Unit 6: Reinforcement Learning and Big Data Mining

Q 1. What is Reinforcement Learning?

- **R**einforcement Learning is a type of *Machine Learning*, and thereby also a branch of *Artificial Intelligence*.
- It allows machines and software agents to automatically determine the ideal behaviour within a specific context, in order to maximize its performance.
- Simple reward feedback is required for the agent to learn its behaviour; this is known as the reinforcement signal.
- **T**here are many different algorithms that tackle this issue. As a matter of fact, Reinforcement Learning is defined by a specific type of problem, and all its solutions are classed as Reinforcement Learning algorithms. In the problem, an agent is supposed decide the best action to select based on his current state. When this step is repeated, the problem is known as a *Markov Decision Process*.

- **R**einforcement Learning allows the machine or software agent to learn its behaviour based on feedback from the environment. This behaviour can be learnt once and for all, or keep on adapting as time goes by. If the problem is modelled with care, some Reinforcement Learning algorithms can converge to the global optimum; this is the ideal behaviour that maximises the reward.
- **T**his automated learning scheme implies that there is little need for a human expert who knows about the domain of application. Much less time will be spent designing a solution, since there is no need for hand-crafting complex sets of rules as with *Expert Systems*, and all that is required is someone familiar with Reinforcement Learning.
- **T**here are many challenges in current Reinforcement Learning research. Firstly, it is often too memory expensive to store values of each state, since the problems can be pretty complex. Solving this involves looking into value approximation techniques, such as *Decision Trees* or *Neural Networks*. There are many consequence of introducing these imperfect value estimations, and research tries to minimise their impact on the quality of the solution..

Q 2. NOTE ON SUPERVISED, UNSUPERVISED, AND SEMISUPERVISED MACHINE LEARNING

It is learning based on labeled data. In short, while learning, the system has knowledge of a set of labeled data. This is one of the most common and frequently used learning methods. Let us begin by considering the simplest machine-learning task: supervised learning for classification. Let us take an example of classification of documents. In this particular case a learner learns based on the available documents and their classes. This is also referred to as labeled data. The program that can map the input documents to appropriate classes is called a classifier, because it assigns a class (i.e., document type) to an object (i.e., a document). The task of supervised learning is to construct a classifier given a set of classified training examples. A typical classification is depicted in Figure 1.1. Figure 1.1 represents a hyperplane that has been generated after learning, separating two classes—class A and class B in different parts. Each input point presents input–output instance from sample space. In case of document classification, these points are documents. Learning computes a separating line or hyperplane among documents. An unknown document type will be decided by its position with respect to a separator.

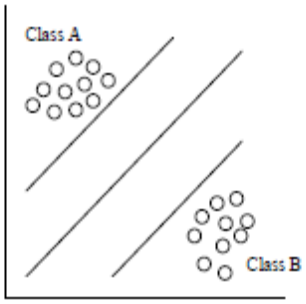

Figure 1.1 Supervised learning.

There are a number of challenges in supervised classification such as generalization, selection of right data for learning, and dealing with variations. Labeled examples are used for training in case of supervised learning. The set of labeled examples provided to the learning algorithm is called the training set. The classifier and of course the decision-making engine should minimize false positives and false negatives. Here false positives stand for the result yes—that is, classified in a particular group wrongly. False negative is the case where it should have been accepted as a class but got rejected. For example, apples not classified as apples is false negative, while an orange or some other fruit classified as an apple is false positive in the apple class. Another

example of it is when guilty but not convicted is false positive, while innocent but convicted or declared innocent is false negative. Typically, wrongly classified are more harmful than unclassified elements. If a classifier knew that the data consisted of sets or batches, it could achieve higher accuracy by trying to identify the boundary between two adjacent sets. It is true in the case of sets of documents to be separated from one another. Though it depends on the scenario, typically false negatives are more costly than false positives, so we might want the learning algorithm to prefer classifiers that make fewer false negative errors, even if they make more false positives as a result. This is so because false negative generally takes away the identity of the objects or elements that are classified correctly. It is believed that the false positive can be corrected in next pass, but there is no such scope for false negative. Supervised learning is not just about classification, but it is the overall process that with guidelines maps to the most appropriate decision. Unsupervised learning refers to learning from unlabeled data. It is basedmore on similarity and differences than on anything else. In this type of learning, all similar items are clustered together in a particular class where the label of a class is not
known. It is not possible to learn in a supervised way in the absence of properly labeled data. In these scenarios there is need to learn in an unsupervised way. Here the learning is based more on similarities and differences that are visible. These differences and similarities are mathematically represented in unsupervised learning. Given a large collection of objects, we often want to be able to understand these objects and visualize their relationships. For an example based on similarities, a kid can separate birds from other animals. It may use some property or similarity while separating, such as the birds have wings. The criterion in initial stages is the most visible aspects of those objects. Linnaeus devoted much of his life to arranging living organisms into a hierarchy of classes, with the goal of arranging similar organisms together at all levels of the hierarchy. Many unsupervised learning algorithms create
similar hierarchical arrangements based on similarity-based mappings. The task of hierarchical clustering is to arrange a set of objects into a hierarchy such that similar objects are grouped together. Nonhierarchical clustering seeks to partition the data into some number of disjoint clusters. The process of clustering is depicted in Figure 1.2. A learner is fed with a set of scattered points, and it generates two clusters with representative centroids after learning. Clusters show that points with similar properties and closeness are grouped together.

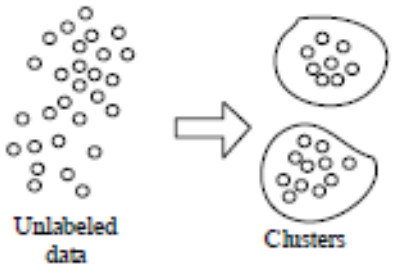

Figure 1.2 Unsupervised learning.

In practical scenarios there is always need to learn from both labeled and unlabeled data. Even while learning in an unsupervised way, there is the need to make the best use of labeled data available. This is referred to as semisupervised learning. Semisupervised learning is making the best use of two paradigms of learning—that

is, learning based on similarity and learning based on inputs from a teacher. Semisupervised learning tries to get the best of both the worlds.

Q 3: WHAT IS MACHINE LEARNING?

A general concept of machine learning is depicted in Figure 1.3. Machine learning studies computer algorithms for learning. We might, for instance, be interested in learning to complete a task, or to make accurate predictions, reactions in certain situations, or to behave intelligently. The learning that is being done is always based on some sort of observations or data, such as examples (the most common case in this course), direct experience, or instruction. So in general, machine learning is about learning to do better in the future based on what was experienced in the past. It is making a machine to learn from available information, experience, and knowledge building. In the context of the present research, machine learning is the development of programs that allow us to analyze data from the various sources, select relevant data,

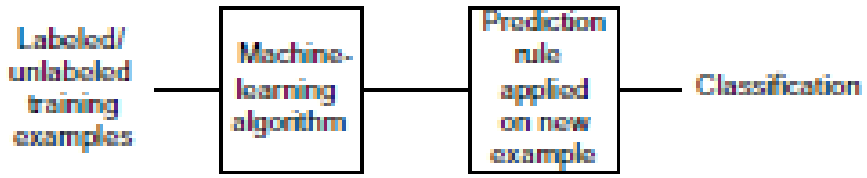

Figure 1.3 Machine learning and classification.

and use those data to predict the behavior of the system in another similar and if possible different scenario. Machine learning also classifies objects and behaviors to finally impart the decisions for new input scenarios. The interesting part is that more learning and intelligence is required to deal with uncertain situations.

MACHINE-LEARNING PROBLEM : It can be easily concluded that all the problems that need intelligence to solve come under the category of machine-learning problems. Typical problems are character recognition, face authentication, document classification, spam filtering, speech recognition, fraud detection, weather forecasting, and occupancy forecasting. Interestingly, many problems that are more complex and involve decision making can be

considered as machine-learning problems as well. These problems typically involve learning from experiences and data, and search for the solutions in known as well as unknown search spaces. It may involve the classification of objects, problems, and mapping them to solutions or decisions. Even classification of any type of objects or events is also a machine-learning problem.

Q 5. Application Of Big Data In Data Mining

In data mining a number of different data repositories can be involved. Data mining should be applicable to any kind of data repository as well as to transient data such as data streams. The challenges and techniques of mining may differ for each of the repository systems.

Advanced databases or information repositories require sophisticated facilities to efficiently store, retrieve and update large amounts of complex data. They also provide fertile grounds to raise many challenging research and implementation issue for data mining.

For data mining in object relational system, techniques need to be developed for handling complex object structures, complex data types, class and sub class hierarchies, property inheritance and methods and procedures.

Data mining techniques can be used to find the characteristics of object evaluation or the trend of changes for objects in the database. Such information can be useful in decision making and strategy planning. For example stock exchange data can be mined to uncover trends that could help to plan investment strategies.

Geographic databases have also numerous applications ranging from forestry and ecology planning to providing public service information regarding the location of cables, pipes or

sewage system. They are also useful for vehicle navigation. Spatiotemporal database that change with time is also a big data in which information can be mined.

Streams of data flow in and out of an observation pattern dynamically. They may be huge infinite volume Usually multi level, multidimensional on-line analysis and mining should be performed on stream data. Even if the web pages are fancy and informative to readers, they can be highly unstructured and lack pattern. Data mining can often provide additional help to the web search services which include big data.

Data mining are used to specify the kind of patterns to be found in data mining task. The tasks can be classified as predictive and descriptive.

Different types of data mining system

There are different types of data mining system which can be used with big data. The main techniques used with data mining are as follows.

1 Classification

Classification is the process of finding a model or function that describes and distinguishes data classes or concepts, for the purpose of being able to use the model to predict the class of objects whose class label is unknown. The derived model is based on the analysis of asset of training data. The model can be represented in various forms such as classification rules, decision tree, mathematical formulae or neural networks.

Classification and prediction may need to be preceded by relevance analysis, which attempts to identify attributes that do not contribute to the classification or prediction process. These attributes can then be excluded.

2. Evolution analysis

Evolution analysis is used with time series data of previous years. Regularities in such time series data is used to predict future trends in stock market prices, contributing to decision making regarding stock investments.

3. Outlier Analysis

Outlier analysis may be detected using statistical tests that assume a distribution or probability model for the data or using distance measures where objects that are a substantial distance from any other cluster are considered outliers.

4. Cluster analysis

In cluster Analysis, there is no class labels in the training data sets. The labels are generating using this techniques. The objects in a cluster are grouped based on their similarity. Then rules are formed from the clusters .The major clustering methods includes portioning methods, hierarchical methods, density based methods, model based methods and constraint based clustering method. If the clusters contains large number of data or big data, then it has to used methods like frequent pattern based clustering or high dimensional data clustering.

TOOLS FOR HANDLING BIG DATA

There are many tools are currently available for handling big data Some of them are follows.

MapReduce is a programming model for handling complex combination of several tasks and it was published by Google. It is a batch query processor and can run an ad hoc query for whole dataset and get the results in a sensible manner which has to be transformative. It has two steps.

1. Map: Queries are divided into sub queries and allocated to several nodes in the distributed system and processed in parallel.
2. Reduce: Results are assembled and delivered.

Oracle has introduced the total solution for the scope of enterprise which requires Big Data. Oracle Big Data Appliance is a tool to integrate optimized hardware and extensive software into Oracle Database to endure the Big Data challenges.

The Real-time application of Big Data can also be in Patient Health Information System on Cloud. Patient Health Record (PHR) is an emerging technique to store the Patient Heath Information Record and exchange the data over the network, which is stored at the cloud for accessing the data log anytime and anywhere. To assure more security individuals are given with their own login and data stored over the cloud would be encrypted. PHR includes variety of data such as structured, unstructured, and semi-structured. In PHR, we propose machine generated data by acquiring the finger print or iris pattern or face of the patient for saving the entire data log of the patient. It uses finger print sensor or Iris scanner or face recognizer for capturing the patient Identification. Finger print or iris pattern or facial expression act as a key for retrieving the data saved in the database.