Fine-tuning de GPT-2 para diagnósticos

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Introducción

Problema a resolver

Se tiene un dataset con información de síntomas y diagnósticos, con la peculiaridad de que se tiene un label por fila.
Entonces es posible entrenar algún modelo que pueda aprender de estos datos para dar un diagnóstico?

Propuesta

Se propusieron 3 modelos: un fine-tuning de GPT-2 como modelo principal y un clasificador con Naive Bayes y una LSTM como modelos base de comparación

Objetivos

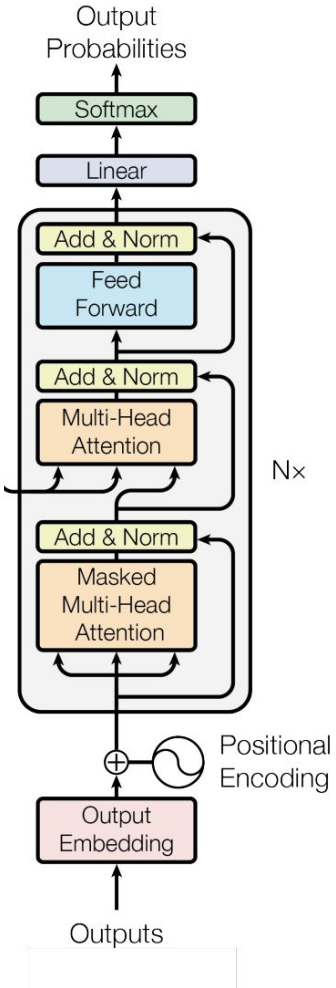
- Obtener un **buen modelo** para diagnósticos médicos mediante lenguaje natural
- Mejor manera de **aprovechar** el dataset
- **Determinar**: fine-tuning vs no fine-tuning
- **Determinar**: GPT-2 con fine-tuning vs LSTM personalizado vs Naive Bayes

Dataset

"For the first few days, the symptoms of bronchiolitis are much like a cold: Runny nose. Stuffy nose. Cough. Sometimes a slight fever. Later, your child may have a week or more of working harder than usual to breathe,…	"bronchiolitis"
"Ulcerative colitis symptoms can vary, depending on the severity of inflammation and where it occurs. Signs and symptoms may include: Diarrhea, often with blood or pus Rectal bleeding – passing small amount of blood with…	"ulcerative-colitis"
"The signs and symptoms of hydrocephalus vary somewhat by age of onset. Infants Common signs and symptoms of hydrocephalus in infants include: Changes in the head An unusually large head A rapid increase in the size of…	"hydrocephalus"
"Optic neuritis usually affects one eye. Symptoms might include: Pain. Most people who develop optic neuritis have eye pain that's worsened by eye movement. Sometimes the pain feels like a dull ache behind the eye. Visio…	"optic-neuritis"
"If your child has clubfoot, here's what it might look like: The top of the foot is usually twisted downward and inward, increasing the arch and turning the heel inward. The foot may be turned so severely that it…	"clubfoot"
"Usually, a split (cleft) in the lip or palate is immediately identifiable at birth. Cleft lip and cleft palate may appear as: A split in the lip and roof of the mouth (palate) that affects one or both sides of the face A…	"cleft-palate"
"Reactive attachment disorder usually starts in infancy. There's little research on signs and symptoms of reactive attachment disorder beyond early childhood, and it remains uncertain whether it occurs in children…	"reactive-attachment-disorder"
"Signs and symptoms of sinus headaches may include: Pain, pressure and fullness in the cheeks, brow or forehead Worsening pain if you bend forward or lie down Stuffy nose Fatigue Achy feeling in the upper teeth Sinusitis o…	"sinus-headaches"

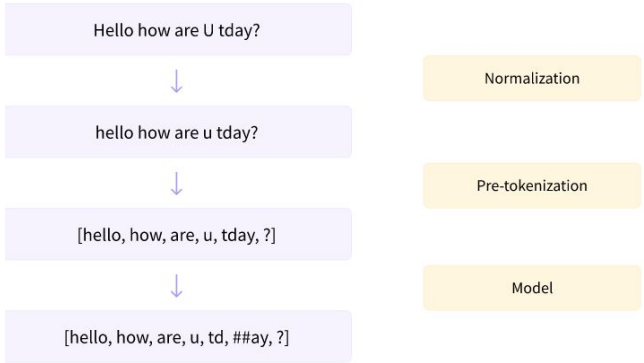
Método

GPT-2

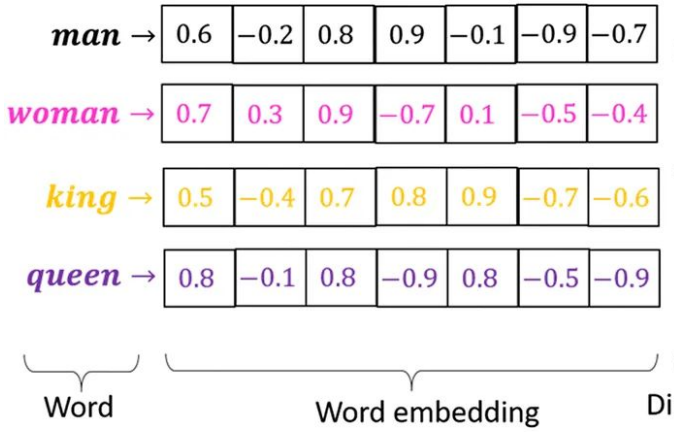

Output Probabilities
Softmax
Linear
Add & Norm
Feed Forward
Add & Norm
Multi-Head Attention
Add & Norm
Masked Multi-Head Attention
Nx
Positional Encoding
Output Embedding
Outputs

Procesamiento de entradas

Tokenizer



Word embedding

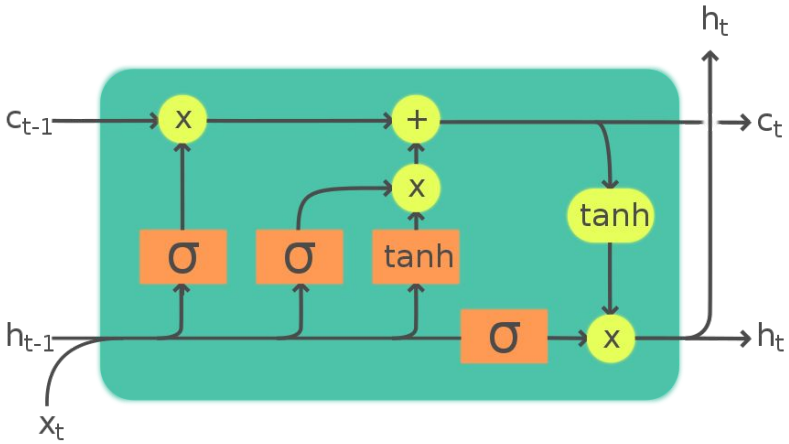


Entrenamiento no supervisado

- **Entrada:** The patient has fever, throat pain and headache. What would be his diagnosis?
- **Salida esperada:** Common cold
- **En conjunto de entrenamiento:** The patient has fever, throat pain and headache. What would be his diagnosis? Common cold.

Nota: en el conjunto de entrenamiento la pregunta varía.

LSTM


h_t
c_{t-1}
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+
c_t
x
tanh
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σ
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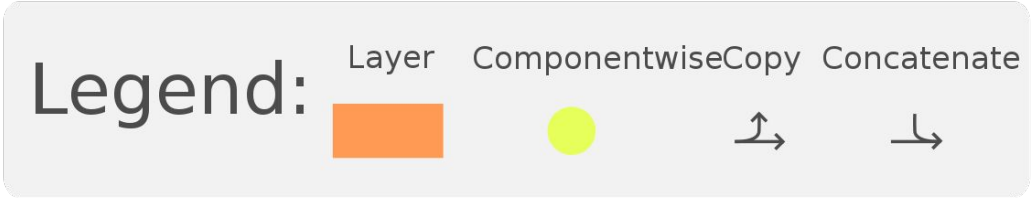
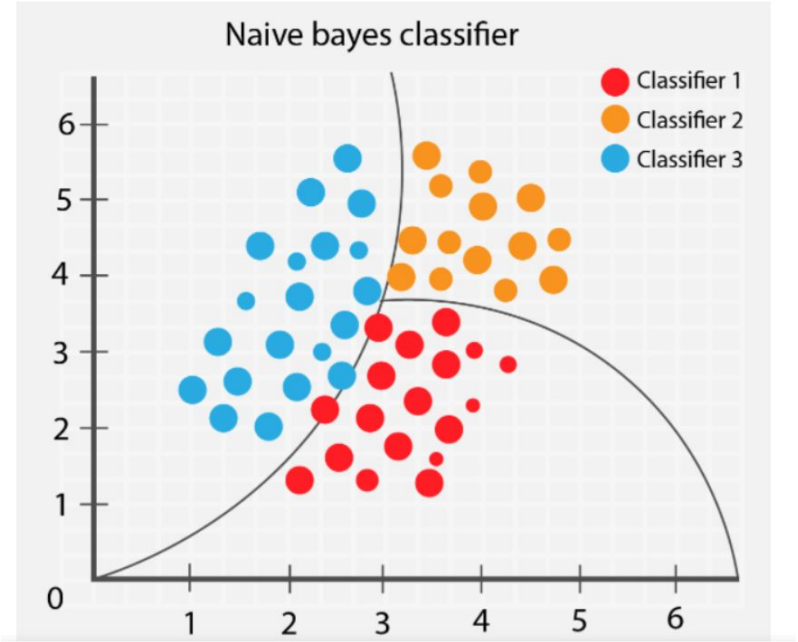
h_{t-1}
h_t
x_t


Legend:
Layer
Componentwise
Copy
Concatenate

Clasificación



Resultados

GPT-2

- Perplexity **con** fine-tuning:

  7.70

- Perplexity **sin** fine-tuning:

  18.26

$$PP(W) = \sqrt[N]{\frac{1}{P(w_1, w_2, \ldots, w_N)}}$$

Inferencias coherentes

- **Prompt**: The patient has fever, throat pain and headache. What would be his diagnosis?
- **Output**: Influenza

- **Prompt**: The patient has a swollen mole that is itchy and reddish in color. What would be his most likely diagnosis?
- **Output**: Ulcerative colitis

Inferencias incoherentes

- **Prompt**: The patient has fever, throat pain and headache. What would be his diagnosis?
- **Output**: hairdresser

- **Prompt**: The patient has a swollen mole that is itchy and reddish in color. What would be his most likely diagnosis?
- **Output**: anXiaVent

LSTM

- Perplexity:

  44941

- Accuracy:

  0.1217

$$PP(W) = \sqrt[N]{\frac{1}{P(w_1, w_2, \ldots, w_N)}}$$

Inferencias incoherentes

- **Prompt**: The patient has a swollen mole that is itchy and reddish in color. What would be his diagnosis?
- **Output**: vaginitis

- **Prompt**: The patient has fever, throat pain and headache. What would be his most likely diagnosis?
- **Output**: dermatomyositis
-

Conclusiones

- **Fine-tuning vs no fine-tuning**: fine-tuning wins
- **Dataset muy pequeño**, el dataset es muy pequeño para poder hacer predicciones con una red neuronal y su **cualidad** no permite hacer clasificación, pues solo se tiene una fila de información por cada label
- El **bajo accuracy y alta perplejidad** del modelo del LSTM refleja que no es posible capturar la información de este dataset comparado con el modelo de fine-tuning.

Referencias

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Gracias. Por favor, siéntase libre de hacer cualquier pregunta. 😄