Chapter 27
Medical Image Lossy Compression With LSTM Networks

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ABSTRACT

Medical images have a larger size when compared to normal images. There arises a problem in the storage as well as in the transmission of a large number of medical images. Hence, there exists a need for compressing these images to reduce the size as much as possible and also to maintain a better quality. The authors propose a method for lossy image compression of a set of medical images which is based on Recurrent Neural Network (RNN). So, the proposed method produces images of variable compression rates to maintain the quality aspect and to preserve some of the important contents present in these images.

INTRODUCTION

The process of reducing the size of any data file is referred as data compression. It is essential as most of the real world data is rich and redundant in nature. Major types of data compression are either lossless or lossy. The compression that condenses the binary data by recognizing and removing statistical redundancy is referred as lossless data compression. Generally no information will be missing in case of lossless data compression. On the contrary, the process that reduces binary data by removing less important or noisy information is said to be lossy data compression. Further, compression is applied on various types of digital media such as text, image, audio and video for reducing storage and transmission cost.

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Here the authors are interested in medical images and its associated compression operations. Medical image compression is a process in which the compression of data is executed where in few bits are encoded into the actual image. Decreasing the irrelevance redundancy of data present in images is the main purpose of it. The medical image transmission speed is slower when the actual image is transmitted, but the compression techniques help to increase the speed of transmission. Medical image compression mainly concentrates on reducing the image data size and attempts to retain most of the necessary details.

The core objective of compressing the medical images is to show these images in terms of small quantity of bits without losing the needed content of information within the actual image. This is because each and every medical image has important information that should not be lost while decreasing the volume of the image. By the expeditious growth of the technology, there is a need for managing a large quantity of medical image data and also to store those images in the right way by the use of fruitful techniques. This normally results in compressing the images. So again there arises an issue regarding the different approaches to optimally compress the medical images. Again there are two major techniques to compress images as seen in data compression. Hence image compression can also be either lossy or lossless. There are many algorithms and methodologies for image compressions which deal with the elimination of different data redundancies like inter pixel, coding and psycho visual, etc. Even though the lossless technique is about not losing the major data present in images, it fails to compress the images in an optimal way.

Therefore the authors are trying to use lossy compression technique to compress a set of medical images and also to show that it is a better technique to compress medical images when compared to other approaches.

However, following a normal method for lossy image compression will not yield the desired results. To accomplish the aforementioned results, advanced neural network architecture called as Recurrent Neural Network (RNN) is adopted for lossy compression. The traditional neural networks cannot use its power of reasoning about the previously occurred events to decide the events that may occur in future, at every point of time of that event. RNN stands different as it overcomes this drawback by allowing the information to stay for a long time by making use of its loop. In other words, the network forms loops within itself. The RNN's can be imagined where in multiple copies of the existing network loops within itself there by passing the information and evaluating as many times as required. Most important feature of RNN is the ability to connect the information that has occurred in the previous event to the ongoing event.

In case of lossy compression of medical images RNN's are used to provide the knowledge of the previously processed image block to understand the present block of image. This also helps in different phases of lossy compression to preserve the quality of image. The size of the image is reduced significantly but the quality of the image is preserved even after n iterations of compression. Hence, only a very small difference in the quality can be observed when compared to the original medical image. Therefore loss in the data present in medical images is highly reduced. Another advantage of RNN is that it can reduce the number of parameters by the method of weight sharing as the depth of the network increases after different time steps. Also when there is some kind of sequential data in images, RNN's are very useful in compression.