Detecting Textual Analogies Using Semi-Supervised Learning
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Motivation
- Analogy is an integral aspect of human communication, understanding, and knowledge sharing.
- Cognitive systems that can process through textual analogies can learn more from what they read.
- However, strategies for detecting analogy with a machine are largely unexplored.
- There is also no standard corpus of analogy text, an important and expensive tool for developing algorithms for analogy text classification.
- A corpus of analogies is manually created and semi-supervised learning techniques are used to develop a system that can properly identify them.

Background
Analogy
- The process of comparing a base case to a structurally similar target case. They share relationships.
  Rutherford Atom and Solar System

<table>
<thead>
<tr>
<th>Atom</th>
<th>Solar System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus</td>
<td>Sun</td>
</tr>
<tr>
<td>Electron</td>
<td>Planet</td>
</tr>
<tr>
<td>Electromagnetism</td>
<td>Gravity</td>
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</tbody>
</table>

Natural Language Processing
- Natural language processing (NLP) is an intersectional field concerning interactions and relationships between computers and natural languages.

Methods
The model is initially trained with 20387 training examples, out of which 386 are labeled. The model was then tested on 69 sentences. Prominent features from the original texts are extracted using NLP techniques. These features are then used to train the classifier.

Semi-supervised learning
- Semi-supervised learning is a machine learning technique which can be used for classification or regression.
- It considers the problem when only a small subset of the training data has corresponding class labels.

Feature extraction
Before training the classifier, feature extractors process raw text and represent it in ways that are suitable for classification. Three different feature extraction techniques were tested namely count vectorization, hash vectorization and tf-idf vectorization.

Classifiers
The model uses two semi-supervised classifiers:
- Transductive Support Vector Machines
- Label Propagation

Exhaustive parameter search
To boost the performance of the classifiers, an exhaustive search over specified parameters values for each combination of feature extraction tools and classifier is computed.

Preliminary Findings
- TSVM and Label Propagation had similar results when considering the accuracy of the model.
- However, the f-scores were significantly different. Label Propagation classified everything as non-analogies, leading to a precision, recall, and f1-score equal to 0.

Future work
- Instead of considering the full sentence, I would like to use a parser to extract the base and target from each sentence.
- Expand the corpus to have a bigger training and testing set.

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References
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