Spark Program

Chapter 10: Natural Language Processing

Chapter Objectives

In this chapter, we will:

- Explore unstructured text
- Use NLTK and Spark pipeline transformation to process natural language
- Visualize natural language with Word Clouds
- Explore how to monitor and optimize Spark

Chapter Concepts

Natural Language

Optimizations

Chapter Summary

Natural Language Processing

- Processing free-form text is not as simple as a formatted table-structured object
- You need to break the natural language up into pieces and fix variations in the wording to try to standardize it and extract meaning
- There are many different types of transformations you can do to text and they vary depending on the text and what you're trying to do with the results
- Generally though, it comes down to some common steps:
  - Break the text up into sentences and words
  - Fix the words by adjusting everything to the same case
  - Remove punctuation
  - Standardize word variations to the root word
  - Remove insignificant words
  - Find natural word groupings that make up a phrase
  - Determine the overall sentiment of the words

NLTK

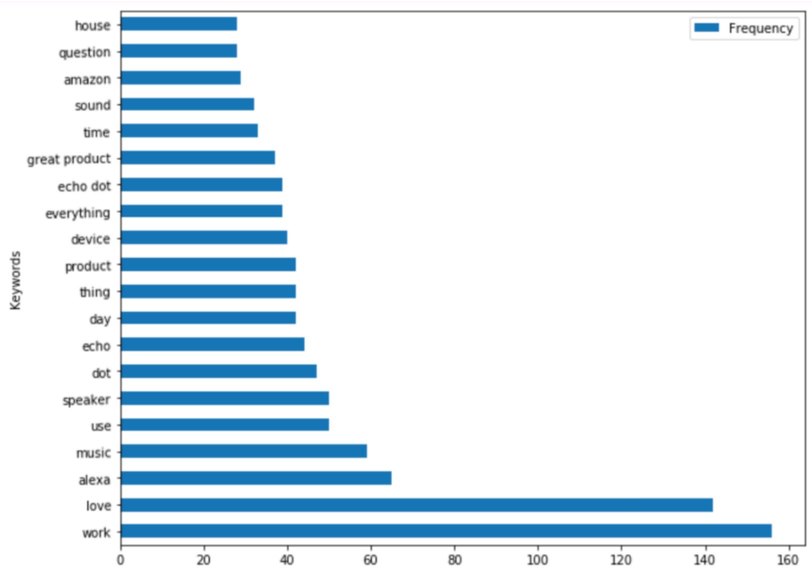
- NLTK stands for **N**atural **L**anguage **T**ool **K**it and is a comprehensive Python package with lots of functions to manipulate text
- It is a stand-alone Python package, but it works in a distributed mode on Spark RDDs
- Install it as normal: `pip install nltk`
- Import it as normal: `import nltk`
- Let's explore the features and examples in Jupyter

Spark Text Processing

- Spark also has some of its own text processing features
- Found in `pyspark.ml.features`
- `Tokenizer` breaks up a document into words
- `RegexTokenizer` allows more control
- `StopWordsRemover` removes insignificant words
- `HashingTF` transforms a set of words and vectorizes them
- `IDF` rescales the numbers in the vector to de-emphasize words that occur a lot in the entire corpus
- Usually, just follow a common recipe to fix up a DataFrame into the shape you need for ML operations by putting the various steps into a pipeline

Word Cloud

- Word Clouds and other charts can be made from the results of the text processing by bringing the small DataFrame results back to the driver



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Monitoring

- You can monitor the Spark processes by navigating in a browser to the address of the cluster and port 4040
  - `localhost:4040`
- You will see various tabs where you can:
  - Watch the progress of jobs
  - Watch the progress of stages
  - See what objects are cached
  - Get an overview of the environment
  - See the nodes that are executing

Caching

- Because an RDD is a lazy evaluation of a chain of transformations, each time you do an action on that RDD or DataFrame, it recalculates everything from the very beginning
- This can cause performance problems if you want to do several different actions to the same set of data
- Caching is the answer—it allows you to pin the results of an RDD in the cluster for the duration of the session or until you manually release it
- You can cache to either memory or disk or a combination of the two
- You also have control over how many redundant copies it stores and whether it should store it as:
  - Deserialized which takes more memory but less CPU
  - Serialized Java object which is more memory efficient but uses more CPU
- There are two methods, `persist` and `cache`, which is simply a shorthand for persist with the default option of memory only
- To remove a cached object, use `unpersist`

Broadcast Variables

- It is also sometimes desirable to keep a copy of a variable on each node instead of passing it around each time it receives instructions to do a new task
- This is useful if you need to pass around something like a reference table to each node
- Broadcast variables allow you to accomplish this

```
lookupTable = sc.broadcast([1, 2, 3])

lookupTable.value → [1, 2, 3]
```

Accumulators

- Sometimes you want to create a counter that is global to the entire process
- Using a regular Python variable would not scale out to the cluster level, so you need a special way to handle this so that each node can contribute to one global counter
- There is an `accumulator` method on the Spark context meant just for this

```
counter = sc.accumulator(0)
def fun2(x):
    global counter
    counter += x

x0.foreach(fun2)
print (counter.value)
```

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