Large Language Models for Natural Language Processing

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If You Remember Three Things

Large Language Models can provide fast-to-build and accurate-enough solution for tasks like named entity recognition, summarization, and classification

You can (and should!) systematically assess your output

Think carefully about risk – what you're putting in and what you're doing with the results

“I Used To Be At Army”

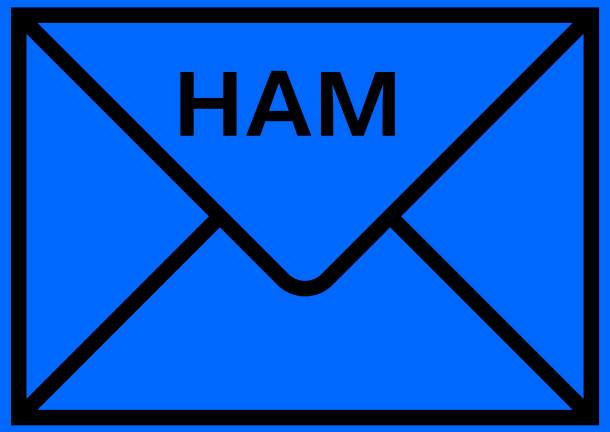
-Public policy PhD from RAND -> data science
-Around Army/DoD after that
-Worked on various NLP projects:

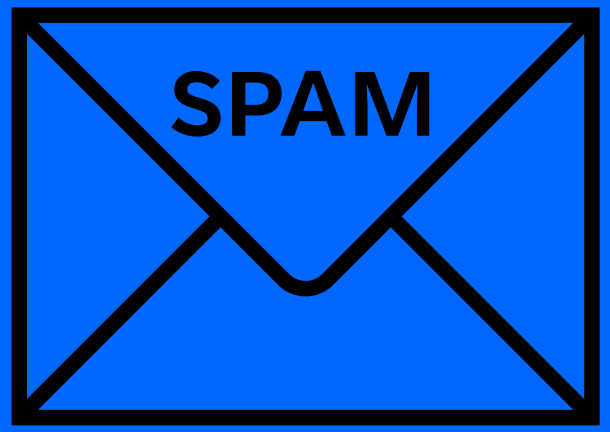
- Text pipeline for processing PDF documents for classification model
- “How much duplication of buying classes is there in DoD?”
- Analysis of USAJobs Army hiring announcements

What is Natural Language Processing (NLP)?

A set of techniques that let computers analyze human language

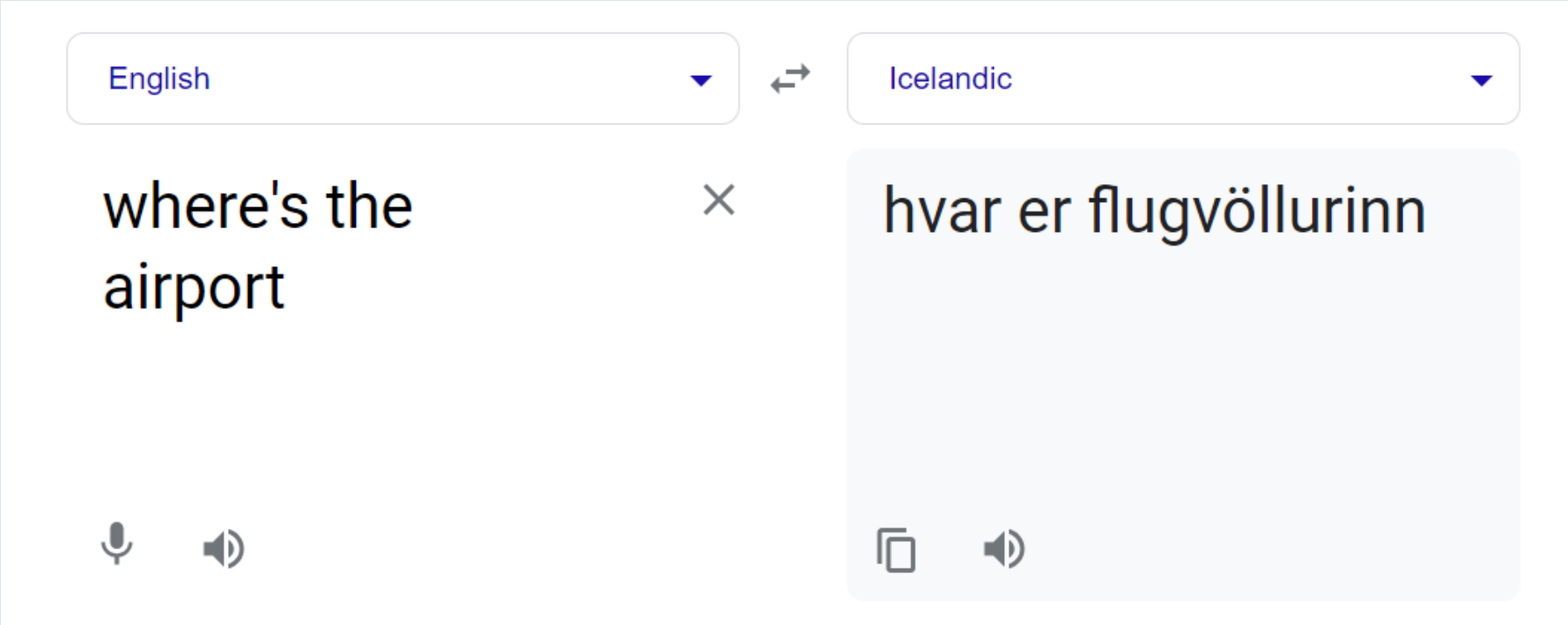
Classification





Sentiment Analysis

Language Translation



Summarization

BERT (Bidirectional Encoder Representations from Transformers) is a powerful method for natural language processing (NLP) tasks developed by Google. It's considered a breakthrough because it handles the context of words in a sentence in a way that hadn't been done before. Before BERT, models read text input from left to right or from right to left. But BERT, as the "bidirectional" part of its name suggests, reads the entire sequence of words at once in both directions, which is beneficial because the meaning of a word can depend on what comes before and after it .BERT is pre-trained on a large corpus of text (like the entirety of Wikipedia) and then fine-tuned for specific tasks, like sentiment analysis, question answering, or named entity recognition. The pre-training phase helps BERT understand the general context of language, like how words are usually used together, and the fine-tuning phase adapts this knowledge to specific tasks. An additional benefit of BERT is that you can use it right out of the box for your NLP task. You just take the pre-trained BERT model and fine-tune it on your specific task. This "transfer learning" approach saves you from having to train a model from scratch, which can be very time-consuming and requires a lot of data.

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Named Entity Recognition

John Doe, an employee of **Google Inc.**, bought 500 shares of the company's stock on **July 1, 2023**, at the **New York Stock Exchange** for **$1000**.

New LLMs as “Pretrained Everything” Models

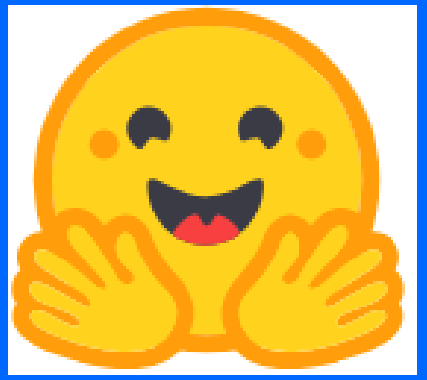
Some of these tasks we previously had out-of-box solutions for

Others required labeling massive amounts of data just to see if it might work

Now, you can build and test faster

How Fast Are We Talking?

- ~100 lines of code/ an afternoon for OpenAI's API's – you may spend longer pulling/cleaning your data
- Potentially longer if you want to use open-source tools (more setup/dependency management/environment management)



Process

Read in your text

Get your text from your .csv file, API, etc.

Concatenate it with your prompt (“summarize this text”, “find names of places”, “does this candidate have a professional software development background?”

Use With OpenAI API

Sending a block of text

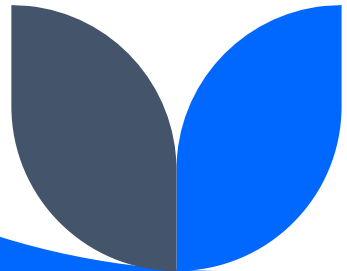
Getting back a result

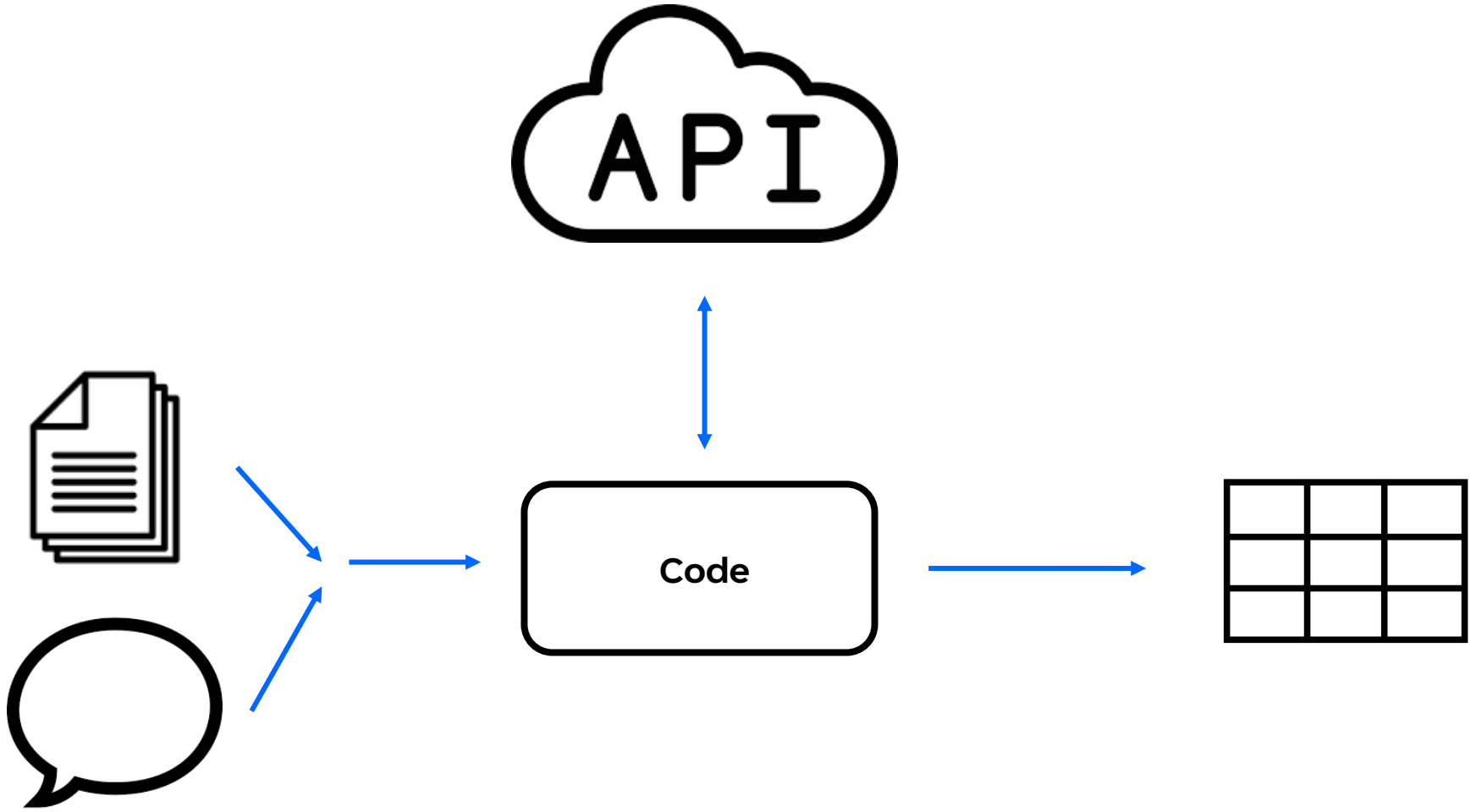
Putting it in a table/data frame

Evaluate the Results

Informally: does it look like you want?

Formally: via comparing with your ‘labeled’ data




API
Code

Can I Do This In R?

OpenAI API Interaction

Yes.

Small open-source models

Yes, but it'll probably require being a little bilingual

Big open-source models/fancier stuff

It's going to be trickier

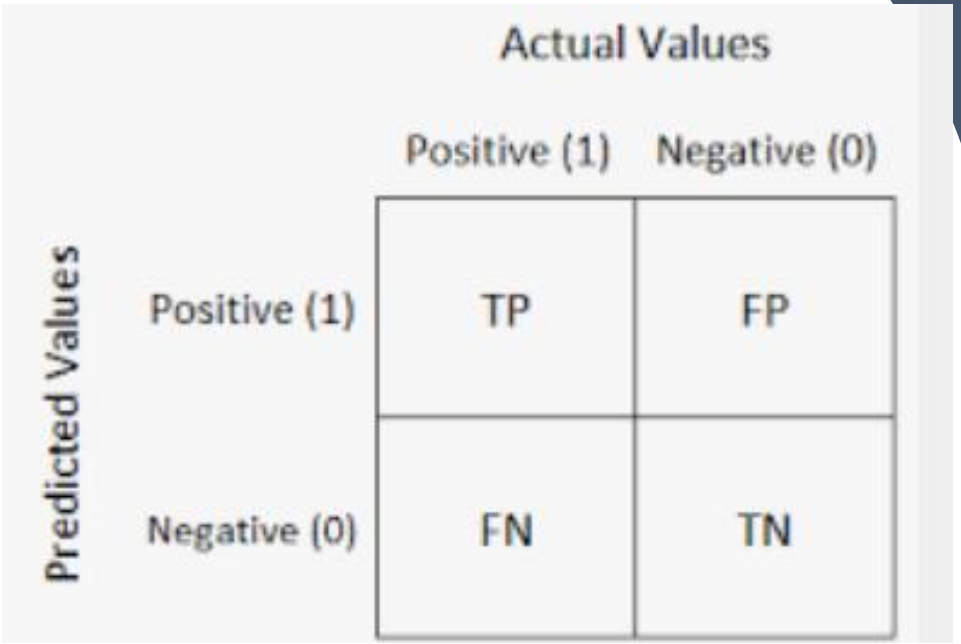
Formal Model Assessment

Comparing your initial labeled data to the model results

If you’re going to use this with ongoing data, monitoring your model to see if it’s still working

Binary Classification Assessment

- “Good” vs. “bad” data science resumes
- Tested combinations of models (GPT 3.5/GPT 4) and prompts
- Results: confusion matrices
- Strategies for handling future out-of-distribution data



Named Entity Recognition Assessment

- USAJobs postings: wanted names of tools and software
- Didn’t fully label all data:
  - Tested vs. keyword searches for several software/tool names
  - Tested against all of the text for several job ads
- Didn’t get to 100% - but better than previous efforts

Tools for Comparing Text to the Text You Wanted (Your Label)

Exact search (yes/no)

Regex/keywords (“does it include ‘python’”)

Text similarity metrics

Ask the LLM!

Managing Risk: What You Put In

Follow your organization’s policies

Prototype with fake data to prove out your use case

Managing Risk: What You Get Out

What level of accuracy do you need?

How do you feel about Type 1 vs. Type 2 error?

Do you need a human in the loop?

For More Information

https://presentofcoding.substack.com/

https://github.com/abigailhaddad/resume_classification

For R Users: https://rpubs.com/eR_ic/transfoRmers

For your in-production needs:

https://python.langchain.com/docs/ecosystem/integrations/whylabs_profiling