

# Natural Language Processing applied to Finance

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October 2021

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# NLP ?

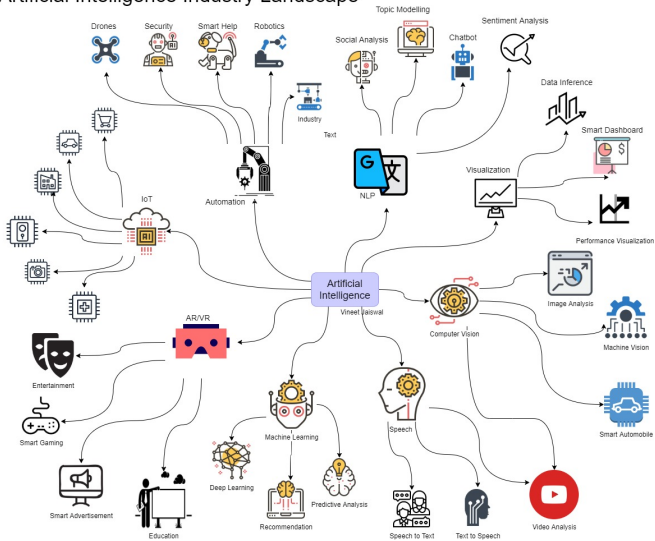
## Definition

Natural language processing (NLP) is a subfield of linguistics, computer science, and artificial intelligence concerned with the interactions between computers and human language, in particular how to program computers to process and analyze large amounts of natural language data.

## Goal

The goal is a computer capable of "understanding" the contents of documents, including the contextual nuances of the language within them. The technology can then accurately extract information and insights contained in the documents as well as categorize and organize the documents themselves.

## Artificial Intelligence Industry Landscape



## Example : Sentiment Analysis

### Classic data processing

```
String a = "I buy TSLA";  
String b = "I sell TSLA";  
a.equals(b);  
» FALSE
```

Because  $b \neq s$ ,  $u \neq e$  ...

### Natural Language Processing

```
String a = "I buy TSLA";  
String b = "I sell TSLA";  
findSentiment(a).equals(findSentiment(b));  
» FALSE
```

Because  $\text{buy} \neq \text{sell}$  in the meaning

# How it works

3 algorithms :

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Automatic : machine learning techniques to learn from data.

Hybrid : both rule-based and automatic approaches.



## Risk assessments (loans...)

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Financial sentiment analysis (positive  $\neq$  positive market reaction), BioBERT, FinBERT...

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Accounting and auditing (document reviews...)

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Accounting and auditing (document reviews...)

Portfolio selection & optimization (filter desirable & undesirable stocks)

## Just an example

Algorithm idea :

- 1) We define an asset universe  $U$
- 2) We get  $U_i$ 's underlying sentiment  $S_t$  at a time  $t$
- 3) Then we get  $S_{t+x}$  at a time  $t+x$  where  $x > 0$ , a fixed delay.
- 4) If  $S_{t+x} > (1 + y)S_t$ , we open a long position for  $U_i$ , where  $0 \leq y \leq 1$  representing the equivalent of a "take profit".
- 5) Else if  $S_{t+x} < (1 - z)S_t$ , we open a short position for  $U_i$ , where  $0 \leq z \leq 1$  representing the equivalent of a "stop loss".

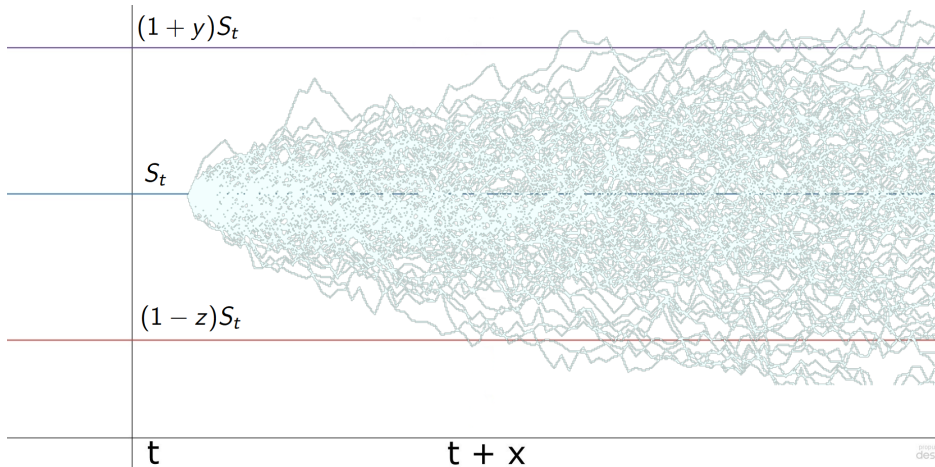
## Just an example

6) Else if  $(1 - z)S_t < S_{t+x} < (1 + y)S_t$ , we wait a fixed time  $t$  and reiterate from step 2.

We can go much further in the algorithm:

- what to do after a long position opened ?
- what to do after a short position ?
- best values for  $x, y, z$  ?
- how many confirmations (out of boundaries) before positions opening / closing ?





# Just an example

```
def get_twitter_BTC():  
    ratios = 0  
    for keyword in keywords:  
        tweets = tweepy.Cursor(api2.search, q=keyword, lang="en").items(nb)  
        pos = 0  
        neg = 0  
        for tweet in tweets:  
            analysis = TextBlob(tweet.text)  
            if 0 <= analysis.sentiment.polarity <= 1:  
                pos += 1  
            elif -1 <= analysis.sentiment.polarity < 0:  
                neg += 1  
        pos = perc(pos, nb)  
        neg = perc(neg, nb)  
        if float(neg) > 0:  
            ratio = float(pos) / float(neg)  
        else:  
            ratio = float(pos)  
        ratios += ratio  
    return ratios
```

# Just an example

```
for k in range(1000):
    score = get_twitter_BTC()
    min1 = score + (score * 30 / 100)
    time.sleep(60*5)
    new_score = get_twitter_BTC()

    if new_score > min1:
        btc_price = get_current_price("BTC-USD")
        buy = "\nBUY : " + str(btc_price)
        f = open("output.txt", "a")
        f.write(buy)
        f.close()
        time.sleep(60*5)
        new_new_score = get_twitter_BTC()
        min2 = new_score - (new_score * 30 / 100)

        if new_new_score < min2:
            new_btc_price = get_current_price("BTC-USD")
            sell_at = "SELL : " + str(new_btc_price)
            trade_profit = new_btc_price - btc_price
            perc_profit = trade_profit / btc_price * 100
            perc_profit_round = round(perc_profit, 3)
            sell_message = sell_at + " | " + " Profit = " + str(perc_profit_round) + " %"
            f = open("output.txt", "a")
            f.write(sell_message)
            f.close()
            time.sleep(60*5)
    else:
        time.sleep(60*5)
```



## No backtesting

Not enough data

13/17

No backtesting

Not enough data

Context

"What do you like about TSLA ? : Everything !"



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"What do you like about TSLA ? : Everything !"

"What do you hate about TSLA ? : Everything !"

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Irony & sarcasm



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"BTC is not volatile enough"

Comparisons

No backtesting

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"AAPL's stock return is higher than my previous investment"

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Information weight

Elon Musk : "Let's buy TSLA"





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