diccionario en inglés y codificaciones e.g. Europa del Este, Asia).
  - Tweet no tiene texto (sucio)
  - El campo del lenguaje está vacío (sucio)

AFINN is a list of English words rated for valence with an integer between minus five (negative) and plus five (positive). The words have been manually labeled by Finn Årup Nielsen in 2009-2011. The file is tab-separated. Used version AFINN-111: Newest version with 2477 words and phrases.

Output Stream

- Dos opciones: 0,-4,0,0,0,0,4,0,0,1,0,0,2,0,0,0,-3,0,0,5,0,0..... o bien....

('Not English', u'in', 'sentiment=', 0)
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('Not English', u'ko', 'sentiment=', 0)
('Not English', u'th', 'sentiment=', 0)
('Not English', u'pt', 'sentiment=', 0)
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('Not English', u'in', 'sentiment=', 0)
('Not English', u'es', 'sentiment=', 0)
('ENGLISH', u'en', 'loc:', None, 'text:', u'RT @NoHoesGeorge: gamer girls https://t.co/XeJ3GTUJQu', 'unknown', 'sentiment=', 0)
('Not English', u'tr', 'sentiment=', 0)
('ENGLISH', u'en', 'loc:', None, 'text:', u'RT @sttepodcast: RT & Follow us to #win a @SignatureEntertainment 5-film romance movie DVD bundle to celebrate the release of #MeghanMarkle\u2026', 'unknown', 'sentiment=', 5)
('ENGLISH', u'en', 'loc:', None, 'text:', u'RT @Sanemavcil: LumiWatch: On-Arm Projected Graphics and Touch Input by Robert Xiao\nOriginal Video: https://t.co/y3WlnmYzkF\n\n#Technology #A\u2026', 'unknown', 'sentiment=', 0)
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HAS NO TEXT,sentiment=0
HAS NO TEXT,sentiment=0
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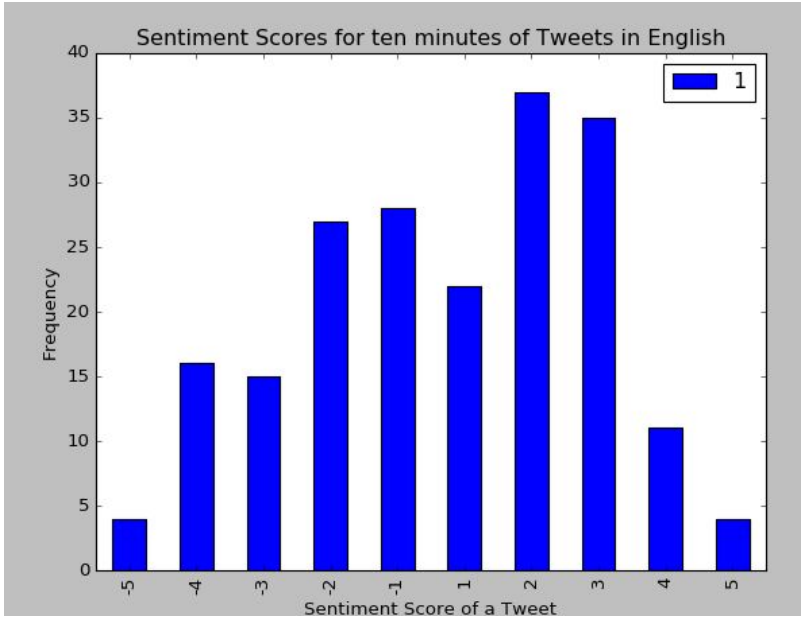
Resultados y Posibilidades

- El análisis de sentimiento por 10 minutos (~150MB) un sábado en la noche fue



- También podemos incluir información sobre la geolocalización

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Topic Modeling

- Implementación de un código que mina temas en el dataset “all the news”
- articles1.csv, ~50k líneas: Artículos publicados en diversos medios de comunicación de habla inglesa.
    - Dataset->Corpus: colección de documentos
- Latent Dirichlet Allocation (LDA): modelo probabilístico para inferir una distribución de temas
    - Es un tipo de clustering: documentos->temas, temas->palabras
    - Objetivo: Dada una bolsa de palabras (documento), determina los temas presentes.
    - Un documento es una distribución de temas
    - Un tema es una distribución de palabras que pertenecen a un vocabulario

Aprendizaje en LDA

- Escogemos un K número de temas (clusters), N documentos, M vocabulario
- Asignamos palabras a temas en <u>forma aleatoria</u>, construimos:

	W1	W2	W3	Wn
D1	0	2	1	3
D2	1	4	0	0
D3	0	2	3	1
Dn	1	1	3	0

	K1	K2	K3	K
D1	1	0	0	1
D2	1	1	0	0
D3	1	0	0	1
Dn	1	0	1	0

	W1	W2	W3	Wm
K1	0	1	1	1
K2	1	1	1	0
K3	1	0	0	1
K	1	1	0	0

- Para mejorar las distribuciones (i.e. inferir o aprender de los datos/documentos), iteramos:
- Para cada W en doc:
- Tema 1 a K:
  - ¿Cuantas palabras en el doc ya pertenecen al tema 1? P1(tema 1| doc d)
  - ¿Con qué frecuencia W aparece en el tema 1 en <u>todos</u> los docs? P2(word W| tema i)
  - P1*P2 = Probabilidad de que W vino del tema 1
  - Si (P1*P2)_tema 2 > (P1*P2)_tema 1 ----> Cambio a tema 2
  - Continua hasta iteraciones deseadas o estado estacionario

Implementación

- Este código es relativamente sencillo, K=10 temas,
  - Un solo pase, aprox 2 horas para 50k líneas de articles1.csv

- Corpus (articles1.csv) es bajado a mano

- Selección de las columnas a usar (headers)

- Limpieza del corpus
  - líneas defectuosas,
  - stop_words i.e. palabras irrelevantes e.g. conjunciones: “of”, “or”, etc.

- One-Shot encoding: Datos categóricos, etiquetas->valores numéricos,

- gensim, *Topic modeling* package para construir el modelo LDA y la matriz documentos-temas.
  - Diccionario: id-strings *mappings* , doc2bow (bag of words) format, etc. Escalable.

Resultados - Temas (topic clusters) inferidos

```
benjamin@higgs:~/topic$ python topic_modeling.py
c = 49999 / 49999
0.048*"-" + 0.016*"The" + 0.013*"Donald" + 0.013*"New" + 0.012*"Trump" + 0.010*"York" + 0.010*"Times" + 0.009*"Paul" +
0.006*"Because" + 0.006*"Anti-Trump"
0.034*"-" + 0.020*"Trump" + 0.013*"White" + 0.012*"Texas" + 0.011*"House" + 0.010*"Illegal" + 0.010*"Border" + 0.007*"The" +
0.007*"New" + 0.007*"After"
0.044*"-" + 0.037*"Hillary" + 0.036*"Clinton" + 0.014*"Trump" + 0.010*"The" + 0.010*"New" + 0.007*"Times" + 0.007*"York" +
0.007*"Donald" + 0.005*"Clinton's"
0.033*"-" + 0.016*"Cruz" + 0.014*"Ted" + 0.010*"Donald" + 0.009*"President" + 0.009*"Is" + 0.008*"Bernie" + 0.007*"Trump" +
0.006*"Control" + 0.006*"Sanders"
0.032*"-" + 0.020*"Islamic" + 0.018*"Trump" + 0.017*"State" + 0.010*"American" + 0.009*"John" + 0.008*"To" + 0.007*"The" +
0.006*"New" + 0.006*"Court"
0.038*"-" + 0.012*"Trump" + 0.010*"The" + 0.009*"New" + 0.007*"Rubio" + 0.007*"York" + 0.007*"Ryan" + 0.006*"Open" +
0.006*"Times" + 0.006*"Is"
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0.005*"The" + 0.004*"GOP"
0.036*"To" + 0.026*"-" + 0.011*"Man" + 0.010*"Migrant" + 0.007*"Terror" + 0.007*"The" + 0.006*"New" + 0.006*"Following" +
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0.005*"Two" + 0.005*"Terrorist"
0.035*"-" + 0.009*"Gun" + 0.008*"The" + 0.008*"New" + 0.006*"Times" + 0.006*"Must" + 0.006*"York" + 0.005*"Email" +
0.005*"Trump" + 0.005*"Days"
```
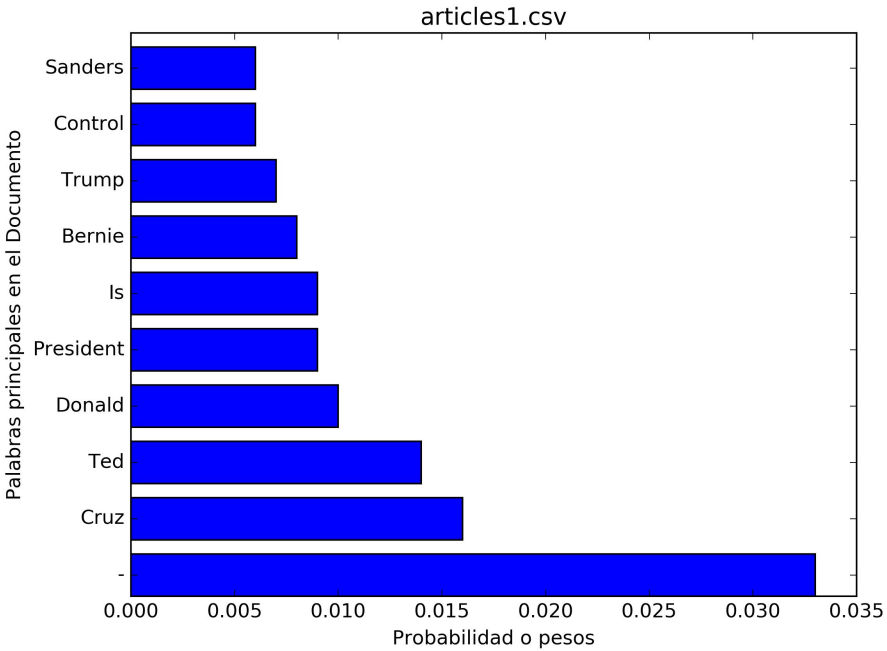
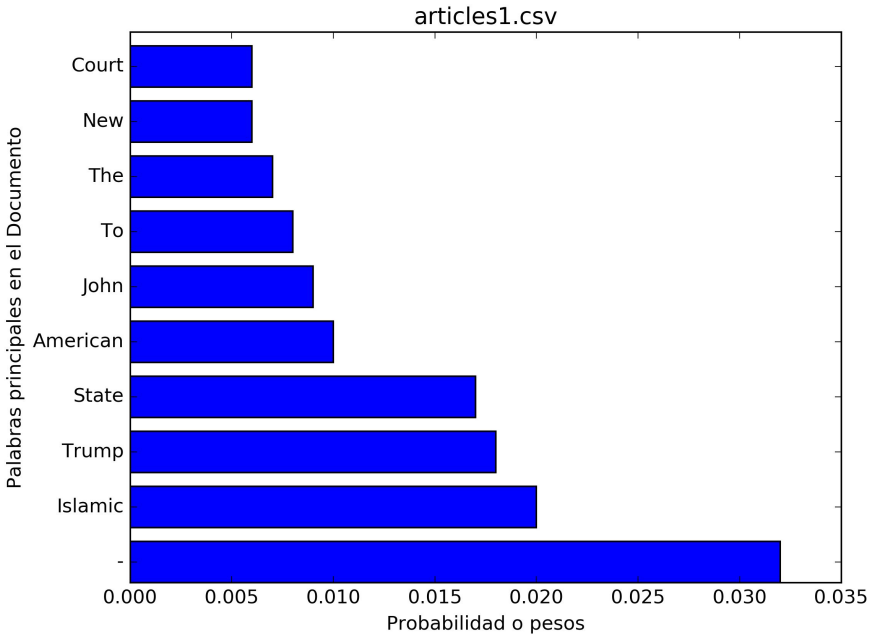
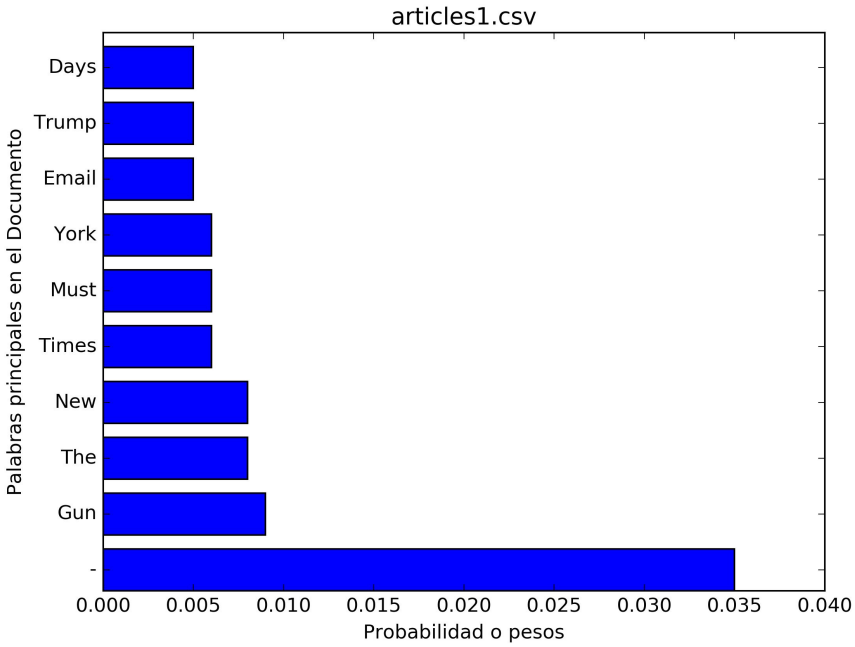
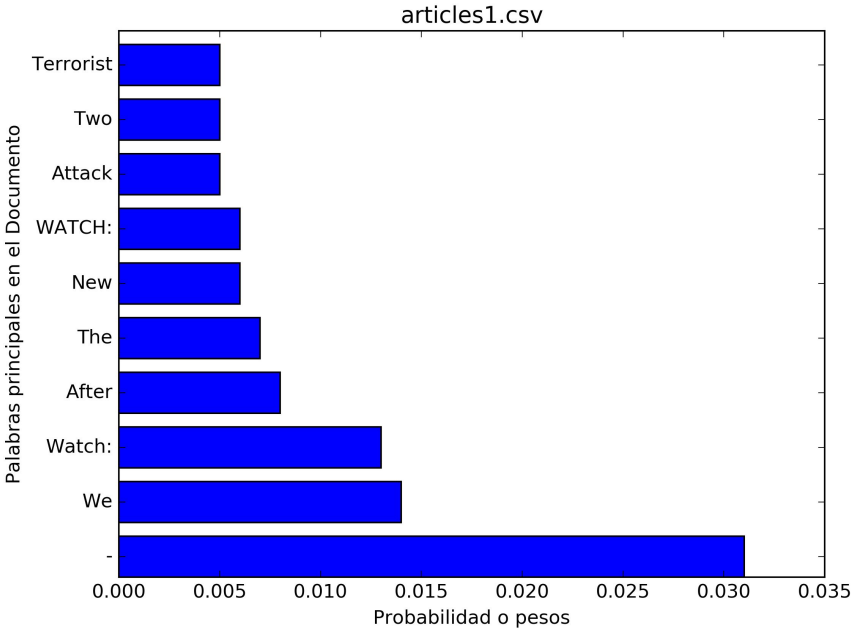

Resultados


articles1.csv
Sanders
Control
Trump
Bernie
Is
President
Donald
Ted
Cruz
-
Palabras principales en el Documento
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Probabilidad o pesos


articles1.csv
Court
New
The
To
John
American
State
Trump
Islamic
-
Palabras principales en el Documento
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Probabilidad o pesos

Resultados


articles1.csv
Days
Trump
Email
York
Must
Times
New
The
Gun
-
Palabras principales en el Documento
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
Probabilidad o pesos


articles1.csv
Terrorist
Two
Attack
WATCH:
New
The
After
Watch:
We
-
Palabras principales en el Documento
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
Probabilidad o pesos

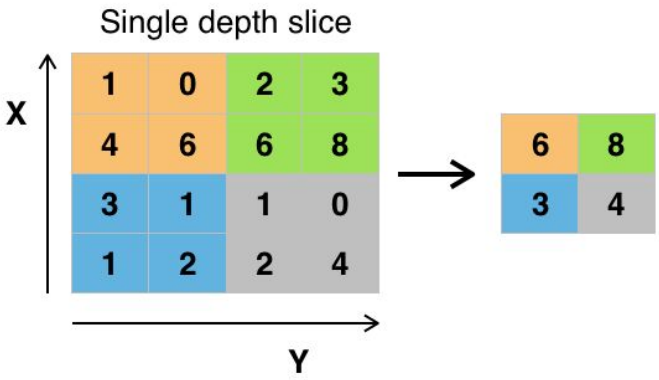
Gracias

Convolución

$$-(y\log(p) + (1-y)\log(1-p))$$

$$-\sum_{c=1}^{M} y_{o,c}\log(p_{o,c})$$

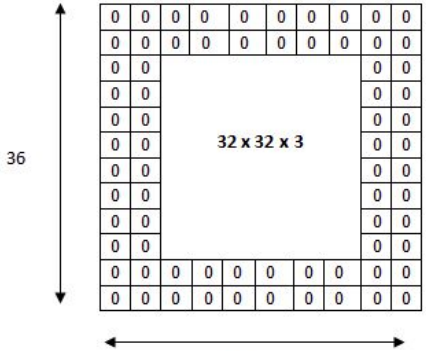
Pooling layers



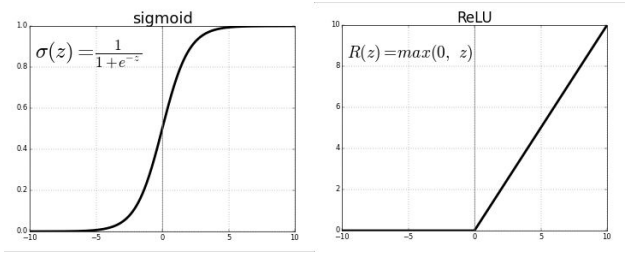
Example of Maxpool with a 2x2 filter and a stride of 2

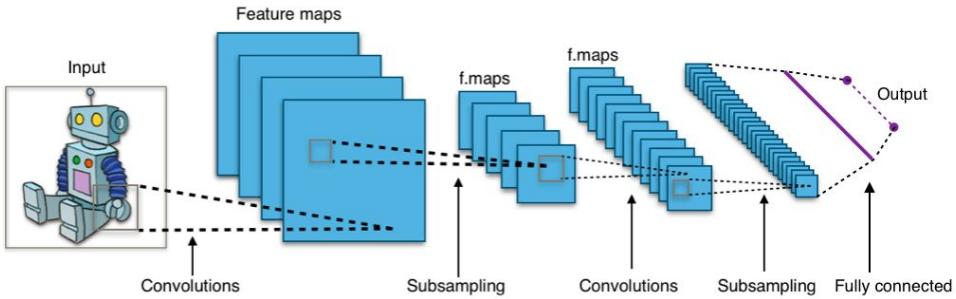
$$z = \frac{x-\mu}{\sigma}$$

Padding



ReLU





hardware

- Este código se ejecutó en Ubuntu 16.04.4 LTS, python3.5.2. En una máquina de 8 cores (Intel(R) Core(TM) i7-2600K CPU @ 3.40GHz) con 32 GB de RAM.