Letter to the Editor

Artificial intelligence in dermatology: the 'unsupervised' learning

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Dear Editor, The potential areas of application of artificial intelligence in dermatology are ever increasing. With the wide availability of smartphones equipped with high-resolution cameras and impressive processing powers, harnessing these capabilities using machine learning (ML) could open new prospects in the management of dermatological disorders. Du-Harpur *et al.* have done a commendable job reviewing the utility of artificial intelligence in dermatology in an easily

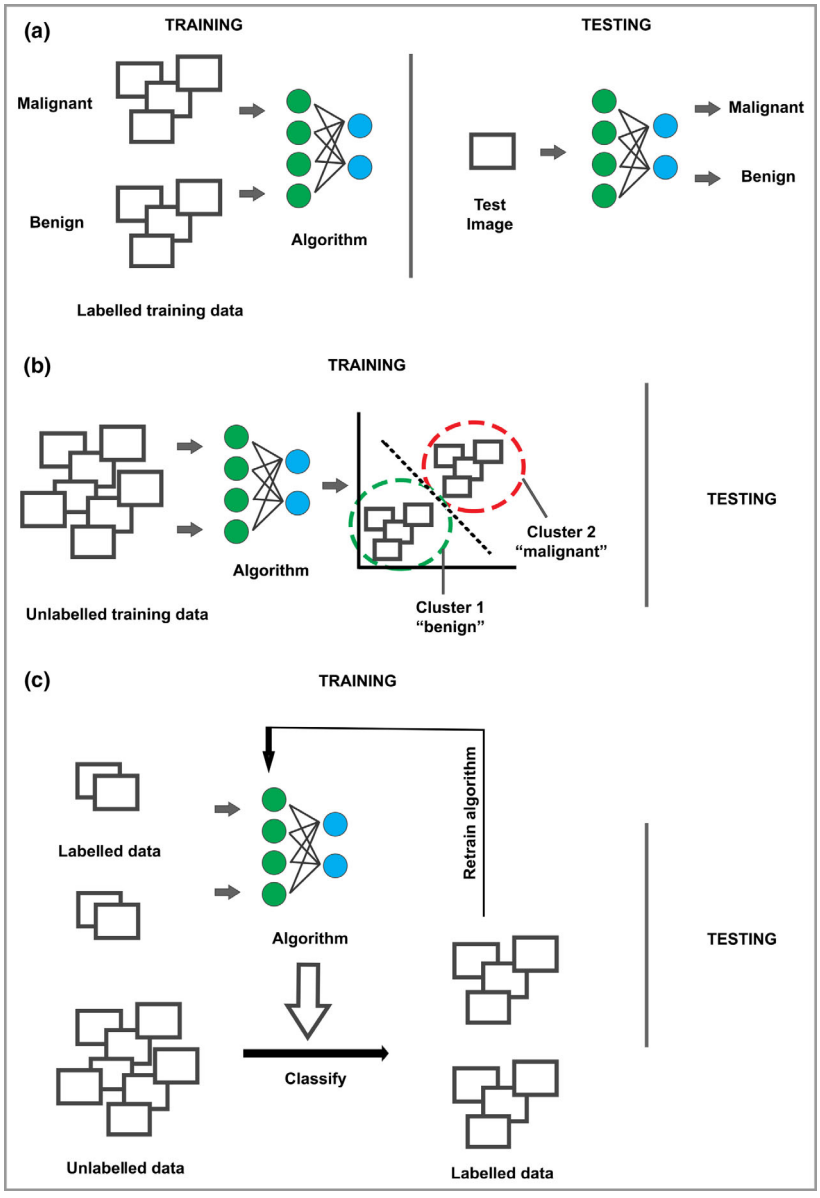

Figure 1 (a) Supervised learning using labelled data to train the algorithm, followed by testing using the same algorithm. (b) Unsupervised learning using unlabelled data to generate an algorithm capable of classifying the data into two clusters, which can be assigned as 'benign' and 'malignant' according to their features, followed by testing in the same manner as supervised learning. (c) Semisupervised learning using less labelled data to train an algorithm, which can be used to classify and label the unlabelled data, which can be further used to retrain the algorithm. This is followed by testing in the same manner as supervised learning.

understandable manner for most dermatologists.[1] The authors focus primarily on the 'supervised learning' aspect of ML during image classification, and rightly so because most of the existing studies have used this model. However, we think that it is equally important to discuss and understand the concept of 'unsupervised learning' in ML, which can have enormous potential during the development of ML models for use in dermatology.

While the supervised method uses labelled data to train the ML models (Figure 1a), the unsupervised method does not require any labelled data. By using unlabelled data, the unsupervised method groups the data into 'clusters' without any prior knowledge (Figure 1b). The meaning of these clusters can be determined later, such as 'malignant lesions' and 'benign lesions'. Kharazmi *et al.*, in their study of basal cell carcinoma (BCC) detection, used an unsupervised feature learning framework to achieve an area under the curve of 91·1%.[2] Their study integrated patient information along with dermoscopic images of BCCs to achieve the result. Similarly, Arevalo *et al.* used the unsupervised feature learning framework to detect BCC in histological images and achieved an area under the curve of 98·1%.[3]

As it is difficult to obtain expert-labelled dermatological images, the unsupervised method has an advantage over the supervised method when a large amount of unlabelled data is present.[4] However, this method suffers from the lack of an 'expert' touch during the training. The combination method, or 'semisupervised learning', has also been introduced, which utilizes a small amount of labelled data and a larger amount of unlabelled data.[4] The unlabelled data are categorized using the algorithm obtained from the labelled data, and the same categorized labelled data can be used to retrain the algorithm (Figure 1c). Thus, this method has the advantage of using the knowledge of the professionals while minimizing the use of resources during the labelling of a large amount of data. Each of the described methods has its own advantages, and future studies can help to determine the best-fit model for performing certain tasks or classifications.

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