

# Determining the Malignancy of Breast Cancer Using a Combined Neural Network-Support Vector Machine Scheme

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## Abstract

Data mining has been useful in medical diagnosis area. The current research proposes a new combined classification technique based on support vector machine and neural network to determine malignancy of breast cancer tumours. The proposed method uses a meta-heuristic algorithm to find the best weights for combining the results of two aforementioned techniques. The numerical and statistical results confirm the superiority of our model in comparison to the previous methods. Following the results, the best accuracies are 98.23% and 96.85% for proposed and the previous methods, respectively. The method has potential to be implemented as a decision support system for breast cancer diagnosis.

Keywords: Classification, Breast cancer, Artificial Neural Network, Support Vector Machine, Wilcoxon hypothesis test

## 1. Introduction

Breast cancer diagnosis would be verified by biopsy of lump. After diagnosis of cancer, further test will be done to determine whether the cancer has spread to other parts of the body and what therapies might not react to disease (Polat & Günes, 2007).

According to World Cancer Research Fund (Stewart & Wild), breast cancer is the most common type of cancer among women, in 2012, 1.7 million cases of breast cancer were reported. On average, 37.3% of the patients regain their health completely; this rate of success is the result of early diagnosis in addition to correct evaluation of severity of malignancy (Salama, Abdelhalim, & Zeid, 2012). In this regard, detection of malignancy severity of a cancerous lump is the main subject of this research. In this content, the present study, by focusing on the breast cancer-related data, is intended to combine two training methods-Artificial Neural Network (ANN) and Support Vector Machine (SVM). Different kernel functions in SVM and layers and neurons in each layer of neural network lead to flexibility of these two methods and application of a combinational approach could improve the prediction precision in comparison with the state in which these two methods were applied alone.

The objectives of this research are:

- i. Developing a model for determining the malignancy of a cancerous lump in the breast.

- ii. Increasing the prediction precision by combining ANN and SVM.

The rest of the article is organized as follows. Support Vector Machine and Artificial Neural Network algorithms are introduced in Section 2. Section 3 presents a literature review on researches about breast cancer. Section 4 is devoted to explanation and implementation of the proposed method. Experimental results are addressed in Section 5. The recommendations for future studies are provided in Section 6.

## 2. Background

### 2.2 Artificial Neural Network

ANN is one of machine training methods inspired by biological neural network which is used for function estimation. This network is generally made in the form of interconnected neurons which transfer messages. Neural network connections have weights adjusted to obtain maximum efficiency (McCulloch & Pitts, 1943). In neural network, layer implies number of adjacent neurons at the same level; in addition, neurons are the nodes in the structure by which the data move from input to output along the layers. Any neuron has a weight, sum of these weights affect the performance of neural network. Neural network training means adjustment of these weights to achieve the best performance (Tu, 1996).