INTRODUCTION:
In recent years significant progress has been achieved in the creation of e-Learning systems based on Web-Technologies. During this short period such systems have passed the way from simple hypertext textbooks and tests delivered through WWW to educational portals integrating all instructional resources within educational environment. The forms of instructional materials have been enriched substantially using multimedia technologies. The remote administration tools for instructional resources, educational organizations and their divisions have evolved.
Traditionally e-learning systems are emphasized on the content generation and most of them fail in considering the end user, while representing it. Therefore, appears the need for adaptation to the user’s interface. Adaptive e-learning refers to an educational system that understands the learning content and the user interface together. End users have unique ways of learning which may directly and indirectly affecting on the learning process and its outcome. In order to implement effective and efficient e-learning, the system should be capable not only in adapting the content of course to the individual characteristics of users but also concentrate on the adaptive user interface according to user’s requirements. Since e-learning is web-based educational systems which are capable of collecting vast amounts of user profile data, data mining and knowledge discovery techniques can be applied to find interesting relationships between attributes of users and the solution strategies adopted by users to provide recommendations through user interfaces.
Nowadays, many software platforms (Learning Space, WebCT and ToolBook) support these technologies and make possible the rapid transfer of educational content to e-Learning and asynchronous learning with customer’s choice of this process. Whilst some research has begun to examine the functionality of e-learning systems which had not concentrated on usability issues, in particular to the accessibility of complex web based interfaces. Standards for achieving accessibility via technical specifications and interface design have been established for the conventional Web, however, it remains to be seen how far e-learning systems are conforming to these standards, and where the conflicts might be between educational features and usability.
Typically e-learning of educational system provides the same resources to all users even though different users need different information according to their level of knowledge, ways of learning preferences.
Course sequencing is a technology originated in the Area of Intelligent / Adaptive Learning System with the basic aim to provide end user/user with the most suitable sequence of knowledge content to learn, and sequence of learning tasks (examples, exercise, problems, contents etc) to work with. The expansion of e-learning does not mean that existing market products and applications are obsolete. Existing e-learning systems are based on the quantity of information. They fail to consider an important factor for the success of the system, namely the user.

The adaptive user interface is basic and important requirement of e-learning systems now days, to take care of an individual user. A good user interface facilitates effective communication between the user and the software. Good design of such an interface is vital for the success of any computer application. As a result of this increasing complexity, creators of Web applications are posed with big challenges to simplify the user interfaces and help users complete their tasks with ease. Such simplification is challenging considering the diversity of users in terms of age, geography, knowledge level, and so on. An interface that is simple for one user might not be simple for another. Therefore, it is important to adapt the user interface to different types of users based on their profiles.

Adaptive user interfaces also make it easier to comply with the changing rules and regulations around access control of information. They provide more flexibility to administrators in dealing with such changes. Such adaptive interfaces can be used in a wide range of domains and in a variety of applications.

The proposed approach monitors the user’s actions and tries to identify usage patterns and accordingly adjust the interface components or content provided by the system. To accommodate such differences in user skills, knowledge and preferences are very important to understand user’s learning style. An adaptable user interface allows the user to learn different controls by providing guidance or specialized help. An intermediate alternative is a mixed initiative user interface, which allows both types of adaptation control: (i) control initiated by the user (ii) automated control provided by the system. In the proposed architecture the Adaptive User Interface emphasizes on following points with respect to e-learning:

- Create personalized environment
- Acquisition of user preferences
- Take control of task from the user
• Adaptive display management
• Reduce information overflow
• Provide help on new and complex function

To achieve above objectives it is very essential to introduce web data mining technique. Web usage mining is dealing with the extraction of knowledge from web server log files. It mines the useful behavior to define accurate user profiles for the intelligent adaptive personalized e-learning system.

2. LITERATURE REVIEW

Most of the studies in the area of web usage mining are very new, and the topic of clustering web sessions has recently become popular in the field of real application. The literature survey contain the different research on e-learning application domain with web usage mining which is useful to find the path for adaptive e-learning with user interface and contents.

1. Chun-Hui Wu et al (2017): Adaptive learning for individual learners has recently become popular in education. This study aims to fill the void in the existing literature by building an adaptive e-learning system with self-assessment rubrics based on the dynamic scaffolding theory in response to different student needs. Meanwhile, the purpose of this study is to explore the effectiveness of using adaptive e-learning with dynamic scaffoldings and rubrics in fostering students’ learning outcomes. An experimental design was conducted to evaluate learning effectiveness and learning satisfaction in the Excel(spreadsheet) of the course for using the developed adaptive e-learning system. Sixty undergraduate students from a technology university in central Taiwan participated in this experimental study and executed a pretest and a posttest. Research results revealed that the developed adaptive e-learning system can effectively support students with personalized learning materials and successfully helps students acquired knowledge and develop cognitive abilities. The results recommend that teachers could employ rubrics as a self-assessment tool for supporting students with dynamic scaffoldings to conduct a learner-centered e-learning environment. Additionally, the lack of generalizability is clearly a limitation of the present data due to a few participants. Finally, future research direction of this study was also discussed.

2. S. Ouf et al (2017): The current approaches of e-learning face challenges, in isolation of learners from learning process, and shortage of learning process quality. The researchers mentioned that the next generation of e-learning is e-learning ecosystem. E-learning ecosystem
has many advantages, in which, learners form groups, collaborate with each other and with educators, and content designed for interaction. E-learning ecosystem faces some issues. It applies teacher-student model, in which, fixed learning pathway is considered suitable for all learners. Consequently, learners are presented with limited personalized materials. E-learning ecosystem needs to merge the personalization's concept. Semantic web ontology based personalization of learning environment plays a leading role to build smart e-learning ecosystem. This paper previews a detailed study which addresses research papers that apply ontology within learning environment. Most of these studies focus on personalizing e-learning by providing learners with suitable learning objects, ignoring the other learning process components. This paper proposes and implements framework for smart e-learning ecosystem using ontology and SWRL. A new direction is proposed. This direction fosters the creation of a separate four ontology's for the personalized full learning package which is composed of learner model and all the learning process components (learning objects, learning activities and teaching methods).

3. Dr. Yogesh Kumar Sharma, et. al (2016), This paper is a mere attempt to present a glimpse of meaning of ICT, its importance & its mandatory need for education, which is indispensable. ICT stands for INFORMATION & COMMUNICATION TECHNOLOGY. These technologies include: computers, the Internet, Broadcasting technologies (radio and television), Telephony. One of the many challenges facing developing countries today is that of preparing their societies and governments for globalization and the information and communication revolution. Policy-makers, educationists, non-governmental organizations, academics, and ordinary citizens are increasingly concerned with the need to make their societies competitive in the emergent information economy. Globalization and innovations in technology have led to an increased use of ICTs in all sectors – and education is no exception. Uses of ICTs in education are widespread and are continually growing worldwide. It is generally believed that ICTs can empower teachers and learners, making significant contributions to learning and achievement. Of the teachers interviewed on the effectiveness of ICT in education majority of them felt that introduction and use of ICT adequately will be extremely effective in children's learning and achievement. However, current research on the impacts of ICTs on student achievement yields few conclusive statements, pros or con, about the use of ICTs in education. Studies have shown that even in the most advanced schools in industrialized
countries, ICTs are generally not considered central to the teaching and learning process. However, there appears to be a mismatch between methods used to measure effects and the type of learning promoted. Standardized testing, for example, tends to measure the results of traditional teaching practices, rather than new knowledge and skills related to the use of ICTs.

4. Dr. Yogesh Kumar Sharma, et. al (2016), Information and communication technology (ICT) is major backbone of Indian education system. Now days, the higher educational Institutions are using ICT based teaching and learning. Many of researchers, educators and students from the world are adapting sharply ICT in their educational life. Indian students have variety of thoughts towards ICT usage in their education. We have tried to explore the outlook difference among Indian students receiving higher education in Universities. More than five hundred students from six Universities located in Haryana and Punjab have participated in this study. This article is focusing on to find outlook difference among students towards ICT in relation to their locality and level of study. The statistically test like Z-test and T-test proves that educational standard and demography of students did not affect the outlook towards ICT awareness in higher education. This paper will support to investigators over the globe those are conducting their research on ICT awareness in higher educational institutions.

5. Dr. Yogesh Kumar Sharma, Chaman Verma (2016), Indian higher education system is being developing due to rapid Information and communication Technology (ICT) involvement. The development of Indian higher education is affected by heavily involvement of students, faculty and researcher in technological based education. To encourage the ICT based education in Indian institutions, government had taken several meticulous steps in time. Now day’s access rate and availability of ICT resources are enough in educational institutions. Thus, researcher believed to investigate the ICT awareness among educators and students involving in higher education in Indian institutions. Almost every Indian institution is encouraging and developing ICT based teaching, learning and research. This study explores the ICT awareness among students and faculty of Chandigarh University in relation to gender variable. Results of this paper are revealing significant difference between boys and girl students towards ICT awareness in relation to their gender. Findings of this paper are also proving no meaningful difference between male and female faculty members towards ICT awareness in relation to their gender. More than hundred students and eighty six faculty members have participated from various
departments of University. The findings of this research paper are beneficial and supportive lead to University administration to understand ICT awareness level in their students and faculty members.

6. Huong May Truong (2016): Learning styles which refer to students’ preferred ways to learn can play an important role in adaptive e-learning systems. With the knowledge of different styles, the system can offer valuable advice and instructions to students and teachers to optimize students’ learning process. Moreover, e-learning system which allows computerized and statistical algorithms opens the opportunity to overcome drawbacks of the traditional detection method that uses mainly questionnaire. These appealing reasons have led to a growing number of researches looking into the integration of learning styles and adaptive learning system. This paper, by reviewing 51 studies, delves deeply into different parts of the integration process. It captures a variety of aspects from learning styles theories selection in e-learning environment, online learning styles predictors, automatic learning styles classification to numerous learning styles applications.

The results offer insights into different developments, achievements and open problems in the field. Based on these findings, the paper also provides discussion, recommendations and guidelines for future researches.

7. R. Mahajan et al (2016): An important research area in education and technology is how the learners use e-learning. By exploring the various factors and relationships between them, we can get an insight into the learners’ behaviors for delivering tailored e-content required by them. Although many tools exist to record detailed navigational activities, they don’t explore the learners’ usage patterns for an adaptive e-learning site. The previous weblog data analyses, done so far, have been very limited in their scope as they lack detailed empirical results on the learning technology usage. This paper discusses the detailed results of a case study of web data mining in a specific e-learning application. The main objective of this study is to conduct research on usability and effectiveness of the e-content by analyzing the web log. For this, a suitable data set was retrieved from raw web log records, to which various web mining & statistical techniques could be applied. We have evaluated different features of e-content that can lead to better learning outcomes for the learners, by understanding their navigational behaviors, their interaction with system and their area of interest. We found, for example, what sequence of
topics were the most liked and the least liked by the learners; we also found that these patterns, lead us to hypothesize, the correlation and regression analysis between the average time, test score and total attempts.

8. **Hyungjoo Park and Hae-Deok Song (2015):** Given that a user interface interacts with users, a critical factor to be considered in improving the usability of an e-learning user interface is user-friendliness. Affordances enable users to more easily approach and engage in learning tasks because they strengthen positive, activating emotions. However, most studies on affordances limit themselves to an examination of the affordance attributes of e-learning tools rather than determining how to increase such attributes. A design approach is needed to improve affordances for e-learning user interfaces. Using Maier and Fade’s Affordance-Based Design methodology as a framework, the researchers in this study identified affordance factors, suggested affordance design strategies for the user interface, and redesigned an affordable user interface prototype. The identified affordance factors and strategies were reviewed and validated in Delphi meetings whose members were teachers, e-learning specialists, and educational researchers. The effects of the redesigned user interface on usability were evaluated by fifth-grade participating in the experimental study. The results show that affordances led users to experience positive emotions, and as a result, use the interface effectively, efficiently, and satisfactorily. Implications were discussed for designing strategies to enhance the affordances of the user interfaces of e-learning and other learning technology tools.

9. **Juan Feldman et al.(2015):** A learning style describes the attitudes and behaviors, which determine an individual’s preferred way of learning. Learning styles are particularly important in educational settings since they may help students and tutors become more self-aware of their strengths and weaknesses as learners. The traditional way to identify learning styles is using a test or questionnaire. Despite being reliable, these instruments present some problems that hinder the learning style identification. Some of these problems include students’ lack of motivation to fill out a questionnaire and lack of self-awareness of their learning preferences. Thus, over the last years, several approaches have been proposed for automatically detecting learning styles, which aim to solve these problems. In this work, we review and analyze current trends in the field of automatic detection of learning styles. We present the results of our analysis and discuss
some limitations, implications and research gaps that can be helpful to researchers working in the field of learning styles.

10. **M. Abdullah et al. (2015):** Due to growing popularity of E-Learning, personalization has emerged as important need. Differences of learners’ abilities and their learning styles have affected the learning outcomes significantly. Meanwhile, with the development of E-Learning technologies, learners can be provided more effective learning environment to optimize their performance. The purpose of this study is to determine the impact of learning styles on learner’s performance in e-learning environment, and use this learning style data to make recommendations for learners, instructors, and contents of online courses. Data analysis in this research represented by user performance gathered from an E-learning platform (Blackboard), where this user performance data is represented by actions performed by platform's users. A 10-fold cross validation was used to create and test the model, and the data was analyzed by the WEKA software. Classification accuracy, MAE, and the ROC area have been observed. The results show that the accuracy of classification by means of NBTree technique had the highest correct value at 69.697% and it could be applied to develop Felder Silverman's learning style while taking into consideration students’ preference. Moreover, students’ performance increased by more than 12%.

11. **F. Doelitzscher et. al. (2014):** It has been established through literature that, if an e-learning system could adapt to learning characteristics of learners, it will increase learning performance and content knowledge acquisition of learners. This paper is a basic research work for knowledge that lay down a foundation for application and implementation. We reviewed trends in adaptive e-learning system development, make an expository on learning-style models towards learners’ learning character and propose an Architectural model of Automatic Adaptive E-learning System (AAeLS) based on learning-style concept/models. The concept it to model an e-learning system that will automatically adapt to learning preference of users’, the system learn about users’ learning style while the user learn the material content of the system; thus the learning process in two ways, the system is learning when the user is learning. We recommend further work on implementation and testing of the model, in an applied research.
12. A. Al-Azawei and A. Badii (2014): This paper investigates the pedagogical basis of Adaptive Educational Hypermedia Systems (AEHS) that incorporate Learning Styles in order to accommodate user's learning style preferences and needs. Therefore, AES adapt the learning content, its presentation and navigation to the user's learning style preferences. We collect thirty three (33) Adaptive and Intelligent Web-based Educational Systems (AIWBES) that incorporate learning styles and discuss twenty of them, namely the AEHS, as the remaining are Intelligent Tutoring Systems. The main achievement of this work is the investigation of AEHS' pedagogical basis in terms of adaptation rules. We conclude that these systems follow similar patterns in their adaptation logic.

13. Ali Tarhini et. al (2014): The main objective of our study is to (1) empirically investigate the factors that affect the acceptance and use of e-learning in Lebanon, and (2) investigate the role of a set of individual differences as moderators(e.g., age, gender, experience, educational level) in an extended Technology Acceptance Model (TAM). A quantitative methodology approach was adopted in this study. To test the hypothesized research model, data was collected from 569 undergraduate and postgraduate students studying in Lebanon via questionnaire. The collected data were analyzed using Structural Equation Modeling (SEM) technique based on AMOS methods in conjunction with multi-group analysis. The result revealed that perceived usefulness (PU), perceived ease of use (PEOU), subjective norms (SN) and Quality of Work Life (QWL) positively affect students’ behavioral intention (BI). We also found that experience moderates the relationship between PEOU, PU and SN on e-learning use intention, and that age difference moderates the effects of PEOU, SN and QWL on BI. In addition, educational level moderates the effects of PEOU, SN on BI, and gender moderates the effects of PU, SN and QWL on BI. Contrary to expectations, a moderating role of age on the relationship between PU and BI was not found. Similarly, gender was not found to affect the relationship between PEOU and BI, and educational level did not moderate the relationship between PU or QWL and BI. In light of these findings, implications to both theory and practice are discussed.

14. M. Jafari et al. (2013): Web Usage Mining (WUM) is a kind of data mining method that can be used to discover user access patterns from Web log data. A lot of research has been done already about this area and the obtained results are used in different applications such as recommending the Web usage patterns, personalization, system improvement and business intelligence. WUM includes three phases that are called preprocessing, pattern discovery and
pattern analysis. There are different techniques for WUM that have their own advantages and disadvantages. This paper presents a survey on some of the existing WUM techniques and it is shown that how WUM can be applied to Web server logs.

15. **N. Lakshmi et al (2013):** Web has been growing as a dominant platform for retrieving information and discovering knowledge from web data. Web data is stored in web server log files. Web usage analysis or web usage mining or web log mining or click stream analysis is the process of extracting useful knowledge from web server logs, database logs, user queries, client side cookies and user profiles in order to analyze web users’ behavior. Web usage analysis requires data abstraction for pattern discovery. This data abstraction can be achieved through data preprocessing. This paper presents different formats of web server log files and how web server log data is preprocessed for web usage analysis.

16. **G. Sudhamathy and C. Jothi Venkateswaran (2011):** As more organization rely on the Internet and the World Wide Web to conduct business, the proposed strategies and techniques for market analysis need to be revisited in this context. We therefore present a survey of the most recent work in the field of Web usage mining, focusing on three different approaches towards web logs clustering. Clustering analysis is a widely used data mining algorithm which is a process of partitioning a set of data objects into a number of object clusters, where each data object shares the high similarity with the other objects within the same cluster but is quite dissimilar to objects in other clusters. In this work we discuss three different approaches on web logs clustering, analyze their benefits and drawbacks. We finally conclude on the most efficient algorithm based on the results of experiments conducted with various web log files.

17. **A.Anitha and N.Krishnan (2011):** World wide web is a huge information source, broadly used for learning now-a-days due to flexibility of time, sharing of learning resources and infrastructure etc., Most of web based learning system lacks expert-learner interaction, assessment of user activities and learners are getting drowned by huge number of web pages in the learning web site and they find difficulties in choosing suitable materials relevant to their interest. This work attempts to engage e-learners at an early stage of learning by providing navigation recommendations. E-learning personalization is done by mining the web usage data like recent browsing histories of learners of similar interest. The proposed method uses upper
approximation based rough set clustering and dynamic all $k^{th}$ order association rule mining using apriority for personalizing e-learners by providing learning shortcuts. The essence of combing association rule and clustering is that, using clustered access patterns can reduce the data set size for association rule mining task, and improves the recommendation accuracy.

18. **K.Suresh et al. (2011):** In this paper we present clustering method is very Sensitive to the initial center values, requirements on the dataset too high, and cannot handle noisy data the proposal method is using information entropy to initialize the cluster centers and introduce weighting parameters to adjust the location of cluster centers and noise problems. The navigation datasets which are sequential in nature. Clustering web data is finding the groups which share common interests and behavior by analyzing the data collected in the web servers, this improves clustering on web data efficiently using improved fuzzy c-means(FCM)clustering. Web usage mining is the application of data mining techniques to web log data repositories. It is used in finding the user access patterns from web access log. Web data Clusters are formed using on MSNBC web navigation dataset.

19. **Ondřej Takács et al. (2011):** In adaptive e-learning we try to make learning more efficient by adapting the process of learning to students’ individual needs. To make this adaptation possible, we need to know key students characteristics – his motivation, group learning preferences, sensual type and various learning styles. One of the easiest ways to measure these characteristics is to use questionnaires. New questionnaire was created because there was no questionnaire to measure all these characteristics at once. This questionnaire was filled by 500 students from different fields of study. These results were analyzed using clustering, decision tree and principal component analysis. Several interesting dependencies between students’ properties were discovered using this analysis.

20. **Mofreh A. Hogo (2010):** This paper introduces an evaluation methodologies for the e-learners’ behaviour that will be a feedback to the decision makers in e-learning system. Learner's profile plays a crucial role in the evaluation process to improve the e-learning process performance. The work focuses on the clustering of the e-learners based on their behaviour into specific categories that represent the learner's profiles. The learners' classes named as regular, workers, casual, bad, and absent. The work may answer the question of how to return bad students to be regular ones. The work presented the use of different fuzzy clustering techniques
As fuzzy c-means and kernelized fuzzy c-means to find the learners’ categories and predict their profiles. The paper presents the main phases as data description, preparation, features selection, and the experiments design using different fuzzy clustering models. Analysis of the obtained results and comparison with the real world behavior of those learners proved that there is a match with percentage of 78%. Fuzzy clustering reflects the learners’ behavior more than crisp clustering. Comparison between FCM and KFCM proved that the KFCM is much better than FCM in predicting the learners’ behaviour.

21. Behram Beldagli and Tufan Adiguzel (2010): Advancement in Internet and multimedia technologies has positively influenced the efficient use of e-learning environments while removing the time and space limitations created a convenient learning environment for e-users, having a diverse audience (different goals, knowledge levels, backgrounds or learning capabilities) forced the designers of e-learning systems to create adaptive and flexible e-learning environments with the potential of improving the learner performance. Although e-learning systems with adaptively functions have been developed to solve these flexibility problems by changing the presentation of materials to suit each individual user, they do not satisfy all adaptive related needs in theory and application. Therefore, more research and framework are needed to be able to use e-learning environments efficiently as an alternative to traditional ones. This study illustrates potential functions of an ideal adaptive e-learning with their definitions and practices.

22. U. Markowska-Kaczmar et al. (2010): This chapter contains an overview of intelligent techniques that can be applied in different stages of e-learning systems to achieve personalization. It describes examples of their application to various e-learning platforms to create profiles of learners and to define learning path. The typical approach to obtain learner’s profile is the usage one of the clustering methods, such as: the simple kmeans, Self Organizing Map, hierarchical clustering or fuzzy clustering. Classification methods like: C4.5 or C.5, k-Nearest Neighbor and Naive Bayes are also useful, but they need to define classes and training patterns by an expert. In contrary, clustering is unsupervised learning method and the categories are discovered by the method itself. The recommending system is responsible for proposing individual learning path for each learner. The most popular approach is an application of the Aprori method which searches for association rules. However, it seems that it is rather inefficient
method when the number of data to process is huge. Other methods and models that can be useful for knowledge representation are also discussed. Recommending systems are mainly built as a knowledge based. Most of them are implemented as rule based systems. An interesting approach implementing case-based reasoning paradigm to recommend learning path is described as well. The end of the chapter contains a critical discussion of existing solutions and suggests possible research in this field.

23. Elvira Popescu et al. (2010): Integrating learning styles in adaptive educational systems is a relatively recent trend in technology enhanced learning. The rationale is that adapting courses to the learning preferences of the students has a positive effect on the learning process, leading to an increased efficiency, effectiveness and/or learner satisfaction. The purpose of this paper is twofold: i) to provide an extensive review of existing learning style-based adaptive educational systems (LSAES); ii) to propose an innovative system (called WELSA), which alleviates some of the encountered limitations. Specifically, WELSA is based on: i) a comprehensive set of learning style preferences; ii) an implicit and dynamic learner modeling method; iii) a dynamic adaptation approach. The system’s architecture is presented, together with the main components responsible for its functionalities: authoring tool, data analysis tool and adaptation component. Encouraging experimental data are also reported.

24. Jyoti et al. (2009): Web usage mining has assumed importance in learning about web user’s behavior and user interactions with the website. It uses data mining techniques to discover non-trivial user behavior patterns. These patterns can then be used to make the predictions of next page to be accessed by the user. Web usage mining consists of the steps like web log preprocessing, pattern discovery and pattern analysis. This paper proposes a novel approach for preprocessing wherein rough set clustering is applied to form the clusters of sessions. These sessions could later on be used to form the knowledge base of rules on the basis of which the next page to be accessed could be pre-fetched.

25. Olfa Nasraoui et al (2009): In this paper, we present a complete framework and findings in mining Web usage patterns from Web log files of a real Website that has all the challenging aspects of real-life Web usage mining, including evolving user profiles and external data describing an ontology of the Web content. Even though the Web site under study is part of a nonprofit organization that does not “sell” any products, it was crucial to understand “who” the
users were, “what” they looked at, and “how their interests changed with time,” all of which are important questions in Customer Relationship Management (CRM). Hence, we present an approach for discovering and tracking evolving user profiles. We also describe how the discovered user profiles can be enriched with explicit information need that is inferred from search queries extracted from Web log data. Profiles are also enriched with other domain-specific information facets that give a panoramic view of the discovered mass usage modes. An objective validation strategy is also used to assess the quality of the mined profiles, in particular their adaptability in the face of evolving user behavior.

26. P. Shi (2009): The interests of web users can be revealed by their visited web pages and time duration on these web pages during their surfing. Time duration on a web page is characterized as a fuzzy linguistic variable because linguistic variable makes users easily understand the expression of time duration and can disregard subtle difference between two time durations. Each web access pattern from web logs is transformed as corresponding fuzzy web access pattern, which is a fuzzy vector composed of fuzzy linguistic variables or 0. Each element in fuzzy web access patterns represents visited web page and time duration on this web page. This paper proposed a rough k-means clustering algorithm based on properties of rough variable to group the gained fuzzy web access patterns. Finally, an example and experiment is provided to illustrate the clustering process. Using this approach, users can effectively mine web logs records to discover interesting user access patterns.

27. Resul Das and Ibrahim Turkoglu (2009): Web usage mining is to analyze web log files to discover user accessing patterns of web pages. In order to effectively manage and report on a website, it is necessary to get feedback about activity on the web servers. The aim of this study is to help the web designer and web administrator to improve the impressiveness of a website by determining occurred link connections on the website. Therefore, web log files are pre-processed and then path analysis technique is used to investigate the URL information concerning access to electronic sources. The proposed methodology is applied to the web log files in the web server of Firat University. The results and findings of this experimental study can be used by the web designer inorder to plan the upgrading and enhancement to the website.

28. Ahmad Baylari, and Gh.A. Montazer (2007): In web-based educational systems the structure of learning domain and content are usually presented in the static way, without taking into account the learners’ goals, their experiences, their existing knowledge, their ability (known
as insufficient flexibility), and without interactivity (means there is less opportunity for receiving instant responses or feedbacks from the instructor when learners need support). Therefore, considering personalization and interactivity will increase the quality of learning. In the other side, among numerous components of e-learning, assessment is an important part. Generally, the process of instruction completes with the assessment and it is used to evaluate learners’ learning efficiency, skill and knowledge. But in web-based educational systems there is less attention on adaptive and personalized assessment. Having considered the importance of tests, this paper proposes a personalized multi-agent e-learning system based on item response theory (IRT) and artificial neural network (ANN) which presents adaptive tests (based on IRT) and personalized recommendations (based on ANN). These agents add adaptively and interactivity to the learning environment and act as a human instructor which guides the learners in a friendly and personalized teaching environment.

29. Haibin Liu, Vlado Keselj (2007): We present a study of the automatic classification of web user navigation patterns and propose a novel approach to classifying user navigation patterns and predicting users’ future requests. The approach is based on the combined mining of Web server logs and the contents of the retrieved web pages. The textual content of web pages is captured through extraction of character N-grams, which are combined with Web server log files to derive user navigation profiles. The approach is implemented as an experimental system, and its performance is evaluated based on two tasks: classification and prediction. The system achieves the classification accuracy of nearly 70% and the prediction accuracy of about 65%, which is about 20% higher than the classification accuracy by mining Web server logs alone. This approach maybe used to facilitate better web personalization and website organization.

30. Sophia Petridou, et al (2007): Web users clustering is a crucial task for mining information related to users needs and preferences. Up to now, popular clustering approaches build clusters based on usage patterns derived from users’ page preferences. This paper emphasizes the need to discover similarities in users’ accessing behavior with respect to the time locality of their navigational acts. In this context, we present two time aware clustering approaches for tuning and binding the page and time visiting criteria. The two tracks of the proposed algorithms define clusters with users that show similar visiting behavior at the same time period, by varying the priority given to page or time visiting. The proposed algorithms are evaluated using both synthetic and real data sets and the experimentation has shown that the new clustering schemes
result in enriched clusters compared to those created by the conventional non-time aware users clustering approaches. These clusters contain users exhibiting similar access behavior not only in terms of their page preferences but also of their access time.

31. C. Romero and S. Ventura (2006): Currently there is an increasing interest in data mining and educational systems, making educational data mining as a new growing research community. This paper surveys the application of data mining to traditional educational systems, particular web-based courses, well-known learning content management systems, and adaptive and intelligent web-based educational systems. Each of these systems has different data source and objectives for knowledge discovering. After preprocessing the available data in each case, data mining techniques can be applied: statistics and visualization; clustering, classification and outlier detection; association rule mining and pattern mining; and text mining. The success of the plentiful work needs much more specialized work in order for educational data mining to become a mature area.

32. Renata Ivancsy and Ferenc Kovac (2006): Clustering is the process of grouping objects together in such a way that the objects belonging to the same group are similar and those belonging to different groups are dissimilar. Clustering technique can be used in many applications for example biological, financial applications and many more. One of these application types is Web clustering where different types of objects can be clustered into different groups for various purposes. This paper deals with the different aspects of Web data mining and provides an overview about the various techniques used in this field.

33. D. Arotaritei and S. Mitra (2004): This article provides a survey of the available literature on fuzzy Web mining. The different aspects of Web mining, like clustering, association rule mining, navigation, personalization, Semantic Web, information retrieval, text and image mining are considered under the existing taxonomy. The role of fuzzy sets in handling the different types of uncertainties/imprecision is highlighted. A hybridization of fuzzy sets with genetic algorithms (another soft computing tool) is described for information retrieval. An extensive bibliography is also included.

34. Santosh K. Rangarajan et al (2004): A neural network based on adaptive resonance theory dynamically groups users based on their Web access patterns. A prefetching application of this clustering technique showed prediction accuracy as high as 97.78 percent.
35. D. Pierrakos et. al (2003): This paper is a survey of recent work in the field of web usage mining for the benefit of research on the personalization of Web-based information services. The essence of personalization is the adaptability of information systems to the needs of their users. This issue is becoming increasingly important on the Web, as non-expert users are overwhelmed by the quantity of information available online, while commercial Web sites strive to add value to their services in order to create loyal relationships with their visitors-customers. This article views Web personalization through the prism of personalization policies adopted by Web sites and implementing a variety of functions. In this context, the area of Web usage mining is a valuable source of ideas and methods for the implementation of personalization functionality. We therefore present a survey of the most recent work in the field of Web usage mining, focusing on the problems that have been identified and the solutions that have been proposed.

36. Runkler, T., and Beadek, J (2003): Clustering is an unsupervised learning method that determines partitions and (possibly) prototypes from pattern sets. Sets of numerical patterns can be clustered by alternating optimization (AO) of clustering objective functions or by alternating cluster estimation (ACE). Sets of non-numerical patterns can often be represented numerically by (pairwise) relations. These relational data sets can be clustered by relational AO and by relational ACE (RACE). We consider two kinds of non-numerical patterns provided by the World Wide Web: document contents such as the text parts of WebPages, and sequences of web pages visited by particular users, so-called web logs. The analysis of document contents is often called web content mining, and the analysis of log files with web page sequences is called web log mining. For both non-numerical pattern types (text and web page sequences) relational data sets can be automatically generated using the Levenshtein (edit) distance or using graph distances. The prototypes found for text data can be interpreted as keywords that serve for document classification and automatic archiving. The prototypes found for web page sequences can be interpreted as prototypical click streams that indicate typical user interests, and therefore serve as a basis for web content and web structure management.