Exploring a new approach for improving

Argumentation Mining

B.Tech. Project

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Project Guides

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Brief Introduction

What is Argumentation Mining?

- **Argument:** *conclusions* can be reached through logical reasoning; that is, claims based, soundly or not, on *premises*.as defined by Wikipedia

- **Aim of Argumentation Mining:** automatically *detect*, *classify* and *structure* argumentation in text.[1]

1. **Detect:** Separating out useless data, i.e. *Non-Argumentative Text*

2. **Classify:** Classification into **Premises** and **Conclusions**.

3. **Structure:** Finding out the structure of an argument and how different arguments are connected.

State of the art
<u>**Detection**</u>

- Similar to the **binary classification** of all the propositions of the text as **argumentative** or **non-argumentative**.

- **Limitation:** Requires text <u>*segmentation*</u> beforehand, i.e. we must figure out how information is split while forming individual arguments.

- State of the art <u>[1]</u>:

  - <u>Classifier:</u> **Maximum Entropy Model**

  - <u>Features Used:</u>

    - Unigrams, Bigrams, Trigrams, Adverbs, Verbs, Word Couples,
      Text Statistics, Punctuations, Keywords, Modal auxiliary, Parse Features

  - <u>Accuracy:</u>

    - **73**% - **80**%

State of the art
Classification

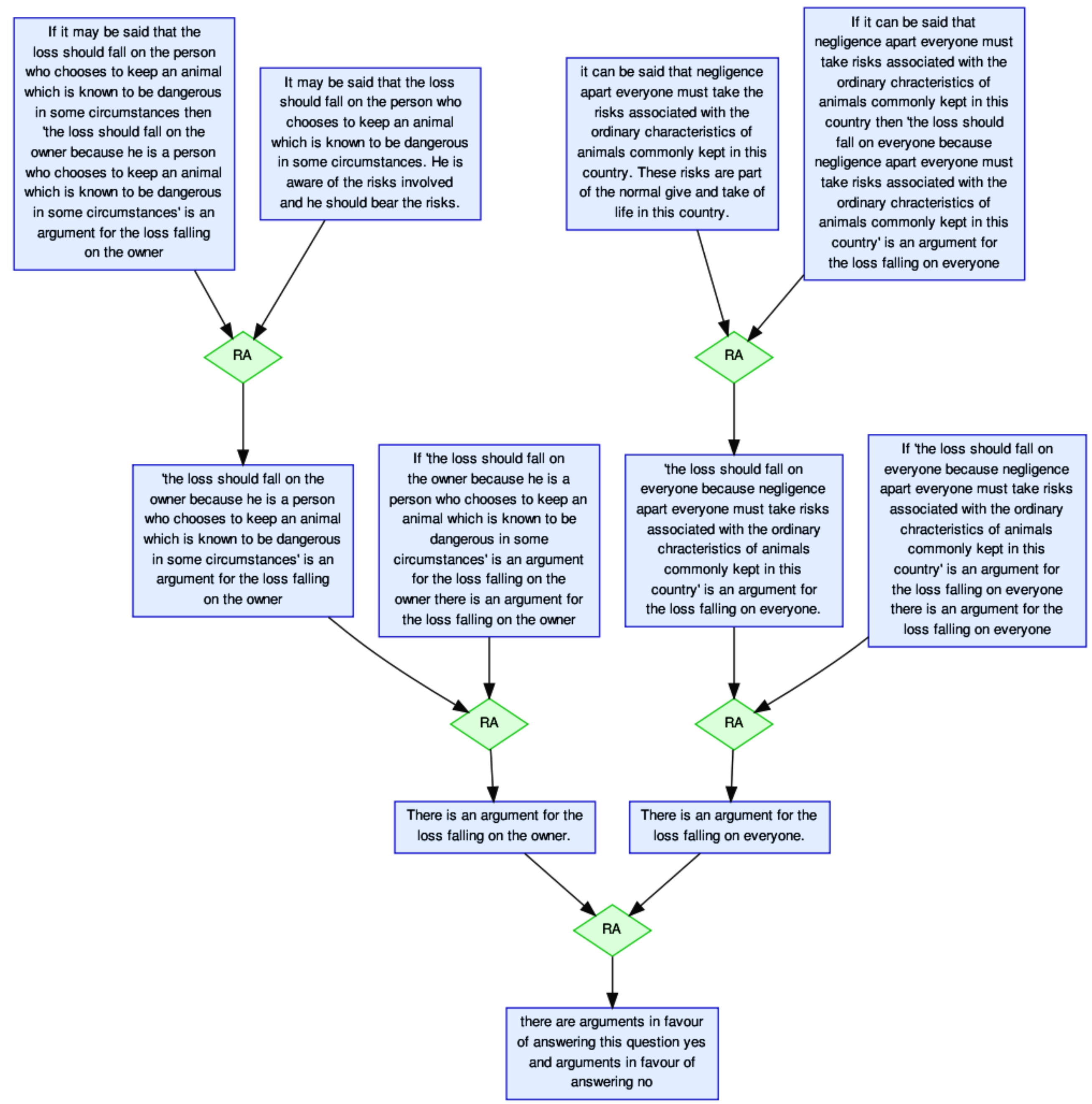
- Again, **binary classification** of all the *argumentative propositions* as **premises** or **conclusions**.
- State of the art [1]:
    - Classifier: **SVM**
    - Features Used:
        - More Sophisticated This Time.
        - Absolute Location, Sentence Length, Tense of Main Verb, History, Rhetorical Patterns, Article Reference, Argumentative Patterns, Type of Subject, Type of Main Verb.
    - Accuracy:
        - **68**% - **74**%

State of the art
<u>**Structure**</u>

- Undoubtedly, The hardest task.
- State of the art?
  - None really.
  - [1] uses CFGs to generate argumentative structures.
  - <u>**Approaches towards automated mining:**</u>
    - [3] Joining propositions with euclidean distance (over LDA modelled topics) below a threshold, Accuracy : **33**% - **60**%. Also the joining in this work is bidirectional, hence no information of conclusions is obtained.

The General Structure of an Argument

- Can be represented in many cases as a tree.
- Assumption supported by around **95**% of argument analyses of AIFDb [3]
- [1] claims that an individual argument can be identified by its unique corresponding conclusion.
- A conclusion can then form a support for another argument.
- <u>*Other Theories Include*</u> e.g.:
  (Freeman's Theory) Argumentative conversation between proponent and opponent, thus text contains **proponent nodes** and **opponent nodes**



Our Proposed Problem

- Automatically structuring the arguments ***given*** the detected argumentative propositions (detection phase).

- ***Initial Approach:*** Formulating the problem as an **Optimization problem**, which will give rise to the *best argumentation scheme*.

- Upto date no work has been done which treats argumentation as an optimization problem. This is because quantifying the quality of an argumentation scheme is not an easy task.

Going a little more explicit.

- **Input:** The set of argumentative propositions. Ordering information might as well turn out to be useful.

- **Output:** Directed edges between the input propositions describing the support relations. These edges can be *intra-argument* (**premise -> conclusion**) or *inter-argument* (**conclusion->conclusion** or **conclusion->premise**).

- **Accuracy:** Recall and Precision values corresponding to the manually annotated edges in the dataset.

Formulating the Cost Function

- The entailment score of (premise,conclusion) pairs have should correspond to a better structure.

- Since arguments quite often form a recursive structure, premises can also entail premises, we have to come up with a measure when to break arguments. This can be taken into account using a threshold value for connecting propositions inside a argument inspired by [3].

- [4] Already uses textual entailment as the first stage of joining arguments and then uses argumentation theory to reject invalid arguments.

    - However the confidence level might not be above the threshold when individually annotating pairs, rather it should optimize the overall cost function.

Textual Entailment System

- There are various existing systems for recognizing textual entailment (RTE problem) in a T-H (Text-Hypothesis) pair.
- Excitement Open Platform (EOP) is a generic architecture and a comprehensive implementation for textual inference in multiple languages. The platform includes state-of-art algorithms. It also provides APIs that can be trained on a resource and can be used for annotation. We implemented it and it worked okay.
- However, when it comes to argumentation, the entailment is much more complex. E.g. there can be various possible types of entailments:
  - Cause to effect, Practical Reasoning, Entailment by example, Expert Opinion, etc.
  - E.g.:
    - **Text:** Research shows that drivers speaking on a mobile phone have much slower reactions in braking tests than non-users, and are worse even than if they have been drinking.
    - **Hypothesis:** The use of cell-phones while driving is a public hazard.
    - Even the most advanced entailment systems couldn't annotate this as an entailment relation with appropriate confidence. EDITS (used by [4]) annotated this as NonEntailment with confidence 0.33.

References

[1] Argumentation Mining, Moens et al., 2011

[2] Aifdb: Infrastructure for the argument web, Lawrence et al., 2012

[3] Mining Arguments From 19th Century Philosophical Texts Using Topic Based Modelling, Lawrence et al., 2014

[4] Combining Textual Entailment and Argumentation Theory for Supporting Online Debates Interactions, Cabrio et al., 2012