

Analytics Edge Ecosystem Workloads- GSoC

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1 Introduction

1.1 Motivation

Today's society, where technology has broken down all barriers, makes it simple to address the majority of human issues. One of these issues includes traffic congestion. Over the years, there has been a sharp increase in traffic congestion, which has had detrimental effects on safety, accidents, air pollution, fuel waste, and most crucially, avoidable delays. At SUSE, we made an effort to develop a straightforward machine learning application that solves this issue.

Smart as a vertical — Many of us are very familiar with the word smart. In my opinion, everything which has the capability and sense to do something on its falls under the category of smart. Smart has now become a suffix to symbolize a person and any type of commodity. For Ex- Smartphones, Smart TVs, Smart cities, and many more...

More specifically this project falls under smart cities.

1.2 Scope

This Traffic Management System app's objectives are to enhance transportation processes, lessen traffic congestion and fatalities, offer users general notifications and alerts, and maintain traffic law enforcement.

1.3 Audience

This document is intended for DOT(Department Of Transportation), ATMS(Advance Traffic Management System) Team, Machine Learning Enthusiast, data analyst and Mlops and Devops practitioner.

2 Overview of the App

This application has two user interfaces.

1. User Interface - This interface allows us, as users, to enter the date and time of their journey in order to obtain the traffic flow at that specific time. This will assist users plan their trips.
2. Admin Interface – Through this interface, the Department of Transportation (DOT) can access the camera installed on the highway and watch the traffic's live stream.

To better comprehend traffic and gather additional information, they can also download the video and use car counting on it.

3 Technical overview

Using GRU, we developed a traffic prediction model machine learning model.

HTML,CSS and Javascript had been used to develop frontend part of the application and flask is used as backend to integrate ml model with the app.

Kubeflow is used to pipeline the process of getting the newer dataset and training model over it.

Docker is used to containerise the app and deploying the app over kubernetes with help of Rancher.

4 Tools and Components used

1. GRU Model (<https://towardsdatascience.com/understanding-gru-networks-2ef37df6c9be>) ↗
2. HTML (<https://www.w3schools.com/html/>) ↗, CSS (https://www.w3schools.com/css/css_intro.asp) ↗ and JS (https://www.w3schools.com/js/js_intro.asp) ↗
3. Flask (<https://flask.palletsprojects.com/en/2.2.x/>) ↗
4. Kubeflow (<https://www.kubeflow.org/docs/components/pipelines/v1/introduction/>) ↗
5. Docker (<https://docs.docker.com/>) ↗
6. Kubernetes (<https://kubernetes.io/docs/home/>) ↗
7. Rancher (<https://rancher.com/docs/>) ↗

5 Prerequisites



Note

All versions mentioned below are the updated versions while we are working on this project . While downloading you may get different versions for some tools.

- SUSE Rancher version - 2.5
- k3s version - 1.24.4 + k3s1
- kubeflow version - 1.8.3
- Docker version - 20.10.12

6 Installation

7 Creating ML Model

ML Model

GRU (Gated Recurrent Unit) aims to solve the vanishing gradient problem which comes with a standard recurrent neural network. GRU can also be considered as a variation on the LSTM because both are designed similarly and, in some cases, produce equally excellent results.



Tip

You can learn more about GRU from here - <https://towardsdatascience.com/understanding-gru-networks-2ef37df6c9be> ↗



Note

The below mentioned code is just a code snippet of building GRU model . Full code can be downloaded from github gist- <https://gist.github.com/akshat5302/81770ccf6fb369948f169652c36777c#file-model-py> ↗

```
# building model
def build_GRU():
    model = Sequential()
    model.add(GRU(64, input_shape=(lag, 1), return_sequences=True))
    model.add(GRU(64))
    model.add(Dropout(0.2))
    model.add(Dense(1, activation='sigmoid'))
    return model

model_struct = "GRU"
x_train = np.reshape(x_train, (x_train.shape[0], x_train.shape[1], 1))
model = build_GRU()
model.compile(loss="mse", optimizer="rmsprop", metrics=['mape'])
monitor = EarlyStopping(monitor='val_loss', patience=40, verbose=1,
    mode='auto', restore_best_weights=True)
hist = model.fit(x_train,
    y_train, batch_size=64, epochs=600, callbacks=[monitor], validation_split=0.05)
model.save('models/GRU.h5')
df = pd.DataFrame.from_dict(hist.history)
```



Note

We will use generated h5 file in our flask app to predict road traffic according to user input.

8 Creating Flask App

Flask App - Flask is a lightweight Python web framework that provides useful tools and features for creating web applications in the Python Language.



Note

The below mentioned code is just a code using the h5 file in flask app to get road traffic prediction using the ml model. Full code can be downloaded from github gist- <https://gist.github.com/akshat5302/87c23e81561729db3998900afbf65c49> ↗

```
print("Loading GRU keras model...")
model_GRU = load_model('./models/GRU.h5')
print("GRU model successfully loaded")
predicted_GRU = model_GRU.predict(x_test)
```

```

predicted_GRU = scaler.inverse_transform(predicted_GRU.reshape(-1, 1)).reshape(1, -1)
[0]
if flask.request.method == 'GET':
    return(flask.render_template('index.html'))
if flask.request.method == 'POST':
    date = flask.request.form['date']
    time = flask.request.form['time']

    col = getTimeAndDate(date, time)
    currTimeList=getCurrentTimestmap().split(" ")
    x=df.loc[df['5 Minutes'] ==col]

```

9 Creating Kubeflow pipelines

Kubeflow - The Kubeflow project is dedicated to making deployments of machine learning (ML) workflows on Kubernetes simple, portable and scalable.



Tip

You can read more about building your own pipelines from here - <https://www.kubeflow.org/docs/components/pipelines/v1/sdk/build-pipeline/> ↗

10 Demonstration

11 Summary

12 Additional resources

13 Legal notice

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