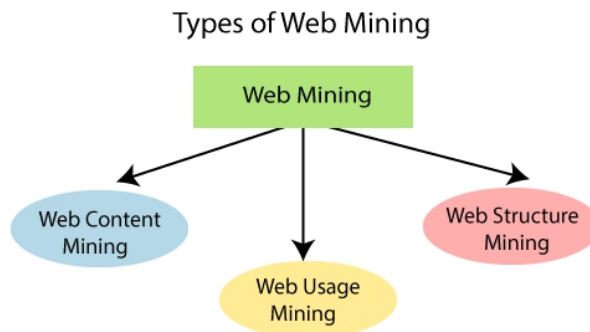


What is Web Mining?

Web mining can widely be seen as the application of adapted data mining techniques to the web, whereas data mining is defined as the application of the algorithm to discover patterns on mostly structured data embedded into a **knowledge discovery process**. Web mining has a distinctive property to provide a set of various data types. The web has multiple aspects that yield different approaches for the mining process, such as web pages consist of text, web pages are linked via hyperlinks, and user activity can be monitored via web server logs. These three features lead to the differentiation between the three areas are web content mining, web structure mining, web usage mining.

There are three types of data mining:



1. Web Content Mining:

Web content mining can be used to extract useful data, information, knowledge from the web page content. In web content mining, each web page is considered as an individual document. The individual can take advantage of the semi-structured nature of web pages, as HTML provides information that concerns not only the layout but also logical structure. The primary task of content mining is data extraction, where structured data is extracted from unstructured websites. The objective is to facilitate data aggregation over various web sites by using the extracted structured data. Web content mining can be utilized to distinguish topics on the web. For Example, if any user searches for a specific task on the search engine, then the user will get a list of suggestions.

What is Web Content Mining?

Web Content Mining can be used for the mining of useful data, information, and knowledge from web page content. Web content mining performs scanning and mining of the text, images, and group of web pages according to the content of the input by displaying the list in search engines.

It is also quite different from data mining because web data are mainly semi-structured or unstructured, while data mining deals primarily with structured data. Web content mining is also different from text mining because of the semi-structured nature of the web, while text mining focuses on unstructured texts. Thus, Web content mining requires creative applications of data mining and text mining techniques and its own unique approaches.

In the past few years, there has been a rapid expansion of activities in the web content mining area. This is not surprising because of the phenomenal growth of web content and the significant economic benefit of such mining. However, due to the heterogeneity and the lack of structure of web data, automated discovery of targeted or unexpected knowledge information still present many challenging research problems. Web content mining could be differentiated from two approaches, such as:

1. Agent-based Approach

This approach involves intelligent systems. It aims to improve information finding and filtering. It usually relies on autonomous agents that can identify relevant websites. And it could be placed into the following three categories, such as:

- o **Intelligent Search Agents:** These agents search for relevant information using domain characteristics and user profiles to organize and interpret the discovered information.
- o **Information Filtering or Categorization:** These agents use information retrieval techniques and characteristics of open hypertext Web documents to retrieve automatically, filter, and categorize them.
- o **Personalized Web Agents:** These agents learn user preferences and discover Web information based on other users' preferences with similar interests.

2. Data based approach

Data based approach is used to organize semi-structured data present on the internet into structured data. It aims to model the web data into a more structured form to apply standard database querying mechanisms and data mining applications to analyze it.

2. Web Structured Mining:

The web structure mining can be used to find the link structure of hyperlink. It is used to identify that data either link the web pages or direct link network. In Web Structure Mining, an individual considers the web as a directed graph, with the web pages being the vertices that are associated with hyperlinks. The most important application in this regard is the Google search engine, which estimates the ranking of its outcomes primarily with the PageRank algorithm. It characterizes a page to be exceptionally relevant when frequently connected by other highly related pages. Structure and content mining methodologies are usually combined. For example, web structured mining can be beneficial to organizations to regulate the network between two commercial sites.

What is Web Structure Mining?

The challenge for Web structure mining is to deal with the structure of the hyperlinks within the web itself. Link analysis is an old area of research. However, with the growing interest in Web mining, the research of structure analysis has increased. These efforts resulted in a newly emerging research area called **Link Mining**, which is located at the intersection of the work in link analysis, hypertext, web mining, relational learning, inductive logic programming, and graph mining.

Web structure mining uses graph theory to analyze a website's node and connection structure. According to the type of web structural data, web structure mining can be divided into two kinds:

- o **Extracting patterns from hyperlinks in the web:** a hyperlink is a structural component that connects the web page to a different location.
- o **Mining the document structure:** analysis of the tree-like structure of page structures to describe HTML or XML tag usage.

The web contains a variety of objects with almost no unifying structure, with differences in the authoring style and content much greater than in traditional collections of text documents. The objects in the WWW are web pages, and links are in, out, and co-citation (two pages linked to by the same page). Attributes include HTML tags, word appearances, and anchor texts. Web structure mining includes the following terminology, such as:

- o **Web graph:** directed graph representing web.
- o **Node:** web page in the graph.
- o **Edge:** hyperlinks.
- o **In degree:** the number of links pointing to a particular node.
- o **Out degree:** number of links generated from a particular node.

An example of a technique of web structure mining is the **PageRank** algorithm used by Google to rank search results. A page's rank is decided by the number and quality of links pointing to the target node.

Link mining had produced some agitation on some traditional data mining tasks. Below we summarize some of these possible tasks of link mining which are applicable in Web structure mining, such as:

1. **Link-based Classification:** The most recent upgrade of a classic data mining task to linked Domains. The task is to predict the category of a web page based on words that occur on the page, links between pages, anchor text, html tags, and other possible attributes found on the web page.
2. **Link-based Cluster Analysis:** The data is segmented into groups, where similar objects are grouped together, and dissimilar objects are grouped into different groups. Unlike the previous task, link-based cluster analysis is unsupervised and can be used to discover hidden patterns from data.
3. **Link Type:** There is a wide range of tasks concerning predicting the existence of links, such as predicting the type of link between two entities or predicting the purpose of a link.
4. **Link Strength:** Links could be associated with weights.
5. **Link Cardinality:** The main task is to predict the number of links between objects. page categorization used to
 - o Finding related pages.
 - o Finding duplicated websites and finding out the similarity between them.

3. Web Usage Mining:

Web usage mining is used to extract useful data, information, knowledge from the weblog records, and assists in recognizing the user access patterns for web pages. In Mining, the usage of web resources, the individual is thinking about records of requests of visitors of a website, that are often collected as web server logs. While the content and structure of the collection of web pages follow the intentions of the authors of the pages, the individual requests demonstrate how the consumers see these pages. Web usage mining may disclose relationships that were not proposed by the creator of the pages.

Some of the methods to identify and analyze the web usage patterns are given below:

I. Session and visitor analysis:

The analysis of preprocessed data can be accomplished in session analysis, which incorporates the guest records, days, time, sessions, etc. This data can be utilized to analyze the visitor's behavior.

The document is created after this analysis, which contains the details of repeatedly visited web pages, common entry, and exit.

II. OLAP (Online Analytical Processing):

OLAP accomplishes a multidimensional analysis of advanced data.

OLAP can be accomplished on various parts of log related data in a specific period.

OLAP tools can be used to infer important business intelligence metrics

What is Web Usage Mining?

Web Usage Mining focuses on techniques that could predict the behavior of users while they are interacting with the WWW. Web usage mining, discovering user navigation patterns from web data, trying to discover useful information from the secondary data derived from users' interactions while surfing the web. Web usage mining collects the data from Weblog records to discover user access patterns of web pages. Several available research projects and commercial tools analyze those patterns for different purposes. The insight knowledge could be utilized in personalization, system improvement, site modification, business intelligence, and usage characterization.

The only information left behind by many users visiting a Web site is the path through the pages they have accessed. Most of the Web information retrieval tools only use textual information, while they ignore the link information that could be very valuable. In general, there are mainly four kinds of data mining techniques applied to the web mining domain to discover the user navigation pattern, such as:

1. Association Rule Mining

Association rule is the most basic rule of data mining methods which is used more than other methods in web usage mining. This method enables the website for more efficient content organization or provides recommendations for an effective cross-selling product.

These rules are statements in the form $X \Rightarrow Y$ where (X) and (Y) are the set of available items in a series of transactions. The rule of $X \Rightarrow Y$ states that transactions that contain items in X may also include items in Y. Association rules in the web usage mining are used to find relationships between pages that frequently appear next to one another in user sessions.

2. Sequential Patterns

Sequential patterns are used to discover the subsequence in a large volume of sequential data. In web usage mining, sequential patterns are used to find user navigation patterns that frequently appear at meetings. The sequential patterns may seem to be association rules. But the sequential patterns are included the time, which means that the sequence of events that occurred is defined in sequential patterns. Algorithms that are used to extract association rules can also be used to generate sequential patterns. Two types of algorithms are used for sequential mining patterns.

- o The first type of algorithm is based on association rules mining. Many common algorithms of sequential mining patterns have been changed for mining association rules. For example, GSP and AprioriAll are two developed species of Apriori algorithms that are used to extract association rules. But some researchers believe that association rules mining algorithms do not have enough performance in the long sequential patterns mining.
- o The second type of sequential patterns mining algorithms has been introduced in which the tree structure and Markov chain are used to represent survey patterns. For example, in one of these algorithms called WAP-mine, the tree structure called WAP-tree is used to explore access patterns to the web. Evaluation results show that its performance is higher than an algorithm such as GSP.

3. Clustering

Clustering techniques diagnose groups of similar items among high volumes of data. This is done based on distance functions which measure the degree of similarity between different items. Clustering in web usage mining is used for grouping similar meetings. What is important in this type of search is the contrast

between the user and individual groups. Two types of interesting clustering can be found in this area: user clustering and page clustering.

Clustering of user records is usually used to analyze web mining and web analytics tasks. More knowledge derived from clustering is used to partition the market in e-commerce. Different methods and techniques are used for clustering, which includes:

- o Using the similarity graph and the amount of time spent viewing a page to estimate the similarity of meetings.
- o Using genetic algorithms and user feedback.
- o Clustering matrix.
- o K -means algorithm, which is the most classic clustering method.

The repetitive patterns are first extracted from the user's sessions using association rules in other clustering methods. Then, these patterns are used to construct a graph where the nodes are the visited pages. The edges of the graph connect two or more pages. If these pages exist in a pattern extracted, the weight will be assigned to the edges that show the relationship between the nodes. Then, for clustering, this graph is recursively divided to user behavior groups are detected.

4. Classification Mining

Discovering classification rules allows one to develop a profile of items belonging to a particular group according to their common attributes. This profile can classify new data items added to the database. In Web Mining, classified techniques allow one to develop a profile for clients who access particular server files based on demographic information available on those clients or their navigation patterns.

Advantages

Web usage mining has many advantages, making this technology attractive to corporations, including government agencies.

- o This technology has enabled e-commerce to do personalized marketing, resulting in higher trade volumes. Government agencies are using this technology to classify threats and fight against terrorism.
- o Companies can establish better customer relationships by understanding the customer's needs better and reacting to customer needs faster. They can increase profitability by target pricing based on the profiles created. They can even find customers who might default to a competitor. The company will try to retain the customer by providing promotional offers to the specific customer, thus reducing the risk of losing a customer or customers.
- o More benefits of web usage mining, particularly personalization, are outlined in specific frameworks like the probabilistic latent semantic analysis model, which offers additional features to user behavior and access patterns. This is because the process provides the user with more relevant content through collaborative recommendations.
- o There are also elements unique to web usage mining that show the technology's benefits. These include the way semantic knowledge is applied when interpreting, analyzing and reasoning about usage patterns during the mining phase.

Disadvantages

Web usage mining by itself does not create issues, but when used on data of personal nature, this technology might cause concerns.

- o The most criticized ethical issue involving web usage mining is the invasion of privacy. Privacy is considered lost when information concerning an individual is obtained, used, or disseminated, especially if this occurs without the individual's knowledge or consent. The obtained data will be analyzed, made anonymous, and then clustered to form anonymous profiles.
- o These applications de-individualize users by judging them by their mouse clicks rather than by identifying information. De-individualization, in general, can be defined as a tendency to judge and treat people based on group characteristics instead of on their characteristics and merits.
- o The companies collecting the data for a specific purpose might use the data for totally different purposes, violating the user's interests.

Web Usage Mining Applications

The main objective of web usage mining is to collect data about the user's navigation patterns. This information can improve the Web sites in the user view. There are three main applications of this mining, such as:

1. Privatization of web content

Web usage mining techniques can be used for the personalization of web users. For example, user behavior can be immediately predicted by comparing her current survey patterns with those extracted from the log files. Recommendation systems with a real application in this area suggest links that direct the user to his favorite pages. Some sites also organize their product catalogs based on the predicted interests of a specific user and represent them.

2. Pre - recovery

The results of web usage mining can be used to improve the performance of Web servers and Web-based applications. Web usage mining can be used for retrieving and caching strategies and thus reduce the response time of Web servers.

3. Improvement of Web site design

Usability is one of the most important issues in designing and implementing websites. The results of web usage mining can help to appropriate the design of websites. Adaptive websites are an application of this type of mining. Website content and structure are dynamically reorganized based on data derived from user behavior in these sites.

Challenges in Web Mining:

The web presents incredible challenges for resources, and knowledge discovery based on the following observations:

o The complexity of web pages:

The site pages don't have a unifying structure. They are extremely complicated as compared to traditional text documents. There are enormous amounts of documents in the digital library of the web. These libraries are not organized according to a specific order.

o The web is a dynamic data source:

The data on the internet is quickly updated. For example, news, climate, shopping, financial news, sports, and so on.

- o **Diversity of client networks:**

The client network on the web is quickly expanding. These clients have different interests, backgrounds, and usage purposes. There are over a hundred million workstations that are associated with the internet and still increasing tremendously.

- o **Relevancy of data:**

It is considered that a specific person is generally concerned about a small portion of the web, while the rest of the segment of the web contains the data that is not familiar to the user and may lead to unwanted results.

- o **The web is too broad:**

The size of the web is tremendous and rapidly increasing. It appears that the web is too huge for data warehousing and data mining.

Mining the Web's Link Structures to recognize Authoritative Web Pages:

The web comprises of pages as well as hyperlinks indicating from one to another page. When a creator of a Web page creates a hyperlink showing another Web page, this can be considered as the creator's authorization of the other page. The unified authorization of a given page by various creators on the web may indicate the significance of the page and may naturally prompt the discovery of authoritative web pages. The web linkage data provide rich data about the relevance, the quality, and structure of the web's content, and thus is a rich source of web mining.

Application of Web Mining:

Web mining has an extensive application because of various uses of the web. The list of some applications of web mining is given below.

- o Marketing and conversion tool
- o Data analysis on website and application accomplishment.
- o Audience behavior analysis
- o Advertising and campaign accomplishment analysis.
- o Testing and analysis of a site.

Difference between Web Content, Web Structure, and Web Usage Mining

Web mining is the application of data mining techniques to extract knowledge from web data, including web documents, hyperlinks between documents, usage logs of websites, etc. Web mining aims to discover and retrieve useful and interesting patterns from large data sets and classic data mining. Big data act as data sets on web mining. Web data includes information, documents, structure, and profile. Web mining is based on two concepts defined, process-based and data-driven. In general, the use of web mining typically involves several steps, such as collecting data, selecting the data before processing, knowledge discovery, and analysis.

The internet has become a crucial part of our lives nowadays, so the techniques that help extract data on the web are an interesting area of research. These techniques help to extract knowledge from Web data, in which at least one of structure or usage (Weblog) data is used in the mining process (with or without other types of the web). In general, Web mining tasks can be classified into three categories:

1. Web content mining
2. Web structure mining

3. Web usage mining

All three categories focus on the process of knowledge discovery of implicit, previously unknown, and potentially useful information from the web. Each of them focuses on different mining objects of the web. Let's study all of the three categories in brief for good understanding.

Web Content Mining Challenges

Web content mining has the following problems or challenges also with their solutions, such as:

- o **Data Extraction:** Extraction of structured data from Web pages, such as products and search results. Extracting such data allows one to provide services. Two main types of techniques, machine learning and automatic extraction, are used to solve this problem.
- o **Web Information Integration and Schema Matching:** Although the Web contains a huge amount of data, each website (or even page) represents similar information differently. Identifying or matching semantically similar data is an important problem with many practical applications.
- o **Opinion extraction from online sources:** There are many online opinion sources, e.g., customer reviews of products, forums, blogs, and chat rooms. Mining opinions are of great importance for marketing intelligence and product benchmarking.
- o **Knowledge synthesis:** Concept hierarchies or ontology are useful in many applications. However, generating them manually is very time-consuming. The main application is to synthesize and organize the pieces of information on the web to give the user a coherent picture of the topic domain. A few existing methods that explore the web's information redundancy will be presented.
- o **Segmenting Web pages and detecting noise:** In many Web applications, one only wants the main content of the Web page without advertisements, navigation links, copyright notices. Automatically segmenting Web pages to extract the pages' main content is an interesting problem.

Difference between Web Content, Web Structure, and Web Usage Mining

Here are the following difference between web content, web structure, and web usage mining, such as:

Terms	Web Content		Web Structure	Web Usage
	IR View	DB View		
View of data	<ul style="list-style-type: none"> ◦ Unstructured ◦ Structured 	<ul style="list-style-type: none"> ◦ Semi-structured ◦ Website as DB 	Link structure	Interactivity
Main data	<ul style="list-style-type: none"> ◦ Text documents ◦ Hypertext documents 	Hypertext documents	Link structure	<ul style="list-style-type: none"> ◦ Server logs ◦ Browser logs
Method	<ul style="list-style-type: none"> ◦ Machine Learning ◦ Statistical (Including NLP) 	<ul style="list-style-type: none"> ◦ Proprietary algorithm ◦ Association rules 	Proprietary algorithm	<ul style="list-style-type: none"> ◦ Machine learning ◦ Statistical ◦ Association Rules
Representation	<ul style="list-style-type: none"> ◦ Bag of words, n-gram terms ◦ Phrases, concepts, or ontology ◦ Relational 	<ul style="list-style-type: none"> ◦ Edged labeled graph ◦ Relational 	Graph	<ul style="list-style-type: none"> ◦ Relational Table ◦ Graph
Application Categories	<ul style="list-style-type: none"> ◦ Categorization ◦ Clustering ◦ Finding Extract rules ◦ Finding Patterns in text 	<ul style="list-style-type: none"> ◦ Finding frequent substructures ◦ Web site schema discovery 	<ul style="list-style-type: none"> ◦ Categorization ◦ Clustering 	<ul style="list-style-type: none"> ◦ Site construction ◦ Adaptation and management

Text Data Mining

Text data mining can be described as the process of extracting essential data from standard language text. All the data that we generate via text messages, documents, emails, files are written in common language text. Text mining is primarily used to draw useful insights or patterns from such data.

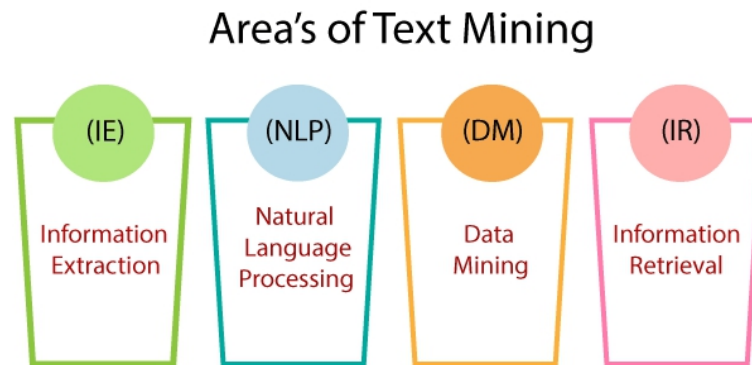


The text mining market has experienced exponential growth and adoption over the last few years and also expected to gain significant growth and adoption in the coming future. One of the primary reasons behind the adoption of text mining is higher competition in the business market, many organizations seeking value-added solutions to compete with other organizations. With increasing completion in business and changing customer perspectives, organizations are making huge investments to find a solution that is capable of analyzing customer and competitor data to improve competitiveness. The primary source of data is e-commerce websites, social media platforms, published articles, survey, and many more. The larger part of the generated data is unstructured, which makes it challenging and expensive for the organizations to

analyze with the help of the people. This challenge integrates with the exponential growth in data generation has led to the growth of analytical tools. It is not only able to handle large volumes of text data but also helps in decision-making purposes. Text mining software empowers a user to draw useful information from a huge set of data available sources.

Areas of text mining in data mining:

These are the following area of text mining :



- o **Information Extraction:**

The automatic extraction of structured data such as entities, entities relationships, and attributes describing entities from an unstructured source is called information extraction.

- o **Natural Language Processing:**

NLP stands for Natural language processing. Computer software can understand human language as same as it is spoken. NLP is primarily a component of artificial intelligence(AI). The development of the NLP application is difficult because computers generally expect humans to "Speak" to them in a programming language that is accurate, clear, and exceptionally structured. Human speech is usually not authentic so that it can depend on many complex variables, including slang, social context, and regional dialects.

- o **Data Mining:**

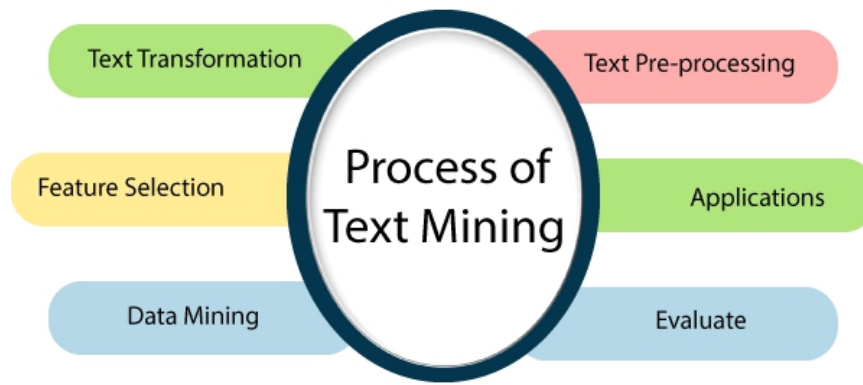
Data mining refers to the extraction of useful data, hidden patterns from large data sets. Data mining tools can predict behaviors and future trends that allow businesses to make a better data-driven decision. Data mining tools can be used to resolve many business problems that have traditionally been too time-consuming.

- o **Information Retrieval:**

Information retrieval deals with retrieving useful data from data that is stored in our systems. Alternately, as an analogy, we can view search engines that happen on websites such as e-commerce sites or any other sites as part of information retrieval.

Text Mining Process:

The text mining process incorporates the following steps to extract the data from the document.



- o **Text transformation**

A text transformation is a technique that is used to control the capitalization of the text. Here the two major way of document representation is given.

1. Bag of words
2. Vector Space

- o **Text Pre-processing**

Pre-processing is a significant task and a critical step in Text Mining, Natural Language Processing (NLP), and information retrieval(IR). In the field of text mining, data pre-processing is used for extracting useful information and knowledge from unstructured text data. Information Retrieval (IR) is a matter of choosing which documents in a collection should be retrieved to fulfill the user's need.

- o **Feature selection:**

Feature selection is a significant part of data mining. Feature selection can be defined as the process of reducing the input of processing or finding the essential information sources. The feature selection is also called variable selection.

- o **Data Mining:**

Now, in this step, the text mining procedure merges with the conventional process. Classic Data Mining procedures are used in the structural database.

- o **Evaluate:**

Afterward, it evaluates the results. Once the result is evaluated, the result abandon.

- o **Applications:**

These are the following text mining applications:

- o **Risk Management:**

Risk Management is a systematic and logical procedure of analyzing, identifying, treating, and monitoring the risks involved in any action or process in organizations. Insufficient risk analysis is usually a leading cause of disappointment. It is particularly true in the financial organizations where adoption of Risk Management Software based on text mining technology can effectively enhance the ability to diminish risk. It enables the administration of millions of sources and petabytes of text documents, and giving the ability to connect the data. It helps to access the appropriate data at the right time.

- o **Customer Care Service:**

Text mining methods, particularly NLP, are finding increasing significance in the field of customer care. Organizations are spending in text analytics programming to improve their overall experience by accessing the textual data from different sources such as customer feedback, surveys, customer calls, etc. The primary objective of text analysis is to reduce the response time of the organizations and help to address the complaints of the customer rapidly and productively.

- o **Business Intelligence:**

Companies and business firms have started to use text mining strategies as a major aspect of their business intelligence. Besides providing significant insights into customer behavior and trends, text mining strategies also support organizations to analyze the qualities and weaknesses of their opponent's so, giving them a competitive advantage in the market.

- o **Social Media Analysis:**

Social media analysis helps to track the online data, and there are numerous text mining tools designed particularly for performance analysis of social media sites. These tools help to monitor and interpret the text generated via the internet from the news, emails, blogs, etc. Text mining tools can precisely analyze the total no of posts, followers, and total no of likes of your brand on a social media platform that enables you to understand the response of the individuals who are interacting with your brand and content.

Text Mining Approaches in Data Mining:

These are the following text mining approaches that are used in data mining.

1. Keyword-based Association Analysis:

It collects sets of keywords or terms that often happen together and afterward discover the association relationship among them. First, it preprocesses the text data by parsing, stemming, removing stop words, etc. Once it pre-processed the data, then it induces association mining algorithms. Here, human effort is not required, so the number of unwanted results and the execution time is reduced.

2. Document Classification Analysis:

Automatic document classification:

This analysis is used for the automatic classification of the huge number of online text documents like web pages, emails, etc. Text document classification varies with the classification of relational data as document databases are not organized according to attribute values pairs.

Numericizing text:

- o **Stemming algorithms**

A significant pre-processing step before ordering of input documents starts with the stemming of words. The terms "stemming" can be defined as a reduction of words to their roots. For example, different grammatical forms of words and ordered are the same. The primary purpose of stemming is to ensure a similar word by text mining program.

- o **Support for different languages:**

There are some highly language-dependent operations such as stemming, synonyms, the letters that are allowed in words. Therefore, support for various languages is important.

- o **Exclude certain character:**

Excluding numbers, specific characters, or series of characters, or words that are shorter or longer than a specific number of letters can be done before the ordering of the input documents.

- o **Include lists, exclude lists (stop-words):**

A particular list of words to be listed can be characterized, and it is useful when we want to search for a specific word. It also classifies the input documents based on the frequencies with which those words occur. Additionally, "stop words," which means terms that are to be rejected from the ordering can be characterized. Normally, a default list of English stop words incorporates "the," "a," "since," etc. These words are used in the respective language very often but communicate very little data in the document.

Difference between Spatial and Temporal Data Mining

1. Spatial Data Mining :

Spatial data mining is the process of discovering interesting and previously unknown, but potentially useful

patterns from spatial databases. In spatial data mining analyst use geographical or spatial information to produce business intelligence or other results. Challenges involved in spatial data mining include identifying patterns or finding objects that are relevant to research project.

2. Temporal Data Mining :

Temporal data refers to the extraction of implicit, non-trivial and potentially useful abstract information from large collection of temporal data. It is concerned with the analysis of temporal data and for finding temporal patterns and regularities in sets of temporal data tasks of temporal data mining are –

Data Characterization and Comparison

Cluster Analysis

Classification

Association rules

Prediction and Trend Analysis

Pattern Analysis

Difference between Spatial and Temporal Data Mining :

SNO.	Spatial data mining	Temporal data mining
1.	It requires space.	It requires time.
2.	Spatial mining is the extraction of knowledge/spatial relationship and interesting measures that are not explicitly stored in spatial database.	Temporal mining is the extraction of knowledge about occurrence of an event whether they follow Cyclic , Random ,Seasonal variations etc.
3.	It deals with spatial (location , Geo-referenced) data.	It deals with implicit or explicit Temporal content , from large quantities of data.
4.	Spatial databases reverses spatial objects derived by spatial data. types and spatial association among such objects.	Temporal data mining comprises the subject as well as its utilization in modification of fields.
5.	It includes finding characteristic rules, discriminant rules, association rules and evaluation rules etc.	It aims at mining new and unknown knowledge, which takes into account the temporal aspects of data.

6.	It is the method of identifying unusual and unexplored data but useful models from spatial databases.	It deals with useful knowledge from temporal data.
7.	Examples – Determining hotspots , Unusual locations.	Examples – An association rule which looks like – “Any Person who buys a car also buys steering lock”. By temporal aspect this rule would be – ” Any person who buys a car also buys a steering lock after that “.