Fuzzy Systems and Soft Computing
ISSN : 1819-4362

CLASSIFICATION OF BRAIN TUMORS IN MR IMAGES USING UNSUPERVISED MACHINE LEARNING ALGORITHMS

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ABSTRACT
A brain tumor is a growth of cells in the brain or near it. Brain tumors can happen in the brain tissue. We can classify brain tumors in a human brain with the help of these MR Images collected as Big Data. As there are numerous competing algorithms and techniques for tumor detection and classification, our comparative study mainly focuses on unsupervised machine learning algorithms. In this paper, the K-means (KM) Clustering Algorithms and Fuzzy C-means (FCM) Clustering Algorithms are used to locate, classify and extract the brain tumor. Unsupervised machine learning algorithms are compared to evaluate performance by evaluating execution time and accuracy. These algorithms are applied to different images of the brain detected with the tumor and show the desired output.
KEYWORDS: Classification, Clustering, Magnetic Resonance Imaging (MRI), Fuzzy C–Means Clustering Algorithm, K-means (KM) Clustering Algorithm, Unsupervised Machine Learning Algorithms.

I. INTRODUCTION

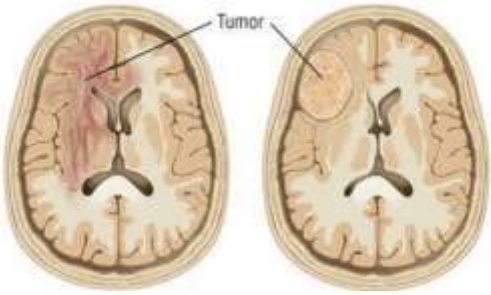
The brain tumor is the main cause of cancer deaths worldwide. The brain tumor can affect people of any age. There are more than 100 billion nerves present in the human brain that are in an overlapped form. So the diagnosis of the tumor area in the brain is a challenging task. The tumor is due to the uncontrollable growth of cells in the brain[1].

A. Types of Brain Tumors

Brain tumors are divided into two main types:

1) Benign Tumors: Benign brain tumors not contain cancer cells. The benign tumors can be easily removed and it rarely grows back. Benign tumor cells do not infect surrounding tissues or transmit in other body parts. These tumors can cause serious problems by suppressing the sensitive areas of brain. Very rarely, they are life threatening and become malignant [2], as shown in Fig.1 (b).

2) Malignant Tumors: This type of brain tumors is more serious than Benign tumor as they are life threatening. Malignant tumor can be primary or secondary type of tumor, originating from brain tissue or metastasis from other tumor in the body at any other place. They can grow rapidly and affect nearby healthy brain tissues. Very rarely, cancer cells may break away from malignant tumor and spread to other parts of the body [2] as shown in Fig.1 (a).



(a) (b)
Fig. 1 (a) Malignant (b) Benign

B. Magnetic Resonance Imaging

MRI scan uses a large magnet, radio waves, and a computer to create a detailed, cross- sectional image of internal organs of a human body. This MRI scan differs from CT scans and X-rays, as it does not use potentially harmful ionizing radiation [3].

Uses of MRI

The following are examples are in which an MRI scanner would be used:

- anomalies of the brain tumor and spinal cord
- tumors, cysts, and other anomalies in various parts of the body
- certain types of heart problems, diseases of the liver and other abdominal organs

This list is by no means exhaustive. The uses of MRI scan are always expanding in its cope and use.

II. UNSUPERVISED MACHINE LEARNING ALGORITHMS

There are two classifications exist to recognize a pattern, and they are Supervised and Unsupervised Machine Learning Algorithms. In Unsupervised Machine Learning commonly used algorithms are K – Means Clustering Algorithms and Fuzzy C – Means Clustering Algorithms [3]. These two algorithms are used to classify brain tumors in a human brain with the help of MR Images collected as Big Data.

K – Means Clustering Algorithm:

Clustering is defined as the process of which similar objects are grouped together. Clustering is widely used in unsupervised machine learning. In K-means clustering, the objects are grouped together into k clusters where k is a positive integer. These k clusters are based on the similarity between the objects here in our case it is similar pixels in image. K- means groups the image pixels based on some features and similarity between the pixels. In this segmentation algorithm, the number of k clusters and their centroid points is computed randomly or by using some heuristic data. The straight line distance between each cluster centroid and the pixel is calculated. The pixel with the minimum distance is moved into the corresponding cluster. Again the new center pixels are calculated by average values of the pixels in the cluster. These two steps are repeated until the values of the central pixels do not change on average. K-means is one of the most widely used clustering algorithms when image data is large. It is simple and has less computational complexity [7]. Segmentation method using adaptive K – Means Clustering divides the MRI image into multiple segments from which a meaningful extract of the brain tumor is obtained. Then segmented image is classified using classifier. That classifier determines the type of the tumor.

Fuzzy C – Means Clustering Algorithm:

The goal of a clustering analysis is to divide a given set of data into a cluster, which represents subsets or a group. The partition should have two properties: 1. Homogeneity inside clusters: the data, which belongs to aone cluster, should be as similar as possible. 2. Heterogeneity between the clusters: the data, which belongs to a different cluster, should be as different as possible. The membership functions do not reflect the actual data distribution in input and output spaces. They may not to be suitable for fuzzy pattern recognition. To build membership functions from the data available, a clustering technique may be used to partition the data, and then produce membership functions from the resulting clustering [3].

MRI images of brain applied to Fuzzy C – Means Algorithm then it will segment the entire tumor region and calculates the area and volume of individual MRI images.

III. PATH-WAY ON RESEARCH METHODS

Table-1: Comparison between Unsupervised Machine Learning Algorithms (K – Means and Fuzzy C – Means Clustering)

K – Means Clustering	**Fuzzy C – Means Clustering**
Hard clustering method	Soft clustering method
It will do a distance calculation	It will do a full inverse-distance weighting
The entire dataset into K number of cluster where a data should belong to only one cluster	Create K numbers of clusters and then assign each data to each cluster, but there will be a factor which will define how strongly the data belongs to that cluster.
It runs faster	It runs medium
Each point either is a part of the first centroids, or the second centroids.	One point can be part of first centroids (90%) and second centroids (10%)
Accuracy is high	Accuracy is medium

The above table represents the comparison between K – Means and Fuzzy C – Means Clustering Algorithms. These comparisons are based on analysis and accuracy of the algorithms present in each type.

IV. CONCLUSION

This paper proposes the assessment on the two clustering algorithms that can be used for brain tumor classification. It focuses on the Unsupervised Machine Learning Algorithms on the era of Big Data. Table show the difference between two different classification techniques K - Means and Fuzzy C –Means Clustering Algorithms. The selection of the algorithm will depend on the need of the user. It indicates that the classification accuracy of K – Means clustering algorithm was better than Fuzzy C – Means Clustering algorithm.

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