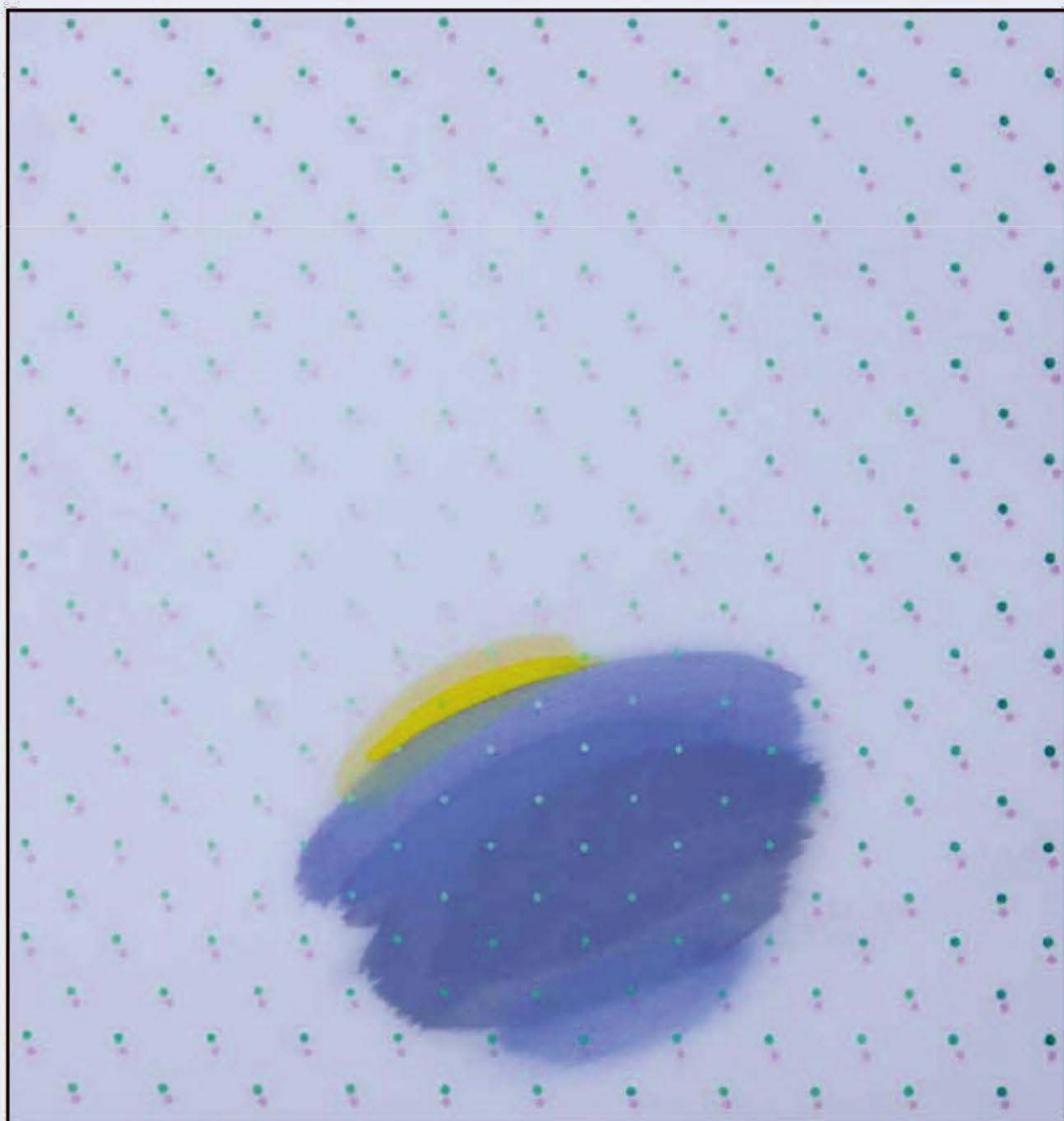


SEEJSD

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Vol. 4 (1/2020)



Skopje, North Macedonia

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Contents

SECTION A

Research article 9

MATHEMATICAL MODELING AND SIMULATIONS OF PATH PLANNING AND OBSTACLES OF MOBILE ROBOT

Vesna Knights, Olivera Petrovska, Stojce Deskovski

Research article 16

NEW NONSTANDARD METHOD FOR MEASURING PHYSICAL PROPERTIES OF HOMEMADE POLYMER FILAMENTS FOR FFD 3D PRINTING

Arta Veliu, Riste Popeski-Dimovski

Research article 22

INTRODUCING TRAFFIC CALMING MEASURES AND INCREASING TRAFFIC SAFETY IN THE SCHOOL ZONES-“11th October” PRIMARY SCHOOL IN SKOPJE

Olivera Petrovska, Andon Petrovski, Vesna Antovska Knights, Jovan Hristoski

Professional article 29

TRANSFORMATION OF BORDER TOWNS IN THE REPUBLIC OF THROUGH DEVELOPMENT OF STRATEGIC AND ACTION PLANS

Damjan Balkoski

Research article 36

USING PYTHON PROGRAMMING FOR ASSESSING AND SOLVING HEALTH MANAGEMENT ISSUES

Lindita Loku, Bekim Fetaji, Aleksandar Krsteski, Majlinda Fetaji, Zoran Zdravev

SECTION B

Case study 42

THE STATUS ON THE IMPLEMENTATION OF THE RIGHT TO ADDRESS PUBLIC AUTHORITIES IN NORTH MACEDONIA

Aleksandar Petkovski, Daniel Pavlovski

Author Guidelines – SEEJSD 52

EDITOR'S MESSAGE

It has been almost 350 years since the founding of the first scientific journals, the *Philosophical Transactions* in England and the *Journal des Sçavansin France*. Now, there are many diverse publications in various scientific fields which have shown enormous development, both in terms of quantity and quality.

Over time, published scientific papers have heralded the development of societies and global welfare. New scientific findings, innovations and research methodologies have become the determinants of the advancement of humanity. Those publications have surpassed any ownership and crossed over the borders of the places where they were produced and emerged to build solid research in the interest of the advancement of the needs and interests of humankind.

In this spirit, as a result of our willingness to engage in contemporary scientific developments and debates, the academic staff of the Mother Teresa University, the youngest University in the Republic of North Macedonia, decided to establish the International Scientific Journal "South East European Journal for Sustainable Development (SEEJSD)."

The editorial board of the Journal, constituted of researchers, experts and young scholars of various fields relevant to sustainable development, took the responsibility to consolidate and advance the content and quality of the Journal, to increase its scientific credibility and to align it in accordance with the requirements of the Science Citation Index (SCI).

The Journal will be published biannually and will include original peer-reviewed articles, book reviews and short essays, from various areas that have an impact on sustainable development. We believe that our Journal will contribute towards the enrichment of scientific thought and the affirmation of ideas in different fields from established and young researchers. We are also convinced that this scientific platform will affirm the new scientists and enthusiasts of our University to engage in international theoretical and empirical debates.

The editorial board of the Journal is well aware of the great challenges ahead. Undoubtedly, in order to produce a successful and effective Journal and make our contribution to the scientific community, a lot of hard work and commitment is required. I am certain that our board members, teaching and research in various universities and countries, will contribute greatly towards our goal with their experience and willingness to sustain the SEEJSD and its community. I take this opportunity to thank the members of the editorial board and welcome them to their important role.

Lastly, I would like to express my sincere hope that the "South East European Journal for Sustainable Development" will succeed in the realization of its mission to positively contribute to science, education and human development.

Editor in Chief,
Prof. Aziz Pollozhani, PhD



Using Python Programming For Assessing And Solving Health Management Issues

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ABSTRACT

In general, data analytics and data science have changed the way we treat, analyze and exploit information in every field. Healthcare is one of the most exciting fields where it can be implemented to make a difference. One of the most advantageous facets of healthcare is type 2 diabetes analytics. Healthcare analytics have the ability to minimize medical costs, handle resources better, and forecast shortages. Therefore, the research focuses on the treatment of health conditions with an emphasis on type 2 diabetes and explores a model for improved management. Predictive models can make human decisions more productive and make an entire decision-making process more highly automated. The automation of the healthcare industry is moving toward processing and accessing vast health records for study, and this will improve the healthcare in general. The Artificial Neural Network (ANN) model was evaluated, adapted from Sristava and further developed by adding and evaluating the attributes with additional impact factors. There is debate and argumentation of perspectives, advice and guidance.

CCS

Applied computing > Life and medical sciences > Health informatics

KEYWORDS

data analytics, healthcare, comparative analyses, diabetes, python programming

1 Introduction

Data science is interdisciplinary, incorporating elements of statistics, data mining, and predictive analysis, and focusing on processes and systems that extract knowledge and insights from data. It is also known as “analytics transformation” because the goal is to “transform” raw data into usable insights. It has also been called “industrial analytics” because the context is industrial rather than scientific – to analyze data for

competitive or quality improvements that can be gained by having a better understanding of one's customers, potential customers, service model, and almost any aspect of the organization that can be represented in bytes. Data science has been a term in the computing field since around 1960 when it was first floated as a substitute for the term "computer science". Over the next twenty years or so, it gradually came to mean that blend of statistics and methodology that specifically pertained to data analysis. However, it was not until the much more recent emergence of Big Data and its role in organizational development and direction, that data science began to be a fundamental requirement of any organization working out how to analyze such massive amounts of data.

2 LITERATURE REVIEW

Data analytics in health sector provides stakeholders new insights that have the potential to improve personalized treatment as well as patient outcomes and avoid unnecessary costs. To date, health care industry has not fully grasped the potential benefits of data analytics.

In 1959, Arthur Samuel defined machine learning as "a field of study that gives computers the ability to learn without being explicitly programmed" (Panesar, 2019, p. 78). In essence, computers can learn to recognize patterns without being programmed to perform specific tasks (i.e., systems that learn without being explicitly programmed). As a result, learning is driven by data – with the intelligence acquired through the ability to make effective decisions based on the nature of the learning signal or feedback (Panesar, 2019). Machine learning focuses on the development of algorithms that learn to adapt to new data. It exemplifies the principles of data mining but is also able to infer correlations and learn from them to apply to new algorithms. The goal, then, is to mimic the ability to learn by experience like humans and achieve tasks without, or with minimal, external (i.e., human) intervention or assistance (Panesar, 2019).

There are many approaches employed by machine learning including memorization, extraction of information, and learning by example. It differs from traditional software engineering as instead of providing instructions about the function f (as in traditional software engineering), the computer is provided input x and output y and is expected to determine or predict function f using what has been provided (i.e., $Y = f(x)$, which can be understood as Output = function(Input)). Machine learning programs learn through reasoning to solve a problem from examples, rules, and information. It can also learn to generalize and help with issues of uncertainty with the use of statistics and probability-drive techniques. Models can also learn from previous computations or experiences to produce reliable and repeatable decisions and results (Panesar, 2019).

Machine learning usually involves seven steps including (1) specifying the problem as a learning task(s); (2) preparing the data; (3) choosing the learning method; (4) applying the learning method; (5) assessing the method and results; (6) optimization; and (7) reporting the results. The following is a practical example of machine learning in the field of healthcare: disease diagnosis x is the properties of the patient $f(x)$ is whether a patient has a disease (Panesar, 2019). Basically, it begins with input data provided as examples, direct experience, or instructions in order to identify patterns within the data and make better decisions in the future based on the data provided. As previously mentioned, the rationale of a machine learning program is to enable the program to learn automatically without human intervention or assistance. It should allow for adjustment of rational actions accordingly (Panesar, 2019).

There are various types of machine learning techniques and some of which include supervised learning, unsupervised learning, semi-supervised learning, reinforcement learning, and neural networks (Indoria and Rathore, 2018; Panesar, 2019). An example of how this can be applied in the field of healthcare is through the use of a supervised learning problem in the form of classification. Classification can predict the outcome based on a training dataset where the output variable is in the form of distinct categories. In this case, the model is built through inputting training data in the form of pre-labeled data. It will then define decision boundaries and include support vector machines, naïve Bayes, Gaussian Bayes, k-nearest neighbors (KNN), and logistic regression. An example of a real-world application of this is in

determining if an individual is sick or unhealthy based on a set of symptoms (Panesar, 2019). Another example is through the use of association for unsupervised learning problems. The association technique is able to discover the probability of the co-occurrence of items in a collection wherein any attribute can be predicted in association. For example, this can be used in calculating for percentage of likelihood of developing any form of cancer when one is diagnosed with poorly controlled type 2 diabetes (Panesar, 2019). Another example is through the use of neural networks, specifically artificial neural networks.

Artificial neural networks are made of perceptrons (i.e., mimicking biological neurons where dendrites receive an input; it has a bias similar to b of the linear function $y = ax+b$) and contain one or more hidden layers (Panesar, 2019). It has several topologies with the simplest being a feedforward method. Backpropagation is the method used for determining the error or loss at the output and propagating it back to the network. Artificial neural networks will be important in a subsequent paragraph and will be discussed in-depth then.

Machine learning tasks are usually conducted using various programming languages such as R, Python, Matlab, SQL, Java, and C (Panesar, 2019). This paper focuses on the use of Python. Python is a language that is well suited to machine learning. It is a general-purpose interpreted, object-oriented, and high-level programming language released by Guido van Rossum in 1991 (Sambyal, Javid, & Bansal, 2018). Extensions such as NumPy and SciPy are particularly useful for machine learning and data analysis (Panesar, 2019). It should be noted that Python is open-source and would therefore cost nothing when procured (Sambyal, Javid, & Bansal, 2018). In Sristava et al.'s (2018) study below, this is the programming language they employ along with the artificial neural network (ANN) approach.

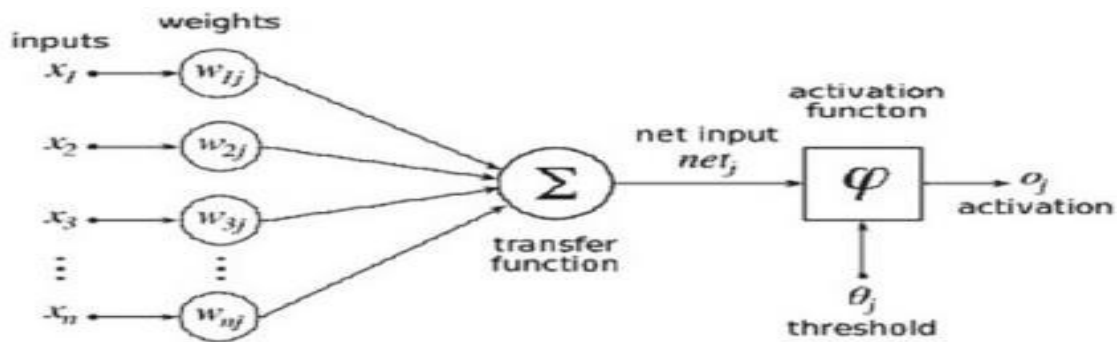


Figure 1. Artificial Neural Network (ANN) model. Adapted from Sristava et al. (2018).

Diabetes mellitus, often referred to as simply diabetes, is a disease that is increasing in prevalence on a global scale. The World Health Organization (WHO, 2018) estimated that the number of individuals with diabetes has risen to 422 million worldwide in 2014. In the United States, the Centers for Disease Control and Prevention (CDC, 2019) estimated that more than 7.2 million individuals have undiagnosed diabetes. On a global scale, it causes more than 2.2 million deaths yearly. It costs \$327 billion dollars in healthcare expenses and decreased productivity in the United States alone (CDC, 2019). Tests that could be used to diagnose diabetes include fasting plasma glucose (FPG) and hemoglobin A1c (HbA1c) or the average blood glucose level for the past two to three months (Sambyal, Javid, & Bansal, 2018). While these tests are widely available, it is often only useful when the individual is already manifesting symptoms of diabetes, meaning it is too late for these tests to be considered an effective screening tool (i.e., at that point, the patient will receive treatment for diabetes instead of following ways to prevent it) (Sambyal, Javid, & Bansal, 2018). With today's technology, the amount of data that has been collected from patients over the years, coupled with machine learning, can reliably and non-invasively predict individuals at risk for diabetes. This paper will discuss the real-world application considerations for devising new machine learning algorithm for the detection and prediction of diabetes using Python.

Diabetes is a chronic condition that causes abnormally increased levels of glucose in the blood (Sristava et al., 2018). There are three types of diabetes – the first is type 1, the second is type 2, and the third is gestational diabetes. Type 1 diabetes refers to the autoimmune disorder wherein the pancreas is

unable to produce insulin because its beta cells are being attacked by the body’s own immune system (i.e., hence, making it an autoimmune disorder), therefore causing high blood sugar (i.e., hyperglycemia) (Indoria and Rathore, 2018). The second type is type 2 diabetes, the most prevalent type, and also the type that most individuals refer to when they mention ‘diabetes.’ Type 2 diabetes is the result of the body’s ineffective use of insulin, most commonly due to excess body weight and physical inactivity (WHO, 2018). The third type is gestational diabetes; and as its name suggests, it occurs during gestation or pregnancy. It is associated with increased blood glucose levels and can cause complications during pregnancy and during delivery. The WHO (2018) added that children born from mothers with gestational diabetes are at risk of developing type 2 diabetes in the future. It is imperative that these three types of diabetes are predicted and detected as soon as possible as it can cause complications such as cardiovascular disorders, stroke, foot ulcers, kidney failure, and even death (WHO, 2018).

While there are a host of methods currently employed to predict and detect diabetes, they can only most often diagnose diabetes when an individual is already manifesting symptoms such as frequent urination, increased thirst, and increased hunger (Indoria and Rathore, 2018). This therefore calls for a more efficient and effective method of predicting and detecting diabetes so it can be addressed before symptoms and other possible complications begin to manifest. Indoria and Rathore (2018) explained that computer-aided diagnosis is increasingly being employed in the medical industry and that recent researchers have found machine learning promising in accurately perceiving and diagnosis diabetes. Various types of machine learning techniques are available including supervised, unsupervised, semi-supervised, and reinforcement (Panesar, 2019).

3 Analyses of a Model using Python Programming

Sristava et al. (2018) proposed a model to predict diabetes wherein the model is built in core Python using ANN algorithm.

Attribute name	Mean value
Number of times pregnant	3.8
Plasma glucose concentration	120.9
Diastolic blood pressure (mm Hg)	69.1
Triceps skin fold thickness (mm)	20.5
2-hour serum insulin (mu U/ml)	79.8
Body mass index	32.0
Diabetes pedigree function	0.5
Age (years)	33.2

Figure 2. Mean value of attributes. Adapted from Sristava et al. (2018).

Before discussing the machine learning technique and programming language used, it is important to discuss how data was collected as it is a core component of the development of a machine learning program. Data was collected through a platform for predictive modeling and analytics competition in which companies and researchers post data for research purpose. Attributes were assigned with numeric values and the following were included: (1) number of times pregnant; (2) plasma glucose concentration at 2 hours after administration of oral glucose tolerance test; (3) diastolic blood pressure; (4) triceps skinfold thickness; (4) 2-hour serum insulin; (5) body mass index (BMI); (6) diabetes pedigree function; (7) age; and (8) class variable. This dataset contains Missing Attribute Values handled in the preprocessing stage of methodology. An example of the attributes is seen in Figure 2. They explained that they chose Python due to its efficient high-level data structures and simple but effective approach to object-oriented programming. ANN was employed due to its ability to estimate or approximate functions that can depend on a large number of inputs and are unknown. ANNs are presented as systems of interconnected “neurons” which exchange messages between each other, and their connections have numeric weights that can be tuned

based on experience (i.e., enabling its capability to learn). Sristava et al. (2018) explained that three types of parameters define an ANN: (1) interconnection pattern between the different layers of neurons; (2) learning process for updating weights of interconnections; and (3) activation function that converts a neuron's weighted input to its output activation. The model can be seen in Figure 1. Sristava et al. (2018) included the following components written in Python as a function to call and execute: (1) Read_CSV(); (2) Assigning Random weight(); (3) NeuralNetwork(); (4) feedforward (); (5) backPropagate(); (6) sigmoid(val); (7) ErrorCal(); (8) Graph_Plot(). The specifics of these components can be seen in Figure 3. Attributes that will be included can be seen in Figure 4, listed according to priority.

1. **Read_CSV():** Training data file Diabetes_TrainingData.csv and converting in array to read by python. Using Pandas package [18] and related function array can be formed to easily supply as input Training values.
2. **Assigning Random weight():** INPUT_NEURONS variables used to weight for input Hidden (WiH), Then HiD (Hidden input Neurons) to HIDDEN_NEURONS for assigning weight. Finally, transfer HIDDEN_NEURONS weights to OUTPUT_NEURONS.
3. **NeuralNetwork():** First define number of epoch, which is epoch = 0 for initial and give training rate, which is TRAINING_REPS should always be greater than epoch. TrainInputs[] is an array which stores weight and input neurons values, trainOutput[] stores output hidden neurons values and learn for new values.
4. **feedForward():** First Neurons values are transferred to hidden layer neurons, where these values for each neurons are multiplied and stored in actual variable, which is the sum of all the multiplied neurons and weight value.
5. **backPropagate():** Backpropagation is a method to calculate the gradient of the loss function with respect to the weights in an artificial neural network [19]. It is commonly used as a part of algorithms that optimize the performance of the network by adjusting the weights. Here, backpropagation call the sigmoidDerivative function and define LEARN_RATE (Initially lower value), then calculate error in each sigmoid layer.
6. **sigmoid(val):** The sigmoid function is a type of activation function for artificial neurons. The most basic activation function is the heaviside (binary step, 0 or 1, high or low). The sigmoid function (a special case of the logistic function) and its formula looks as shown in Fig. 4.
7. **ErrorCal():** Here, the final error shows the model accuracy and Actual and Predicted values, which is finally 8% at the end of building model and get prediction.
8. **Graph_Plot():** This shows the result in graphical format. Package MatPlotLib used to plot the graph of actual and predicted values [20]. This graph shows under result section.

Figure 3. Components written in Python as a function to call and execute. Adapted from Sristava et al.(2018).

Also for the model it is very important to assess the priority of the attributes that are going to be measured and defined as impacting factors. Below is given assessment of the attributes.

Attribute name	Priority ^a
Diastolic blood pressure (mm Hg)	1
Number of times pregnant	2
Age (years)	3
Triceps skin fold thickness (mm)	4
Diabetes pedigree function	5
Body mass index (weight in kg/(height in m) ²)	6
2-hour serum insulin (mu U/ml)	7
Plasma glucose concentration a 2 h in an oral glucose tolerance test	8

^ameans lower weight, 8 means higher weight

Figure 4. Attribute priority. Adapted from Sristava et al. (2018).Conclusion

The main purpose of the research study was to investigate data analytics and its applications in healthcare using machine learning and python programming. Primarily the focus was on diabetes as one of the biggest silent killers of patients. There are many approaches employed by machine learning including memorization, extraction of information, and learning by example. It differs from traditional software engineering as instead of providing instructions about the function f (as in traditional software engineering), the computer is provided input x and output y and is expected to determine or predict function f using what has been provided (i.e., $Y = f(x)$, which can be understood as $\text{Output} = \text{function}(\text{Input})$).

Analyzed was the Sristava model to predict diabetes wherein the model is built in core Python using ANN algorithm. We have modified the provided algorithm by employing attribute priority and changing the number of impacting factors.

In conclusion, the developed machine learning model for the prediction and detection of diabetes is important as the condition continues to increase in prevalence worldwide while simultaneously increasing its economic burden. There are various considerations that need to be made when developing a machine learning program including the machine learning technique of choice and programming language to use. Another important consideration is the source of data.

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