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# Artificial Neural Network Prediction of the Academic Warning of Students in the Faculty of Engineering and Information Technology in Al-Azhar University-Gaza

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***Abstract:*** *In this research, an Artificial Neural Network (ANN) model was developed and tested for predicting that students from the Faculty of Engineering and Information Technology at Al-Azhar University in Gaza would receive an academic warning or expelled. Through the dataset obtained from the Faculty of Engineering and Information Technology, the factors - columns - that may affect the ANN model such as the number of semesters completed by the student, the student's GPA for the last 3 semesters, were identified as input variables for the JustNN tool environment used in building Sample. The results column was also selected, which was used in the internal comparison with the model results to see the extent of convergence in the results from the resulting accuracy ratio. The network model has been developed and trained by relying on the topology of multi-layered perception on this data that includes x generations of students of the Faculty of Engineering and Information Technology at the university. The resulting accuracy rate was 99.42%, which confirms that the ANN model is able to predict, with very high accuracy, the probability that any of the students will have an expulsion or academic warnings in the future. This prediction will benefit the university from an academic point of view to direct students to raise their GPA, or to direct them to one major instead of another.*

**Keywords:** *Artificial Neural Networks, Academic, Warning program, JustNN, Academic Expulsion, Predictive Model, ANN*

## 1. INTRODUCTION

The essence of the Early Warning System (EWS) in the Faculty of Engineering and Information Technology at Al-Azhar University – Gaza, Palestine is to predict a decline in the academic level of students before they actually fail some subjects in the upcoming semesters. This prediction entails many things, such as a first warning to the student in order to improve his performance as he continues in the educational process.

The quality of administration and education at the university increases the level of research capacity and management of the educational process in the country, which increases the country's progress for many generations.

Al-Azhar University administration starts at the stage of students' admission at the faculty of Engineering and IT, which takes place after students of the scientific branch have passed the high school exam with a GPA of no less than 70% as a whole.

The first year student studies in the College of Engineering and IT with a general specialization, in which he is acquainted with many subjects in different engineering specialties, such as the basics of computer science, electricity, electronics, mathematics and others, which enable him determine his specialization for the following years.

After the student succeeds with an average of no less than 80% for approximately 30 credit hours, the student achieves a specialization in one of the fields of engineering at Al-Azhar University, such as Computer System, Communications, or Mechatronics Engineering.

In particular, this study seeks the feasibility of using an Artificial Neural Network (ANN) model to predict the number of students who might receive academic warnings or expulsions. This prediction will affect the future of students in terms of directing them to early improvement in their studies, and on the academic path of raising the academic level of students.

The research paper presents its content in the form of a presentation of information from previous literature that succeeded in clarifying the research point in the next section.

After that, the paper presents the basic information on the two topics of academic warning in Al-Azhar University in general and the College of Engineering and IT in particular, and a topic on ANN in Section 2.

Section 3 of the paper discusses the methodology and design of a neural network applied to solve the discussion topic.

Section 4 explains testing and training the neural network, followed by a discussion of the accuracy of the conclusion in predicting performance in Section 5, and the conclusion comes with the results of the research in Section 6.

## 2. RELATED WORK

**Abu-Naser, S. S. [1]** demonstrated the use of ANN technology to obtain a prediction of learners' academic performance in the LP-ITS. Determining the level of performance of learners level of difficulty necessary to train each learner in the system.
A back propagation neural network was trained using data from the LP-ITS log file in fall of 2010/2011 at the Faculty of Engineering and IT, Al-Azhar University - Gaza.
The aim of this prediction was to determine the number of errors a learner could make in solving the problem, so the learner model was made first using all the data, with an accuracy of approximately 92%.
The research paper is a useful teacher for students to examine themselves and develop their academic skills, was also presented by organizing explaining lessons and solving examples and random questions to consolidate information with the learner.

**Sadek, R. M., and et al. [2]** introduced an artificial neural network system with a reverse propagation algorithm to help clinicians identify the presence of Parkinson's disease. The accuracy of the prediction shown by this research compared to the above is an increase and strength in durability as it reached 100%, after it was at the beginning of 93%.

**Demth, H. B., Beale, M. H., De Jess, O., & Hagan, M. T. [3]** provided a clear and detailed explanation of building basic artificial neural networks. In addition, they explained how to deal with them in the training and testing phase for application to practical problems. The authors also covered training methods for repetitive and forward feeding networks (radial and multi-layer). He also took an interest in explaining the back propagation algorithm, the difference in conjugate gradient, Levenberg-Marquardt, and many other details of neural networks.
They showed detailed examples of how these neural networks are used in the application, and provided solutions to problems that appear to the user.

**Alajrami, E., and et al. [4]** suggested ANN model to see if blood donors can be requested in the future. The researchers enlisted the help of JustNN to solve the problem of donating blood or not. The tool gave 99.31% accuracy in the testing phase, which is higher than previous studies in this area.
They also pointed out that time, freshness, and repetition are factors that influence the outcome.

**Abu-Naser, S. S., and et al. [5]** developed an artificial neural network model to find out the level of a second-year student in the Faculty of Engineering and Information Technology at Al-Azhar University in Gaza.
In building the model, the developers relied on multiple, more comprehensive variables, starting from high school for students through to university level.
The researchers took into account the multi-layered perception topology of this data. The model gave a prediction of 84.6% accuracy for the neural network to give correct results on student performance.

**Eriki, P. O., & Udegbunam, R. I. [6]** used the Artificial Neural Network (Artificial Neural Network) to make a comparison between the Multiple Regression Model (MRM) and the Brain Maker Neural Network (BMNN) application for house prices sold in Nigeria between 1980 and 2001. Research has demonstrated that BMNN performs better than MRM on all parameters used.
The researchers emphasized that the use of neural networks by the state's real estate sector in assessing and setting house prices will help in making a fair assessment of all homes across the country. The use of this model of artificial neural networks will also help Nigerian capital flourish and attract more investors to the country.

## 3. BACKGROUND OF FACULTY'S WARNING SYSTEM AND ARTIFICIAL NEURAL NETWORK

### 3.1 The Faculty of Engineering and Information Technology warning system at Al-Azhar University - Gaza

The Early Warning System (EWS) at the University is a system that works to warn students, whose university GPA for at least two consecutive semesters has fallen below a certain degree. It is used to give students the opportunity to improve their placement before the student receives a "university expulsion".
The EWS system differs from one university to another based on the existing administrative system. This difference is in the levels of alerts sent to students.

In past, EWS needed a permanent manually monitoring to student's files at the end of each semester from his/her academic supervisor. However, at these days and after using technology, especially artificial intelligence, in academic management, all the processes becoming easier and more flexible.

The system of EUW depends on the second Grade Point Average (GPA) of the regular student in the university. The system starts to take in to account the GPA of the second semester from which the student enrolled in the university. The counting is being that if the GPA is under a certain grade, the student has a first warning without Academic Expulsion. In addition, if it is under that GPA or the student has two warnings, the student has a warning with Academic Expulsion. However, if the student has a first warning and improve his grade at the next semester, he is as a normal student even if his GPA fall down.
To having a good prediction to the percentage of the students who may have a warning status in the future, ANN examines the database that contains information about students from Al-Azhar University-Gaza from 2010 to 2014.

### 3.2 Artificial Neural Network

Artificial neural network: It is an arithmetical model [1] educational [2] that stimulates through the organization or functional distinction of biological neural networks. It derives its name and function from the neural networks of the human brain, as the human thinking changes with teaching and training for the human being to a better level.

#### 3.2.1 As a grid:

Neural networks are composed of a group of layers that contain a number of cells connected together to perform similar functions.

The basic structure of an ANN is three layers - in general -: the input, output, and hidden layer. The minimum number of layers in the network is two, input and output, while the hidden layer may not be used if the results are better in not using it, it is optional. It is also possible to work with one layer as input and output [3].

The function of each layer is important in the network as the input layer receives the data that the user program has, and the data is sent back to the program through the output layer. The layer or hidden layers are in the middle of these two layers, linking them and not directly dealing with the user program.

Each cell in these layers that make up the network has the ability to influence the process of processing the data, changing the results sent to the user.

#### 3.2.2 As for the mathematical graph:

The correlation between the layers is via weights, except for the input layer [4] to form a vector graph. The cell has a linear or non-linear activation function that affects the formation of the calculation of the next cell. The learning process of the network is in two phases: the forward feeding, which the weights are assigned to each cell, and the back feed in which the actual learning occurs. The learning process takes place by calculating the error in each node, the weights occur after that and this process continues in every cell in the network until the algorithm converges.

Generally, an ANN system changes based on the internal and external information that is used in the learning phase. Whereas, neurons rely on an arithmetic communication model to process that information. The newly used networks are digital nonlinear data modeling tools that aim to uncover the types of data used and model complex relationships between inputs and outputs.

### 3.3 ANN relationship with data:

The data included in the study is divided into two parts, data for training and data for testing.
Training data is approximately 70% of the data and is used to teach and train the network to give the expected convergence results. As for the remaining 30% of the data, it is used to test the prediction process if it had led to the expected result with a slight acceptable error in the results and this is called Supervised Training. As Unsupervised Training [5], it differs from its predecessor in that the ANN divides the input data into several groups and goes through many courses in training, and as the training progresses, the neural network "discovers" [6] its classification groups.

### 3.4 Dataset

JustNN tool was used to build an ANN model to classify whether a student will receive any type of academic warning at the Faculty of Engineering and Information Technology at Al-Azhar University – Gaza, Palestine.
The data record file used in the study is a file that contains 2705 records or students at the faculty of Engineering and IT at Al-Azhar University - Gaza - between 2010 and 2014. This information was cleaned from data unnecessary in building ANN, such as the number of hours and the GPA for semester 1, and the study included only the necessary data, including: the number of semesters completed by the student, and the GPA for the last 3 semesters.

**Table 1**: Description of the dataset (input Fields)

| Attribute Name | Attribute Type | Attribute Description | Included? |
|---|---|---|---|
| Number of Credits | Numeric | The sum of the official hours the student enrolled | No |
| Number of Semesters | Numeric | The number of semesters the student attended | Yes |
| GPA1 | Numeric | GPA for the last semester the student had | No |
| GPA2 | Numeric | GPA for the second last semester the student had | Yes |
| GPA3 | Numeric | GPA for the third last semester the student had | Yes |
| GPA4 | Numeric | GPA for the fourth last semester the student had | Yes |
| Result | Numeric | If the student will have warning – depends on Table 2 | Yes |

**Table 2:** Description of the Warning System at the faculty of Engineering and IT at Al-Azhar University – Gaza (output)

| | |
|---|---|
| 0 | No warning |
| 1 | First Warning |
| 2 | Second Warning |
| 3 | Third Warning and expulsion |
| 4 | The student had GPA Less than 55% - Expulsion |

The dataset that used to build the EWS system was divided into 2021 records, approximately 70%, of data for training, and 684 records, approximately 30%, for testing.
To obtain more accurate results, the numbers have been converted into ratios as the program gives better results for smaller numbers than for larger ones.

### 3.1 Problem Difficulty Predictor

One of the limitations of the model is that the records are limited to 4 years only, from 2010 to 2014.

## 4. TRAINING AND TESTING OF THE NEURAL NETWORK

The JustNN tool, which we referred to earlier, was used to analyze the input from the user program in three layers: the input layer, one hidden layer and the output layer.
Figure 1 shows the ANN model predictive as result.

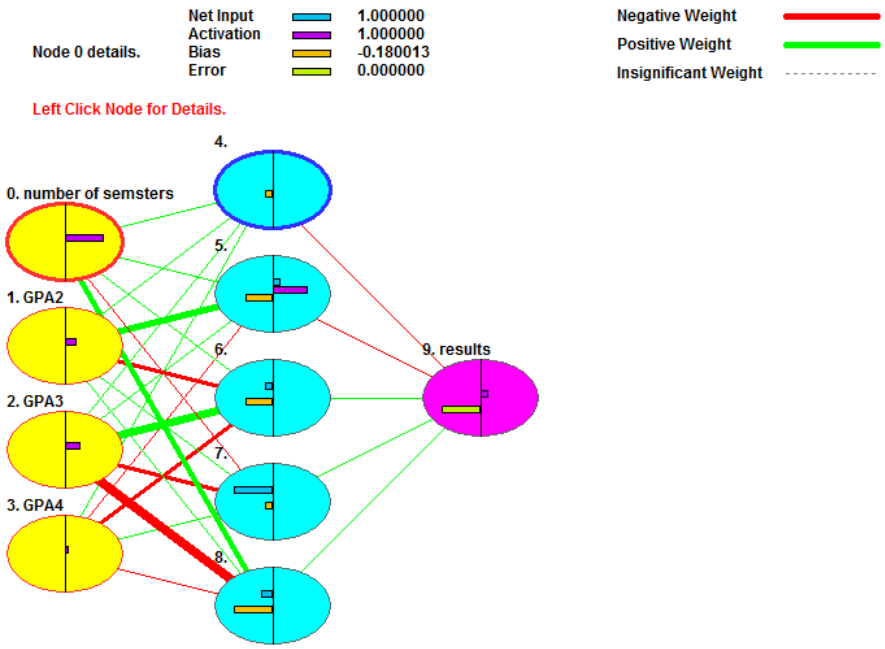


**Figure 1:** Architecture of the ANN model

Figure 2 shows the columns that were used in the analysis and construction of the ANN. These columns varied from input, output, and excluded columns from analysis. It also shows the number of hidden layers, which is one layer, and the number of cells that make them up, which is five nodes. The figure also shows the number of records we used in training, 2021, and the number of records used in the test, 684. The learning cycles were 2014108 cycle.
It also shows the most important point, which is the average training error or the training error, which did not exceed 0.000231

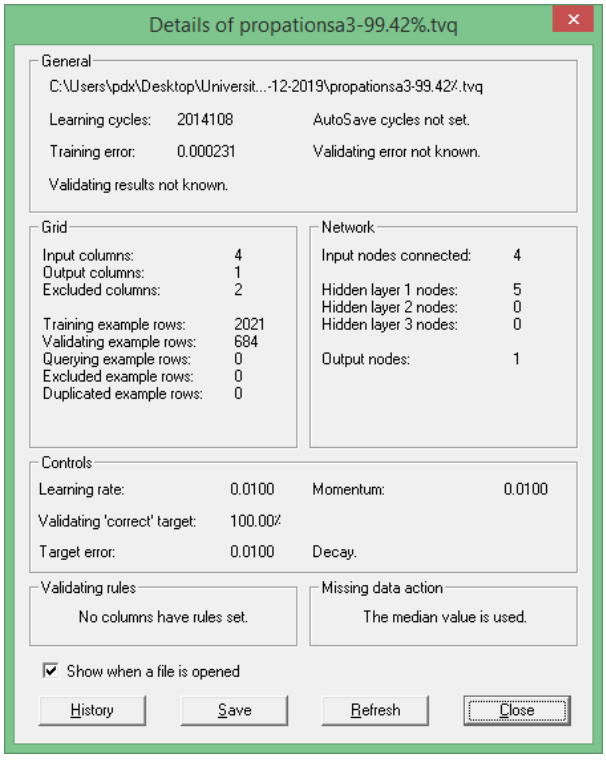


**Figure 2:** The entire data of ANN model

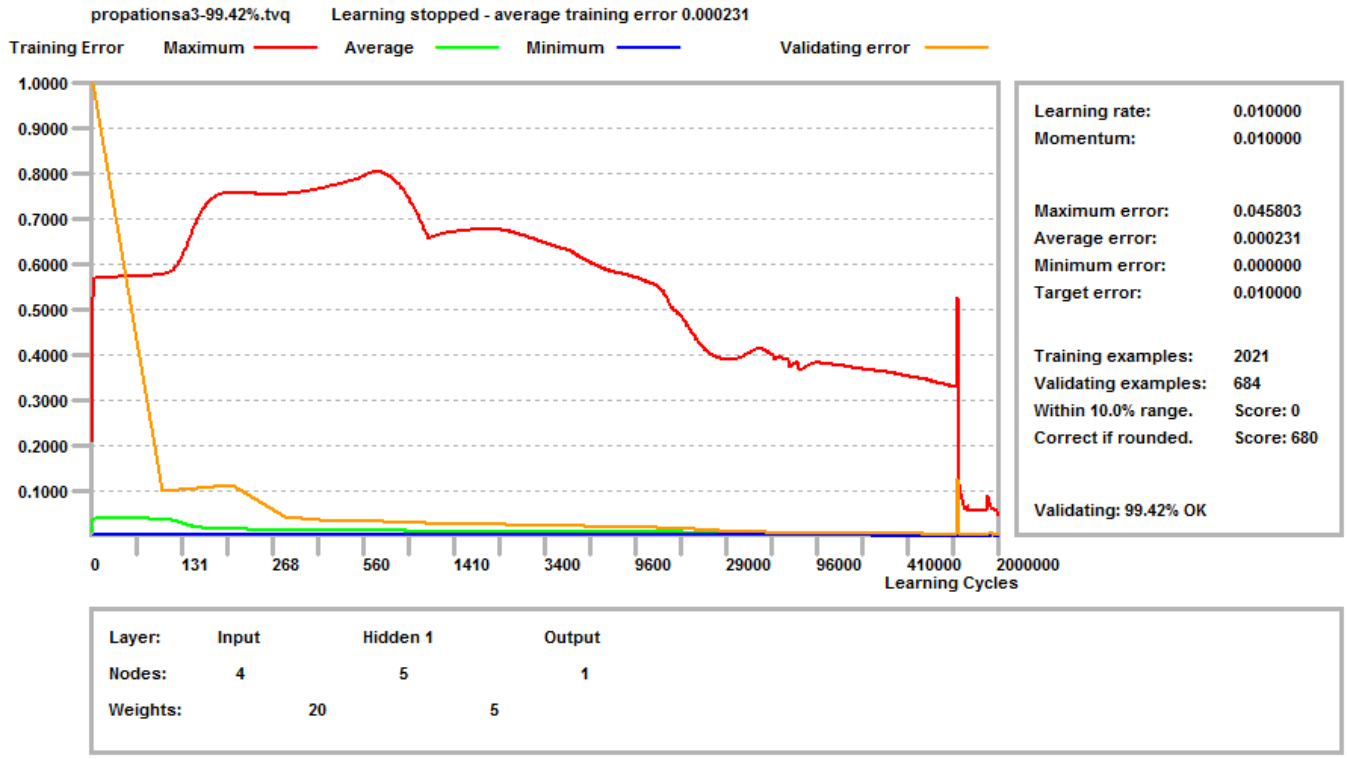


**Figure 3:** The result of training and validation ANN model

## 5. CONCLUSION AND FUTURE WORK

This paper presented an Artificial Neural Network model for predicting the academic warning eligibility for students in the Faculty of Engineering and Information Technology at Al-Azhar University - Gaza. The goal of this prediction is to advance students' levels in advance and raise their academic averages.

The model used a back-propagation algorithm for training. A dataset was used for students between 2010 and 2014. The neural network was trained and tested the model and the overall score was 99.42%. This study demonstrated the ability of the characteristic ANN to predict academic warning merit for students.

### Future Work

One of the limitations of the model is that the records are limited to 4 years only, so work can be done to improve this work by expanding the database range.

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