Cost prediction using gradient descent algorithm

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Abstract: In recent days booking through web sites has become very prominent. Almost 70% of bookings or transactions are happening through online. Of all the sales web sites housing websites has become a great platform for sales. Different companies provide different services like selling new house, house rentals, sale of used houses etc. Price matters a lot in any sales. As houses are one time buy in the life for most of the Indians, they do a lot of research related to price, area and facilities while buying a house. The first thing common middle-class person looks at is the price based on their requirement. Integration of Machine learning algorithm to these web sites or application can be a great advantage. This can reduce the manual effort of sending quotations or negotiations. Presently we see many web sites which give us the details regarding the houses and their prices, but a person must invest more time to search the house which fits his necessities and budget. By integrating a machine learning algorithm into these websites, it helps the user just to sort his necessities and saves his time. In this paper the usage of this algorithm is explained practically and how the functionality can help improve the deliverability of the application is also discussed.

1. INTRODUCTION

Presently in India there are many websites and applications through which houses are sold or given for rent. All these websites or applications help the owners to place the photos and cost for that house. This helps the buyers to view the houses based on city, area, type etc. But one of the challenges in this process is user must search a lot to get an idea on the prices of the houses based on locality, type etc. By using machine learning algorithm all this will be analysed by the application and user can just give the information of type and locality and get the estimated price without wasting his time. Below figure 1 shows the general search format in a housing website or applications.

![Figure 1. Search format in Housing Websites/Applications](image-url)
We can just search using few criteria’s and getting our required model at an affordable price is really a challenge as it consumes a lot of time of the user. Instead if a predictor is added to the same home page it makes the user comfortable in understanding the prices of his requirements in different localities.

To predict the prices based up on number of bedrooms, locality, type of house etc we can use Machine learning where the system is trained with the past and existing data and using the algorithm system can estimate the price and help the user find the best match in very less time. Especially in developing countries like India, where possessing a house is a lifetime dream People put lot of efforts in finding the best choice, where cost of the house plays an important role. This integration plays a major role in saving the time for the user and helps the seller to understand easily about the conversions.

2. PROBLEM STATEMENT

In real estate and house rental applications one of major challenge faced by the user is while searching for the houses or property with his desired properties and at an affordable price to him. Present day application and web sites provide all this information, but the user must go through each entry to get the full details about the pricing based on the facilities. This consumes a lot of time and sometimes misleads the user which causes the seller to loosen few potential customers.

3. METHODOLOGY

Machine learning plays a major role in giving a prediction analysis based up on the data. The above challenge can easily be handled by Machine Learning technique called Linear Regression using an algorithm Gradient Descent Algorithm which is a simple algorithm used to find the optimized solution from the given data and helps in prediction. System is trained with input data and using gradient descent algorithm the output is given. System can be trained with input data using OCTAVE. The program is written in Octave environment where the logic for gradient descent algorithm is also given.

4. MACHINE LEARNING

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide[1]. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

4.1. Categorization of Machine Learning

There are generally three types of machine learning based on the ongoing problem and the given data set, (1) supervised learning, (2) unsupervised learning, and (3) reinforcement learning

4.1.1 Supervised Learning

This can apply what has been learned in the past to new data using labelled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system can provide targets for any new input after enough training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.
4.1.2 Unsupervised Learning
These algorithms are used when the information used to train is neither classified nor labelled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabelled data. The system doesn’t figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabelled data.

4.1.3 Reinforcement Learning
This is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behaviour within a specific context in order to maximize its performance[2]. Simple reward feedback is required for the agent to learn which action is best; this is known as the reinforcement signal.

5. LINEAR REGRESSION USING GRADIENT DESCENT ALGORITHM
The objective of linear regression is to minimize the cost function

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} (h_{\theta}(x^{(i)}) - y^{(i)})^2$$  \hspace{1cm} (1)

where the hypothesis $h_\theta(x)$ is given by the linear model

$$h_\theta(x) = \theta^T x = \theta_0 + \theta_1 x_1$$  \hspace{1cm} (2)

Recall that the parameters of your model are the $\theta_j$ values. These are the values you will adjust to minimize cost $J(\theta)$[3]. One way to do this is to use the batch gradient descent algorithm. In batch gradient descent, each iteration performs the update.

$$\theta_j := \theta_j - \alpha \frac{1}{m} \sum_{i=1}^{m} (h_{\theta}(x^{(i)}) - y^{(i)})x_j^{(i)}$$  \hspace{1cm} (3)

(simultaneously update $\theta_j$ for all $j$).

With each step of gradient descent, your parameters $\theta_j$ come closer to the optimal values that will achieve the lowest cost $J(\theta)$.

Combining the above equations in the code with training set can help us in predicting the values correctly. Training set plays a very crucial role in prediction. The more the number of training sets and the more accurate training set can give us more accurate output[4][5]. In this paper we have considered one variable i.e. area in sft and based on the area the price is decided. This algorithm can also be used for multiple variables.
6. RESULTS

Figure 2. Linear Regression plot based on training data

Figure 3. Visualizing the values of J

Figure 4. Contour of Visualizing J values
Fig. 5. Predicted value for the price for 7000 sft area

We can get a proper idea on the estimations from the above figures. Here figure 2 shows the linear plot between the dependent variable and independent variable. Figure 2 helps to understand the best fit of the given dataset. Figure 3 and figure 4 are the gradient descent plots, which helps us to know the global minimum point. Most important thing for any machine learning model is the accuracy of the prediction and figure 5 shows the predicted price for a random value of area which is not in the dataset.

7. CONCLUSION

Technology helps mankind to make things simpler and the above results clearly show that a huge effort of user can be reduces by using few algorithms for predicting prices in applications. This can also be used in different sectors like share market where the user can get a prediction of tomorrows share value from the previous share price data and in all kind of online selling applications.

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