

Accident Number Forecasting

Introduction (Mission 1)

Forecasting the accidents counts is an important topic to prepare aids, ambulances for victims. Also, it helps to expect the hospitals preparations. Also, it helps to avoid it. This dataset has been prepared, cleaned, analyzed, and visualized as all in the `All_Data_Analysis_Visualization.ipynb`. and in from this Analysis, I found the following properties:

- 1764 rows of data.
- This data is from 2000 to 2020
- It has three types of accidents as follows 'insgesamt', 'Verletzte und Getötete', and 'mit Personenschäden'
- These accidents have the following categories 'Alkoholunfälle', 'Fluchtunfälle', and 'Verkehrsunfälle'

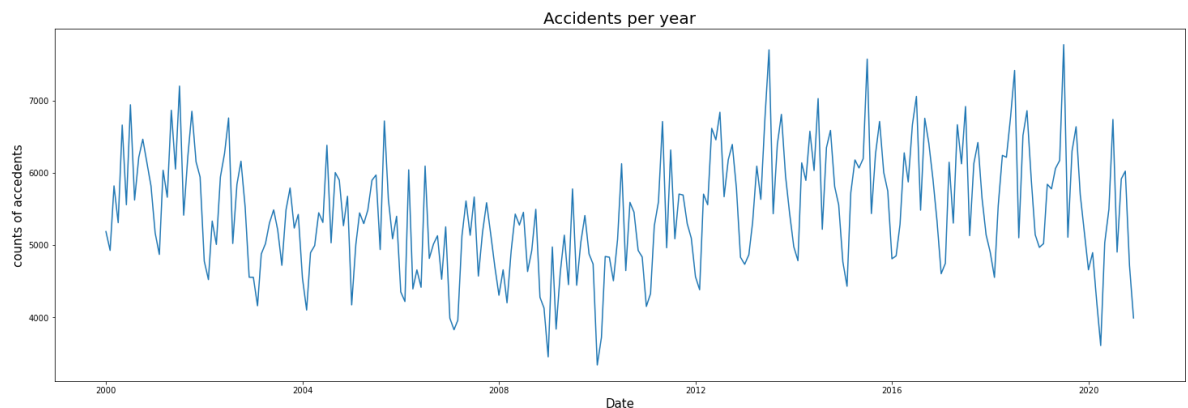
Analyzing all data Notebook Parts (`All_Accidents_Data_Analysis.ipynb`)

In the cleaning part, I applied the following to clean it before analysis or visualization.

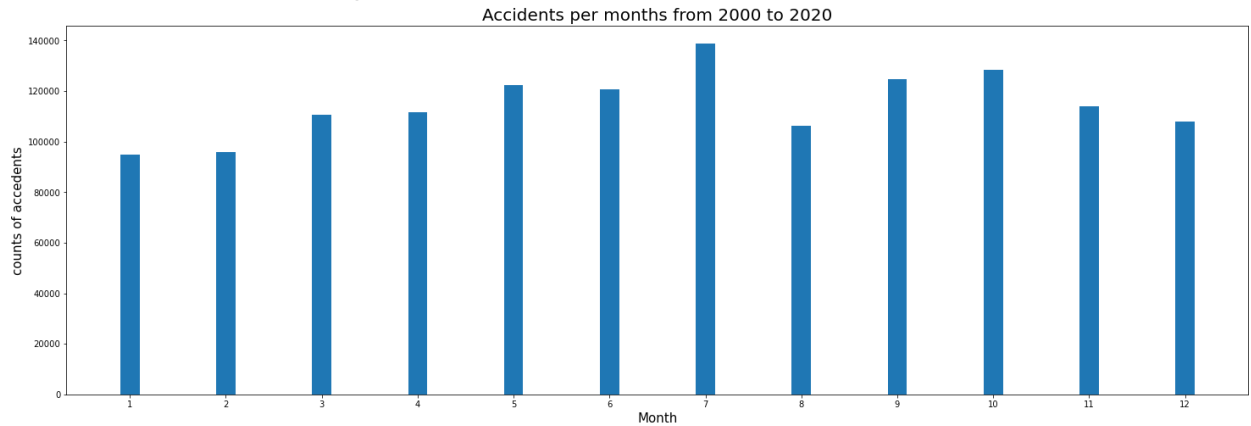
- Remove the row with month equal=Summe.
- Create the date column.
- Sort the values according to the date column. This step is mandatory in time-series analysis.
- Put the date column as the main index.
- Fill the month column with values from 1 to 12

In the Analysis data part, I analyzed and visualized the data to explore some insights and relationship between data columns such as,

- Accidents per year from different types and categories.

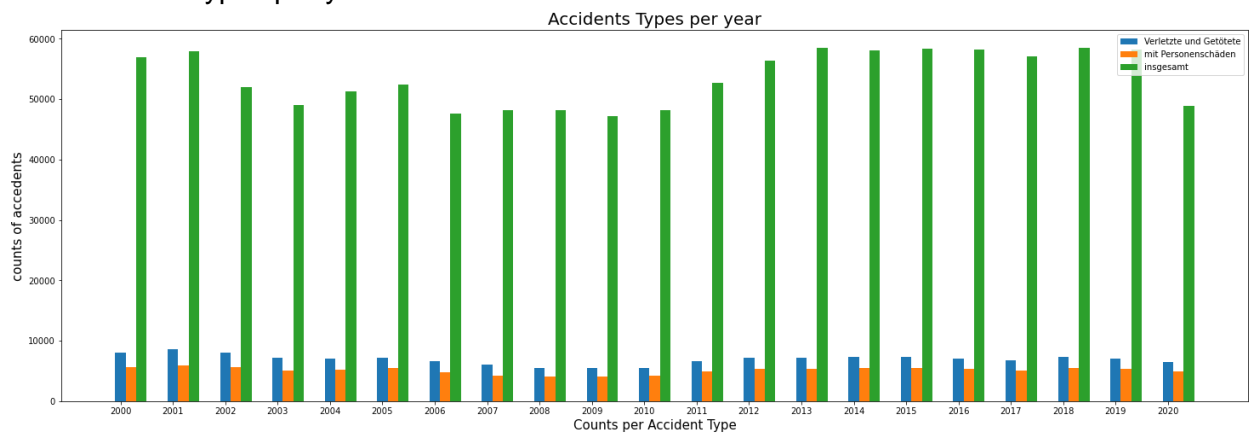


- Summation Accidents per month



We notice from above figure that July month has the maximum number of accidents.

- Accident's types per year



From here, we found that 'insgesamt' caused the highest count of accidents.

- Obtaining the relationship between accidents' types and categories. We notice from her that the 'Verkehrsunfälle' has the highest number of accidents.

category	accident_type	
Alkoholunfälle	Verletzte und Getötete	5216
	insgesamt	11026
Fluchtunfälle	Verletzte und Getötete	11312
	insgesamt	221616
Verkehrsunfälle	Verletzte und Getötete	128906
	insgesamt	891374
	mit Personenschäden	106986

In Saving data part

After all cleaning steps, the data is save to be used in the Insgesamt_Accidents_Analysis_and_Modeling notebook to build the model.

[Insgesamt Accidents Analysis and Modeling Notebook](#)

[Insgesamt_Accidents_Analysis_and_Modeling](#)

In this notebook, I will model the data of only 'insgesamt' from 'Alkoholunfälle' category. As far as I know in time-series, (It is my 1st time to work time series) the data should be sequential to build sequences. But the data in our hand has more than type of accidents happened in the same month. So, you can see more than row has the same date. As result of that I propose to build model for each category inside each type to model all data.

So, I decided to model 'insgesamt' type from the Alkoholunfälle category the 'to predict your example inside the challenge'. But in real world every type of each category should be modeled individually. In prediction time, we should call the most suitable model according to the data category. Let's go through notebook parts.

[Data Preparing](#)

Where the cleaned data is read and extract the data of 'Alkoholunfälle' category and 'insgesamt' accident type.

[Preprocessing](#)

[Modelling](#)

As mentioned above, I modelled the 'insgesamt' type from the Alkoholunfälle category.

Although, all rows in my hand are 252 only. I could tune the LSTM to model it ☺.

The model architecture is as follows:

```
Model: "sequential"
```

Layer (type)	Output Shape	Param #
=====	=====	=====
rnn (RNN)	(None, 64)	17408
dense (Dense)	(None, 1)	65
=====	=====	=====
Total params: 17,473		
Trainable params: 17,473		
Non-trainable params: 0		

During modeling, I used the following configuration parameters:

- Epoch=10000 with early stoping, learning rate= 0.00001, LSTM size =64, batch_size=4, validation split = 0.25 of training data, testing split = 0.1 of data, loss is mean square error, patience parameter in early stopping is 2, and dense layer size=1.
- keras is used to build, train this model.

Note: the mode is trained and save in Insgesamt_Accidents_Analysis_and_Modeling.

Inference (Mission2)

I tried to forecast the value of the following example (inside the challenge):

Category: 'Alkoholunfälle'
Type: 'insgesamt'
Year: '2021'
Month: '01'

The predicted value from the 1st model is 14.6 15, the real value is 35
Note that the inference python code is in Inference the notebook.

Local Deployment using FastApi (app.py)

To do model serving, it is required to deploy the model to the server. In this scenario, put the model on the server “End point” and this point accepts http request, so we need a rest API, inside it there is a prediction function.

I used the FastApi to deploy the model. The app.py includes all the code of FastApi as follows:

- Imports
- Creating API
- Preprocessing part which looks like the preprocessing in the training part.
- Loading the model locally if it is available or from the server if it is deployed on the server.
- The get request root which returns the message to the user.
- The post request which receives Json containing the values of year and month and returns the value of the prediction.
- Necessary definitions and their validators.

1. Running the Get request, use the following command from gitbash:

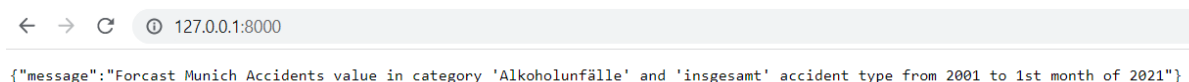
```
uvicorn app:app --reload
```

Use the following URL on any browser <http://127.0.0.1:8000/>

or

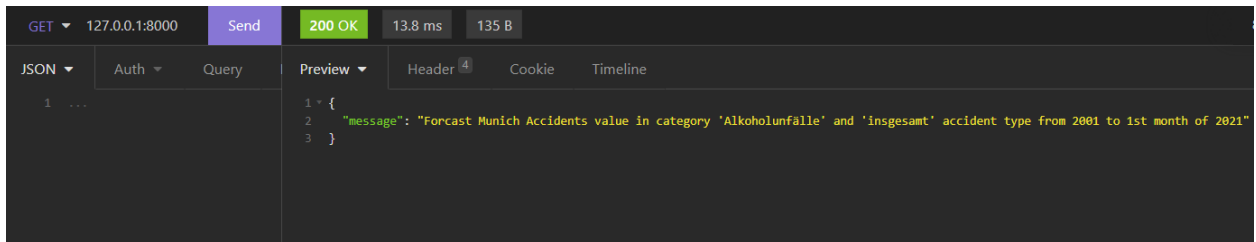
The Get request using Insomina on <http://127.0.0.1:8000/>

The output looks like the following:



```
{\"message\": \"Forecast Munich Accidents value in category 'Alkoholunfälle' and 'insgesamt' accident type from 2001 to 1st month of 2021\"}
```

Or



2. Running the Post to pass a certain value in JSON file, then

I tried to send the fill the post request with json using “Ensomnia” application.

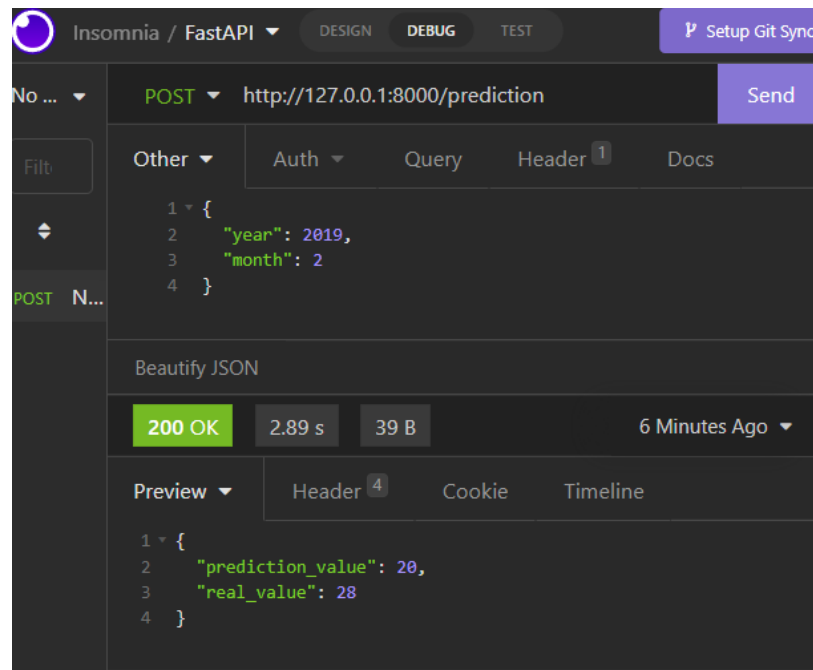


Figure 1 shows the post request input and return values

Google Cloud Deployment

I deployed the best_model.h5 to google cloud forecast123_bucket bucket inside project ForecastingAccidentsApp. The model link is at:

```
'gs://forecast123/best_model.h5'
```

Containerization

Containerization is essential in the development cycle because it enables you to reproduce your colleague's work regardless of the OS used to develop the software component without sophisticated steps. Also, it simplifies the deployment and the automation on the server.

One of the most famous tools used for this purpose is the Docker. I used it in this project to containerize my app.py, gap.py which used FASTAPI to predict the count of accidents local deployment and google cloud deployment application files.

To do that I did the following:

- Writing the Dockerfile.
- Building Docker image using the following command:

```
$ docker build -t c_app:1.0 .
```

- Running the container

```
$ docker run -d --name contain -p 8000:5000 -t -i c_app:1.0
```

- Entering inside the container its bash run the following:

```
$ docker exec -it container_id /bin/bash
```

container_id: output from previous step.

```
$ uvicorn app:app --reload
```

```
$ uvicorn gapp:app --reload
```

```
(base) root@c83afc5299f7:/home/app# uvicorn gapp:app --reload
INFO: Will watch for changes in these directories: ['/home/app']
INFO: Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to quit)
INFO: Started reload process [21] using StatReload
2022-06-27 13:45:56.621910: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcudart.so.11.0'; dlerror: libcudart.so.11.0: cannot open shared object file: No such file or directory
2022-06-27 13:45:56.621913: I tensorflow/stream_executor/cuda/cudart_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.
2022-06-27 13:45:58.687539: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcudart.so.1'; dlerror: libcudart.so.1: cannot open shared object file: No such file or directory
2022-06-27 13:45:58.687539: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] Failed call to cuInit: UNKNOWN ERROR (303)
2022-06-27 13:45:58.687619: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:156] kernel driver does not appear to be running on this host (c83afc5299f7): /proc/driver/nvidia/version does not exist
2022-06-27 13:45:58.687800: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations:
AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
/opt/conda/lib/python3.9/site-packages/sklearn/base.py:318: UserWarning: Trying to unpickle estimator RobustScaler from version 0.24.1 when using version 0.24.2. This might lead to breaking code or invalid results. Use at your own risk.
warnings.warn(
INFO: Started server process [1]
INFO: Waiting for application startup.
INFO: Application startup complete.
INFO: 127.0.0.1:56804 - "GET / HTTP/1.1" 200 OK
2/1 [=====] - @s 12ms/step
INFO: 127.0.0.1:56810 - "POST /prediction HTTP/1.1" 200 OK
INFO: 127.0.0.1:56812 - "POST /prediction HTTP/1.1" 200 OK (cached)
2/1 [=====] - @s 14ms/step
INFO: 127.0.0.1:56814 - "POST /prediction HTTP/1.1" 200 OK
2/1 [=====] - @s 14ms/step
INFO: 127.0.0.1:56816 - "POST /prediction HTTP/1.1" 200 OK
```

Figure 2: Output after Executing the above Commands.

- Testing the page contents of the page the get request to see the index page message and the post request using the following commands:

```
curl -X POST -H "content-Type: application/json" -d '{"year":2020, "month":3}'  
127.0.0.1:8000/prediction
```

```
(base) root@a2ff9aacc10a:/home/app# curl http://127.0.0.1:8000  
{"message":"Forecast Munich Accidents value in category 'Alkoholunfälle' and 'insgesamt' accident type in 2020 and 12st month of 2021"}
```

```
(base) root@a2ff9aacc10a:/home/app# curl -X POST -H "Content-Type: application/json" -d '{"year":2020, "month":3}' 127.0.0.1:8000/prediction  
{"prediction_value":23}(base) root@a2ff9aacc10a:/home/app#
```

It works fine in both get and post as shown in the above figures.