Betting models using AI: a review on ANN, SVM, and Markov chain

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Abstract

In today's modern world, sports generate a great deal of data about each athlete, team, event, and season. Many people, from spectators to bettors, find it fascinating to predict the outcomes of sporting events. With the available data, the sports betting industry is turning to Artificial Intelligence. Working with a great deal of data and information is needed in sports betting all over the world. Artificial intelligence and machine learning are assisting in the prediction of sporting trends. The true influence of technology is felt as it offers these observations in real-time, which can have an impact on important factors in betting. An artificial neural network is made up of several small, interconnected processors called neurons, which are similar to the biological neurons in the brain. In ANN framework, MLP, the most applicable NN algorithm, are generally selected as the best model for predicting the outcomes of football matches. This review also discussed another common technique of modern intelligent technique, namely Support Vector Machines (SVM). Lastly, we also discussed the Markov chain to predict the result of a sport. Markov chain is the sequence or chain from which the next sample from this state space is sampled.

Keywords: Artificial Intelligence, ANN, Betting, sports, SVM, Markov chain

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Introduction

In today's modern world, sports generate a great deal of data about each athlete, team, event, and season. Experts, players, team managers, and analyzers were thought to be the owners of research in traditional sports science. Sports organizations, on the other hand, have only recently recognized the wealth of science contained in their data and have tried to exploit it using AI techniques. Coaches and managers may use sports AI to forecast outcomes, evaluate player performance, predict player injury, identify sports talent, and evaluate game strategy [1].

Many people, from spectators to bettors, find it fascinating to predict the outcomes of sporting events. It's also fascinating as a research issue, in part because of its complexity, because the outcome of a sports match is decided by a number of variables, including a team's (or a player's) morale, abilities, current score, and so on [2]. As a consequence, even sports experts find it difficult to predict the exact outcome of sporting events.

Sport betting offers numerous benefits [3]. First and foremost, there is the importance of entertainment. Sports betting has a lot of advantages, which is why a lot of people participate in sports to enjoy the entertainment value. Nothing beats a live game with money involved for entertainment and intrigue. However, one may bet on a losing team or on a team that does not play every day or every week. Whatever team an individual supports, the main objective will be to cheer them on and hope they win. Second, it provides an additional source of income. When there is money on the line, sports betting has an advantage. As long as he bets on a reputable betting organization, any amount a person has will win him some money. Some people also give up their work and rely exclusively on betting as a way of living. However, just a small number of people give up betting.

The third advantage is the ease of use. Despite the fact that there are several hobbies available, one cannot engage in them all of the time. This is due to the fact that certain games are costly, and he cannot afford to play them all of the time. Sports betting is a low-cost pastime that can be enjoyed at any time and on any day. He may also opt to gamble online or in a land-based casino and still profit from the games' features. Some sports, such as bowling, can necessitate him being present at the bowling alley at particular times, which may cause you inconvenience. He can, however, bet online in his spare time when it comes to sports betting.

Another advantage is that it is simple to get started. A person's participation in a variety of hobbies necessitates adherence to strict rules as well as time. If a person's schedule is too tight or he doesn't have the money, this might pose a problem. The positive thing about sports betting is that he won't need any special equipment or a huge amount of money to start staking. He also has the option of betting the same amount every now and then. Finally, since there are so many sports betting sites, a person can start betting whenever he wants. Furthermore, there are so many reputable casinos that he won't need to look for any more until he begins betting. As a result, he is free to begin betting whenever and wherever he wants.

With the available data, the sports betting industry is turning to Artificial Intelligence. Working with a great deal of data and information is needed in sports betting all over the world. Various sports leagues around the world provide this information to bookmakers, allowing them to develop better products and improve legal betting. And no technology could work better than Artificial Intelligence to develop the area of legal sports betting with huge data.

Artificial intelligence and machine learning are assisting in the prediction of trends in sports, but in order for AI to function efficiently, the sport must be predictive and adhere to a set of rules. For example, football, which has a set of rules that are short in length and can be repeated, can be used in an AI model, with over a lakh videos of games being run through the algorithm to see patterns that can be predicted by AI. The true influence of technology is felt as it offers these observations in real-time, which can have an impact on important factors in betting [4].

Artificial Neural Network (ANN) for sport prediction

A neural network is a model of human thinking based on the human brain. The brain is made up of a closely connected array of nerve cells or basic data processing units, or neurons. There are approximately 10 billion neurons and 60 trillion synapses in the human brain. By using many neurons at the same time, the brain can achieve its goal much faster than the world's fastest computers. Although each neuron has a simple structure, a division is a powerful computing force. A neuron is made up of a cell, a soma, multiple dendrites, and a thin, long fiber called the axon [5].

The axon spreads to other neurons' dendrites and somas, despite the fact that dendrites branch along the soma. Figure 1 depicts the schematics of a neural network. Signals are transmitted from one neuron to another by complex electrochemical reactions. Chemical compounds released from synapses affect the electrical potencies of the cell body. The axon generates an electric pulse, which is an action force, when the potential reaches its threshold. The pulses travel through the body and eventually reach synapses, where they can be increased or decreased in intensity. However, the most intriguing discovery is that a neural network can be plastic [6] .

In response to the stimulus pattern, the neurons show long-term changes in the frequency of their partnerships. The neurons may also form new connections with other neurons. Even whole neuron collections can frequently be moved from one location to another. The basis for brain learning is given by these processes. The brain can be used as a parallel information processing system that is both extremely complex and non-linear. In a neural network, data is collected and processed continuously over the entire network, rather than at discrete points. To put it another way, in neural networks, both data and computation are global rather than local.

Neurons that contribute to the 'right answer' are strengthened, while those that contribute to the 'wrong response' are diminished, thanks to plasticity. Neural networks can learn from their experiences in this way[7]. Learning is a central and critical characteristic of neural biological networks. Because of the versatility and naturalness with which you can learn, machines have attempted to mimic biological neural networks.

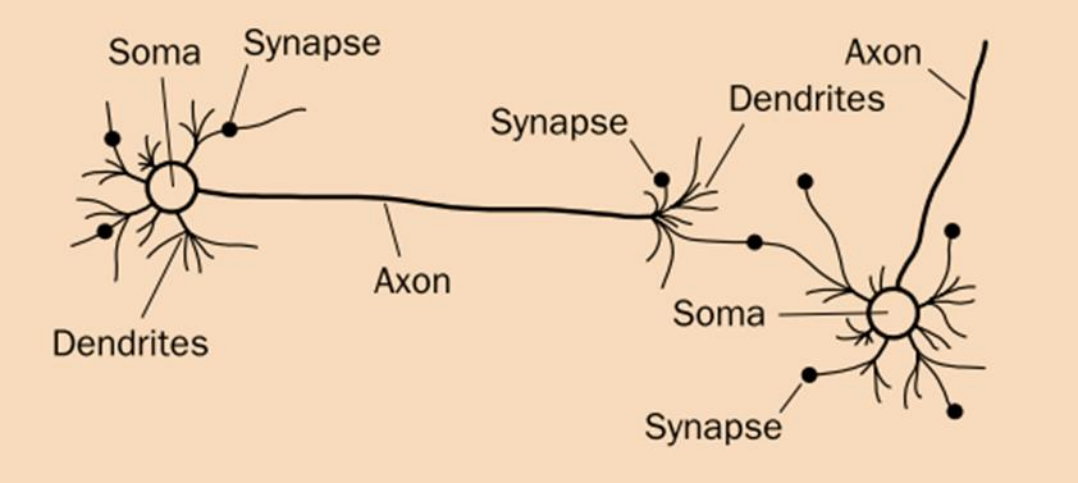

Figure 1.

An artificial neural network is made up of several small, interconnected processors called neurons, which are similar to the biological neurons in the brain. A weighted relationship exists between the neurons, which links them. Each neuron receives a number of input signals via its connections, but never produces more than one output signal. The output signal is transmitted by the neuron's output (corresponding to the biological axon). The outgoing link is divided into several branches, each of which transmits the same signal (the signal is not divided among these branches in any way). The outgoing branches of the network come to a halt at the network's incoming neurons. Figure 2 depicts the relationships of a typical ANN.

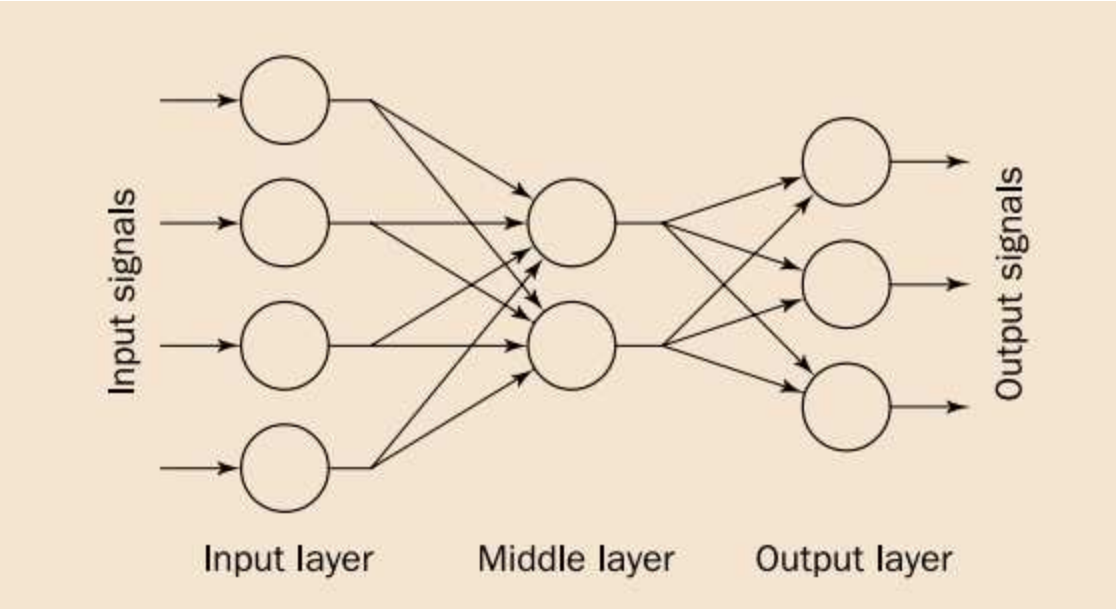

Figure 2.

Steps in ANN to predict match results

Step 1	Selecting prediction parameter
Step 2	Designing appropriate NN model
Step 3	Gathering data Step
Step 4	Predicting the match results

Seven match-based criteria are chosen as prediction parameters in order to predict the match outcome. The teams, the state of the teams in recent weeks, the condition of the teams in the competition, the quality of opponents in recent matches, the league of the match, the week of the match, and the results of the match compose these parameters. The seven criteria are used to generate prediction parameters (Table 1). The parameters are used as inputs to the NN model, and the collected results from the previous leagues and weeks are used as outputs (Figure 3).

Match-based prediction criteria	**Prediction parameters**	***Symbols***
Teams	*The code of Home team*	I_1
	The code of Away team	I_2
Condition of teams in recent weeks	*Average of obtained points in recent 4 matches for Home team*	I_3
	Average of obtained points in recent 4 matches for Away team	I_4
Condition of teams in the league	*Average of obtained points in the league for Home team*	I_5
	Average of obtained points in the league for Away team	I_6
Quality of opponents in the last matches	*Average of obtained points by previous opponents in recent 4 matches for Home team*	I_7
	Average of obtained points by previous opponents in recent 4 matches for Away team	I_8
League of match	*The number of the league*	I_9
Week of match	*The number of the week*	I_{10}
Match results	*The number of goals by Home team*	O_1
	The number of goals by Away team	O_2

Table 1: Prediction parameter

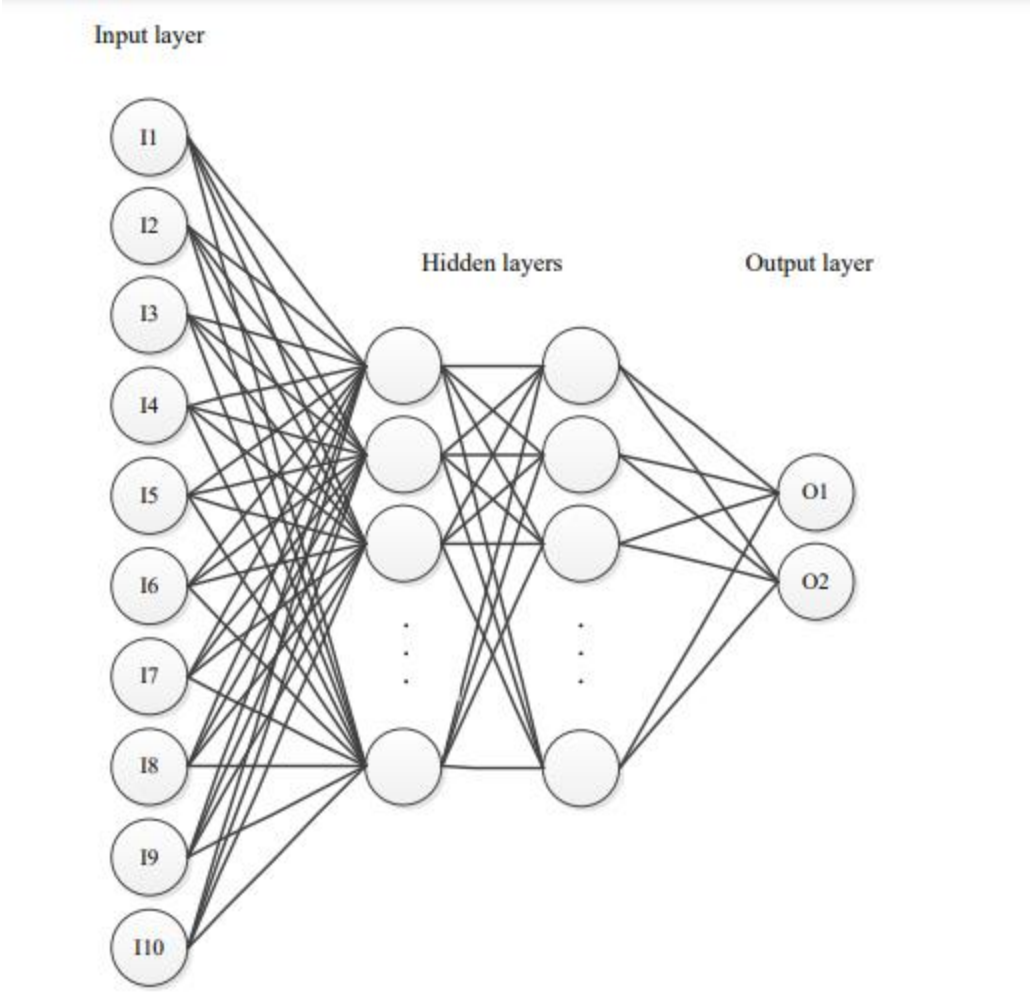

Figure 3

MLP, the most applicable NN algorithm, are selected as the best model for predicting the outcomes of football matches. The configuration of the MLP model is made up of ten inputs and one output. In addition, to deal with the problem's complexity, two hidden layers with a total of 20 neurons on each layer are considered [4].

Support Vector Machines (SVM) [8]

A non-linear mapping of a high-dimensional training set is used by an SVM in the majority of cases. To put it another way, the algorithm searches out the best dividing hyper-plane between the two groups, which acts as a decision boundary. An SVM can locate the hyperplane using vectors (training dataset) and margins (defined by vectors). Although SVM training takes longer than other methods, the algorithm's ability to create non-linear, complex decision boundaries is thought to give it a high degree of accuracy. There's even less of a chance of being over-fitted. Cao used an SVM, a simple logistic classifier (a mixture of algorithms based on logistic regression and using LogitBoost as a simple regression function), nave Bayes, and a multilayer perceptron neural network to predict basketball performance. Due to the nature of two groups, two outputs were considered. The output with the highest value was selected, as predicted. He then subjected his models to a scoring method to assess how realistic they were (a process to test a model in prediction of events not yet occurred)

Markov chains

A sequence of random variables is used to define a Markov chain. The state space is a set of variables, with each variable representing a single state. The Markov chain is the sequence or chain from which the next sample from this state space is sampled. Furthermore, it is presumed that the next state is only based on a finite number of previous states [9]. The first-order Markov chain is the simplest Markov chain. The current state is solely based on the previous state in this case.

$$P(X_t|X_{0:t-1}) = P(X_t|X_{t-1})$$

The unobservable variables are represented by Xt. The set of variables from X0 to Xt1 is denoted by the notation X0:t1. P(Xt|Xt1) is the transition model for a first order Markov process, while P(Xt|Xt2, Xt1) is the transition model for a second order Markov process. A transformation model depicts the progression of a domain. It also defines, given the previous value, the probability distribution over the newest state variable.

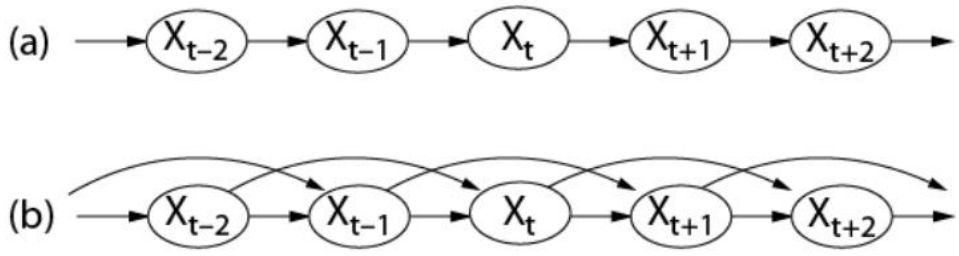

Figure 4

Figure 4 depicts the Bayesian networks for the first and second order Markov chains, which correspond to the two transformation models above. Rather than defining a new distribution for each time phase, the assumption is made that changes in the domain state are induced by a stationary mechanism.

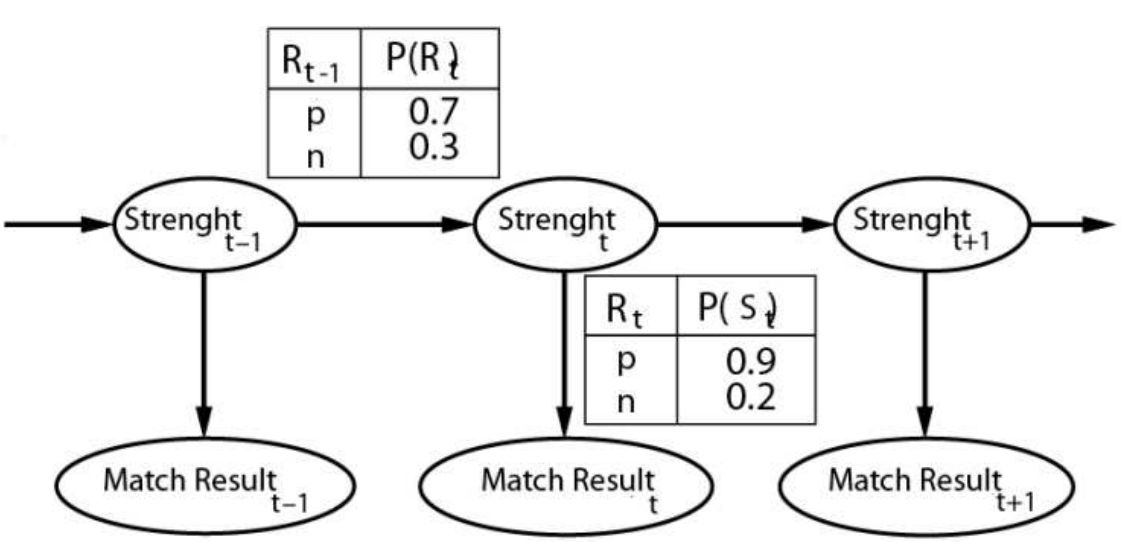

Figure 5.

In the example (figure 5): we want to measure a team's strength solely on the basis of a match outcome; if the team's result is positive, the strength is updated with a positive value; if the result is negative, the strength is updated with a negative value [10]. Naturally, this is a condensed example intended to illustrate the definition. Since the conditional probability of the outcome in the given example is the same for all t, P(Rt|Rt1), a conditional probability table is only needed once.

It's important to determine how proof variables get their values after identifying the transformation model. This is known as the sensor model, and it is based on the sensor Markov assumption. The prior probability distribution, P(X0), must also be defined in addition to the two models.

The Markov assumption, combined with the Ergodic theorem, guarantees that the chain will eventually converge to a single stationary distribution, regardless of its initial state. In simple terms, the Ergodic theorem for a Markov chain states that the chain can go from any state to any other state and that the chain does not repeat the same loop. This means that no samples are replicated [11].

Burn-in is the term for when a chain converges. Since they are still dependent (correlated) on the chain's initial state, the samples taken during this time are rarely useful. Samples that are only associated with the stationary distribution are favored.

$$f = \frac{1}{n-m} \sum_{t=m+1}^{n}$$

where n denotes the number of samples to determine the expectation over and m denotes the number of burn-in samples to discard.

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