DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

DESIGN AND IMPLEMENTATION OF TURKISH QUESTION ANSWERING SYSTEM

by
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İZMİR

DESIGN AND IMPLEMENTATION OF TURKISH QUESTION ANSWERING SYSTEM

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M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"DESIGN AND IMPLEMENTATION OF TURKISH QUESTION ANSWERING SYSTEM"** completed by **OKAN ÖZTÜRKMENOĞLU** under supervision of **ASST. PROF. DR. ADİL ALPKOÇAK** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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DESIGN AND IMPLEMENTATION OF TURKISH QUESTION ANSWERING SYSTEM

ABSTRACT

In this study, we investigated the design and implementation of named-entity (NE) based question answering system for Turkish text collections. Researches and works on this subject have shown that question answering systems has a complex structure composed of several modules. Thus, we first discussed the structure of a question answering system in three basic phases: question processing, document analysis and answer processing.

Firstly, we developed named-entity recognition (NER) tool, which is capable to manage extended named entity hierarchy, annotate data collection, rule-based and dictionary-based named entities extraction and provides a performance evaluation. We also provide a set of rules and dictionaries for NER in Turkish and we present the whole application system in detail. We run a set of experimentation to evaluate the performance of NER system using METU Turkish Corpus. The results we gained from experimentations show that our NER approach produced good results.

Then, we propose a new approach, which is named-entity based Questions Answering system for Turkish collections. We designed and implemented our system in structure of boolean information retrieval. We created the structure of indexing for information retrieval and retrieved the relevant documents as results. Then, we found named entities in documents and questions and we matched them using named entity hierarchy. In summary, this work is a starting work in this research area and is thought to produce the best results in terms of performance.

Keywords : Information retrieval, question answering systems, named entity recognition, Turkish information retrieval

TÜRKÇE SORU CEVAP SİSTEMİ TASARIMI VE GERÇEKLEŞTİRİMİ

ÖZ

Bu çalışmada, Türkçe metin koleksiyonları üzerinde kullanılmak üzere soru cevap sistemlerinin yapısının tasarımını ve bu sistemlerin gerçekleştirilmesini araştırdık. Bu konu üzerinde yapılan çalışmalar ve araştırmalar da göstermiştir ki, soru cevap sistemleri birkaç modülden oluştuğu için kompleks bir yapıya sahiptir. Yaptığımız araştırmalar neticesinde soru cevap sistemleri yapı tasarımı olarak 3 temel aşamada ele alınmıştır. Bu aşamalar soru işleme, doküman işleme ve cevap işleme aşamalarıdır.

İlk olarak, genişletilmiş varlık ismi hiyerarşisini yönetme, veri koleksiyonlarını işaretleme, kural-tabanlı ve sözlük-tabanlı varlık isimlerini çıkarma ve performans değerlendirmesi yapmayı sağlama yeteneğine sahip olan varlık ismi tanıma (VİT) aracı geliştirdik. Türkçe'de VİT için bir takım kurallar ve sözlükler de oluşturduk ve tüm uygulama sistemini detaylıca hazırladık. ODTÜ Türkçe Derlemini kullanarak VİT sistemlerinin performansını değerlendirmek için bir küme deneyler gerçekleştirdik. Deneylerden elde ettiğimiz sonuçlar göstermiştir ki bizim VİT yaklaşımımız iyi sonuçlar üretti.

Daha sonra, Türkçe koleksiyonlar için varlık ismine dayalı soru cevap sistemleri yaklaşımını önerdik. Sistemimizi doğrusal bilgi gerigetirimi yapısı içinde tasarladık ve gerçekleştirdik. Bilgi geri getirimi için indeksleme yapısı oluşturuldu and ilgili dökümanlar sonuç olarak geri getirildi. Daha sonra, varlık ismi hiyerarşisini kullanarak dökümanlarda ve sorularda geçen varlık isimlerini bulduk ve bunları eşleştirdik. Özetle, bu araştırma alanında bu çalışma bir başlangıç çalışmasıdır ve performans açısından en iyi sonuçları üreteceği düşünülmektedir.

Anahtar sözcükler : Bilgi erişimi, soru cevap sistemleri, varlık ismi tanıma, Türkçe bilgi erişimi

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CHAPTER ONE
INTRODUCTION

1.1 Overview

Mankind throughout his life, he had obtained, learned or heard about working on the data need to save in some sources. Accordance with this need, then this data is required to be reached out for various purposes. These sources may vary depending on the technology offer opportunities to people at that time. Today, advances in computer and web technologies, these data are recorded digitally. These resources could be web, database or corpus. People will create some questions about knowledge in his mind firstly when he wants to achieve the knowledge. He will ask some questions to these sources of knowledge as structured or unstructured data collections about wanted to achieve knowledge. The asked format and structure of these questions are varying according to the format of data source. Sometimes this question may be flatted text, sql-query sentence, keyword-based query or specialized formatted text. We will call these systems depend on the type of answer such as search engine system if answer is web or document link, database system if answer is record or question answering system if answer is direct answer to question. So in this phase, question answering systems are required for answering.

Question Answering (QA) system aims to answer inquirers questions as direct like precise answers with employing information retrieval (IR), information extraction (IE) and natural language processing (NLP) techniques, instead of providing a large number of documents that are potentially relevant for the questions posed by the inquirers.

Named Entity Recognition (NER) is a sub problem of information extraction and involves processing structured and unstructured documents. NER contains two tasks, which the first one is the identification of proper names in text, and second one is the classification of these names into a set of predefined categories of interest such as person names, organizations, locations, and date and time expressions. All of these

categories are known as “Named Entity Hierarchy (NEH)”. The term “Named Entity (NE)”, are proper names in natural language text.

1.2 The Problem Definition

People aim to reach information as directly from data collection as a result of their question. Current search technology returns ranked documents or URL addresses as the results. But people want to get direct answer to their questions, because data has increased every day in web. So QA is the most important research area for the next generation of search engines.

It is hard to extract named-entities from text collection and manually annotate them. Sometimes we could not decide that is the word or word phrase named entity and which class of named entity hierarchy is it involved. Because we used extended named entity hierarchy, so we classified named entities that are in the universe and used these classes for annotating. Furthermore we judged a lot of words for annotation in selected documents that are they named entity or not. We annotated over 4K words and we have created rules and dictionaries to analyzed the results of manually annotation.

The other major difficulty, we could not use stemmer or lemmatizer strictly. Because we worked in this study over Turkish text collection. We know that Turkish is an agglutinative language so stemming and lemmatizing is hard for Turkish, is not easy than English at least. Already we have a few of stemmer or lemmatizer approaches. We compared performance of lemmatization approaches and we decided to use one of them (Ozturkmenoglu and Alpkocak, 2012). But decided one is developed using different programming language. So we could not use it in preprocessing step, only we used the base stemmer approaches such as Porter, Snowball and Lancaster.

1.3 Purpose and Scope of Thesis

Scope of this study is to design and development of Questions Answering systems for Turkish text collections. A tool has been developed to extract named entities using defined rules and dictionaries, answer questions based on extracted named entities and extract some information using boolean information retrieval method. We worked on Turkish text collection for testing, but we removed language constraint. If a new language corpus converter form is designed and developed, can be worked on this corpus, and can be defined and managed new rules and new question expressions. During the study, Boolean information retrieval technique, named entity recognition approaches, natural language processing phases are studied.

We aimed that;

- ✓ To preprocess text collections, such as removing stop words and punctuation characters, convert letter case, normalization etc., and build the structure of information retrieval.
- ✓ To implement NER tool and so provide to extract information.
- ✓ Able to answer user questions in natural language based on named entity and Boolean information retrieval.
- ✓ To provide language independent tool and can apply on different languages text collections.

1.4 Contributions of Thesis

In this thesis study, we propose a named entity-based question answering system for Turkish Text. In order to achieve this, we first developed an independent tool, which is a rule engine extracting named-entities from Turkish. Furthermore, it is also useful tool for Boolean information retrieval. Then, we design and developed a question answering system using named-entities. To the best or our knowledge, it is first question answering system for Turkish collections.

1.5 Thesis Organization

This thesis is divided into 5 Chapters and 3 Appendices. The next chapter presents the definition and structure of information retrieval system including boolean information retrieval. We also mentioned structure of question answering systems and question answering approaches in Chapter 2. Chapter 3 provides a literature survey on named entity recognition works used for question answering system, named entity recognition approaches and extended named entity hierarchy. Chapter 4 presents the architectural and application design of our NER-based Turkish QA system. Chapter 5 discusses the results on this thesis study and concludes the thesis.

CHAPTER TWO
INFORMATION RETRIEVAL

1.1 Overview

"Information retrieval (IR) is the area of study concerned with searching for documents, for information within documents, and for metadata about documents, as well as that of searching structured storage, relational databases, and the World Wide Web. There is overlap in the usage of the terms data retrieval, document retrieval, information retrieval, and text retrieval. IR is interdisciplinary, based on computer science, mathematics, library science, information science, information architecture, cognitive psychology, linguistics, statistics and law." (Wikipedia, 2012)

Throughout our life, we need to use information retrieval in so many places. Today hundreds of millions of people engage in information retrieval every day when they use a web search engine or search their email. Information retrieval is fast becoming the dominant form of information access, overtaking traditional database style searching.

"The idea of using computers to search for relevant pieces of information was popularized in the article "As We May Think" by Vannevar Bush in 1945. The first automated information retrieval systems were introduced in the 1950s and 1960s. By 1970 several different techniques had been shown to perform well on small text corpora such as the Cranfield collection (several thousand documents). Large-scale retrieval systems, such as the Lockheed Dialog system, came into use early in the 1970s.

In 1992, the US Department of Defense along with the National Institute of Standards and Technology (NIST), cosponsored the Text Retrieval Conference (TREC) as part of the TIPSTER text program. The aim of this was to look into the information retrieval community by supplying the infrastructure that was needed for

evaluation of text retrieval methodologies on a very large text collection. This catalyzed research on methods that scale to huge corpora. The introduction of web search engines has boosted the need for very large scale retrieval systems even further.

An information retrieval process begins when a user enters a query into the system. Queries are formal statements of information needs, for example search strings in web search engines. In information retrieval a query does not uniquely identify a single object in the collection. Instead, several objects may match the query, perhaps with different degrees of relevancy.

An object is an entity that is represented by information in a database. User queries are matched against the database information. Depending on the application the data objects may be, for example, text documents, images, audio, mind maps or videos. Often the documents themselves are not kept or stored directly in the IR system, but are instead represented in the system by document surrogates or metadata.

Most IR systems compute a numeric score on how well each object in the database matches the query, and rank the objects according to this value. The top ranking objects are then shown to the user. The process may then be iterated if the user wishes to refine the query."(Wikipedia, 2012)

As an academic field of study, information retrieval might be defined thus: "IR is finding material (usually documents) of an unstructured nature (usually text) that satisfies an information need from within large collections (usually stored on computers)" (Manning, C.D. et al, 2009).

2.2 Structure of IR System

Let us now consider a more realistic scenario to introduce structure of information retrieval system. Suppose we have one million documents. We have decided to build

a retrieval system over these documents. They might be news in daily newspaper between 2007 and 2012 years. We will refer to the group of documents over which we perform retrieval as the (document) collection. It is sometimes also referred to as a corpus (a body of texts). Suppose each document is about 1000 words long (2–3 book pages). If we assume an average of 6 bytes per word including spaces and punctuation, then this is a document collection about 6 GB in size. Typically, there might be about M = 500,000 distinct terms in these documents. There is nothing special about the numbers we have chosen, and they might vary by an order of magnitude or more, but they give us some idea of the dimensions of the kinds of problems we need to handle.

Our goal is to develop a system to address the ad-hoc retrieval task. This is the most standard IR task. In it, a system aims to provide documents from within the collection that are relevant to an arbitrary user information need, communicated to the system by means of a one-off, user-initiated query. An information need is the topic about which the user desires to know more, and is differentiated from a query, which is what the user conveys to the computer in an attempt to communicate the information need. A document is relevant if it is one that the user perceives as containing information of value with respect to their personal information need. To assess the effectiveness of an IR system (i.e., the quality of its search results), a user will usually want to know two key statistics about the system's returned results for a query. One of them is precision that is the fraction of the documents retrieved that are relevant to the user's information need (Equation 1). Another one is recall that is the fraction of the documents that are relevant to the query that are successfully retrieved (Equation 2).

$$Precision = \frac{|\{relevant\ documents\} \cap \{retrieved\ documents\}|}{|\{retrieved\ documents\}|} \quad (1)$$

$$Recall = \frac{|\{relevant\ documents\} \cap \{retrieved\ documents\}|}{|\{relevant\ documents\}|} \quad (2)$$

We now cannot build a term-document matrix in a naive way. A 500K × 1M matrix has half-a-trillion 0's and 1's – too many to fit in a computer's memory. But the crucial observation is that the matrix is extremely sparse, that is, it has few non-zero entries. Because each document is 1000 words long, the matrix has no more than one billion 1's, so a minimum of 99.8% of the cells are zero. A much better representation is to record only the things that do occur, that is, the 1 positions.

This idea is central to the first major concept in information retrieval, the inverted index. The name is actually redundant: an index always maps back from terms to the parts of a document where they occur. Nevertheless, inverted index, or sometimes inverted file, has become the standard term in information retrieval. We keep a dictionary of terms (sometimes also referred to as a vocabulary or lexicon). Then for each term, we have a list that records which documents the term occurs in. Each item in the list – which records that a term appeared in a document (and, later, often, the positions in the document) – is conventionally called a posting. The list is then called a postings list (or inverted list), and all the postings lists taken together are referred to as the postings.

Many different measures for evaluating the performance of information retrieval systems have been proposed. The measures require a collection of documents and a query. All common measures described here assume a ground truth notion of relevancy: every document is known to be either relevant or non-relevant to a particular query.

2.3 Boolean Information Retrieval

The Boolean retrieval model is a model for information retrieval in which we can pose any query which is in the form of a Boolean expression of terms, that is, in which terms are combined with the operators AND, OR, and NOT. The model views each document as just a set of words.

In this work, we applied boolean retrieval model. We used some boolean expression of terms. We expanded the power of a terms and connectors search in our system like Westlaw search engine's "Terms and Connectors". We used the following connectors in boolean queries.

Table 2.1 Used Boolean expression of terms

Connector	**Type this**	**To retrieve documents that contain**
Character Connectors	*****	Any characters after position of this operator
	?	One character in position of this operator
	term1	Search only *term1*
AND	&	Both search terms
OR	(a space)	Either search term or both terms
Phrase	" "	Search terms appearing in the same order as in the quotation marks
Grammatical Connectors	/s	Search terms in the same sentence
	/p	Search terms in the same paragraph
	+s	The first term preceding the second within the same sentence
	+p	The first term preceding the second within the same paragraph
BUT NOT	%	None of the terms following the percent symbol
Dictionary	di (*dict_path*)	Search terms or execute rules in dictionary file

To gain the speed benefits of indexing at retrieval time, we have to build the index in advance. The major steps in this are:

- ✓ Collect the documents to be indexed.
- ✓ Tokenize the text, turning each document into a list of tokens.
- ✓ Do linguistic preprocessing, producing a list of normalized tokens, which are the indexing terms.

- ✓ Index the documents that each term occurs in by creating an inverted index, consisting of a dictionary and postings.

2.4 Question Answering Systems

2.4.1 Overview

As users struggle to navigate the wealth of on-line information now available, the need for automated question answering systems becomes more urgent. We need systems that allow a user to ask a question in everyday language and receive an answer quickly and succinctly, with sufficient context to validate the answer. Current search engines can return ranked lists of documents, but they do not deliver answers to the user.

In information retrieval and natural language processing (NLP), question answering (QA) is the task of automatically answering a question posed in natural language. To find the answer to a question, a QA system may use either a pre-structured database or a collection of natural language documents (a text corpus such as the World Wide Web or some local collection). The goal is to use computers to answer precise or arbitrary questions formulated by users in natural language (NL). Summarizing, the main objective of a QA system is to determine "WHO did WHAT to WHOM, WHERE, WHEN, HOW and WHY?" In this study, over Turkish language, we used question expressions such as "ne? (what?) ne zaman? (when?) nerede? (where?) nasıl? (how?) neden? (why?) kim? (who?)"

There are conferences such as TREC and CLEF, whose aim is to evaluate these systems requiring that all participants use the same corpus in order to answer a specific question set given by the organization. Question sets used to evaluate QA systems are mainly built up from factual questions whose answer is a named entity (NE) (hereafter referred to as NE-based questions).

"QA research attempts to deal with a wide range of question types such as: fact, list, definition, How, Why, hypothetical, semantically constrained, and cross-lingual questions. " (Wikipedia, 2012)

- ✓ *Closed-domain* (*restricted-domain* or *collection-based*) question answering deals with questions under a specific domain (for example, medicine or automotive maintenance), and can be seen as an easier task because NLP systems can exploit domain-specific knowledge frequently formalized in ontologies. Alternatively, closed-domain might refer to a situation where only a limited type of questions are accepted, such as questions asking for descriptive rather than procedural information.

- ✓ *Open-domain* question answering deals with questions about nearly anything, and can only rely on general ontologies and world knowledge. On the other hand, these systems usually have much more data available from which to extract the answer.

"There are important factors that distinguish restricted-domain QA from open-domain QA. Those factors include: (1) size of the data, (2) domain context, and (3) resources. The size of the data available for general open-domain QA tends to be quite large, which justifies the use of redundancy-based answer extraction techniques. In the case of restricted-domain QA, however, the size of the corpus varies from domain to domain, and redundancy-based techniques would not be practical for a domain with a small corpus size. In restricted-domain QA, the domain of application provides a context for the QA process. This involves domain-specific (meanings of) terminologies and domain-specific types of questions, which also differ between domain experts and nonexpert users. Finally, a major difference between open-domain QA and restricted-domain QA exists in the availability of domain-specific resources and the incorporation of domain specific information in the QA process in the latter." (Athenikos, S.J. and Han H., 2010)

2.4.2 QA Approaches

We devised a conceptual framework within which to categorize current QA approaches. These categories are corpus-based and knowledge-based QA systems.

2.4.2.1 Corpus-based QA

Corpus-based QA systems can analyze documents and questions and so can extract answer easily and quickly. Corpus-based QA systems take advantege of dataset size, domain-dependent context and domain-specific resources such as preprocessing tools, analyzing tools, specific questions and also resources.

2.4.2.2 Knowledge-based QA

We further classified knowledge-based QA system approaches into three subcategories: semantics-based, inference-based, and logic-based.

Most semantics-based open-domain QA approaches take advantage of the lexico-semantic information encoded in WordNet, a prominent terminological resource for the general English domain. Related works used semantic features are about semantic representation of answer (Vicedo and Ferrandez, 2000), semantic distance between question and answer (Alfonseca et al., 2001), semantic patterns of question and answer (Hovy et al., 2001), semantic relations between lexical terms (Fleischman et al., 2003), semantic distance measured by the edit distance between QA dependency trees (Punyakanok et al., 2004).

We reviewed QA approaches that rely on some form of inference or those that involve extracting semantic relations contributing to inference. Some use resources such as FrameNet and PropBank in obtaining frame or predicate argument structures. Related works used inference method/mechanisms are about discovery of inference rules (Lin and Pantel, 2001), detection of causal relations (Girju, 2003), inference on events based on ontological scripts (Beale et al., 2004), inference and reference

resolution mechanisms (Harabagiu et al., 2001), probabilistic inference (Narayanan and Harabagiu, 2004, Narayanan and colleagues, 2004), temporal inference (Harabagiu and Bejan, 2005), assessment of semantic role labeling (Shen and Lapata, 2007), inter-event relationships (Katz et al., 2005).

We reviewed QA approaches that employ explicit logic forms (LFs) and theorem proving techniques. Most approaches adopt First Order Logic (FOL) based formalisms. Related works used logic formalism and reasoning mechanisms are about first order logic (FOL) based (Harabagiu et al., 2000, Clark et al., 2005) formalisms, mechanisms for representation and reasoning such as Prolog, AnsProlog, etc. (Molla et al., 2000, Tari and Baral, 2005, Baral et al., 2005)

2.4.3 Structure of QA Systems

Question answering is an advanced form of information retrieval in which focused answers are generated for either user queries or ad hoc questions. Given a question, in Natural Language most of the time, and a collection of documents, find answer(s) to question.

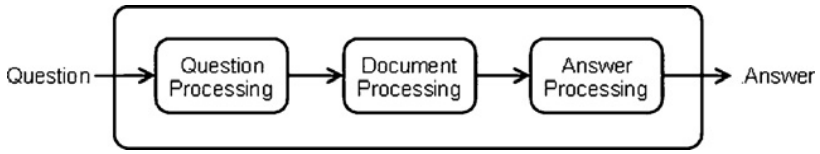

Figure 2.1 Main processing phases of Question Answering system

QA is a tool of information retrieval. Current text-based question answering (QA) systems (Figure 2.3) usually contain a named entity recognizer (NER) as a core component. An important component of a QA system is the named entity recognizer and virtually every QA system incorporates one.

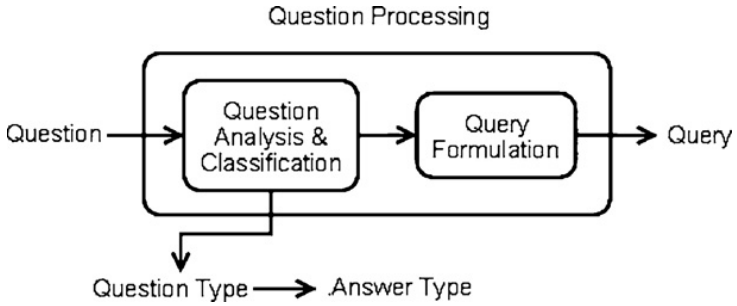

Figure 2.2 Question processing phase of QA

Question processing module accomplishes different tasks. This module extracts main keywords, expands keyword terms, determines question type and builds the semantic context representation of the expected answer. In this stage, a question is given in natural language expressions. Question analysis and classification determines the type of the question and the corresponding type of expected answer. At this stage, we may use more sub processes, such as NER.

Generally, question types are listed in the following:

- ✓ Factual
- ✓ List
- ✓ Definitional
- ✓ Boolean

In Turkish, question types are:

- ✓ Definitional (*"ne (what)"*)
  X nedir?
- ✓ Factual (*"kim,ne zaman,nerede (who, when, where)"*)
  X'in başkenti neresidir? Kimdir? Neresidir?
  (Where is the capital of X? Who is he? Where is there?)
- ✓ Scenario (*"nasıl,neden (how, why)"*)
  X kişisi Y hakkında ne düşünüyor? Nasıl yorumluyor?
  (What does X think about Y? How does he comment?)

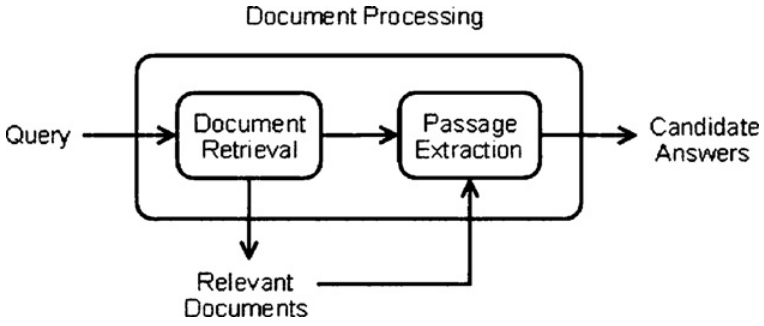

Figure 2.3 Document processing phase of QA

The input to answer processing module is a small number of pre-processed candidate documents and the results of question processing module. Fig.2.5 generate a query to be input to a document retrieval engine, by transforming the question into some canonical form. The query is fed into a search engine in order to retrieve relevant documents. The retrieved document set may be narrowed down to a smaller set of most relevant documents. This phase will generally involve linguistic processing sub processes.

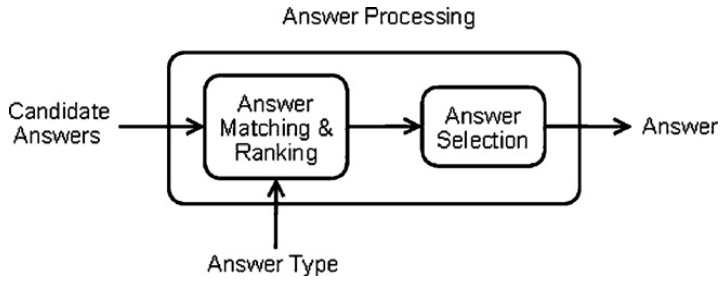

Figure 2.4 Answer processing phase of QA

When this initial sentence ranking has finished, the top number of ranked sentences that include probable answers are selected as the best candidates to contain the correct one. A term is considered a probable answer if it verifies lexical restrictions obtained by question term analysis. The candidate answers are matched against the expected answer type. They are ranked according to the matching scores. More sophisticated linguistic processing may be involved.

The final step is to analyze sentences to extract and rank the windows of the desired length that probably contain the correct answer. The system selects a window

for each probable answer by taking as centre the term considered a probable answer. Each window is assigned a window-score.

Finally, windows are ranked on window-score and the system returns the top number of ranked windows as final result.

CHAPTER THREE
NAMED ENTITY RECOGNITION IN TURKISH

3.1 Overview

Named Entity Recognition (NER) is a sub problem of information extraction and involves processing structured and unstructured documents. NER is a fundamental task and involves two tasks, which is firstly the identification of proper names in text, and secondly the classification of these names into a set of predefined categories of interest, such as person names, organizations (companies, government organizations, committees, etc.), locations (cities, countries, rivers, etc.), date and time expressions. The term “Named Entity (NE)”, are proper names in natural language text. It was introduced in the Sixth Message Understanding Conference (MUC-6). In fact, the MUC conferences were the events that have contributed in a decisive way to the research of this area. It has provided the benchmark for named entity systems that performed a variety of information extraction tasks.

“For humans, NER is intuitively simple, because many named entities are proper names and most of them have initial capital letters and can easily be recognized by that way, but for machine, it is so hard. One might think the named entities can be classified easily using dictionaries, because most of named entities are proper nouns, but this is a wrong opinion. As time passes, new proper nouns are created continuously. Therefore, it is impossible to add all those proper nouns to a dictionary. Even though named entities are registered in the dictionary, it is not easy to decide their senses. Most problems in NER are that they have semantic (sense) ambiguity; on the other hand, a proper noun has different senses according to the context.” (Mansouri A., Affendey L.S. & Mamat A., 2008)

Automatically extracting proper names is useful to many problems such as question answering, information extraction, information retrieval, machine translation, summarization, and semantic web search. For instance, the key to a

question processor is to identify the asking point (who, what, when, where, etc), so in many cases the asking point corresponds to a NE. In biology text data, the named entity system, can automatically extract the predefined names (like protein and DNA names) from raw documents.

3.2 Extended Named Entity Hierarchy

"The Extended Named Entity Hierarchy (Figure 3.1) is required to meet increasing needs for wider range of NE types. It originates from the first Named Entity set defined by MUC (Grishman et al., 1996), the Named Entity set developed by IREX (Sekine et al., 2000), and the Extended Named Entity hierarchy which contains approximately 150 NE types." (Sekine et al., 2002).

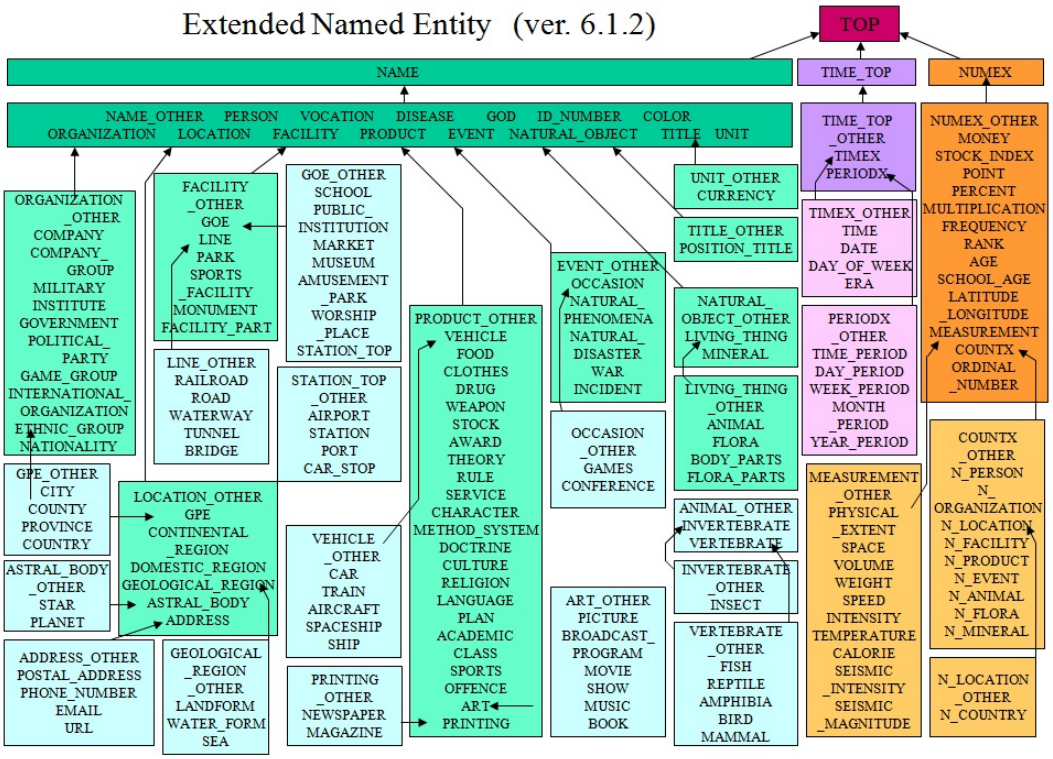

Figure 3.1 The extended named entity hierarchy version 6.1.2

QA system provides information that one wants to know or extract from articles. That information can be categorized into fixed number of classes with hierarchies; Sekine et al.'s designed it in the Extended Named Entity Hierarchy, QA system or IE system assuming that information one wants know is basically in a form of noun

phrase with specific names and numerical values. In other words, it is not a word that expresses general concept or class, but rather a name of concept or thing that can be pointed out physically.

The Extended Named Entity Hierarchy is divided into three major classes; name, time, and numerical expressions (these three classes are the same as NE hierarchy defined in the MUC, IREX project). Based on their observation, they know that one's question on a specific matter often fits in one of these categories. Having these three classes at the top of the Extended Named Entity Hierarchy, Q&A system and IE system are created taking into account the concepts and words that are generally considered as common knowledge in usual newspaper articles and encyclopedias.

They defined the classes based on a criterion that frequently occurring words and noun phrases should be categorized into a class according to its meaning and usage.

3.3 NER Approaches

In recent years, automatic named entity recognition and extraction systems have become one of the popular research areas that a considerable number of studies have been addressed on developing these systems. They can be categorized into three classes, namely, Hand-made Rule-based NER, Machine Learning-based NER and Hybrid NER.

3.3.1 Hand-Made Rule-Based NER

Hand-made Rule-based focuses on extracting names using lots of human-made rules set. Generally the systems consist of a set of patterns using grammatical (e.g. part of speech), syntactic (e.g. word precedence) and orthographic features (e.g. capitalization) in combination with dictionaries. These systems approaches are relying on manually coded rules and manually compiled corpora. These kinds of models have better results for restricted domains, are capable of detecting complex entities that learning models have difficulty with. However, the rule-based NE systems lack the ability of portability and robustness, and furthermore the high cost

of the rule maintains increases even though the data is slightly changed. These type of approaches are often domain and language specific and do not necessarily adapt well to new domains and languages.

3.3.2 Machine Learning-Based NER

"In machine learning-based NER system, the purpose of named entity recognition approach is converting identification problem into a classification problem and employs a classification statistical model to solve it. In this type of approach, the systems look for patterns and relationships into text to make a model using statistical models and machine learning algorithms. The systems identify and classify nouns into particular classes such as persons, locations, times, etc. base on this model, using machine learning algorithms. There are three types of machine learning model that are used for NER: supervised, semi-supervised and unsupervised machine learning model." (Mansouri A., Affendey L.S. & Mamat A., 2008)

3.3.2.1 Supervised Machine Learning-Based NER

"Supervised learning involves using a program that can learn to classify a given set of labeled examples that are made up of the same number of features. Each example is thus represented with respect to the different feature spaces. The learning process is called supervised, because the people who marked up the training examples are teaching the program the right distinctions. The supervised learning approach requires preparing labeled training data to construct a statistical model, but it cannot achieve a good performance without a large amount of training data, because of data sparseness problem. In recent years several statistical methods based on supervised learning method were proposed." (Mansouri A., Affendey L.S. & Mamat A., 2008) This system needs a large annotated corpus, memorizes lists of entities and creates disambiguation rules based on discriminative features. The used methods for this systems, Hidden Markov Models, Decision Trees, Maximum Entropy Models, Support Vector Machines, Conditional Random Fields."

3.3.2.2 Semi-supervised Machine Learning-Based NER

Semi-supervised machine learning is “bootstrapping” and includes little supervision like giving a set of seed for starting learning process. For example, if a system tries to find names of the diseases in texts, a small number of example names can be given to the system. The system then tries to find some common clues about the given disease names and then tries to find other instances of disease names which are used in similar context.

3.3.2.3 Unsupervised Machine Learning-Based NER

“Unsupervised learning method is another type of machine learning model, where an unsupervised model learns without any feedback. In unsupervised learning, the goal of the program is to build representations from data. These representations can then be used for data compression, classifying, decision making, and other purposes. Unsupervised learning is not a very popular approach for NER and the systems that do use unsupervised learning are usually not completely unsupervised.” (Mansouri A., Affendey L.S. & Mamat A., 2008) Unlike the rule based method, these types of approaches can be easily port to different domain or languages.

3.3.3 Hybrid NER

In Hybrid NER system, the approach is to combine rule based and machine learning-based methods, and make new methods using strongest points from each method. In this family of approaches introduce a Hybrid system by combination of HMM, Maximum Entropy, and handcrafted grammatical rules. Although this type of approach can get better result than some other approaches, but the weakness of handcraft rule-based NER remains the same that is when there is a need to change the domain of data.

3.4 Related Works

In this study, we reviewed four related woks that were worked on NER for Turkish language.

The first one of works which was developed by Dilek Küçük et al. at 2009, wanted to extract named entities including the names of people, locations, organizations, time/date, and money/percentage expressions. They worked on METU Corpus, child stories and historical texts. They presented rule-based NER system which employs a set of lexical resources and pattern bases. They did not make use of capitalization and punctuation clues. They annotated 10 articles with MUC format using own annotation tool. Their f-measure result is 78.7%. Their future directions were that the rules can be improved, provided finer grained classes and different machine learning approaches can be employed.

The second one was developed by Faik Erdem Kılıç et al. at 2010. They wanted to extract named entities including the names of people, locations, and organizations in topic independent Turkish documents that contained three categories that has 10 text file for each category, were political, economy, and health. They presented rule-based NER system. They make use of capitalization and punctuation clues. Their f-measure result is 81.6% in person, 88% in location, and 80% in organization. Their future directions were tested the different areas files, develop to different rules, and finding the date/time, formula and money entity.

The third one of works was developed by Gökhan Tür et al. at 2001. They used Milliyet Corpus and their approach is based on n-gram language models embedded in Hidden Markov Model. They used four different information sources to model names: lexical model, contextual model, morphological model and name tag model and used the SRILM toolkit language modeling and decoding in their work. They manually annotated test data. Their f-measure result is 91.56%. Their future directions are using maximum entropy models.

The last work was developed by Özkan Bayraktar et al. at 2008. They used Economy Corpus (EC2000) and METU Turkish Corpus. They wanted to extract named entities including the names of people. They based their approach on the bootstrap method. For extract person names, they applied three steps: concordance analysis, collocation analysis and extracting person names.

3.5 NER for QA Systems

This was an important step in the processing of the text as the QA system initially tried to find sentences containing an appropriate entity that might answer a determined question. NER tool aims to recognize a set of predefined categories of entities.

Clearly these entities expressions help the system to answer questions about these categories. For example, the system would get better performance if a broader range of entities were recognized.

CHAPTER FOUR
NER-BASED TURKISH QA SYSTEM

4.1 Architectural Design

Conceptually, we have considered the overall system architecture in named-entity based and boolean information retrieval system based.

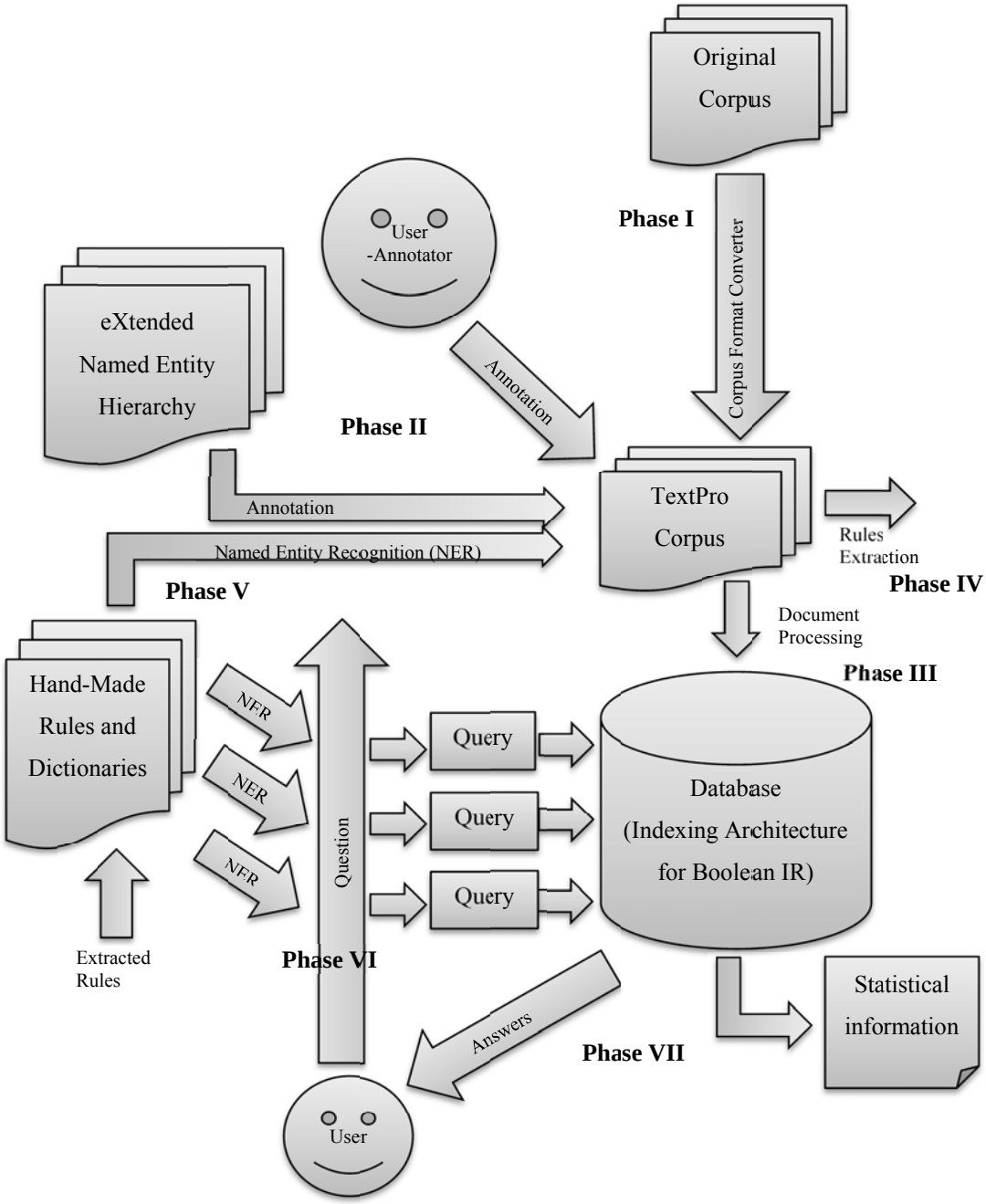

Figure 4.1 The overall system architecture

We designed the overall system in seven phases (Figure 4.1). We aim to answer user's question using named-entities. Generally, questions aim to direct named-entities for answer. Additionally, we must select related named-entities from relevant documents in text collection. So, we build boolean information retrieval system architecture for retrieving relevant documents. Thus, we designed the system architecture in seven phases. These phases are the following items:

- Phase 1: Convert to TextPro Corpus file format from original corpus file format
- Phase 2: Selected documents be annotated using extended NE hierarchy by user
- Phase 3: Import converted files to database tables using bulk insert method
- Phase 4: Extract rules using annotated terms
- Phase 5: Execute NER module using extracted rules and dictionaries
- Phase 6: Apply NER module on user's questions and convert them to query and also send query to database
- Phase 7: Get results and some statistical information from database and give answers to user.

4.2 Application Design

In this work, user can create a new project. If you work any document collection or corpus, you will create a new project and can build all system step by step. In the following screen, you can create a new project or open an existing project (Figure 4.2). At phase of creating a new project, system wants to know some information about project name, project path, corpus directory path, extended named entity hierarchy file (a file of .xml extension), question expressions file, named entity rules file and saved question file. After enter this information in related control, system create a file that its file extension is prj. This file has these informations.

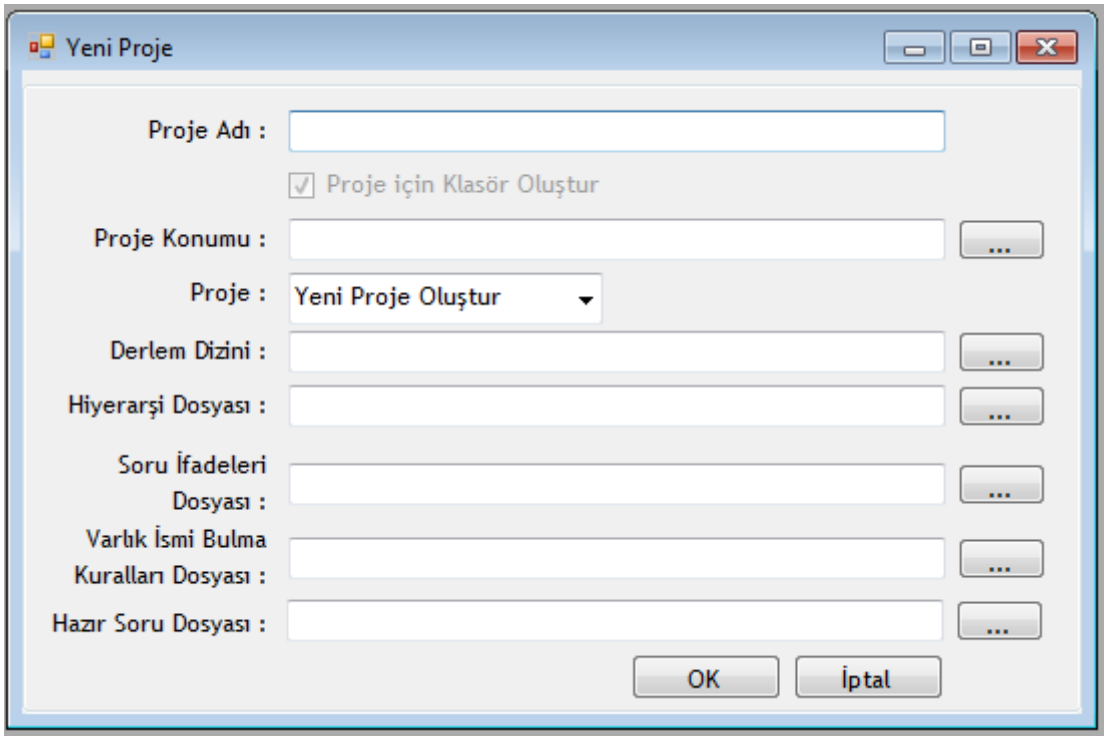

Figure 4.2 The screenshot of form for creating a new project

Also you can save project or close project and view project properties such as hierarchy file, corpus directory, rule file, question expression file, which steps are done etc. (Figure 4.3).

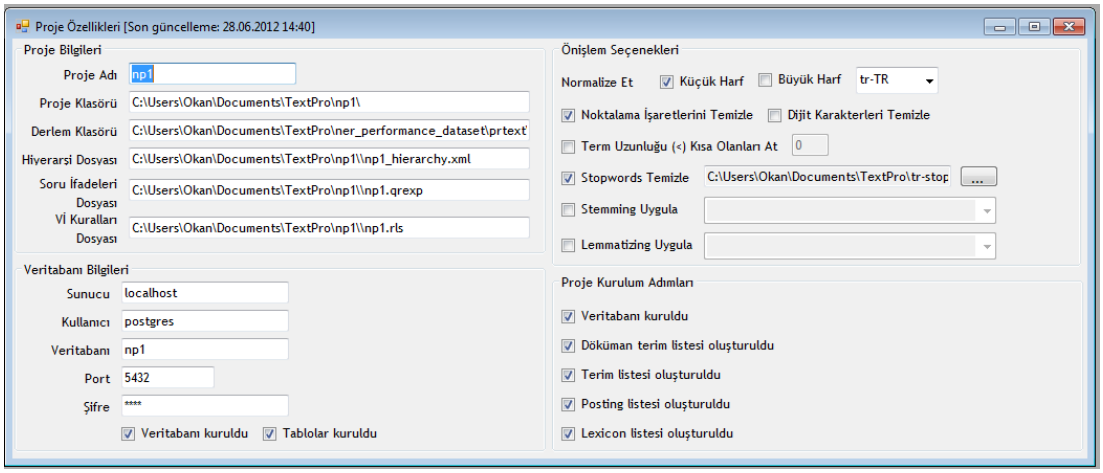

Figure 4.3 Screenshot of form for view existing project properties

Before you create a project, firstly you must implement a converter form to our application's collection file format from original format (Figure 4.4). Application's collection directory format has four directory and one log file.

- ✓ antindx Directory: During annotation process manually, each annotation process write a line in this directory which document of collection is annotating. For example, you are annotating document that document id is 20950000. This directory has 20950000.antindx file and each annotation process write a line in it. Line has some information annotation word, start character position of annotated word, stop character position of annotated word, start index of annotated word, finish index of annotated word and what the class of named entity hierarchy's number is.

  dün#18#20#2#2#2.1
  Kemal Ilıcak'ın#95#109#13#14#1.1
  Tercüman gazetesiyle#39#58#6#7#1.6.4.1

- ✓ docindx Directory: This directory has documents of collection and each document has all words of tokenized text of document. Each word is in a line with its position information (word, start character position, finish character position and word index) such as:

  Akıntıya#4#11#0
  kapılıp#13#19#1
  umulmadık#21#29#2

- ✓ iodd Directory: It has documents of collection and each document of collection has some information in between related tags. These tags are FileTitle, CatRef, FilePath, WordCount, ByteCount, AnalyticTitle, AnalyticAuthor, MonogrTitle, MonogrAuthor, MonogrEdition, ImprintPublisher, ImprintPubDate, ImprintPubPlace, IdNo, BiblScope, Text, SelectedForAnnotated, Annotated, OurCatRef, and OurWordCount.

- ✓ prtext Directory: It has documents of collection and each document of collection has text that stripped html tags.

- ✓ converter_log.txt File: File has log file about convert process (how long time each process was done)

Because when you want to create a new project, system wants to know that what the converted corpus directory path is. We worked on METU Turkish Corpus for testing that is in XCES-Tags file format structure originally (Say, B. et al. 2004).

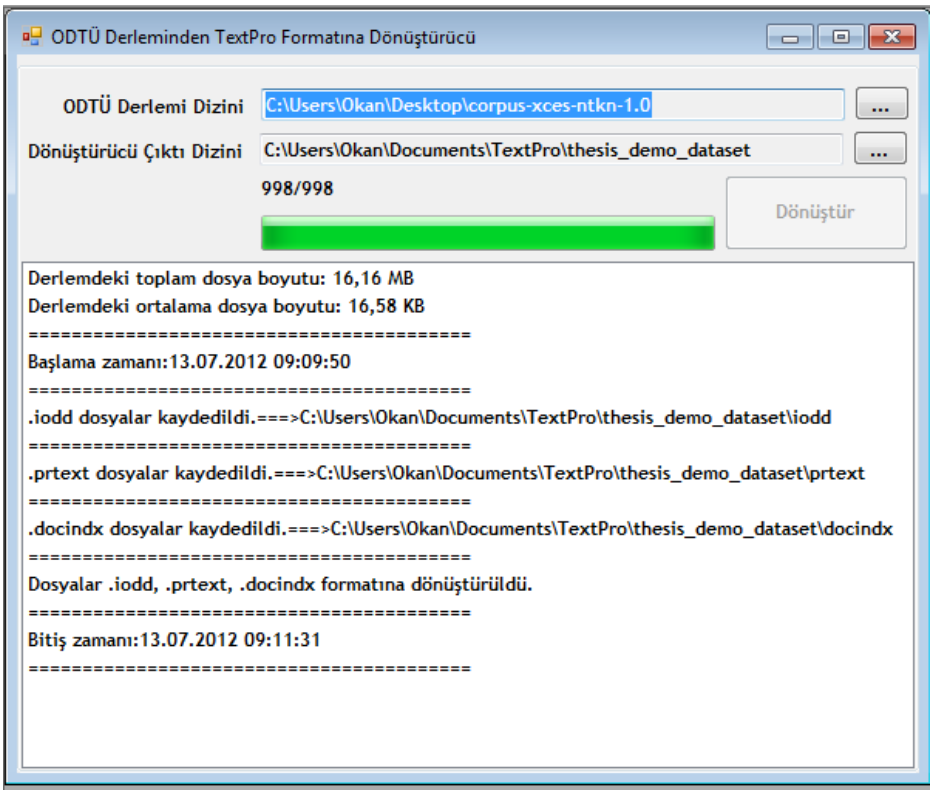

Figure 4.4 Screenshot of form about converting

Furthermore, you can create or edit named entity hierarchy file using this application (Figure 4.5). Hierarchy file is xml formatted. Each category has category number, up category number, down category count, category name, related category number, related name and sample named entities. If you want, you can insert structure of hierarchy into database using "hiyerarşinin db'de oluşturulması *(import hierarchy to db)*"

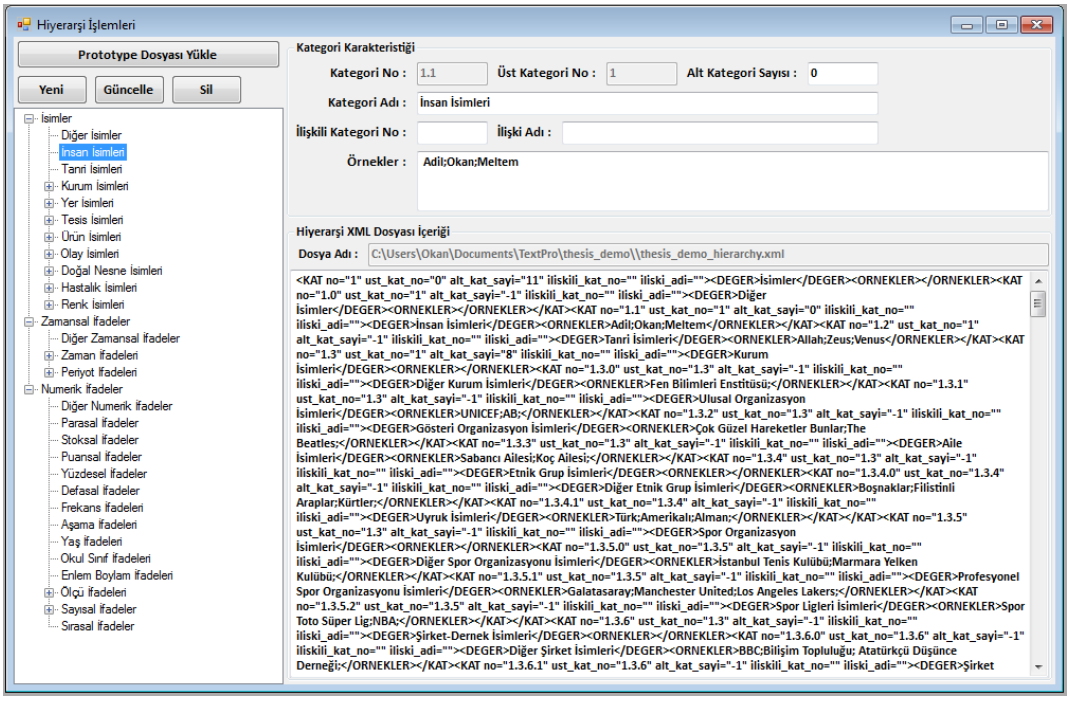

Figure 4.5 Screenshot of form for create or edit named entity hierarchy file

Annotation process in our system was not easy because we used named entity hierarch as extended version. Extended version of named entity hierarchy contains classes of entity in universe. We referenced Sekine's extended named entity hierarchy and we inferenced from this hierarchy to Turkish and so we created our hierarchy. We selected the documents and we designed and implemented the annotator form (Figure 4.6). Then we annotated the selecting documents with using the annotation tool.

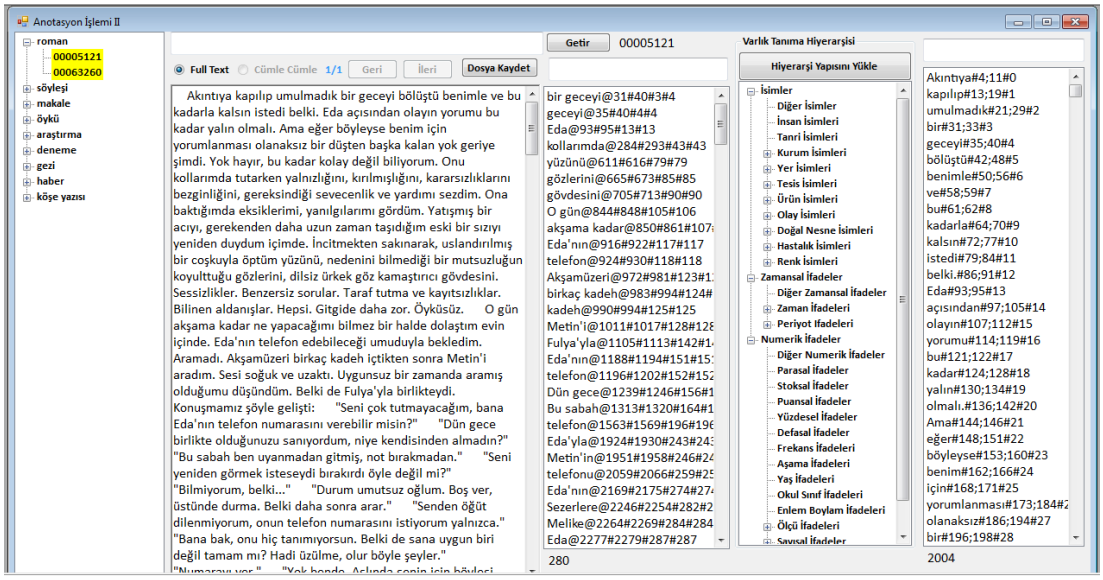

Figure 4.6 Screenshot of form for annotate document

We decided to files count for each category according to the related category's weight in METU corpus. For example, all files count is 998. News category weight is 42%. So, the news files count should be 8 in 20 files. The other categories count are news 8, novel 2, story 2, corner post 2, article 1, trial article 1, research 2, travel 1, and conversation 1. We calculated the average word count for each category. We selected files until calculating the number of file for each category that has the nearest word count to the average word count. Also you can analyze the annotated words and export them to csv file using another form that its name is "Annotate edilmiş kelimelerin analizi *(Analyze to Annotated Words)*".

Now we can setup database structure and than we can create named entities and question rules. So we can take some statistics about terms and documents, run the rules and extract named entities. We talk about database steps in chapter 4.3.

In management of rules, we can insert a new rule or edit existing rules (Figure 4.7). During creating or editing rules, a file is created in project directory that its file extension is rls. This file has rules and a line has each rules. Each rule line has rule expression, related hierarchy number and related hierarchy name. If you want, you can import rules into database. Also, you can insert a dictionary as rule. Dictionary may contain set of rules.

--Project Rules

1=" ada"#1.4.4.2#Ada İsimleri*

2=" gram*"#3.11.4#Ağırlık Ölçüsü İfadeleri*

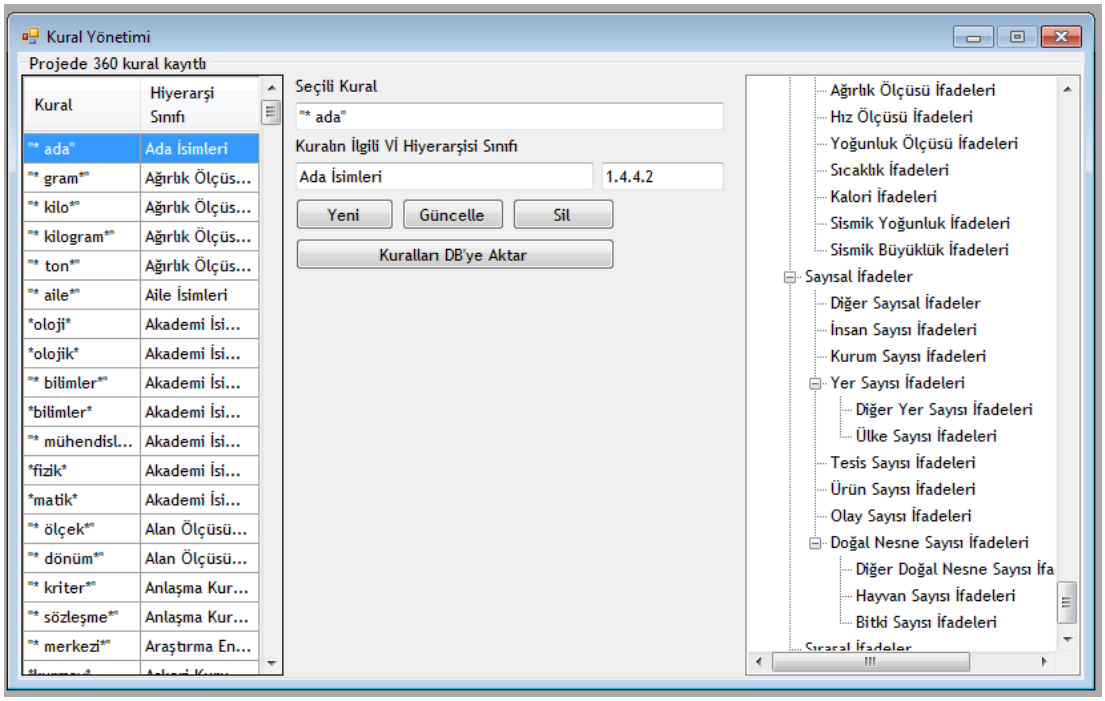

Figure 4.7 Screenshot of form for creating or editing rules and import rules into database

After create rules, you can run the rules. Running rules process creates a directory in project directory its name is rule_res. This directory contains all rules results in separately files. Each file has one rule result has document, index position and rule id such as:

--Rule 103 Results

00037123#1640#103

00037123#1685#103

00159170#765#103

00159170#782#103

00159170#1509#103

20740000#1740#103

20740000#1744#103

You can analyze rules results with form (Figure 4.8). You can see finding named entities using rules in red color. Additionally, you can combine rules with operators

and process results using form its name is “Kural sonuçlarını işle *(Process rule results)*” such as ((R103&R105)|R150). This expression means 103 id of rule and 105 id of rule are combined with AND (&) operator and this combination are combined with 150 id of rule using OR (|) operator.

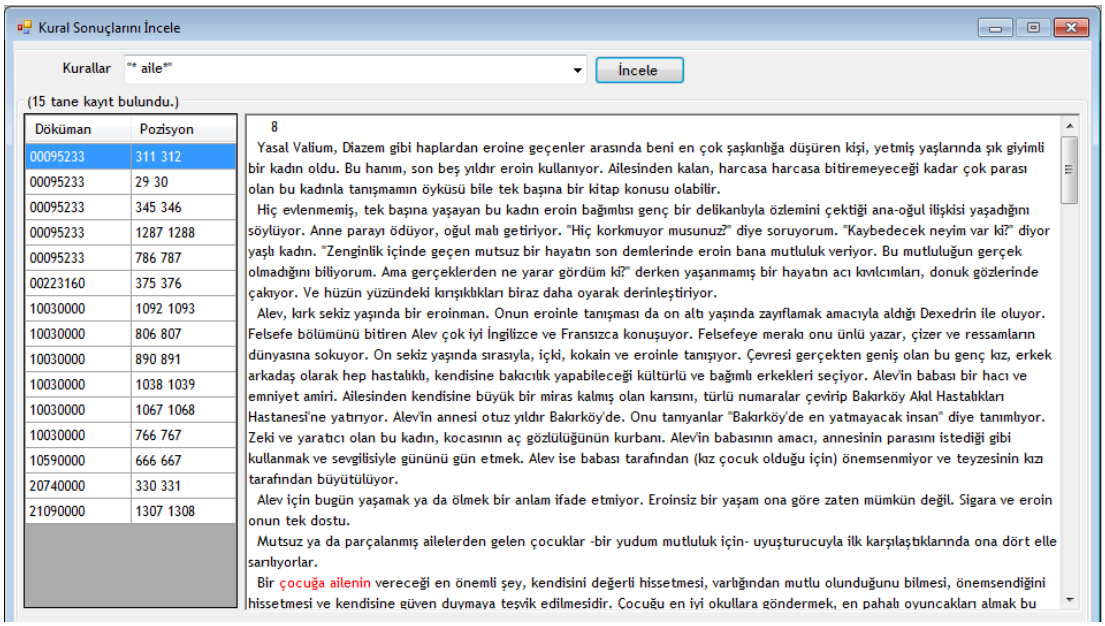

Figure 4.8 Screenshot of form for view finding named entities with rules

Lastly about named entities results, you can evaluate performance of rules (Figure 4.9). We analyze results in three main category of hierarchy. We annotated 4324 named entities manually, and we found 8237 named entities using 360 rules. We found 1559 named entities in set of manually annotated word. Also, you can import annotated and found named entities into database. The success rate of finding named entities in category of name is %38.71, in category of time is %27.59 and in category of numeric is %23.70. The details are shown in the following table.

Table 4.1 Details of evaluation finding named entities

Main Category of Hierarchy	Count of Found Named Entities	Count of Missed Named Entities	Success Rate
Name	1334	2112	%38.71
Time	120	315	%27.59
Numex	105	338	%23.70

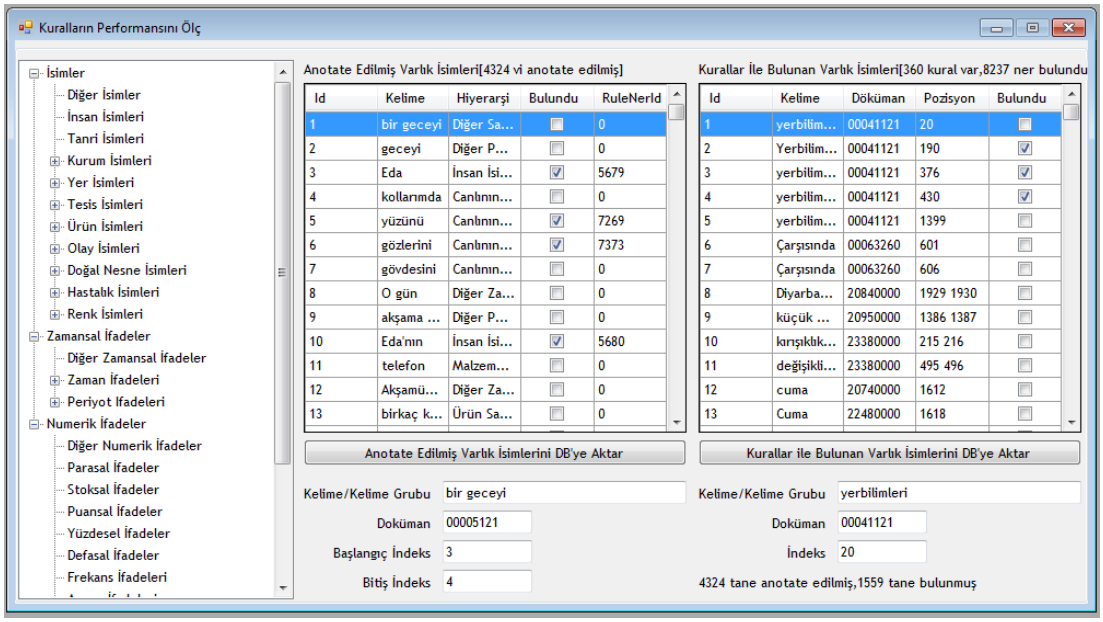

Figure 4.9 Screenshot of form for analyzing the rules results

Using our application, we can manage question expressions and question expression rules and relation between question expression and hierarchy classes (Figure 4.10). We can create a new question and manage its some information (stem of question, its alternatives question expressions and related hierarchy classes. Also you can import these into database. Question expression rules like named entities rule's notation. We define these rules for determining the question type and so determining the expected answer type. For example, we found question expression in user query and look its class of named entities hierarchy. Its category is place names. So answer's named entities hierarchy class may be place names and we look it into place named entities and its subclasses. When we connected question expression to named entities hierarch class, we used second-level classes as deep level. As using this level number, we can go into deeper levels such as tree structure. After define these, system create a file its file extension is qrexp. Its format likes as for each question that contains id, stem of question, question expression rules, related hierarch classes name and their class number:

1#nerede#nered;neres*;nerel*;nerd*;nerey*#Kurum İsimleri;Yer İsimleri;Tesis İsimleri;Enlem Boylam İfadeleri;Diğer İsimler;#1.3;1.4;1.5;3.10;1.0;*

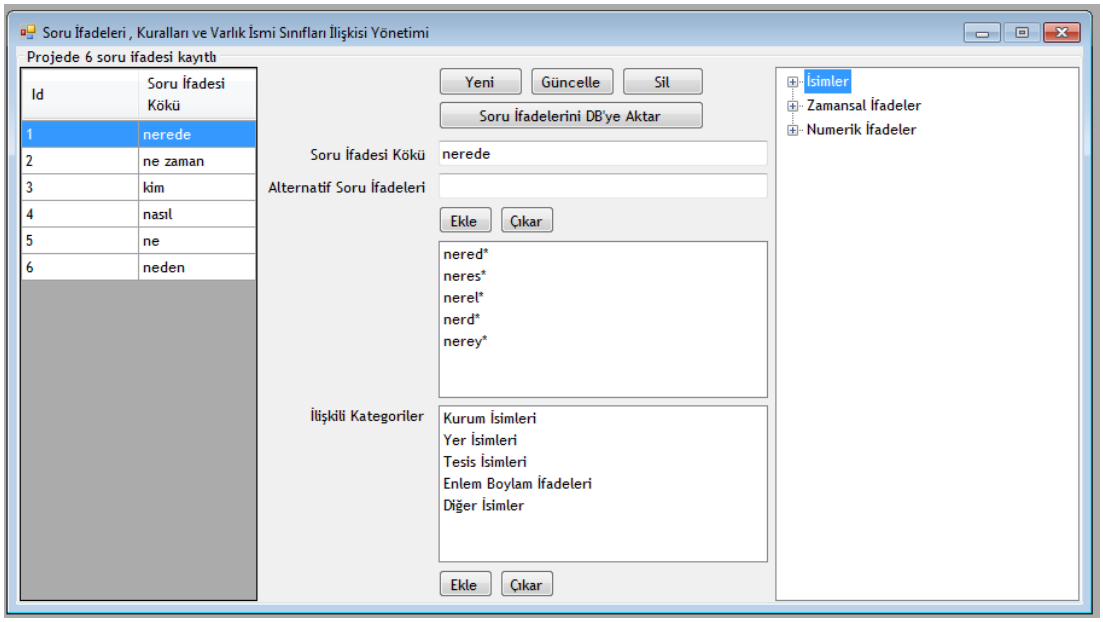

Figure 4.10 Screenshot of form for manage question expressions, their rules and relation to named entities hierarchy

Lastly, we can ask question to system and extract answers based on named entities in information retrieval system after document and question processing phases. We can use saved questions or a new question. Process start firstly processing of question and then find expected answers (Figure 4.11). We have done these using the following screen. We analyze the question and tokenize it and do preprocess operations using project's properties. We use same tokenization expression and preprocess operations at converting applications collection format from original collection format. After we find named entities in query using named entities rules. Than we find question expression in query and we determine expected named entities hierarchy classes.

After them, we run our boolean information retrieval system using keywords in query. We minimize the set of documents via IR system. The document results of IR system, we find named entities in documents and match questions named entities with documents named entities. We search answers in two-level set, one of them is same paragraph and another one is same sentence (Table 4.2).

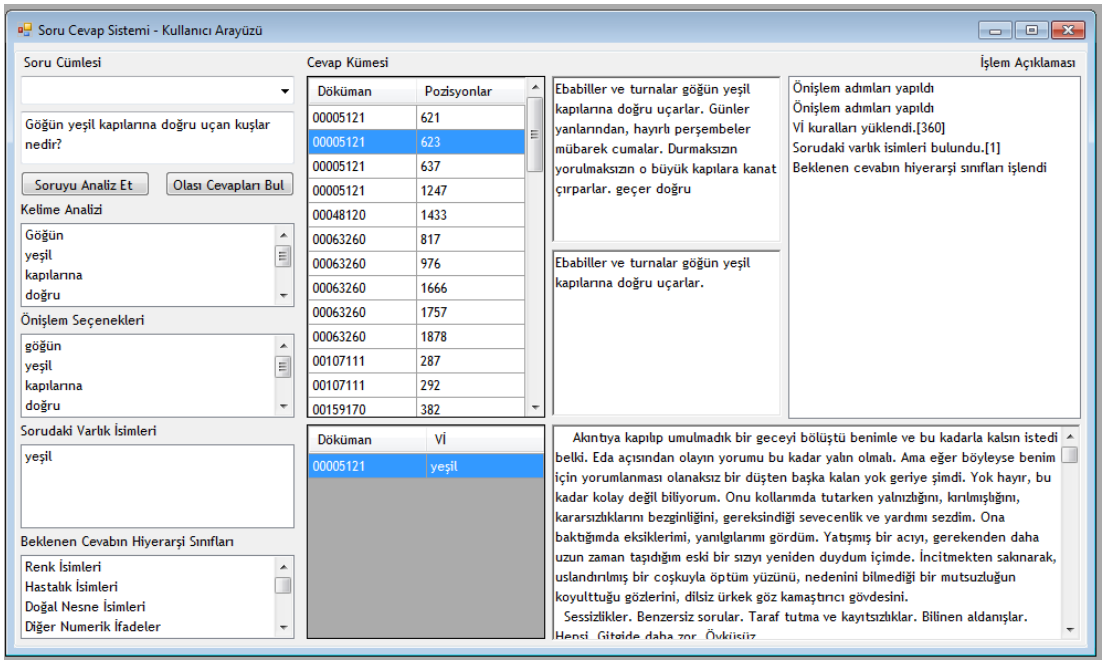

Figure 4.11 Screenshot of form for manage question expressions, their rules and relation to named entities hierarchy

Table 4.2 Example of query and its steps results

User question	*"Göğün yeşil kapılarına doğru uçan kuşlar nedir?"*
Term analysis of query	*"Göğün, yeşil, kapılarına, doğru, uçan, kuşlar, nedir?"*
Terms after preprocessed steps	*"göğün, yeşil, kapılarına, doğru, uçan, kuşlar, nedir"*
Named entities in query	*"yeşil"*
Found question expression	*"nedir"*
Expected answer types	*"Renk isimleri, hastalık isimleri, doğal nesne isimleri, diğer numerik ifadeler, parasal ifadeler, stoksal ifadeler, puansal ifadeler, yüzdesel ifadeler, defasal ifadeler, frekans ifadeleri, aşama ifadeleri, yaş ifadeleri, okul sınıfı ifadeleri"*
Answer (paragraphly)	*"Ebabiller ve turnalar göğün yeşil kapılarına doğru uçarlar. Günler yanlarından, hayırlı perşembeler mübarek cumalar. Durmaksızın yorulmaksızın o büyük kapılara kanat çırparlar. geçer doğru"*
Answer (sentencely)	*"Ebabiller ve turnalar göğün yeşil kapılarına doğru uçarlar."*

Shortly, we have applied the following list items step by step:

- ✓ To design and develop converter form to application's collection format from original format and convert collection.
- ✓ To create a new project and fill its expected informations in fields.
- ✓ To edit Turkish Extended Named Entity Hierarchy xml file if you need.
- ✓ To annotate selected document manually.
- ✓ To setup database and apply step by step.
- ✓ You can retrieve documents using boolean information retrieval techniques and notations or sql query notation.
- ✓ To create named entities rules and run them. So you can evaluate their performance.
- ✓ To create question expressions and their rules.
- ✓ To ask a question to system and process question and find answer.

4.3 Database Design

In this work, we used PostgreSQL 9.1 version as database framework hosted on localhost. For creating structure of our information retrieval system, we created .csv extension files and we import them into database using bulk insert technique. It provides us to be quick.

In our system, steps are in the following list about database operations:

- ✓ We create database tables using this form. We fill database connection information in Figure 4.12.
- ✓ We import data in doc_term_list table. It contains 10 fields such as: position, sentence, paragraph, term, char_start_pos, char_finish_pos, document, termid, id, new_termid (Figure 4.13).
- ✓ We import data in term_list and temp_doc_term tables. Term_list contains 3 fields such as termid, term, frequency and temp_doc_term contains doctermid and termlistid fields (Figure 4.14).

- ✓ We import data in posting_list table that it contains 4 fields such as id, termid, document, and position (Figure 4.15).
- ✓ We import data lastly in lexicon and lexicon_term_detail. Lexicon contains lexiconid, lexicon and type fields. Lexicon_term_detail contains lexiconid and termlistid fields (Figure 4.15).

In this application, we can use quick setup step form and create IR system more quick. This form contains all database steps. And you can test your connection using another form.

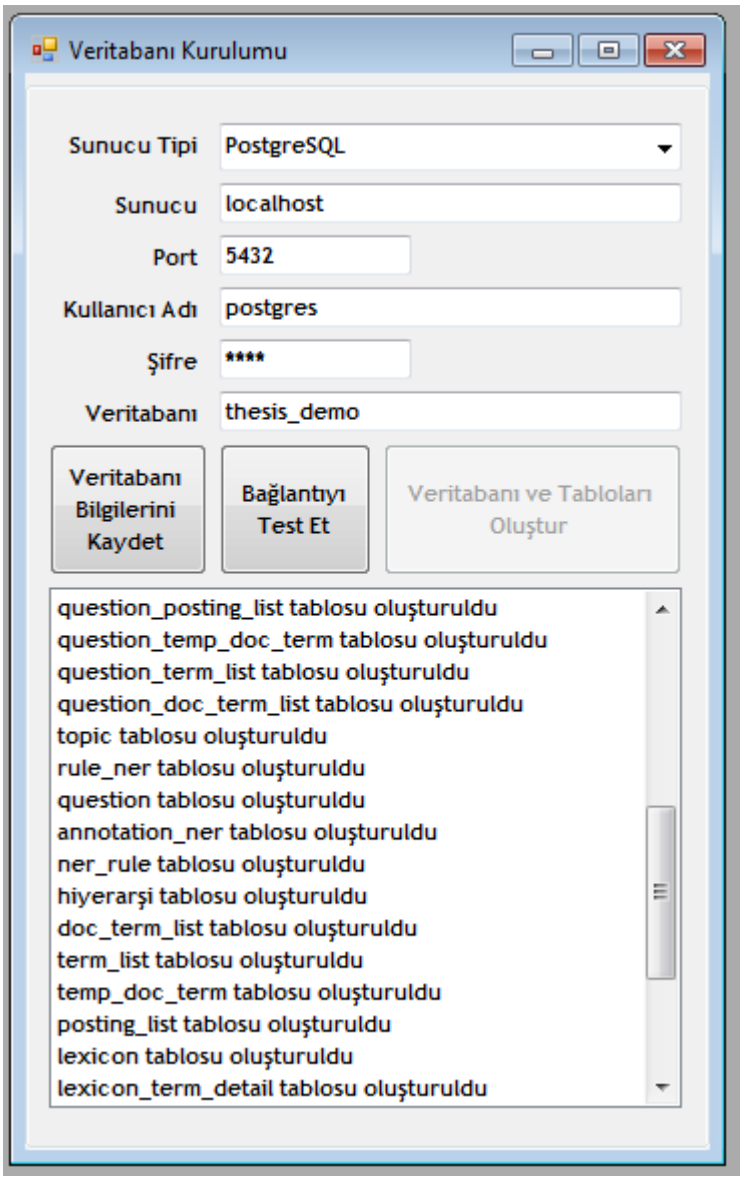

Figure 4.12 Screenshot of form for create database tables

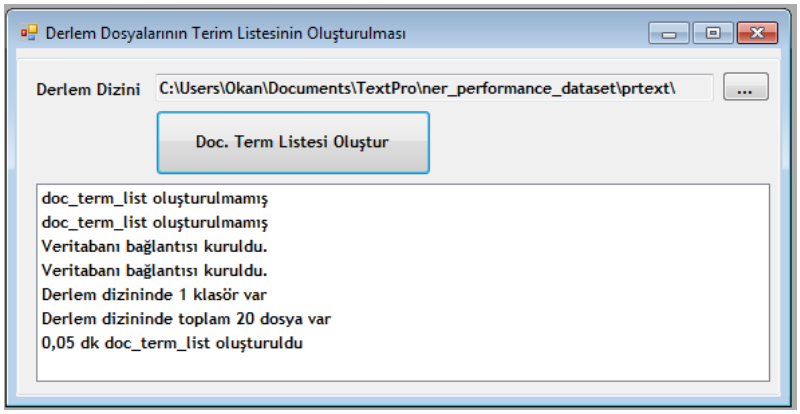

Figure 4.13 Screenshot of form for import data to doc_term_list

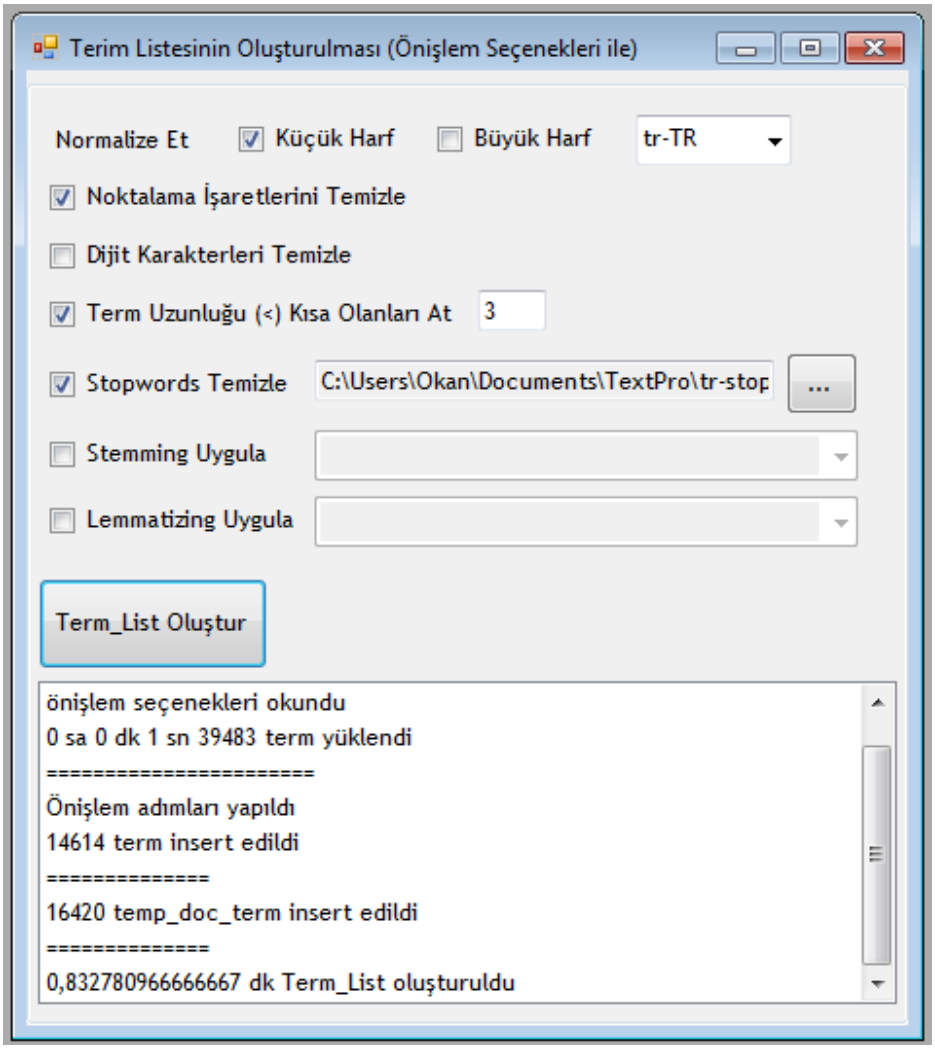

Figure 4.14 Screenshot of form for import data to term_list

a.

b.

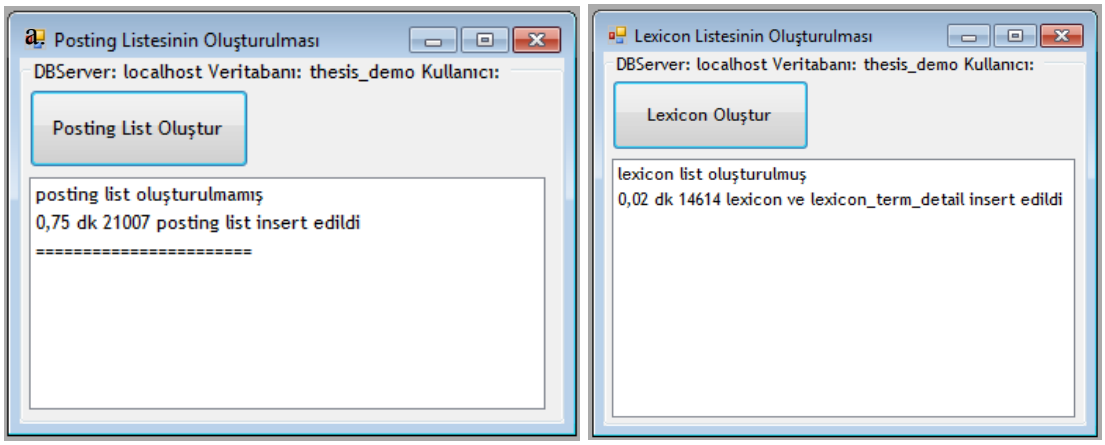

Figure 4.15 a.Screenshot of form for import data to posting_list

b. Screenshot of form for import data to lexicon and lexicon_term_detail

You can see database's entities diagram in Figure 4.16. They are the base entities and we generate objects from these entity classes. Also, we use them for boolean information retrieval system.

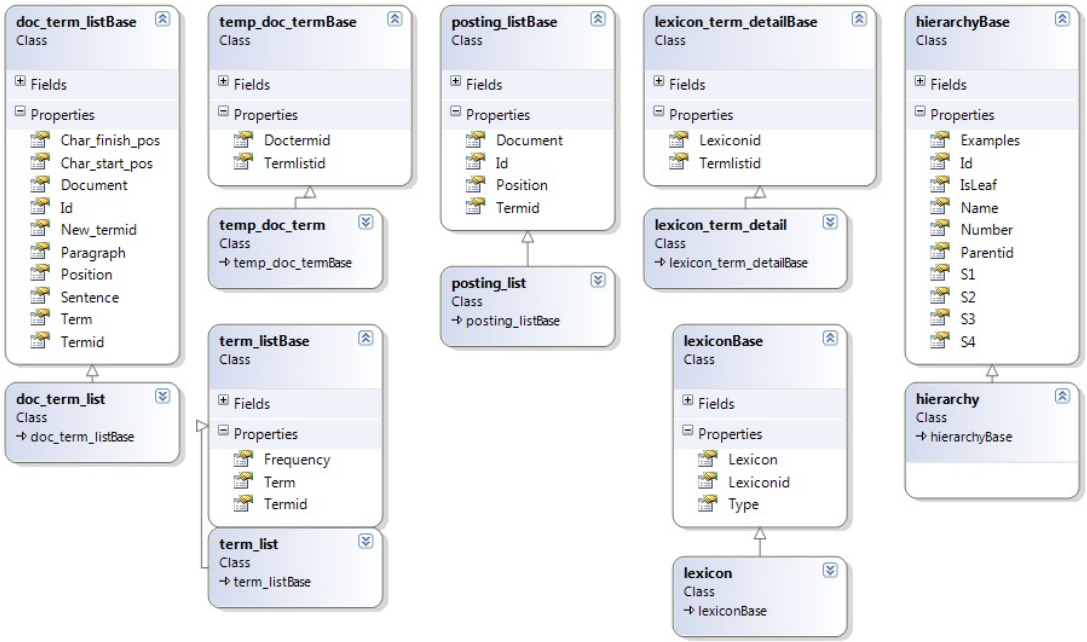

Figure 4.19 Base entities diagram in database

CHAPTER FIVE
CONCLUSIONS

The aim of this study is to design and implement question answering system for Turkish text collection. In this work, we analyzed the architecture of question answering systems in this hot research area and realized that QA systems need NER module for answering questions from relevant documents in document collection. So we need to build the architecture of information retrieval system. As a result of these needs, we decided to design named-entity based QA system. First of all, we reviewed the current NER approaches for Turkish and determined the related works common future directions for realized Turkish language. We generated a test annotated collection using extended NE hierarchy after to implemented extended NE hierarchy for Turkish language. After annotation process, we extracted some rules and created some entity dictionaries. We proposed the hybrid method using hand-made rule-based method and dictionary-based method. We evaluated to our NER module performance that our success rate of finding named entities in category of name is %38.71, in category of time is %27.59 and in category of numeric is %23.70.

Additional to this, we found NE's from a set of relevant documents so we built boolean information retrieval system architecture. Using this system, we retrieved the relevant documents for user's questions. Before of this, we executed NER module for questions. Thus, we matched the relevant documents NE's and question's NE's. We considered also the positions information using IR system such as paragraph and sentence position.

For a further search of this study to extend rules and dictionaries and also aim to apply machine-learning based approaches to our hybrid approach. Additionally, to can apply to different Turkish text collection.

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APPENDICES

A Turkish Extended Named Entity Hierarchy

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  <DEGER>Okul Sınıf İfadeleri</DEGER>
  <ORNEKLER>Birinci sınıf;ortaokul;lise;</ORNEKLER>
</KAT>
<KAT no="3.10" ust_kat_no="3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Enlem Boylam İfadeleri</DEGER>
  <ORNEKLER>30 derece enlem;130 derece batı boylamı;</ORNEKLER>
</KAT>
<KAT no="3.11" ust_kat_no="3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Ölçü İfadeleri</DEGER>
  <ORNEKLER>
  </ORNEKLER>
      <KAT no="3.11.0" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Diğer Ölçü İfadeleri</DEGER>
    <ORNEKLER>20 watt;5 desibel;yüzlerce bin kilowatt;</ORNEKLER>
  </KAT>
  <KAT no="3.11.1" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Uzunluk Ölçüsü İfadeleri</DEGER>
    <ORNEKLER>1 metre;8 santimetre;on inç;42195km;</ORNEKLER>
  </KAT>
  <KAT no="3.11.2" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Alan Ölçüsü İfadeleri</DEGER>
    <ORNEKLER>3 hektar;100 metrekare;</ORNEKLER>
  </KAT>
  <KAT no="3.11.3" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Hacim Ölçüsü İfadeleri</DEGER>
    <ORNEKLER>330 ml;5 litre;20 cc;</ORNEKLER>
  </KAT>
  <KAT no="3.11.4" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Ağırlık Ölçüsü İfadeleri</DEGER>
    <ORNEKLER>1 kilogram;6 ton;</ORNEKLER>
  </KAT>
  <KAT no="3.11.5" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Hız Ölçüsü İfadeleri</DEGER>
    <ORNEKLER>100 km/sa;saatte 100 mil;</ORNEKLER>
  </KAT>
```

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 <KAT no="3.11.6" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Yoğunluk Ölçüsü İfadeleri</DEGER>
  <ORNEKLER>
  </ORNEKLER>
 </KAT>
 <KAT no="3.11.7" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Sıcaklık İfadeleri</DEGER>
  <ORNEKLER>15 derece;-2ºC;</ORNEKLER>
 </KAT>
 <KAT no="3.11.8" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Kalori İfadeleri</DEGER>
  <ORNEKLER>2000 kalori;200kcal;</ORNEKLER>
 </KAT>
 <KAT no="3.11.9" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Sismik Yoğunluk İfadeleri</DEGER>
  <ORNEKLER>
  </ORNEKLER>
 </KAT>
 <KAT no="3.11.10" ust_kat_no="3.11" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Sismik Büyüklük İfadeleri</DEGER>
  <ORNEKLER>6 büyüklüğünde;</ORNEKLER>
 </KAT>
</KAT>
<KAT no="3.12" ust_kat_no="3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
 <DEGER>Sayısal İfadeler</DEGER>
 <ORNEKLER>
 </ORNEKLER>
     <KAT no="3.12.0" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Diğer Sayısal İfadeler</DEGER>
  <ORNEKLER>6 bardak;5371 harf;beş parmak;</ORNEKLER>
 </KAT>
 <KAT no="3.12.1" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>İnsan Sayısı İfadeleri</DEGER>
  <ORNEKLER>10 insan;5 üye;sekiz adam;</ORNEKLER>
 </KAT>
 <KAT no="3.12.2" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Kurum Sayısı İfadeleri</DEGER>
  <ORNEKLER>30 şirket;5 grup;iki parti;</ORNEKLER>
 </KAT>
 <KAT no="3.12.3" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Yer Sayısı İfadeleri</DEGER>
  <ORNEKLER>
  </ORNEKLER>
            <KAT no="3.12.3.0" ust_kat_no="3.12.3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
   <DEGER>Diğer Yer Sayısı İfadeleri</DEGER>
   <ORNEKLER>10 bölge;5 eyalet;81 seçim bölgesi;</ORNEKLER>
  </KAT>
  <KAT no="3.12.3.1" ust_kat_no="3.12.3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
   <DEGER>Ülke Sayısı İfadeleri</DEGER>
   <ORNEKLER>Üç ülke;29 ülke;</ORNEKLER>
  </KAT>
 </KAT>
 <KAT no="3.12.4" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Tesis Sayısı İfadeleri</DEGER>
  <ORNEKLER>10 okul;üç yüz ev;2 bina;</ORNEKLER>
 </KAT>
 <KAT no="3.12.5" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Ürün Sayısı İfadeleri</DEGER>
  <ORNEKLER>10 araba;sekiz kalem;yedi sayfa;3 tekne;</ORNEKLER>
 </KAT>
 <KAT no="3.12.6" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Olay Sayısı İfadeleri</DEGER>
  <ORNEKLER>5 toplantı;34 maç;iki konferans;</ORNEKLER>
 </KAT>
 <KAT no="3.12.7" ust_kat_no="3.12" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
  <DEGER>Doğal Nesne Sayısı İfadeleri</DEGER>
  <ORNEKLER>
  </ORNEKLER>
            <KAT no="3.12.7.0" ust_kat_no="3.12.3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
   <DEGER>Diğer Doğal Nesne Sayısı İfadeleri</DEGER>
   <ORNEKLER>6 atom;100 yumurta;</ORNEKLER>
  </KAT>
  <KAT no="3.12.7.1" ust_kat_no="3.12.3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
```

```
      <DEGER>Hayvan Sayısı İfadeleri</DEGER>
      <ORNEKLER>10 köpek;6 inek;</ORNEKLER>
     </KAT>
     <KAT no="3.12.7.2" ust_kat_no="3.12.3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
      <DEGER>Bitki Sayısı İfadeleri</DEGER>
      <ORNEKLER>Bir çiçek;4 çiçek;</ORNEKLER>
     </KAT>
    </KAT>
   </KAT>
   <KAT no="3.13" ust_kat_no="3" alt_kat_sayi="0" iliskili_kat_no="" iliski_adi="">
    <DEGER>Sırasal İfadeler</DEGER>
    <ORNEKLER>4 gün;ikinci oyun;üçüncü çocuk;büyük kız;</ORNEKLER>
   </KAT>
  </KAT>
</KOK>
```

Rules

B.1 NER Rules

```
--Project Rules
1="* ada"#1.4.4.2#Ada İsimleri
2="* gram*"#3.11.4#Ağırlık Ölçüsü İfadeleri
3="* kilo*"#3.11.4#Ağırlık Ölçüsü İfadeleri
4="* kilogram*"#3.11.4#Ağırlık Ölçüsü İfadeleri
5="* ton*"#3.11.4#Ağırlık Ölçüsü İfadeleri
6="* aile*"#1.3.3#Aile İsimleri
7=*oloji*#1.6.5.3#Akademi İsimleri
8=*olojik*#1.6.5.3#Akademi İsimleri
9="* bilimler*"#1.6.5.3#Akademi İsimleri
10=*bilimler*#1.6.5.3#Akademi İsimleri
11="* mühendisliği*"#1.6.5.3#Akademi İsimleri
12=*fizik*#1.6.5.3#Akademi İsimleri
13=*matik*#1.6.5.3#Akademi İsimleri
14="* ölçek*"#3.11.2#Alan Ölçüsü İfadeleri
15="* dönüm*"#3.11.2#Alan Ölçüsü İfadeleri
16="* kriter*"#1.6.6.1#Anlaşma Kural İsimleri
17="* sözleşme*"#1.6.6.1#Anlaşma Kural İsimleri
18="* merkezi*"#1.5.2.3#Araştırma Enstitüsü İsimleri
19=*kurmay*#1.3.7.4#Askeri Kurum İsimleri
20="* kuvvetleri*"#1.3.7.4#Askeri Kurum İsimleri
21="* komutan*"#1.3.7.4#Askeri Kurum İsimleri
22="* ordu*"#1.3.7.4#Askeri Kurum İsimleri
23="* savunma*"#1.3.7.4#Askeri Kurum İsimleri
24="* jandarma*"#1.3.7.4#Askeri Kurum İsimleri
25="* ay*"#2.2.4#Ay Periyotları
26="* ay* içeri*"#2.2.4#Ay Periyotları
27="* bin* dönüm*"#3.11.2#Alan Ölçüsü İfadeleri
28="* milyon* dönüm*"#3.11.2#Alan Ölçüsü İfadeleri
29="* araştırma* merkezi*"#3.11.2#Alan Ölçüsü İfadeleri
30="* il* jandarma*"#1.3.7.4#Askeri Kurum İsimleri
31="* silah* kuvvet*"#1.3.7.4#Askeri Kurum İsimleri
32="* ordu* komuta*"#1.3.7.4#Askeri Kurum İsimleri
33="* kuvvet* komuta*"#1.3.7.4#Askeri Kurum İsimleri
34="* hava* kuvvet*"#1.3.7.4#Askeri Kurum İsimleri
35="* ay* sür*"#1.3.7.4#Askeri Kurum İsimleri
36=*balık#1.8.1.4#Balık İsimleri
37=di(C:\Users\Okan\Documents\TextPro\dictionary\balik_isimleri.txt#1.8.1.4#Balık İsimleri
38=di(C:\Users\Okan\Documents\TextPro\dictionary\askeri_kurum_isimleri.txt#1.3.7.4#Askeri Kurum İsimleri
39=di(C:\Users\Okan\Documents\TextPro\dictionary\ada_isimleri.txt#1.4.4.2#Ada İsimleri
40="* ağaç*"#1.8.1.9#Bitki İsimleri
41=domates*#1.8.1.9#Bitki İsimleri
42=bitki*#1.8.1.9#Bitki İsimleri
43=yaprak*#1.8.2.2#Bitkilerin Bölümleri
44=kol*#1.8.2.0#Canlının Diğer Bölümleri
45=yüz*#1.8.2.0#Canlının Diğer Bölümleri
46=göz*#1.8.2.0#Canlının Diğer Bölümleri
47=gövde*#1.8.2.0#Canlının Diğer Bölümleri
48=ten*#1.8.2.0#Canlının Diğer Bölümleri
49=çıplak*#1.8.2.0#Canlının Diğer Bölümleri
50=avuç*#1.8.2.0#Canlının Diğer Bölümleri
51=saç*#1.8.2.0#Canlının Diğer Bölümleri
52=dil*#1.8.2.0#Canlının Diğer Bölümleri
53=çene*#1.8.2.0#Canlının Diğer Bölümleri
54=*parmak*#1.8.2.0#Canlının Diğer Bölümleri
55="sağ* el*"#1.8.2.0#Canlının Diğer Bölümleri
56="sol* el*"#1.8.2.0#Canlının Diğer Bölümleri
57=göğüs*#1.8.2.0#Canlının Diğer Bölümleri
58=ayak*#1.8.2.0#Canlının Diğer Bölümleri
59=kol*#1.8.2.0#Canlının Diğer Bölümleri
60=kalp*#1.8.2.0#Canlının Diğer Bölümleri
61=kalb*#1.8.2.0#Canlının Diğer Bölümleri
62=kafa*#1.8.2.0#Canlının Diğer Bölümleri
63=meme*#1.8.2.0#Canlının Diğer Bölümleri
64=bacak*#1.8.2.0#Canlının Diğer Bölümleri
65=burun*#1.8.2.0#Canlının Diğer Bölümleri
66=burnu*#1.8.2.0#Canlının Diğer Bölümleri
67=kalça*#1.8.2.0#Canlının Diğer Bölümleri
68=akciğer*#1.8.2.0#Canlının Diğer Bölümleri
```

```
69="* gazi* tepe*"#1.4.4.1#Dağ İsimleri
70=di(C:\Users\Okan\Documents\TextPro\dictionary\cografi_yer_isimleri.txt#1.4#Yer İsimleri
71="ilk* kez*"#3.5#Defasal İfadeler
72="* kere*"#3.5#Defasal İfadeler
73="* defa*"#3.5#Defasal İfadeler
74=defa*#3.5#Defasal İfadeler
75="ilk* defa*"#3.5#Defasal İfadeler
76=yatak*#1.6.17#Dekorasyon İsimleri
77=koltuk*#1.6.17#Dekorasyon İsimleri
78="yatak* örtü*"#1.6.17#Dekorasyon İsimleri
79="* dolap*"#1.6.17#Dekorasyon İsimleri
80="* kapak*"#1.6.17#Dekorasyon İsimleri
81=merdiven*#1.6.17#Dekorasyon İsimleri
82=halı*#1.6.17#Dekorasyon İsimleri
83=ayna*#1.6.17#Dekorasyon İsimleri
84=perde*#1.6.17#Dekorasyon İsimleri
85=kolye*#1.6.17#Dekorasyon İsimleri
86=bilezik*#1.6.17#Dekorasyon İsimleri
87="* takı*"#1.6.17#Dekorasyon İsimleri
88="* taş*"#1.6.17#Dekorasyon İsimleri
89="* saat*"#1.6.17#Dekorasyon İsimleri
90="* deniz*"#1.4.4.5#Deniz İsimleri
91=*deniz*#1.4.4.5#Deniz İsimleri
92="* boğaz*"#1.5.3.3#Deniz Yolu Hattı İsimleri
93=boğaz*#1.5.3.3#Deniz Yolu Hattı İsimleri
94="* deprem*"#1.7.3.2#Deprem Olayları
95="* dergi*"#1.6.4.2#Dergi İsimleri
96="* kral*#1.3.7.1#Devlet İsimleri
97="* imparator*"#1.3.7.1#Devlet İsimleri
98="* hükümet*"#1.3.7.1#Devlet İsimleri
99="* devlet*"#1.3.7.1#Devlet İsimleri
100=*çarşı*#1.4.6#Adres İsimleri
101="* meydan*"#1.4.6#Adres İsimleri
102=di(C:\Users\Okan\Documents\TextPro\dictionary\gün_ay_yil_isimleri.txt#2#Zamansal İfadeler
103=di(C:\Users\Okan\Documents\TextPro\dictionary\ülke_il_ilce_isimleri.txt#1.4.2#Devlet Bölgeleri
104="* mevkii*"#1.4.3.0#Diğer Bölge İsimleri
105=*organizma#1.8.1.0#Diğer Canlı Nesne İsimleri
106=*köy#1.4.2.0#Diğer Devlet Bölgeleri
107=*tepe#1.4.2.0#Diğer Devlet Bölgeleri
108=*dağ#1.4.2.0#Diğer Devlet Bölgeleri
109=*dere#1.4.2.0#Diğer Devlet Bölgeleri
110=di(C:\Users\Okan\Documents\TextPro\dictionary\dil_isimleri.txt#1.6.8.1#Ulusal Dil İsimleri
111=di(C:\Users\Okan\Documents\TextPro\dictionary\kita_bolge_isimleri.txt#1.4.3.1#Kıtasal Bölge İsimleri
112="sismik* hareket*"#1.7.0#Diğer Olay İsimleri
113=nikotin*#1.8.0#Diğer Doğal Nesneler
114=hücre*#1.8.0#Diğer Doğal Nesneler
115="* mezhep*"#1.3.4.0#Diğer Etnik Grup İsimleri
116="* mezheb*"#1.3.4.0#Diğer Etnik Grup İsimleri
117="* kolu*"#1.3.4.0#Diğer Etnik Grup İsimleri
118="* hastalık*"#1.5.3.0#Diğer Hat İsimleri
119="* hastalığ*"#1.5.3.0#Diğer Hat İsimleri
120="* enfeksiyon*"#1.5.3.0#Diğer Hat İsimleri
121="* ağrı*"#1.5.3.0#Diğer Hat İsimleri
122="* bağımlı*"#1.5.3.0#Diğer Hat İsimleri
123=di(C:\Users\Okan\Documents\TextPro\dictionary\hastalik_isimleri.txt#1.5.3.0#Diğer Hat İsimleri
124="* yolu*"#1.5.3.0#Diğer Hat İsimleri
125="* fayı*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
126="* boğaz*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
127="* okyanus*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
128="* çıkışı*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
129="* kuşağı*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
130="* ovası*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
131="* kıyı ötesi*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
132="* baraj*"#1.4.4.0#Diğer Jeolojik Bölge İsimleri
133="* kanun*"#1.6.6.2#Hukuk Kural İsimleri
134="* yasa*"#1.6.6.2#Hukuk Kural İsimleri
135="* bakanlığı*"#1.3.0#Diğer Kurum İsimleri
136="* sandığı"#1.3.0#Diğer Kurum İsimleri
137="* birliği*"#1.3.0#Diğer Kurum İsimleri
138="* belediyesi"#1.3.0#Diğer Kurum İsimleri
139="* encümen*"#1.3.0#Diğer Kurum İsimleri
140="* başsavcılığı*"#1.3.0#Diğer Kurum İsimleri
141="* mahkemesi*"#1.3.0#Diğer Kurum İsimleri
```

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142="* teşkilatı*"#1.3.0#Diğer Kurum İsimleri
143="* kurulu*"#1.3.0#Diğer Kurum İsimleri
144="* müdürlüğü*"#1.3.0#Diğer Kurum İsimleri
145="* komisyonu*"#1.3.0#Diğer Kurum İsimleri
146="* hakimliği*"#1.3.0#Diğer Kurum İsimleri
147="* bankası*"#1.3.0#Diğer Kurum İsimleri
148="* dairesi*"#1.3.0#Diğer Kurum İsimleri
149="* tiyatrosu*"#1.3.0#Diğer Kurum İsimleri
150="* tiyatroları*"#1.3.0#Diğer Kurum İsimleri
151="* dönemi*"#1.7.0#Diğer Olay İsimleri
152="* çağı*"#1.7.0#Diğer Olay İsimleri
153="* sendromu*"#1.7.0#Diğer Olay İsimleri
154="* zirvesi*"#1.7.0#Diğer Olay İsimleri
155="* olayı*"#1.7.0#Diğer Olay İsimleri
156="* toplantısı*"#1.7.0#Diğer Olay İsimleri
157="* sorunu*"#1.7.0#Diğer Olay İsimleri
158="* seçimi*"#1.7.0#Diğer Olay İsimleri
159="* turnesi*"#1.7.0#Diğer Olay İsimleri
160="* namazı*"#1.7.0#Diğer Olay İsimleri
161="* belediye* seçimi*"#1.7.1.0#Diğer Sırasal Olaylar
162="* genel* seçimi*"#1.7.1.0#Diğer Sırasal Olaylar
163="*a kadar*"#2.2.0#Diğer Periyot İfadeleri
164="*e kadar*"#2.2.0#Diğer Periyot İfadeleri
165="birkaç* *"#2.2.0#Diğer Periyot İfadeleri
166="* dönem*"#2.2.0#Diğer Periyot İfadeleri
167="* günlük*"#2.2.0#Diğer Periyot İfadeleri
168="* günlerde*"#2.2.0#Diğer Periyot İfadeleri
169="* sürede*"#2.2.0#Diğer Periyot İfadeleri
170="* vade*"#2.2.0#Diğer Periyot İfadeleri
171=meclis*#1.3.7.0#Diğer Politik Organizasyon İsimleri
172=tbmm*#1.3.7.0#Diğer Politik Organizasyon İsimleri
173="* başkanlığı*"#1.3.7.0#Diğer Politik Organizasyon İsimleri
174="* bakanlığı*"#1.3.7.0#Diğer Politik Organizasyon İsimleri
175="* kurulu*"#1.3.7.0#Diğer Politik Organizasyon İsimleri
176="* renk*"#1.10.0#Diğer Renk İsimleri
177="* reng*"#1.10.0#Diğer Renk İsimleri
178=di(C:\Users\Okan\Documents\TextPro\dictionary\sayisal_isimler.txt#3#Numerik İfadeler
179="* gösterileri*"#1.7.1.0#Diğer Sırasal Olaylar
180="* seçimleri*"#1.7.1.0#Diğer Sırasal Olaylar
181="* sınavları*"#1.7.1.0#Diğer Sırasal Olaylar
182=*spor*#1.3.5.0#Diğer Spor Organizasyonu İsimleri
183="* derneği*"#1.3.6.0#Diğer Şirket İsimleri
184="* vakfı*"#1.3.6.0#Diğer Şirket İsimleri
185="* kulübü*"#1.3.6.0#Diğer Şirket İsimleri
186="* sendikası*"#1.3.6.0#Diğer Şirket İsimleri
187="* sancağı*"#1.5.0#Diğer Tesis İsimleri
188="* bürosu*"#1.5.0#Diğer Tesis İsimleri
189="* çiftliği*"#1.5.0#Diğer Tesis İsimleri
190="* villası*"#1.5.0#Diğer Tesis İsimleri
191=di(C:\Users\Okan\Documents\TextPro\dictionary\meslek_isimleri.txt#1.6#Ürün İsimleri
192="* bahçesi*"#1.4.0#Diğer Yer İsimleri
193="* çarşısı*"#1.4.0#Diğer Yer İsimleri
194="* kalesi*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
195="* surları*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
196="* cezaevi*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
197="* büyükelçiliği*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
198="* bürosu*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
199="* konutu*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
200="* şehitliği*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
201="* mezarlığı*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
202="* şubesi*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
203="* kulesi*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
204="* gece*"#2.1.0#Diğer Zaman İfadeleri
205="hemen* şimdi*"#2.1.0#Diğer Zaman İfadeleri
206="*den sonra*"#2.1.0#Diğer Zaman İfadeleri
207="*dan sonra*"#2.1.0#Diğer Zaman İfadeleri
208=di(C:\Users\Okan\Documents\TextPro\dictionary\din_irk_mezhep_isimleri.txt#1.6.5.2#Din İsimleri
209=di(C:\Users\Okan\Documents\TextPro\dictionary\renk_isimleri.txt#1.10.1#Doğal Renk İsimleri
210="* lokantası*"#1.5.2.9#Eğlence Alanı İsimleri
211="* restorantı*"#1.5.2.9#Eğlence Alanı İsimleri
212="*nci paralel*"#3.10#Enlem Boylam İfadeleri
213="*ncı paralel*"#3.10#Enlem Boylam İfadeleri
214="*nci enlem*"#3.10#Enlem Boylam İfadeleri
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215="*ncı enlem*"#3.10#Enlem Boylam İfadeleri
216="*ncı boylam*"#3.10#Enlem Boylam İfadeleri
217="*nci boylam*"#3.10#Enlem Boylam İfadeleri
218="* gazetesi*"#1.6.4.1#Gazete İsimleri
219=cüzdan*#1.6.11#Giyecek İsimleri
220=saat*#1.6.11#Giyecek İsimleri
221=gömlek*#1.6.11#Giyecek İsimleri
222=çizme*#1.6.11#Giyecek İsimleri
223="* gölü*"#1.4.4.4#Göl İsimleri
224="* bin* metreküp*"#3.11.3#Hacim Ölçüsü İfadeleri
225="* metreküp*"#3.11.3#Hacim Ölçüsü İfadeleri
226="* milyon* metreküp*"#3.11.3#Hacim Ölçüsü İfadeleri
227="* hafta*"#2.2.0#Diğer Periyot İfadeleri
228="* haftalık*"#2.2.0#Diğer Periyot İfadeleri
229="merkez sağ*"#1.6.5.5#Stil İsimleri
230="merkez sol*"#1.6.5.5#Stil İsimleri
231="milli görüş*"#1.6.5.5#Stil İsimleri
232="radikal sağ*"#1.6.5.5#Stil İsimleri
233=liberal*#1.6.5.5#Stil İsimleri
234=kemalist*#1.6.5.5#Stil İsimleri
235=cumhuriyet*#1.6.5.5#Stil İsimleri
236=komunist*#1.6.5.5#Stil İsimleri
237="sosyal demokrat*"#1.6.5.5#Stil İsimleri
238="* havaalanı*"#1.5.2.14#Havaalanı İsimleri
239="* projesi*"#1.6.19#Hizmet İsimleri
240="* yasası*"#1.6.6.2#Hukuk Kural İsimleri
241="* kanunu*"#1.6.6.2#Hukuk Kural İsimleri
242=anayasa*#1.6.6.2#Hukuk Kural İsimleri
243="* yasağı*"#1.6.6.2#Hukuk Kural İsimleri
244="* camii*"#1.5.2.11#İbadet Yeri İsimleri
245="* krem*"#1.6.13#İlaç İsimleri
246=di(C:\Users\Okan\Documents\TextPro\dictionary\ilac_isimleri.txt#1.6.13#İlaç İsimleri
247=di(C:\Users\Okan\Documents\TextPro\dictionary\insan_isimleri.txt#1.1#İnsan İsimleri
248="* kişi*"#3.12.1#İnsan Sayısı İfadeleri
249="* nüfuslu*"#3.12.1#İnsan Sayısı İfadeleri
250="* kadar insan*"#3.12.1#İnsan Sayısı İfadeleri
251="* milyon insan*"#3.12.1#İnsan Sayısı İfadeleri
252="* çocuk*"#3.12.1#İnsan Sayısı İfadeleri
253="* çocuğu"#3.12.1#İnsan Sayısı İfadeleri
254="* bin kişi*"#3.12.1#İnsan Sayısı İfadeleri
255="* müziği*"#1.6.3.5#Müzik İsimleri
256="* üniversitesi*"#1.5.2.1#Okul İsimleri
257="* fakültesi*"#1.5.2.1#Okul İsimleri
258="* liseleri*"#1.5.2.1#Okul İsimleri
259=di(C:\Users\Okan\Documents\TextPro\dictionary\universite_isimleri.txt#1.5.2.1#Okul İsimleri
260="* süreç*"#3.12.6#Olay Sayısı İfadeleri
261="* büyüklük*"#3.12.6#Olay Sayısı İfadeleri
262="* dönem*"#3.12.6#Olay Sayısı İfadeleri
263=dolar*#1.6.9.1#Para Birimi İsimleri
264=lira*#1.6.9.1#Para Birimi İsimleri
265=euro*#1.6.9.1#Para Birimi İsimleri
266=tl#1.6.9.1#Para Birimi İsimleri
267="isviçre frankı*"#1.6.9.1#Para Birimi İsimleri
268="türk lira*"#1.6.9.1#Para Birimi İsimleri
269="* bin dolar*"#3.1#Parasal İfadeler
270="* milyon kuruş*"#3.1#Parasal İfadeler
271="* milyon lira*"#3.1#Parasal İfadeler
272="* milyar dolar*"#3.1#Parasal İfadeler
273="* milyon dolar*"#3.1#Parasal İfadeler
274="* trilyon lira*"#3.1#Parasal İfadeler
275="* milyar lira*"#3.1#Parasal İfadeler
276="* trilyon*"#3.1#Parasal İfadeler
277="* katrilyon lira*"#3.1#Parasal İfadeler
278="* trilyon tl*"#3.1#Parasal İfadeler
279="* bin euro*"#3.1#Parasal İfadeler
280="* milyon isviçre frank*"#3.1#Parasal İfadeler
281=kuruş*#3.1#Parasal İfadeler
282=trilyon*#3.1#Parasal İfadeler
283="* projesi*"#1.6.5.8#Plan İsimleri
284="* planı*"#1.6.5.8#Plan İsimleri
285="* yaklaşımı*"#1.6.5.8#Plan İsimleri
286=beşiktaş*#1.3.5.0#Diğer Spor Organizasyonu İsimleri
287=galatasaray*#1.3.5.0#Diğer Spor Organizasyonu İsimleri
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288=fenerbahçe*#1.3.5.0#Diğer Spor Organizasyonu İsimleri
289="* yildizli otel*"#3.3#Puansal İfadeler
290="* puan*"#3.3#Puansal İfadeler
291="* reyting*"#3.3#Puansal İfadeler
292="* izlenme payı*"#3.3#Puansal İfadeler
293="* dakika*"#2.2.1#Saat Periyotları
294="saat *"#2.2.1#Saat Periyotları
295="* saniye*"#2.2.1#Saat Periyotları
296="* civarında*"#2.2.1#Saat Periyotları
297="* saat*"#2.2.1#Saat Periyotları
298="* savaşı*"#1.7.2.1#Savaş Olayları
299="* operasyonu*"#1.7.2.1#Savaş Olayları
300="* numaralı*"#3.13#Sırasal İfadeler
301="* sayılı*"#3.13#Sırasal İfadeler
302="* bölüm*"#3.13#Sırasal İfadeler
303="* maddesi*"#3.13#Sırasal İfadeler
304="* fıkrası*"#3.13#Sırasal İfadeler
305="* şartı*"#3.13#Sırasal İfadeler
306="* hamle*"#3.13#Sırasal İfadeler
307="* derece*"#3.13#Sırasal İfadeler
308="* kademe*"#3.13#Sırasal İfadeler
309="* durağı*"#3.13#Sırasal İfadeler
310="* partisi*"#1.3.7.2#Siyasi Parti İsimleri
311=di(C:\Users\Okan\Documents\TextPro\dictionary\siyasi_parti_isimleri.txt#1.3.7.2#Siyasi Parti İsimleri
312="* bankası*"#1.3.6.1#Şirket İsimleri
313="* yatırım*"#1.3.6.1#Şirket İsimleri
314=*bank#1.3.6.1#Şirket İsimleri
315="* holding*"#1.3.6.2#Şirketler Grubu İsimleri
316="* grubu*"#1.3.6.2#Şirketler Grubu İsimleri
317="* grup*"#1.3.6.2#Şirketler Grubu İsimleri
318="allah allah*#1.2#Tanri İsimleri
319=allah*#1.2#Tanri İsimleri
320="* yılında*"#2.1.2#Tarih İfadeleri
321="* tarihinde*"#2.1.2#Tarih İfadeleri
322="* yılından beri*"#2.2.2#Tarih Periyotları
323="* yılları arasında*"#2.2.5#Yıl Periyotları
324="* başlarında*"#2.2.2#Tarih Periyotları
325="* fabrika*"#3.12.4#Tesis Sayısı İfadeleri
326="* treni*"#1.6.1.2#Tren İsimleri
327="* örgütü*"#1.3.1#Ulusal Organizasyon İsimleri
328="* fonu*"#1.3.1#Ulusal Organizasyon İsimleri
329="* birliği*"#1.3.1#Ulusal Organizasyon İsimleri
330="* parlemantosu*"#1.3.1#Ulusal Organizasyon İsimleri
331="* milletler*"#1.3.1#Ulusal Organizasyon İsimleri
332="* metre*"#3.11.1#Uzunluk Ölçüsü İfadeleri
333="* kilometre*"#3.11.1#Uzunluk Ölçüsü İfadeleri
334="* bin metre*"#3.11.1#Uzunluk Ölçüsü İfadeleri
335="* santim*"#3.11.1#Uzunluk Ölçüsü İfadeleri
336="* km*"#3.11.1#Uzunluk Ölçüsü İfadeleri
337="* yakınları*"#1.4.3.2#Ülke İçi Bölge İsimleri
338="* mevkii*"#1.4.3.2#Ülke İçi Bölge İsimleri
339="* kesimleri*"#1.4.3.2#Ülke İçi Bölge İsimleri
340="* bölgesi*"#1.4.3.2#Ülke İçi Bölge İsimleri
341="* topraklar*"#1.4.3.2#Ülke İçi Bölge İsimleri
342="tek bir *"#3.12.5#Ürün Sayısı İfadeleri
343="birkaç *"#3.12.5#Ürün Sayısı İfadeleri
344="* milyon* adet*"#3.12.5#Ürün Sayısı İfadeleri
345="* yaşın*"#3.8#Yaş İfadeleri
346="* yaşların*"#3.8#Yaş İfadeleri
347="* yüzyıl*"#2.2.0#Diğer Periyot İfadeleri
348="yüzde* *"#3.4#Yüzdesel İfadeler
349="* tesis*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
350="* köşk*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
351="* daire*"#1.5.2.0#Diğer Yerleşmiş Tesis İsimleri
352="* yaşın*"#3.8#Yaş İfadeleri
353="* km*"#3.11.1#Uzunluk Ölçüsü İfadeleri
354="* örgütü*"#1.3.1#Ulusal Organizasyon İsimleri
355="* fonu*"#1.3.1#Ulusal Organizasyon İsimleri
356="* birliği*"#1.3.0#Diğer Kurum İsimleri
357=ilahe*#1.2#Tanri İsimleri
358=illallah*#1.2#Tanri İsimleri
359=di(C:\Users\Okan\Documents\TextPro\dictionary\makam_unvan_isimleri.txt#1.6.7.1#Makam Ünvan İsimleri
360="binde *"#3.4#Yüzdesel İfadeler
```

B.2 Question Expression Rules

--Project Query Expressions

1#nerede#nered*;neres*;nerel*;nerd*;nerey*#Kurum İsimleri;Yer İsimleri;Tesis İsimleri;Enlem Boylam İfadeleri;Diğer İsimler;#1.3;1.4;1.5;3.10;1.0;

2#ne zaman#"ne zaman*";"saat kaç*";"kaç* beri*";"hangi gün*";"hangi hafta*";"hangi ay*";"hangi yıl*";"ne zaman* beri*";"kaç yıl*"#Zaman İfadeleri;Periyot Ifadeleri;Diğer Zamansal İfadeler;Diğer İsimler;#2.1;2.2;2.0;1.0;

3#kim#kim*;"adı* nedir*";"soyadı* nedir*";hangi*#Diğer İsimler;İnsan İsimleri;Tanri İsimleri;Doğal Nesne İsimleri;#1.0;1.1;1.2;1.8;

4#nasıl#nasıl*#Ürün İsimleri;Olay İsimleri;#1.6;1.7;

5#ne#"* nedir*";"kaç rekât*";ne;nedi?#Renk İsimleri;Hastalık İsimleri;Doğal Nesne İsimleri;Diğer Numerik İfadeler;Parasal İfadeler;Stoksal İfadeler;Puansal İfadeler;Yüzdesel İfadeler;Defasal İfadeler;Frekans İfadeleri;Aşama İfadeleri;Yaş İfadeleri;Okul Sınıf İfadeleri;#1.10;1.9;1.8;3.0;3.1;3.2;3.3;3.4;3.5;3.6;3.7;3.8;3.9;

6#neden#neden*;niçin*;niye*##

C Structure of CES Tags