SEMANTIC WEB: INFORMATION RETRIEVAL FROM WORLD WIDE WEB

Javad Pashaei Barbin[1] and Isa Maleki[2]

[1,2] Department of Computer Engineering, Naghadeh Branch, Islamic Azad University, Naghadeh, Iran

ABSTRACT

The large amount of information on web has led to impossible accurate search and integration of the information. One of the attractive procedures for facing the redundancy of information is the Semantic Web (SW). So, to structuring the information, improving the searches and presenting the meaning of the information, a technology is needed to create relationship between the existing information in the World Wide Web (WWW) and find the clear meaning among them. SW has meaningful relationship among information and is able to revolute the Information Retrieval (IR) method in web environment. SW is the development of the existing web by equipping it with the semantic cognitive elements and content mining, and then a combination of the continuous and accurate information will be produced. The SW creates a procedure by which information will be understandable for the machines. It is possible to suppose the SW as an effective way for presenting information in the web or as a global and universal link to the information database. In the web environment, there is need for a tool for integration of the information and techniques for processing the information because of the non-heterogeneous and non-concentrated information resources. Ontology is a suitable solution for fast and right access to the common information. SW uses the ontology via providing the conceptual and relational structure and makes possible the information be accessed by the users and be smartly retrieved. We in this paper to characteristics, advantages, architecture and problems of the SW and need implement it in the WWW.

KEYWORDS

Semantic Web, Ontology, Information Retrieval, World Wide Web

1. INTRODUCTION

The increasing growth of the resources on WWW, the non-heterogeneous subject information and the high volume of the resources, the diversity of the users and the informational needs of them are of the problems which make the IR more complex day by day on the web environment [1]. Although the specifications of web environment like non-continuousness and the lack of possibility of creating relation among different information are of the most elite advantages on the web environment, but it is possible for them to lead to some problems in IR. For instance the users cannot find their needed information easily when searching the web. The number of the users and the searchers of the web increases day by day and the IR of this environment get more complex as time passes. IR in web is facing the challenges related to retrieval of the large amount

of the wanted and unwanted information and passing these challenges needs finding the ways about simplifying the searching process for all of the users [2].

Now by development of WWW and the high amount of the saved information on it, the techniques are used to retrieve the data saved on web environment and give the information of these retrieving processes to the users. Web environment is one of the biggest general information resources and is shaped by the structured and informational non-structured information [3]. Using the searching motors, there are information given to the users to conclude about the data and the logic relation between them, but when there is large amount of the data, even the master and experienced users will not be able to find the useful information among the large amount of the information [4]. So, because of the instability and the non-limited vastness of the resources in the web environment, we face large amount of information in retrieving them. When we search a text with different explanations, the results will be different in searching and different concepts will be retrieved by the search engines [5]. Because it is possible for different people to use different words explaining a same concept. But SW takes into consideration the factors like the relation of the data and tries to make the process go forward fast and have high accuracy in retrieving the data [6, 7]. SW emergence is a new revolution in accessing and retrieving the useful information on web. SW makes the automatic access to the data according to the meaning of data which could be processed by the machines, possible [8, 9].

In web environment, the saving and propagation of the information are done easily, but it is possible for the IR be not related to the needs of the users. IR is a domain concerned with the structure, analysis, organization, storage and searching. The web pages include a high amount of the structured data which are located with no format or special structure on these pages [10]. The search engines must be able to retrieve the structured data from web to present richer results to the users. In web environment, the search engines return any word which conforms to the name considered by the user. But by the daily increase of the information on web and the informational needs of the uses, the existing searching engines used for searching for information on web are not able to meet all needs of the users. So, retrieving the information from web must be structured and understandable for all users. So, the goal of SW is not to transform the web to a network of the redundant information but to a network of useful information [11, 12]. SW tries to make the IR not include the continuous resources but to make the existing concept be clear in the resources. But semantic means a meaning which could be processed by the machine. To reach the said goal, SW must balance the images and the realities of the web resources. SW is a solution in saving and retrieving problems of the data which aims the commonness of the information in web environment smartly which is not only could be understood by the human being, but could be understood by the machines [13, 14].

The most important goals of SW is to revolute the IR. Now, the IR in web environment takes place generally according to the conformity of the word or the words searched using the key words existing in the pages of the web. But the SW searches according to the subject, the relationship between the information and the type of the information. SW is the third generation of web which retrieves the web information which are related to each other to present a centered search results [15]. And this is useful and very effective in IR. So, the goal of SW is retrieving the information in a vast and efficient level which is not only very fast and accurate in retrieving the information needed for the users, but also create the possibility for automatic servicing the users by the machines in a smart way of finding the information and giving them to the searching engines to retrieve them [16, 17].

The most important challenge in a large amount of the saved information in digital web libraries is related to classification, replacing and the IR of them. Digital libraries have tried to classify, update and be accessible from the very first time they were built. In fact many of the digital libraries cannot meet the needs of the users now and are not able to search or retrieve the information efficiently. Digital libraries are a procedure for collection of scientific web and the multi-media elements of the producers. In [18] a digital meaningful library which is able in mart searching and accessing better information is designed based on SW. The specifications suggested based on SW for the digital libraries have made the IR takes place more accurately. So, using the SW in digital libraries can affect the structure and the conclusion of the information highly.

One of the applications of SW is to use it in Question Answer (QA) system. In QA system no specified grammar structure is used to ask a question. The IR in these systems takes place using the natural language process techniques. QA system is a complex form of IR which faces a large amount of the information to process the information related to a special field. The goal of QA system is the accurate retrieval of the question of the users and reducing the amount of the non-related retrieved information. Researches [19] show that using the SW, the QA system can identify or analyze the question of the users more accurately. The results of the researches show that SW could be a suitable method for searching based on with no grammar questioning and the IR of it will be more accurate.

In this paper, the effect of the SW in IR of the web environment is studied. This paper is organized as follows: In Section 2, the SW is explained; in Section 3, SW and ontology are discussed in web and finally in Section 4, we have presented the conclusion and future works to be done.

2. SEMANTIC WEB

SW is the present web is completed more. SW is suggested to create a semantic environment for the web information and also reaching the goals like searching, retrieving, combining and transferring the information in the existing web environment using the World Wide Web Consortium (W3C) [20]. There are many explanations for SW, but these three are of the most important explanations for SW [21, 22]:

- SW is a global technology for relating the information in a way to be understood or processed by the computer.
- SW is a network of the information in global scale in a way that their process is simply possible by the machines.
- SW is a technology for making the web information smart which could be processed or understood by the machines.

Web environment is important from two points of view: quality and quantity [23, 24]. From quantity point of view the amount of the information hidden in web is much more than the surface part or the clear one and from the quality point of view the information hidden in web are always valuable resources. For instance, many of the continuous electronic information bases which are present on web are not accessible to the search engines. According to this fact that the search engines are not the only way to reach the information, using the SW the hiddenness level on web must be reduced in the search engines and the utilization must be increased.

2.1. Semantic Web Architecture

In SW the layered architecture is implemented and designed in a way that any layer must be able to understand the others and process the others data [20]. In Figure (1), the SW architecture is shown.

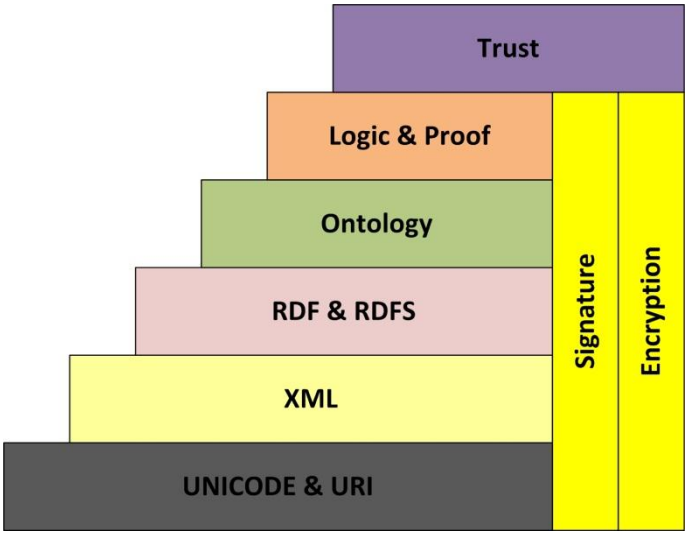

Figure 1: Semantic Web Architecture.

SW is a new architecture for WWW, which locates the concepts of the existing web with a formal and understandable meaning for the machines next to each other [20]. Different architecture layers of SW are shown in Figure (1). Any of the layers has its own responsibilities.

Unicode and Uniform Resource Identifier (URI): This layer shows the text and the sending method of them to the web environment. Also, it is possible to use this layer and make all web environment resources accessible and explainable. The HTML pages are the documents which are implemented in this layer. URI is used to identify the concepts in SW. In fact it is a kind of URI to identify the resources in web. Unicode is used to support the multi- language.

Extensible Markup Language (XML): This layer is a standard language for serializing the data using tagging and like HTML, it is script language and to some extant goes through the way [25, 26]. But it differs in this way that the information on it is saved in syntactic form and is easily accessible or to be linked. This specification makes different elements of the web pages attributed different and favored specifications.

Resource Description Framework (RDF) and RDF Schema (RDFS): RDF is a XML based language which is created to explain the concepts and create the documents in SW. And using a set of mathematic and semantic relations, it is possible to form the relation between the data in a logic way which is accessible directly [27]. RDF documents are able to explain the words in a way that it is understandable to the machine. Now, the different languages are used for presenting the contents of the web pages like HTML and XML. These languages all have some shortages in presenting the structure of the semantic of the documents and could not be used in ontologies. So,

the standard languages are created in web for coding, opening and relating the data. These languages are logic based, frame based or web based [28], and the W3C has developed the RDF language in this way. RDF is a language for coding the existing information in the web pages which uses the XML language for explaining the resources and is a new base for processing the metadata. The use of this model is much seen in creation of metadata. The metadata can create a link between the textual information in the documents and concepts in the ontology. Metadata can also be used to create a link between the information in the document and instances of the concepts. These instances are stored in a knowledgebase. Thus the ontology bears the same relationship to the knowledgebase as a relational database schema bears to the information in the database.

Ontology: Ontologies are of the SW layers and the base columns of it. Ontology is the main and basic element for SW. SW links the real world meaning understandable by the human being to the web environment. In SW, the relationship between the existing concepts in the web documents and ontology is identified [30]. Machines will be able to understand and process the documents using ontologies and will be able to create relationship between them [31]. So, the main parts of the SW are the ontologies which create relationship between the documents tags of the SW and real things which explain the said documents [32]. This layer plays an important role in SW structure. Also, creation of common understanding about the words used in special web fields is the responsibility of the ontology. In other words, ontology identifies the relation between the concepts in web documents and the real world. By this way the documents will be understood or processed by the machines and the sharing of the data will be easier. In web, the ontologies provide a common concept of the domains. Such common understanding is needed for solving the multi-meaning problem because two applicative programs may use two different words for a same meaning or vice versa. In fact ontologies create semantic relation. So, ontology creates a common understanding of a domain for making the relationships easier between people and the non-heterogeneous and distributed systems on web [33].

Ontology is a conceptual model which models the real entities in a special domain and the relationship between them formally and clearly. Using the ontology in SW leads to structural organization of information and provides a suitable format among the information. Also, using ontology not only leads to identification of the information elements, but also contributes identification of the explanations in different sciences. So, ontology is a method for organizing the information and improving the retrieving process in web environment. The language of ontology is Ontology Web Language (OWL). OWL could be used as the presentation and description language of the formal concepts in ontology [34]. This language identifies the formal methods for utilizing and processing the meanings besides symbolic presentation of them. In this language the search and discovering the relations between the concepts, finding the incompatibilities in ontology, processing the information inside the documents take place easily. This language could be used for presenting the clear meaning of the words and the relationship between them. The huge increase in the amount and complexity of reachable information in the WWW caused an excessive demand for tools and techniques that can handle data semantically. The current practice in information retrieval mostly relies on keyword-based search over full-text data, which is model as a bag-of-words. However, such a model misses the actual semantic information of the text. In order to deal with this issue, ontologies are proposed [35] for knowledge representation, which are nowadays the backbone of SW applications. Both the information extraction and IR processes can benefit from such metadata, which gives semantics to plain text.

Logic: Logic layer creates a defined format and standard regulations for the search engines which are responsible to produce the final information in SW. This layer which is located up to the ontology layer is used to explain the understandable words in machine level. In ontology layer, search machine can understand the SW base concepts. So, to improve the power of semantic processing of the search engines, the logic layer is used.

Proof: Regulations proof means that the machines must lay on them retrieving the information in large amount of the information. These regulations are in fact scripts and the software programs.

Trust: One of the goals of SW is to reach trust. As in SW the search operation takes place using the search engines, the users must have the sense of reliability about the security, correction and quality of saving and retrieving the information. This layer is very important in online shopping from security and trust points of view.

2.2. Advantages of Semantic Web

Searching techniques in existing web are focused on finding the documents via key words in contrast to SW and the semantic relations among the resources are ignored. Some of the SW advantages are as follows [36, 37 and 38].

- Expanding the searching and picturing the relations between the explanations
- Automation of the questioning in searches
- Classification of the subjects according to the searching of the information of the users
- Solving the problems of keywords search
- Creating a semantic structure in a special field and the relationship among them
- Simplifying the discovery and retrieval of the resources process
- Supporting the structured learning and presentation of the information
- The languages and the standards of SW are more advanced and complete than HTML.
- Intelligent retrieval of the information in a formal and meaningful format

In SW, like the present web HTTP protocol is used for transferring the data but XML is used instead of HTML language. URI is used instead of URL to identify the resources. In SW it is tried to explain all information according to the specifications. And this causes simplifying the process and retrieval of the information. In Figure (2) the IR system from web environment based on SW is presented.

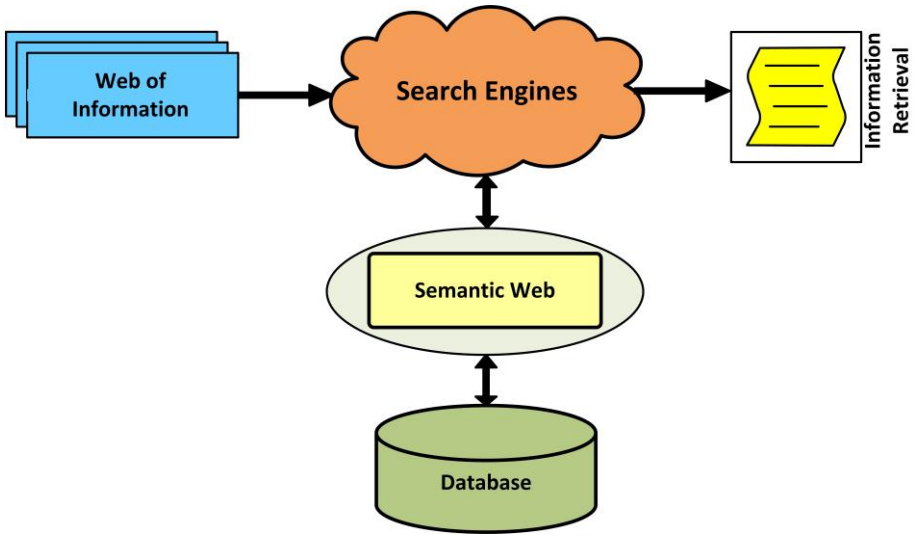

Figure 2: IR from web environment base on SW

The main factor of development and growth of SW is production of ontology in different domains. Production of ontology is usually time-consuming, with error and dependent to the information of engineering the domains in a special field. One of the main problems in ontology production is accessing the valid and complete words. In [39] using the web pages sampling method, the natural language process the statistical analysis and the IR techniques an ontology is suggested. The main goal of it is to create a large set of words and the basic concepts in an automatic manner which makes ontology production easier and fast. So the web pages retrieval related to the search of the users is utilized using a crawler based on the words of the ontology. The behavior of the crawler is generally similar to the crawler of the search engines but it differs in this point that when the web pages are studied, if they are favorite ones it will then save it or index it, else it will not study it.

Castells et al. [40] showed how a comprehensive, personalized retrieval framework can be used to build user requirements into an ontology-based user profile. The extraction of the requirements for the ontology is achieved by applying clustering algorithms to terms in documents the user selects for viewing. The profile enhances the personalized search results in terms of precision and recall. In [41] suggested a personalized browsing method using the personal ontology that builds a user profile from the Web pages the user has visited. The similarities between the terms in Web pages and the concepts of reference ontology are calculated to define the personal ontology, which reflects the user's interests and produces moderate improvements when applied to search results. Mittal et al. [42] suggested a hybrid approach for personalized IR using the user's ontology, a dynamic user profile, and collaborative filtering. The role of the ontology is to extend the user's query and to identify the user's context as expressed in the user profile, which is divided into short-term and long-term preferences and is updated often. Moreover, the search engine can reorganize the personalized search results to be more useful since relevant documents are recommended from similar users, a list of which is generated based on a collaborative filtering algorithm.

In [43] presented a novel approach to SW search, which allows for a semantic processing of Web search queries relative to an underlying ontology, and for evaluating ontology-based complex

Web search queries that involve reasoning over the Web. Have showed how the approach can be implemented on top of standard Web search engines and ontological inference technologies. Have developed the formal model behind this approach, and we have also generalized the PageRank technique to our approach. We have then provided a technique for processing SW search queries, which consists of an offline ontological inference step and an online reduction to standard Web search queries (which can be implemented using efficient relational database technology), and we have proved it ontologically correct (and in many cases also ontologically complete). The offline inference compiles terminological knowledge into completed annotations, which have a polynomial size, can be computed in polynomial time, and are also rather small in practice. Have reported on two prototype implementations in desktop search, and provided very positive experimental results on the running time of the online query processing step, and the precision and the recall of our approach to SW search. Have also showed that SW search can be readily applied to existing Web pages without annotations.

3. DISCUSSION

Ontologies are of the SW tools. Ontology creates a method to imagine the knowledge and then the machines will be able to explain the information. In fact, ontology is an accurate explanation of a shared concept. Ontology models a domain of a knowledge using a set of primary elements like classes, specifications and relations. And by this way explanation of the data for applicative programs is produced. Very ontologies are present in different fields like medical sciences and the use of them increases day by day. As most of the ontology of SW cover each other in different areas, it is possible to use the pre-produced ontologies in building the new ones. But many of these ontologies are very big in size. It is hard to maintain these ontologies which sometimes include thousands of concepts. Also it will be difficult, costing and time consuming to mine and study the whole ontology for reuse. But it is possible to modulate the ontologies and reuse a part of the ontology which would be applicative. By this method, the complexity of ontology will be reduced and the understanding and then data management will be easier.

Ontology is a powerful tool for presenting and explaining the knowledge related to a special field in a formal and processing format by the machine. Using the ontology, it is possible to create relation between the non-heterogeneous systems and improve the mutual relation among the programs, machines and the non-heterogeneous systems. But in real it would be problematic to focus a lot on the ontology. In SW discussion, ontology is a main and basic infrastructure. If two systems use one ontology to get in relationship to each other that ontology will naturally be like a common language and a common ontology and understandable one for both systems. But taking into consideration that these two ontologies are independently and using two different perspectives, it must not be expected that they will completely conform to each other and the system the two ontologies use will simply use the other ontology. In other words, the important point is that although ontology is the solution of the non-heterogeneous systems, it will add a non-heterogeneous layer to the web. So as a result the lack of conformity between ontologies is a point which must be considered. So, if all parts of an ontology are related to a special area, they must be related to each other. This is not only needed from logic and conceptual point of view, but also some of the calculations and the explanations which are done of the ontology graph must be controlled.

Ontology description languages, inference systems and engines, as well as implementations with reasoning capabilities have been developed in order to improve IR and enable knowledge

discovery, if possible. Examining existing approaches reveals that no well established and standardized methodology is followed in general. In addition, the expressiveness achieved varies, not always fulfilling the expressiveness needs of the SW. Finally, current approaches for composing and performing intelligent queries do not seem to be satisfyingly declarative. Most of the time, the user is burdened with the task of collecting the appropriate information needed to construct the query.

Although ontology has many advantages, it could have not been developed completely in web because of these reasons.

- **Accessibility:** SW content is similar to the present web content which is created using the ontology between the concepts. So, the present web content must be transferred to the SW environment and as the information amount is large it is very difficult now to do it.
- **Expandability:** The ontologies which are usable in all domains have not been developed yet. Also the methodology and standard tools for creation of ontology are under evolution now.
- **Scalability:** No firm optimized solution for saving and indexing the SW pages and also searching the SW environment is created.
- **Instability:** The used languages in SW are under evolution. So, this makes using SW difficult.
- **Ambiguity:** There are ambiguous terms in SW for which no unique understanding is created. Combining these terms and trying to create new concepts make the situation more difficult in entrance of SW to the web environment and adds to the ambiguity.

Many struggles are taking place to overcome the said challenges and it is possible to the need for the SW to be felt more and the present web be transferred to the SW in future.

The present web enjoys large amount of the information and different users and is still presenting large amount of information to the users using the technology tools like infra-text links and keyword searching process. This means that the present technologies in the web environment are not able to make the complex searching processes to be executed in an integrate manner and simplify the information process in any way. In addition the diversity of the dispread information and the vast dispread information, the increase of the web contents and the error leading specification of the links in the web have all led to the problems in retrieving the information via searching process. Even the search engines are not able to reflect the information in web environment. So, the SW solutions must be utilized in designing the search engines for organization in sharing, transfer and retrieving the data. In SW, the structure of the data is explained in a way that makes possible the information retrieving according to the syntactic and conceptual identification, specifications and the relations among the information. On this base, SW produces the data structure and the possibility of data transfer in the fields supposed to be related.

Technology and the web capabilities in integration of information in special fields have made tools and the new situations be created for IR process. SW is a suitable tool in organization of the information, classification and the semantic relations. Ontology provides a set of the formal explanations for special concepts in special fields and defines the relations among them and is used in SW and it also creates the path to form an information base in the related fields. SW is a tool for removing the problems in keywords searching according to the semantic structure for

simplifying the discovery and retrieval, expanding the questioning, picturing the relations among words and searching the concepts. The main goal of information organization is discovering the hidden data and their links to the other data and concepts which are saved in printing texts, information bases or information databases in web. To access this hidden knowledge, the data and their links to the other data or concepts must be defined in an integrated manner. In addition to this is the increasing growth and the fast changes in the web make the useful IR face problems and have introduced mining in web process as one of the main shortages in search engines. So, to increase the IR process efficiency in search engines the SW is a good solution. Of the other needs in information organization process is to use the standard languages which provide the possibility of transferring and linking the structured information. Now, XML and RDF are trying to simplify the information in web environment.

Retrieval process of information based on SW is presented via ontology. As different information is presented in web environment, the SW is not able to retrieve the useful information automatically easily. To solve this problem and find SW services an intelligent factor named ontology must be used. In result ontology can understand the way of relations among the information.

4. CONCLUSION AND FUTURE WORKS

Web emergence is an information resource, which holds challenges and chances for retrieving the useful information. The large amount of the different information like information databases, journals, electronic resources and different documents in WWW has made information searching be an inaccessible challenge. So, although web is the most vast information resource, a big part of the information on it holds no favorite organization and finally it faces problems. Even the parts of web like continuous information databases which are organized in saving and retrieving system of themselves lack the relation with each other. IR tools like search engines are not efficient in optimized retrieval of this large amount of information. So, SW is the best method for effective management of the information and integration of information and conceptual information processing. SW has produced a solution by which needed information for the users are efficiently retrieved and the large amount of information is not faced. SW could be imagined as a global space of intelligent calculations in which the data centers, information databases or web pages or any other resources of information are located next to each other in a meaningful manner and holding the ability of understanding each other. The most important layer in SW is the ontology. Ontology produces a dynamic relation of the existing information in web resources for special fields. Ontology can retrieve a vast volume of correct and continuous information using the semantic relationships in a short time. By this paper we hope will be able to design a system in future which will be able to retrieve the information in web environment accurately and related to the search commands of the users.

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Authors

Javad Pashaei Barbin is Currently Ph.D. Candidate in Department of Computer Engineering, Islamic Azad University, Qazvin, Iran. His a Lecturer and Member of The Research Committee of The Department of Computer Engineering, Naghadeh Branch, Islamic Azad University, Naghadeh, Iran. His Interested Research Areas Are in the Software Project Scheduling Problem, Machine Learning, Data Mining and Wireless Networks.

Isa Maleki is a Lecturer of The Department of Computer Engineering, Naghadeh Branch, Islamic Azad University, Naghadeh, Iran. He received his M.Sc. degree in Department of Computer Engineering, Science and Research Branch, Islamic Azad University, West Azerbaijan, Iran, in 2013. He is a Member of Editorial Board and Review Board in Several International Journals and National Conferences. He has published over 30 papers in International journals and conference proceedings. His Interested Research Areas Are in the Machine Learning, Data Mining, Optimization and Artificial Intelligence.