# A Survey of Information Extraction using Different Databases

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## Abstract

Information extraction is one time process for extraction of a particular kind of relationships of interest from a document collection. Information Extraction is the task of automatically extracting structured information from unstructured or semi-structured machine readable documents. A pipeline of special-purpose processing modules is implemented by Information extraction systems. And a pipeline of special-purpose processing modules targeting the extraction of a particular kind of information. But this kind of extraction of information is not enough because there is some disadvantages occurs i.e. when the information have to be modified or improved, here only small part of the corpus might be affected. In this seminar we proposed the new extraction technique in which extraction needs are expressed in the form of database queries, which are evaluated and optimized by database systems. Furthermore, our approach provides automated query generation components so that casual users do not have to learn the query language in order to perform extraction. "Efficiency and quality of extraction "are the two things in which we highlighted in the information extraction system. In this, we propose a new paradigm for information extraction. In this extraction framework, intermediate output of each text processing component is stored so that only the improved component has to be deployed to the entire corpus. Extraction is then performed on both the previously processed data from the unchanged components as well as the updated data generated by the improved component. Performing such kind of incremental extraction can result in a tremendous reduction of processing time. To realize this new information extraction framework, we propose to choose database management systems over file-based storage systems to address the dynamic extraction needs. Our proposed information extraction is composed of two phase's i.e. initial phase and extraction phase. Here we use different types of DBMS and its comparison with conclusion that, which database is efficient for incremental information extraction.

**Keywords- Information extraction, DBMS, file-based storage systems, extraction framework, Efficiency of extraction**

## I. INTRODUCTION

The information extraction (IE) is the technique to extract information from unstructured data into structured data to find out desired pieces of information in natural language texts and store them in a form that is suitable for processing and automatic querying. IE requires a target structure and only searches for facts that fit this representation. Simple target structures define just a number of slots. Each slot is filled with a string extracted from a related text. For adapting an IE system to a new domain, it is essential to either manually rewrite the rules used in the system (in case of static rule-based systems) or to provide annotated training data (in case of trainable systems). Manual rewriting of rules is a time-consuming and intricate task that must be done by experts which are usually hard to get. Providing annotated training data is less costly but still requires a considerable amount of work. Database management system is used by Incremental information extraction framework as an important component. Text processing components of named entity recognition and parsers are deployed for the entire text corpus. The intermediate output of each text processing component is stored in the relational databases called as Parse Tree Database (PTDB). Database query which is used to extract the information from the PTDB is in the form of Parse Tree Query Language (PTQL). Remarkable quantity of information expressed using natural language is contained by World Wide Web. While unsorted text is often hard for systems to understand, the area of Information Extraction (IE) proposes a path to analyze textual content into a structured knowledge base. The ability to amass huge amount of data from number of Web pages has the ability to grow the energy with which an advance search engine can answer complicated queries. We can say that IE is a one-time process. From the collection of documents an IE extracts the entities from the specific type of relationships. IE is considered as a pipeline of special purpose modules. Because of the requirement of IE in particular areas, the number of frameworks like UIMA [1] and GATE [2] has been developed. These types of extraction frameworks are generally file based and the data which is processed in this are used between components. File-based frameworks are only one time applicable for the extraction, because IE is performed repeatedly on the same data collection even a minute changes occurs in the extraction goal. Consider the context that the processing of web documents with modified content the availability of updated ontology's or improved components for named entity recognition, and the realization of new target relationships for extraction. If the available extraction framework is used in any of the context then it is necessary to process repeatedly the whole collection of text, which can be a large process and also computationally costly. If the aim of the extraction is changed then it needs the unwanted repetition of the whole collection of text. In another context if the aim of the extraction

remains same but the new ontology or an improved model based on statistical learning approach becomes available for named entity recognition. Changes in this context only affect piece of information of the text corpus. So a framework which has the ability of maintaining processed data and doing incremental extraction to search affected portion from the components or aims changes. The Web is huge and contains number of different type of information; their identity often unknown and the number of potentially interesting relations are massive. Here we can sort out the information in the form of questioning and get the proper answer, this paper presents Open Information Extraction, a novel extraction paradigm that automatically finds thousands of relations from unsorted text. In this research paper an approach to IE that allows incremental training has been studied. In the following section. We studies different databases which are used for the incremental information extraction and there comparison on the basis of their approaches are explained.

## II. SURVEY OF DIFFERENT DATABASES

### *A. GenerIE: Information Extraction Using Database Queries [1]*

Here author propose a new pattern of information extraction in the form of database queries. He present a general purpose information extraction system, GenerIE, in the context of biomedical extraction, which can efficiently handle diverse extraction needs and keep the extracted information up to date incrementally when new knowledge becomes available. The insight of GenerIE is that changes in extraction goals or deployment of improved processing modules hardly affect all sentences in the entire collection. In this, author presents a new method of information extraction which uses database queries. They present a general-purpose information extraction system, GenerIE, in the scenario of biomedical extraction, which need to handles diverse extraction very efficiently and keep the extracted information neatly incrementally when availability of new information. GenerIE is changes in extraction aim hardly affect all sentences in the total collection. Thus it differentiates two phases of processing.

#### *1) Initial Phase*

Here only one time parse is perform, entity recognition and tagging (identifying individual entries as belonging to a class of interest) on the complete corpus based on current information. And parse tree database (PTDB) stores semantic entity tagging of the processed text and the generated syntactic parse trees.

#### *2) Extraction Phase*

Extracting different type of relations can be done by occurring an appropriate query to parse tree database. As query languages such as XPath and XQuery are not suitable for related linguistic patterns [2], author design and implement a query language called PTQL for pattern extraction which effectively achieves diverse IE goals [6]. To make ease the extraction process for users of systems, this extraction not only allows a user to propose parse tree query language queries, but it can also automatically generate queries for high-quality extraction based on feedback and user input queries. Figure 1 state that system architecture of these GenerIE. The Text Processor performs the Initial Phase for corpus processing and stores the processed information in the Parse Tree Database (PTDB). The extraction patterns over parse trees can be expressed in this proposed parse tree query language. The PTQL query evaluator takes a PTQL query and transforms it into keyword-based queries, which are computed by the underlying RDBMS and IR engine. The index builder creates an inverted index for the corpus as part of the query evaluation by the IR engine.

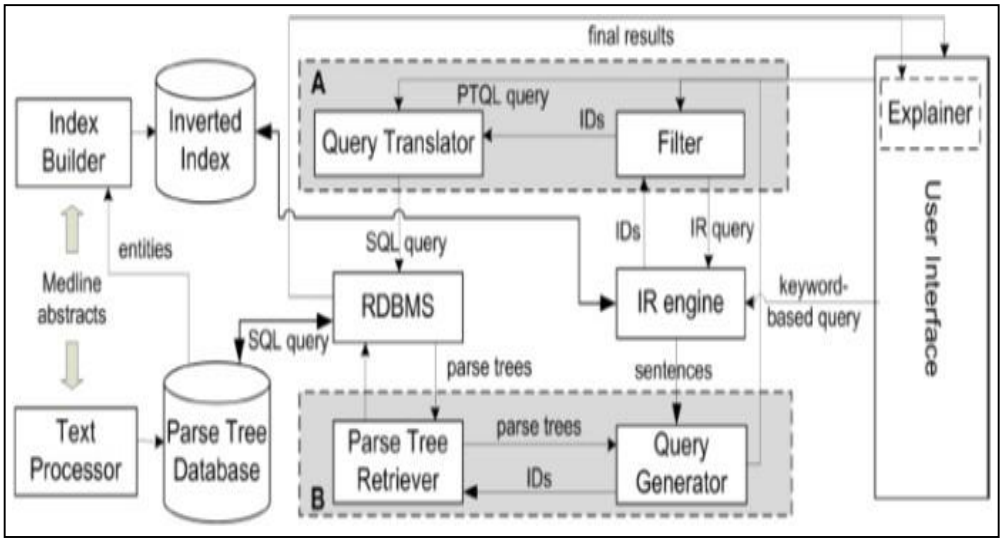


Fig. 1: Architecture of GenerIE

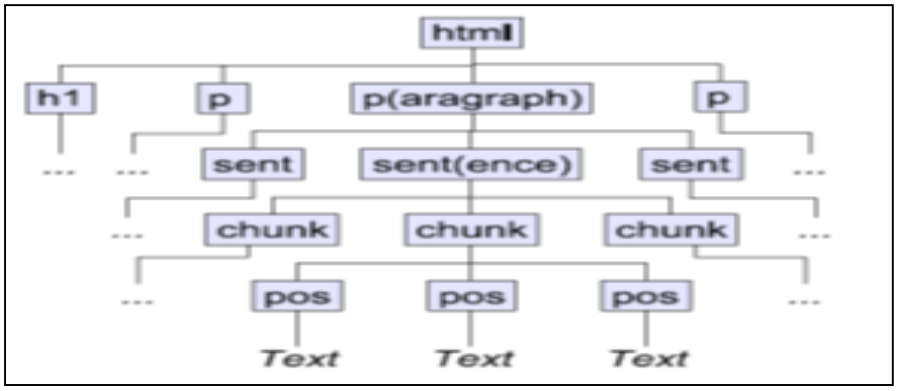


Fig. 2: Partial DOM Tree of a Simple HTML Document with Linguistic Annotations

Two input modes are provided by user interface: query specified extraction mode and pseudo-relevance-feedback extraction mode. A user can directly specify PTQL queries for extraction in query-specified extraction mode. The user interface also provides the capability for users to input a keyword based query. When a user keyword query is issued, relevant sentences are retrieved using an existing IR keyword search engine. With the top-ranked sentences, their corresponding grammatical structures are retrieved from PTDB. The PTQL query generator then uncovers the common grammatical patterns by considering the parse trees of the top-ranked sentences to automatically augment the initial keyword-based queries and generate PTQL queries. Extracted results are presented to the users once the queries are evaluated. Furthermore, an explainer module is available to illustrate the provenance of query results by showing the syntactic structures of the sentences involved in the extracted results. This helps the users understand, and enhance their queries accordingly.

*3) Advantages of Database Queries for Information extraction*

1) Compared with the existing techniques, database queries for information extraction enable generic extraction and avoiding reprocessing.
2) Instead of writing individual programs it uses database queries;
3) Information extraction becomes common for various applications and becomes easier for the user.
4) When a user has a new extraction aim, the user needs only to write another query on PTDB without developing and running new programs.
5) Using databases, GenerIE needs only to perform extraction on the sentences of words, which affects, improved module and thus it is more effective than running the complete extraction programs from scratch

***B. Incremental Information Extraction using Parse Tree Databases [2]***

In this paper, author propose an actual and versatile optimization of queries is hard in database management systems and the complication involved in finding most favorable solutions has led to the development of heuristic approaches. To answering the particular knowledge from the cuprous. Because of increase of the crime on the data set involved, method for solving is essential for emergency answering of data mining queries. In this paper, author proposes a hybrid model using rough sets and genetic algorithms for quick and effective query answering. For classification and summarization the datasets it uses rough set, whereas for answering association related queries it uses genetic algorithms and feedback for adaptive classification. Here, he consider three types of queries, i.e. select, aggregate and classification based data mining queries. The field of information extraction (IE) seeks to develop methods for fetching structured information from natural language text. Examples of structured information are the extraction of entities and relationships between entities. IE is typically seen as a one-time process for the extraction of a particular kind of relationships of interest from a document collection. IE is usually deployed as a pipeline of special purpose programs, which include sentence splitters, tokenizes, named entity recognizers, shallow or deep syntactic parsers, and extraction based on a collection of the development of frameworks such as UIMA and GATE, providing a way to perform extraction by defining workflows of components.

This type of extraction frameworks is usually file based and the processed data can be utilized between components. In this traditional setting, relational databases are typically not involved in the extraction process, but are only used for storing the extracted relationships. While file-based frameworks are suitable for one-time extraction, it is important to notice that there are cases when IE has to be performed repeatedly even on the same document collection. Consider a scenario where a named entity recognition component is deployed with an updated ontology or an improved model based on statistical learning. Typical extraction frameworks would require the reprocessing of the entire corpus with the improve identity recognition component as well as the other unchanged text processing components. Two pages ‘a’ and ‘b’ of the similar URL, retrieved at different times. A matcher has found that regions s1 and s2 of page a match regions t1 and t2 of page b, respectively how to answer queries correct over such compact indexes. In other hand, we utilize the IE results on the overlapping text regions to minimize the overall IE time.

*1) Extraction framework*

Available extraction structure does not allow the power of maintaining midway processed information such as Semantic information and parse tree. This leads to the need of processing again of the whole text, which may be costly. On the another place, by storing the intermediate processed data as in this novel framework, introducing new knowledge can be issued with Simple SQL insert statements on top of the processed data. With the use of parse trees, this framework is most suitable for performing extraction on text corpus written in natural sentences such as the biomedical literature. As indicated in these experiments, this increment extraction approach saves much more time compared to performing extraction by first processing each sentence one-at-a time with linguistic parsers and then other components. This allows PTQL queries to be applied to sentences that are incomplete or casually written, which can appear frequently in web documents. Features such as horizontal axis and proximity conditions can be most useful for performing extraction on replacement parse trees. Parse tree query language. The main contributions of our work are PTQL that enables information extraction over parse trees.

*2) Advantages of Database Information Extraction using Parse Tree Query Language and Parse Tree Databases*

1) In this extraction framework, in between result of each text processing component is placed in the database so that only the new component has to be deployed to the whole corpus.
2) It reduces processing time due to the new paradigm of IE.
3) This technique avoid the overlapping the data.
4) These techniques provide the capabilities of maintaining in between processed data such as parse trees and Semantic information.
5) This allows PTQL queries to be applied to sentences that are incomplete or casually written, which can appear frequently in web documents

*3) Disadvantages of Database Information Extraction using Parse Tree Query Language and Parse Tree Databases*

1) These will be computationally expensive.
2) PTQL lacks the support of common features such as regular expression as frequently used by entity extraction task.
3) PTQL also does not provide the ability to compute statistics across multiple extractions such as taking redundancy into account for boosting the confidence of an extracted fact.

### *C. Incremental Information Extraction Using Tree-based Context representations [3]*

Here author propose the technique that model IE as a token classification task which allows incremental training. To provide sufficient information to the token classifiers, here uses rich, tree-based context representations as feature vectors of each token. These representations make use of the simply deduced document structure in addition to linguistic and semantic information. We consider the resulting feature vectors as ordered and combine proximate features into more expressive joint features, called "Orthogonal Sparse Bigrams" (OSB). Our output shows that this technique makes it possible to utilize IE in an incremental extraction without any lose.

Preprocessing Regarded naively, the result text send to an IE system might visual in the form of flat data with no seen structure; it will only sequence of character. This is a bad impression—there is structure in any text. At a low level, text can be considered as a sequence of words, numbers, and punctuation (tokens). In natural language texts, tokens are arranged in sentences. Sentences are sequence in paragraphs, which are sequence of the sections. In structured text formats the higher level structure (usually down to the paragraph level) is explicitly coded, but the lower-level structure such as sentences; sentence constituents such as verb groups or noun phrases; tokens must usually be induced.

The general format of the IE system is XML based; any well-formed XML document is accepted as raw material. Documents in other formats must be converted to an XML dialect before they can be processed. Recently, converters from SGML-based (legacy) HTML to XHTML and from plain text to XHTML are integrated into the system, the latter uses heuristics to conclude the text structure from ASCII markup language, recognizing section headers, lists and tables etc. In a second step, the text is augmented with explicit linguistic information. We use the well-known Tree Tagger [9] to divide a text into sentences, to Split sentences into "chunks" such as verb groups, noun phrases and prepositional Phrases; 4, to tokenize the input into a sequence of parts-of-speech and determine their syntactic categories and normalized base forms. [5] The result of the tagger is converted to the XML markup mentioned in the footnotes and attached with the explicit markup of the source document. After preprocessing, a text is represented as a DOM (Document Object Model) tree. The structure of the DOM tree of a simple HTML document shown in Fig. 2. Author introduced the technique for modeling information extraction as a token classification task that allows updating of the extraction model. To provide sufficient information to the token classifiers, we use rich, tree-based context representations of each token as feature vectors. These representations make use of the heuristically concluded document structure in addition to linguistic and semantic information. We consider the output feature vectors as ordered and combine proximate features into more expressive joint features, using The OSB combination technique. Our results indicate that this setup makes it possible to employ IE in an incremental fashion without a serious performance penalty.

*1) Advantages of Tree-based Context Representation*

1) Extract text fragments to fill the slots defined by the given target structure.
2) Show the predicted information to a user; ask the user to review the information and to correct any errors and omissions.

3) Adapt the extraction model based on the user's feedback

*2) Disadvantages of Tree-based Context Representation*

1) Manual rewriting of rules is a time-consuming and intricate task that must be done by experts.

### *D. Incremental Information Extraction Using Relational Databases [4]*

In this paper, author proposes a new technique for information extraction in which extraction performs in the form of database queries, which are evaluated and optimized by database systems. Using database queries for information extraction enables generic extraction and minimizes reprocessing of data by performing incremental extraction to identify which part of the data is affected by the change of components or aim. Furthermore, our approach provides automated query generation components so that casual users do not have to learn the query language in order to perform extraction. To demonstrate the feasibility of our incremental extraction approach, here performed experiments to highlight two vital terms of an IE system: quality and reliability of extraction output. Here experiments show that at the time of deployment of a new paradigm, this incremental extraction technique minimize the processing time than the traditional technique. By applying these methods to a corpus of biomedical abstracts, these experiments show that the query performance is convenient for real-time applications. These experiments also prove that this approach earn high quality extraction results.

Their approach is composed of two phases: initial phase for processing of text and extraction phase for using database queries to perform extraction. The Text Processor in the initial phase is responsible for corpus processing and storage of the processed information in the Parse Tree Database (PTDB). The extraction patterns over parse trees can be expressed in our proposed parse tree query language. In the extraction phase, the PTQL query evaluator takes a PTQL query and transforms it into keyword-based queries and SQL queries, which are evaluated by the underlying RDBMS and information retrieval (IR) engine. To speed up query evaluation, the index builder creates an inverted index for the indexing of sentences according to words and the corresponding entity types.

Fig. 3 shows the system architecture. This approach provides two modes of generating PTQL queries for the purpose of information extraction: training set driven query generation and pseudo-relevance feedback driven query generation. To form a set of patterns for information extraction using the training set driven approach, the pattern generator first automatically annotates an unlabeled document collection with information drawn from a problem-specific database. This step necessitates a method for precise recognition and normalization of protein mentions. From this labeled data, initial phrases referring to interactions are extracted.

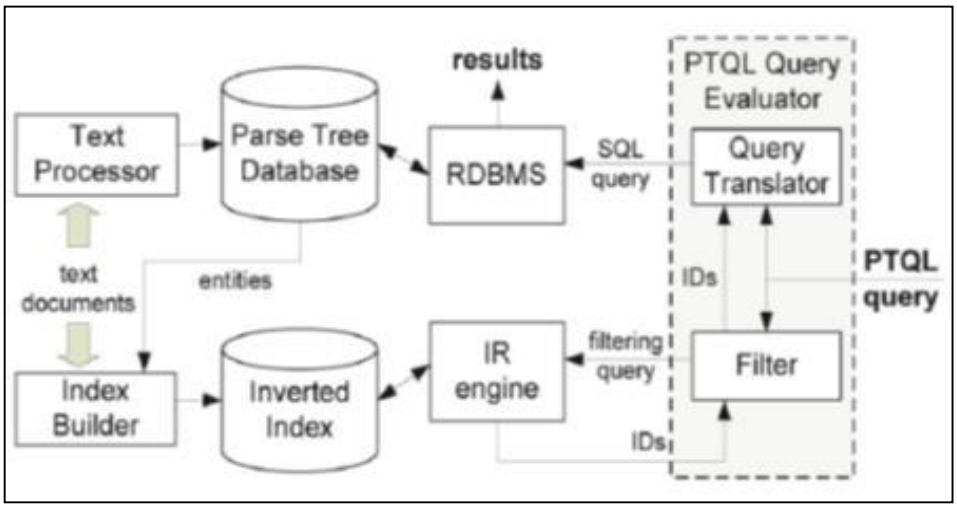


Fig. 3: System architecture of the PTQL framework

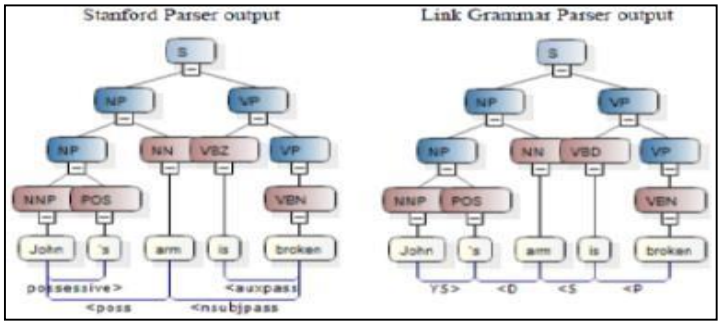


Fig. 4: Parser output for the sentence "John's arm is broken

These phrases are then refined to compute consensus patterns and the resulting PTQL queries are generated by the query generator. However, training data are not always readily available for certain relationships due to the inherent cost of creating a training corpus. In that regards, our approach provides the pseudo relevance feedback driven approach that takes keyword based queries, and the PTQL query generator then finds common grammatical patterns among the top-k retrieved Sentences to generate PTQL queries.

*1) Advantages of Incremental Information Extraction Using Relational Databases*

1) It supports regular expression and utilization of redundancy to compute confidence of the extracted information.
2) It provides automated query generation components in order to perform extraction.
3) It reduces the processing time
4) It shows that the query performance is efficient for real-time applications.
5) This approach achieves high quality extraction results.

### *E. Incremental Information Extraction Using GMMSD2 [5]*

In this paper, authors propose an optional solution for advance extraction using the principles of GMMSD, which is also called GMMSD2. GMMSD2 only need of the computation of centroid matrix, and it can reduce the cost by using systematic QR-updating techniques when new paradigm arrives. These experiments on FERET database shows that incremental version of GMMSD2 removes the complete reprocessing of the training process when arrival of new training samples; it reduced computational cost. Extraction is a general research issue in pattern recognition and machine learning. Effective feature extraction methods normally lead to superior classification performance. In addition, numerous manifold learning methods also are employed to solve the pattern recognition problems and obtain the promising performance. Although the above methods have been widely employed for the aim of feature extraction, they need that the dataset be available in advance and be given once altogether. Furthermore, these methods have to discard the previous training result and repeat the learning process when new sample training is available. As a result, both the computation and space complexity grow dramatically. Thus, an incremental learning method is highly desired to obtain the projection matrix for the insertion of new samples. Some methods cannot perform as well as the batch versions of these. In addition to the involved subspace methods, some manifold learning methods also have been extended to the incremental versions [10]. However, it is difficult to exactly update the between-class and within-class matrices and obtain the same performance with the batch version. FERET database shows differences across gender, ethnicity, and age. In these experiments, it uses a subset of FERET database which contains 200 individuals and seven images for each person. All the images in the subset are resized to the size of 64 × 64. Seven resized images of one person from FERET database are shown in Fig. 5.

Fig. 5: Seven resized images of one person from FERET database

*Table 1: The Average Recognition Accuracies (%) Of Different Methods on Feret Database*

| *P* | *LDA* | *CLDA* | *IDR/QR* | *MMSD* | *GMMSD* | *GMMSD2* |
|---|---|---|---|---|---|---|
| *2* | *46.1%* | *58.85%* | *56.04%* | *59.28%* | *61.3%* | *61.35%* |
| *3* | *51.87%* | *59.8%* | *59.85%* | *65.88%* | *66.95%* | *67.05%* |
| *4* | *60.15%* | *67.9%* | *69.5%* | *73.95%* | *74.85%* | *74%* |

*1) Advantages of GMMSD2*

1) It overcomes computational cost by applying efficient QR-updating techniques when new training samples are presented.
2) The key feature of the algorithm is its ability to accurately and efficiently update the discriminate vectors with new training samples incrementally.
3) Experiments on FERET database demonstrate that incremental version of the algorithm eliminates the complete recompilation of the training process when new training samples are presented; leading to significantly reduced computational cost compared with the batch version of the algorithm.

*2) Disadvantages of GMMSD2*

1) A significant issue with the implementation of GMMSD is the complete recomputation of the training process when new training samples are presented.

### *F. Incremental Information Extraction Using Dependency Parser [6]*

Incremental information extraction framework uses database management system as an essential component. Database management system serves the dynamic extraction needs over the file-based storage systems. Text processing components of

named entity recognition and parsers are deployed for the entire text corpus. The intermediate output of each text processing component is stored in the relational databases called as Parse Tree Database (PTDB). Database query which is used to extract the information from the PTDB is in the form of Parse Tree Query Language (PTQL). If the extraction goal is changed or a module is updated then the corresponded module is deployed and the processed data is populated into the PTDB with the previously processed data. Database queries are given for the extraction and also to identify the sentences with newly recognized mentions. If the changed sentences are identified then extraction is performed only on those sentences rather than the entire corpus. Unlike the file-based pipeline approach, incremental information extraction framework approach stores the intermediate processed data of each component; this avoids the need of reprocessing on the entire text corpus. Avoiding such reprocessing of data is most important for information extraction because it reduces the extraction time tremendously. Information extraction is a technique to extract particular kind of information from large volume of information using the pipeline approach. Failure of this approach is that whenever a new extraction goal is needed or a module is changed, extraction is applied from the initial to the whole text corpus. Small changes in corpus might also affect the entire process. In Information Extraction aim must be in the form of database queries. This has been evaluated and optimized by database system. Database queries are responsible to perform generic extraction and also reduce the reprocessing time by performing incremental information extraction by identifying the part of the data which is affected by the change. Incremental information extraction generates the queries automatically so that it reduces the user's time of learning the query language. Focus of information extraction i.e., efficiency and quality of extraction results is also achieved in incremental information extraction. If a new module is deployed then the incremental information extraction approach reduces processing time than the traditional approach.

Stanford Dependency Parser: The Stanford typed dependencies representation was designed to provide a simple description of the grammatical relationships in a sentence that can easily be understood and effectively used by people without linguistic expertise who want to extract textual relations. Stanford dependencies (SD) are triplets: name of the relation, governor and dependent. The Stanford Parser and the Link Grammar parser produce a forest of parse trees. Each syntactic possible interpretation of a sentence is called an analysis. The Link Grammar and the Stanford parsers share the same interfaces. They can return as many analyses as needed. Consider a sentence "John's arm is broken" as example. The Parse tree structure for both parsers is shown in the figure 4.

*1) Advantages of Dependency Parser*

1) It reduces the extraction time tremendously.
2) The capability of PTQL is expanded, such as the support of regular expression and the utilization of redundancy to compute confidence of the extracted information.

*2) Disadvantages of Dependency Parser*

1) File-based approaches do not recognize relationships between entities until such information is needed by an application.
2) File-based frameworks are suitable for onetime extraction, because IE has to be performed repeatedly even on the same document collection.

## III. COMPARISON OF DATABASES FOR INFORMATION EXTRACTION

*Table 2: Comparison of Databases for Information Extraction*

| *Research Papers* | *Advantages* | *Disadvantages* |
|---|---|---|
| *GenerIE: Information Extraction Using Database Queries* | *Enable database queries for information extraction enable generic extraction and minimize reprocessing. Easier for the user.* | *Optimization Challenges for Query Optimization on Large scale Data. Critical Automated Query Generation.* |
| *Incremental Information Extraction using Parse Tree Databases* | *In this extraction framework, intermediate output of each text processing component is stored so that only the improved component has to be deployed to the entire corpus. Tremendous reduction of processing time. Avoid the overlapping the data.* | *these will be computationally expensive PTQL lacks the support of common features such as regular expression as frequently used by entity extraction task. PTQL also does not provide the ability to compute statistics across multiple extractions.* |
| *Incremental Information Extraction Using Tree-based Context* | *Extract text fragments to fill the slots defined by the given target structure.* | *Manual rewriting of rules is a time-consuming and intricate task that must be done by experts.* |

| | | |
|---|---|---|
| *Incremental Information Extraction Using Relational Databases* | *It reduces the processing time*<br>*It shows that the query performance is efficient for real-time applications.* | *Do not provide capabilities for managing intermediate processed data.*<br>*Lead to the need for reprocessing of entire text collection which can be computationally expensive.* |
| *Incremental Information Extraction Using GMMSD2* | *It can overcome computational cost by applying efficient QR-updating techniques when new training samples are presented.* | *The complete recompilation of the training process when new training samples are presented.* |
| *Incremental Information Extraction Using Dependency Parser* | *It reduces the extraction time tremendously.*<br>*The capability of PTQL is expanded, such as the support of regular expression and the utilization of redundancy to compute confidence of the extracted information.* | *File-based approaches do not recognize relationships between entities until such information is needed by an application.*<br>*File-based frameworks are suitable for onetime extraction, because IE has to be performed repeatedly even on the same document collection.* |
| *Biomedical Information Extraction with Predicate-Argument Structure Patterns* | *The performance is remarkably promising,* | *This technique is more expensive Because of its complicated design.* |

## IV. CONCLUSION

Information extraction system is to extract query language this query language transfer to PTQL (Parse Tree Query Language) tree. This Extraction framework does not provide the capability to manage intermediate process data. This leads to the unnecessary reprocessing of the entire text collection when the extraction goal is modified or improved, which can be computationally expensive and time consuming one. To reduce this reprocessing time the intermediate process data is stored in database. The database is in the form of parse tree. To extract information from parse tree the extraction goal written by the user in natural language text is converted into PTQL and then extraction is performed on text corpus. This increment extraction approach save much more time compared to performing extraction by first processing each sentence one at a time with linguistic parse and then other components.

In this survey, by studying all the databases for the incremental information extraction, I Conclude that GenerIE presents our attempts in providing a versatile approach for information extraction. The elegance of our approach is that unlike typical extraction frameworks, introducing new knowledge in our framework does not require the reprocessing of all modules. Simple SQL insert statements can be issued to store the new entities in PTDB. We believe that studying fundamental database management issues on information extraction – a well-known important problem – opens up a lot of new opportunities and challenges.

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