# Macao Bus Travel Time Prediction Using Neural Network


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## ABSTRACT


It is known that a city like Macao is often plagued by traffic jam and huge demand in public transit, which result in bus delay and long bus waiting time. This is particularly hectic for people travelling in peak hours. In order to estimate the length of travel time, a web-based application for predicting the bus travel time in Macao by using neural network has been developed. The project consists of four main parts. Firstly, a workable neural network was built. Secondly, dozens of sample data was collected for training and adjusting the neural network. Thirdly, a user-friendly website interface was made for almost all platforms and browsers. Finally, setting a server which connects website with the neural network and handling user requests, also opening the port of the application for public access with a public IP address.

As a result, the application allows the user to enter a specific location and a bus route and returns the predicted travel time. Also, the prediction is reasonable and gives the users a rough estimate of the required time. For future works, more data training will help improve the effectiveness of the prediction.


## DESIGN APPROACH

The name of the application is *Macao Bus Predictor*. Basically, there are four components in this project. As seen in the figure 1, there are Database, Neural Network, Server and the web-based application interface. Data is collected from the mobile application "Macao Bus Travelling System". Then it is normalized into a .csv file. The neural network is made by python with PyBrain library, and it is trained by the previous dataset. The server is built for connecting the web application with neural network. Finally, the interface is going to be made to make it easier for users.

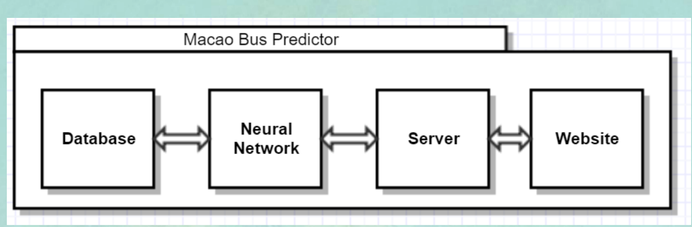


**Figure 1: the system structure of the project**

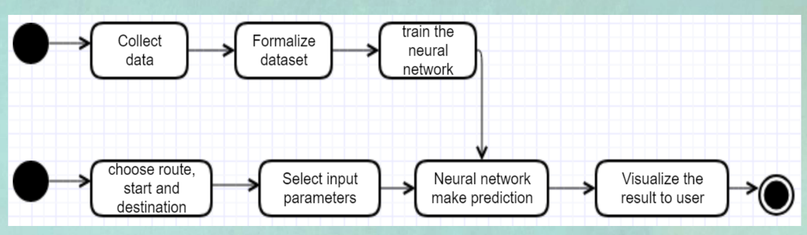


**Figure 2: the activity diagram**

Figure 2 is the activity diagram, showing the basic usage of this project. Firstly, collecting data and build the neural network. Then training and adjust the neural network by this dataset. When the neural network finishes training, it would be written to a local .xml file and ready for reuse. Then users are able to use the application, selecting the parameters and get the result of prediction with the help of a better well-trained neural network.

## INTRODUCTION

As is known to all, Macao is the city which has the highest population density in China, and it is famous for its thriving tourism and gambling industry. Due to the limited land and public transport, traffic jam becomes severe. Also, there are various factors which affect the public transport, such as weather and the time of the day. Hence, due to the unstable bus travelling time, people in Macao clamour for a system that may predict the bus travelling time.

This project proposed to develop a web-based application which is compatible with all platforms, light-weight, convenient and user-friendly. The objectives are as follows:

i. Building a user-friendly interface
ii. Collect the sample data from the application "Bus Traveling System" for training the neural network
iii. Users are able to choose a bus route, starting location and destination and the traffic parameters, then submit them to neural network, and returns the result through the interface.
iv. Making the application compatible for both computer-side and mobile-side.

The bus travel time prediction takes into account various conditions, i.e. the time of the day, the weather conditions and whether it is weekend or not. The outcome may help the users to weight different travel options and make a better schedule beforehand.

## ALGORITHM

1. Creation of neural network doing **regression** job: In this application, the result should be a number which is the travelling prediction time. Also, the output may range from a few minutes to even an hour. Thus, it is better to make the neural network doing regression job instead of classification.

2. The activation function is set to be Tanh rather than Sigmoid .

Tanh function: $$tanh(x) = \frac{e^{2x} - 1}{e^{2x} + 1}.$$

**Figure 3: the equation of Tanh activation function**

3. Training algorithm: Backpropagation

Backpropagation is commonly used by the gradient descent optimization algorithm to adjust the weight of neurons by calculating the gradient of the loss function. Backpropagation as the name suggest, it propagate backwards. Opposite to the direction where forward propagation ends. It is needed to find derivatives which help neural network in performing gradient descent that eventually minimizes the cost function. alpha is the learning rate; δJ/δW, δJ/δb are calculated via back propagation. Go on finding the derivatives and then keep updating the weights in order to achieve a better accuracy. This property of propagating backwards and finding derivatives is what known as backpropagation.

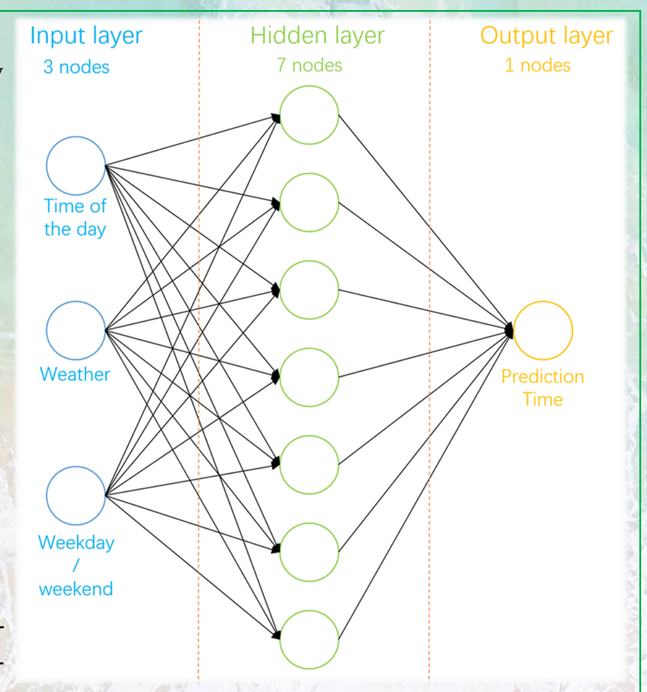


**Figure 4: the neural network of Macao Bus Predictor**

Compute predictions ( $y'^{(i)}$, i ∋ [1,m])
# updating the weight
$W^{[i]} = w^{[i]} - \alpha * \delta J/\delta W^{[i]}$
(# J is the cost function (loss function is for particular row, cost is for whole training data)
$b^{[i]} = b^{[i]} - \alpha * \delta J/\delta b^{[i]}$

**Figure 5: the Pseudo Code for gradient descent**

## CONCLUSIONS

In conclusion, this final year project is a bus travel time predictor with a user-friendly interface which allows users to choose certain real-life conditions by using neural network. As a prototype, although it is only available for route 3 between Almeida Ribeiro and MPI, the application basically met the objectives. An user-friendly interface was developed. Sample bus data was collected and used to train the neural networks. Users are now able to choose a starting location and destination and the traffic parameters, then obtain the predicted travel time.

With the help of this application, Macao people may have more information about bus travel time in order to make a better time schedule when they decide to take a bus.

In the future, people can improve this application by collecting more data and training the neural network to make it more precise and accurate. Besides, the real-time condition such as currently weather and time could be fetched automatically as input parameters. The prediction by neural network could be used not only in bus, but also in any other transportation such as flight and bicycle.

## RESULTS

1. Computer-side. This is the home page of the application. This title tells the user the function of the application, also there is a instruction, which guides the user to use it step by step.

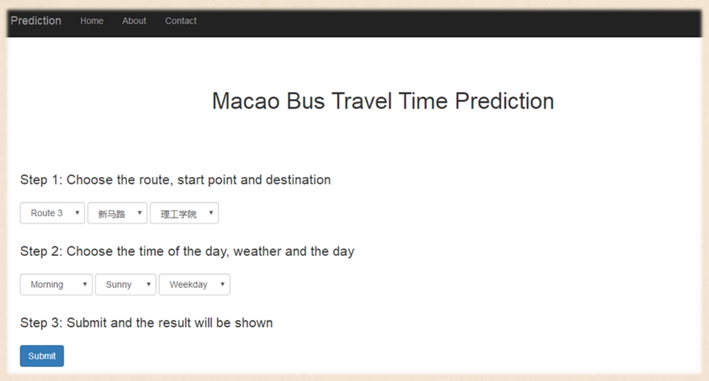


Figure 6: the Home page of the application


Figure 7: the result page of the application

2. Mobile-side. This is the home page of the web application in mobile browser. The layout is perfectly compatible in mobile-side. Also the navigation bar is shrink due to the length limit in smartphone automatically.

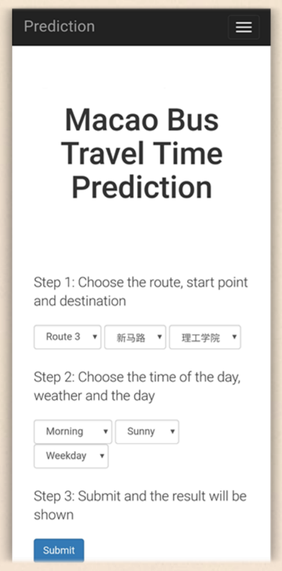


Figure 8: the Home page in mobile-side

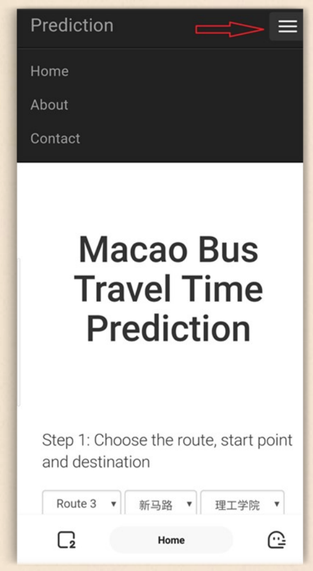


Figure 9: the navigation bar after click