

# Combining Truth Discovery and Open Information Extraction with Active Ensembling

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## ABSTRACT

Web search engines or open information extraction systems usually reply to users' queries with a set of candidate answers that are often conflicting because they are claimed by multiple information sources. In this context, estimating information veracity is difficult for the users especially when they have no prior knowledge about the trustworthiness of the sources. In this demonstration paper, we showcase a system that supports event/entity and relation extraction based on keyword-search from the Web, processes the conflicting outputs, combines multiple truth finding algorithms with active learning to provide the most likely true answers and determine the most trustworthy sources.

## 1. INTRODUCTION

[Lamine: Page allocation]

- 1.25 pages -> abstract + introduction
- 1.5 pages -> Open information extraction + Active Ensembling for Truth Discovery
- 1 pages -> Demonstration System + Scenario
- 0.25 pages -> References

## 2. OPEN INFORMATION EXTRACTION

- décrire le type d'information auquel on s'intéresse par exemple "factoid claim"
- décrire le système sur lequel on se base
- décrire comment on transforme l'output de OpenIE
- donner qq exemples

In this study, we are interested on truth discovering on the large number of "factoid" statements (or claims) made by multiple Web sources in the same real-world domain. A "factoid" claim, e.g., *Barack Obama was born in Kenya*, is a piece of unverified or inaccurate information that is presented as factual, often as part of a publicity effort. Such type of claims is usually accepted as true because of its frequent redundancy over multiple sources. We focus on conflicting factoid claims provided by typical open Web information extraction systems as answers to users' queries.

Concretely, given user input, we retrieve the set of candidate claims, together with the associated sources, returned by TextRunner<sup>1</sup> from a Web corpus. We then format this output in such a way that fits our truth discovering process.

**Data collection.** We analyze claims about real-world facts from TextRunner. TextRunner is an open Web information extraction system relying on an unsupervised extraction process on a Web corpus of unstructured textual data. For more efficiency, it performs a single data-driven pass on this corpus and then extracts a list of candidate relational tuples which might reply a user input query about a given fact. In TextRunner, a user input query is typically a set of keywords consisting of two real-world *entities* and a *relation*. Such a user input query  $q$  can be defined formally as a triplet  $(e_1, r, e_2)$  where  $e_1$  and  $e_2$  are real-world entities and  $r$  is a relation. The argument  $r$  specifies a possible relationship that might exist between the two given entities. None of the three arguments is mandatory, meaning that some of them can be not specified by the user when issuing his query. This captures the fact the user has a partial knowledge about the real world, which is common in practice. Let denote the fact the user input query  $q$  is referred to by  $f_q$ . TextRunner will find and extract a collection of Web claims related to this fact.

TextRunner's output is thus a set of candidate claims about a specific real-world fact. This output is ranked by the system according to the number of sources that supports each claim. A claim in this context can correspond to a tuple, a relation, or an real-world entity with respect to the given keywords. TextRunner also offers the ability, through Web hyperlinks, to access to the meta-data, e.g., the source, the type, the full corpus, etc., associated to each returned claim for further exploration.

**Data formatting.** Given a user query  $q$  about a fact  $f_q$ , we consider the set of  $n$  claims  $c_1, \dots, c_n$  extracted by TextRunner as answers. For each claim  $c_i$ ,  $1 \leq i \leq n$ , we go through the attached Web hyperlink and extract the set  $S_{c_i}$  of sources which support it. We achieve such a extraction by using hand-written mapping rules. We have also assumed that the system returns only one claim per source for a given query, i.e.,  $S_{c_i} \cap S_{c_j} = \emptyset$  for all  $i \neq j$  with  $1 \leq i \leq j \leq n$ . We have now, for the query  $q$  about the fact  $f_q$ , the set of claims together with the sources.

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1. TextRunner is an online at <http://openie.allenai.org/>

### 3. ACTIVE ENSEMBLING FOR TRUTH FINDING

#### 3.1 Ensembling

- donner idée générale pour introduire ce qu'est l'ensembling
- on a besoin de le faire dans le contexte de truth discovery car aucune methode ne bat toutes les autres dans tous les cas de figure - donc on combine les methodes : il y a plusieurs façon de combiner par ex. consensus de méthodes, etc.
- expliquer quelles méthodes on combine avec leurs avantages et inconvénients

An ensemble is a supervised learning algorithm in the sense that it can be trained and then used to make predictions. An ensembling, or commonly an ensemble-based active learning, is a learning process selecting one classifier type, or appropriate combinations of multiple classifier types, to construct ensembles for a given task.

#### 3.2 Active Learning Process

- notre approche que l'on défend ici dans la démo est semi supervisée en impliquant de l'utilisateur de façon active en lui demandant s'il peut confirmer des faits (facts) - si on a une ground truth partielle on la "rejoue" cas par cas

## 4. OUR DEMONSTRATION SYSTEM

#### 4.1 System Architecture and User Interface

The architecture of our demonstration system, given in Figure 1, comprises the following three main components.

*User I/O Interface.* It represents the main entry point of our application for user interaction. The user I/O interface is composed by a text search area where a given user can enter its search keywords, in terms of a relation. The final result of the overall process will be also shown to the users through this component. Finally, the user gives it feedbacks via the user I/O interface through the button options or the form.

*Information extraction module.* This is the information extraction module which considers the input of the user and browses several Web sources in order to return the relevant answers. In our system, we rely on TextRunner in order to extract information from Web corpus.

*Truth Finding Engine.* It corresponds to AllegatorTrack which contains twelve truth finding algorithms with different accuracy according to the types of claims and the characteristics of sources.

*Learning Module.* We have also a learning method that uses our knowledge bases of users' feedbacks. It enables to learn about the best truth finding algorithms, among the twelve, to use with respect to the type of entities or relations searched by the user.

*Knowledge Base.* The knowledge base contains the information used for the learning phase of the truth finding procedure. These informations include the true facts for some relations which have been learnt based on the feedbacks of the users. In addition, our knowledge base could be enriched with ground truth about some facts from reliable sources

such as Wikipedia. Based on the knowledge base, our system has the ability to improve the accuracy of the truth finding process by learning about the best method to use or the best parameters, e.g., sources' accuracy scores, to consider for a better bootstrapping of the process.

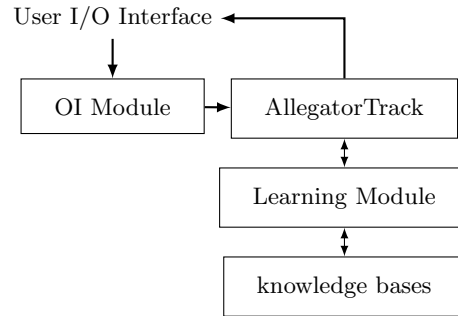


Figure 1: Architecture of our system

#### 4.2 Demonstration Scenario

A given user that wants to interact with our system must do it through the search form. Through the search form, she (or he) provides her searched relation, e.g., "Where is born Barack Obama?". The searched relation is then passed to the information extraction engine, TextRunner system in our case, which returns a set of answers considered to be relevant for the user's request. Each claim in the returned list is processed in order to extract the corresponding sources along with a detailed description of the claim which we format in a certain manner. The set of sources and the formatted versions of all claims are then passed to the truth finding module which integrates all the claims and computes the most probable answer together with the reliability scores of participated sources for the searched relation. Finally, the output of the truth finding process is returned to the user. The user can also want to review the output of our system by definitively validating it or not through its knowledge of the modeled world. For example when the system has totally wrong, it may be interesting to get such a kind of feedbacks from the user in order to change the used method, as there are many available with our system, and to enhance the process for the further search about the same world. The user gives feedbacks using the option buttons on the left-hand side of the outputted claims or the text form. The feedbacks given by the user are saved in knowledge bases within our system for further processes.

## 5. CONCLUSION

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## 6. REFERENCES

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