Project Report

on

PREDICTING LIFE EXPECTANCY USING MACHINE LEARNING

INTERNSHIP TITLE: Predicting Life Expectancy using Machine Learning - SB27373

PROJECT ID: SPS_PRO_215

REMOTE SUMMER INTERNSHIP PROGRAM by **SMARTINTERNZ**

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CONTENTS:

1 INTRODUCTION

1.1 Overview

A typical Regression Machine Learning project leverages historical data to predict insights into the future. This problem statement is aimed at predicting Life Expectancy rate of a country given various features.

Life expectancy is a statistical measure of the average time a human being is expected to live, Life expectancy depends on various factors: Country, Status, infant deaths, GDP, Population, BMI, other factors. This problem statement provides a way to predict average life expectancy of people living in a country when various factors such as year, GDP, education, alcohol intake of people in the country, expenditure on healthcare system and some specific disease related deaths that happened in the country are given.

1.2 Purpose

Predicting the life expectancy will give the country an idea of the factors which can be improved to increase the lifespan of the people living. For example, by improving the health care facilities and immunization vaccines for infants or by making changes in lifestyle, a person can live a long, healthy and good quality life. This will also benefit the country by increasing manpower that will contribute to the economic growth. We should take full advantage of this new era advanced technology to improve the future by predicting it in the present.

The project uses a **Regression Model** which is a classification algorithm. It is a measure of the relation between the mean value of one variable (the output feature - Life Expectancy) and corresponding values of other variables. The dataset used to train this model was downloaded from kaggle.com (https://www.kaggle.com/kumarajarshi/life-expectancy-who), and we used Python to write the code for the Machine Learning model.

2 LITERATURE SURVEY

2.1 Existing Problem

One major problem that we encoutered was that collecting data for predicting the average life expectancy is a big challenge due to the considerations related to many privacy and government policies.

A second hurdle that we faced was the features that were included in the dataset with which we predicted the expected lifespan. The factors that we have used to make our predictions were just personal causes and not related to the surrounding, healthcare facilities, demographic, social, regional and economic factors of the country in which the person resides. These country dependent factors can also be an important feature to predict the life expectancy of an individual.

The third issue that we faced is that it is feasible only for individuals using technologies such as mobile health monitoring and tracking devices.

Finally, there have been lot of studies undertaken in the past on factors affecting life expectancy considering demographic variables, income composition and mortality rates. It was found that effect of immunization and human development index was not taken into account in the past. Also, some of the past research has been done considering multiple linear regressions based on the data gathered of one only particular year.

2.2 Proposed Solution

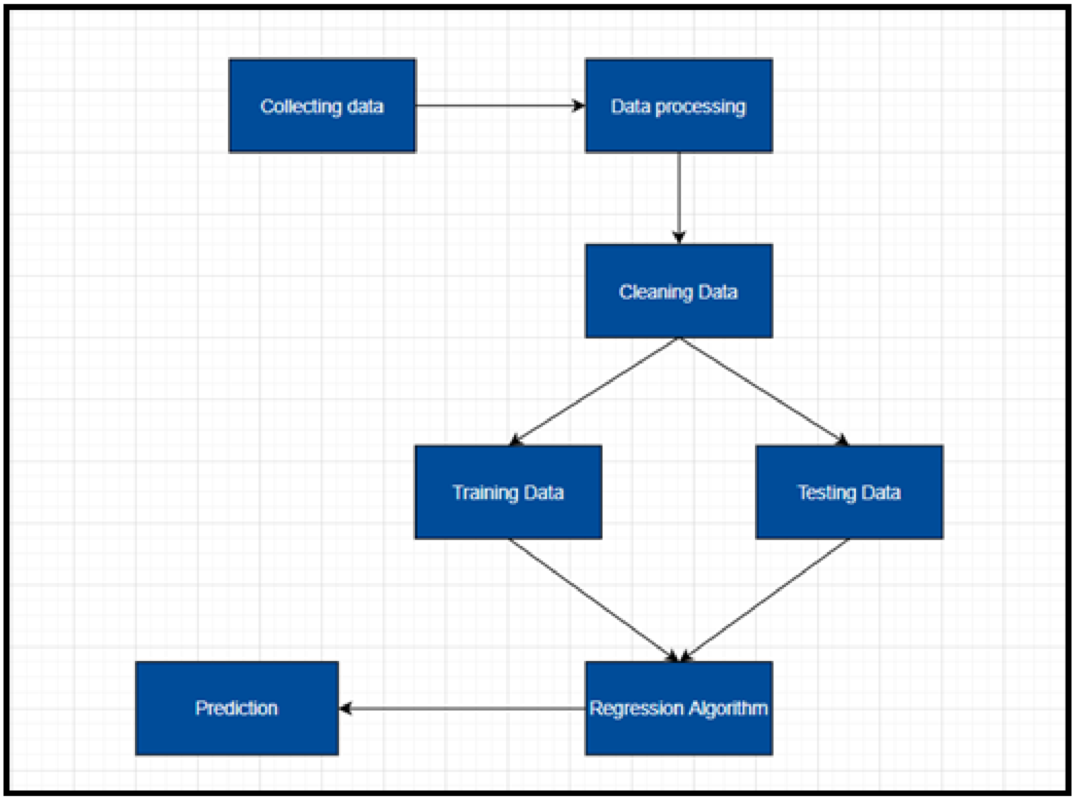
As Artificial Intelligence and Machine Learning technologies are developing and quickly being implemented, the ease of gathering health data from the public as well as current government agencies such as centralized health servers should be increased

The previous factors were good on a personal level but it is important to know the economic, regional, social and demographic factors like the population change, birth ratio, foeticide rate, literacy level, levels and dosages of immunizations, history of chronic or genetic diseases, health care facility provided by the country, funds allocated by the government, schemes, cost of medical expenditures (if the cost of basic medical facilites and healthcare is very high, then people will not go to get regular medical checkups done).

For the above problem to be solved, we should have a dataset that consists of various other factors. So the target output variable, that is, expected lifespan of people depends upon variety of factors and not just factors of particular fields. Important immunization like Hepatitis B, Polio and Diphtheria should also be considered.

3 THEORETICAL ANALYSIS

3.1 Block Diagrams



3.2 Hardware/Software Designing

i. Create necessary IBM Cloud services

ii. Configure Watson Studio and create Watson studio project

iii. Create an IBM Machine Learning instance

iv. Create machine learning model in the Watson notebook

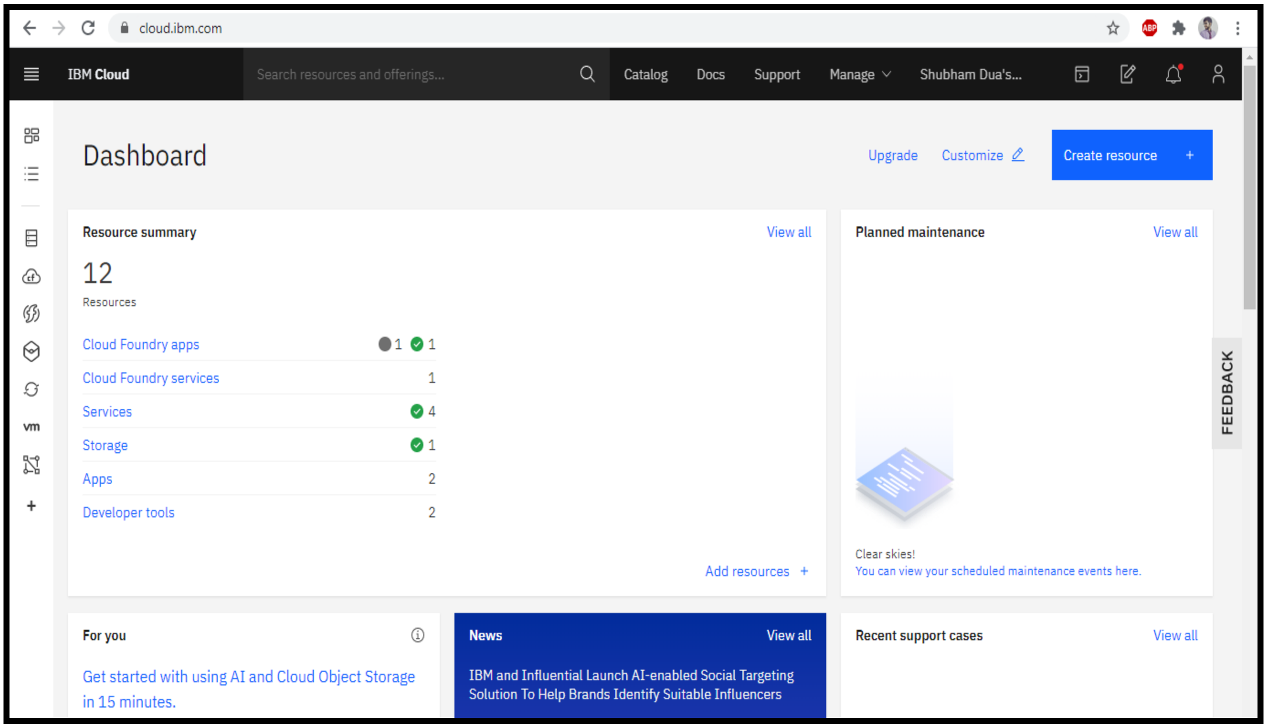
v. Deploy the machine learning model

vi. Create a UI using node-red flow and integrate the flow with the Machine Learning model

vii. Deploy and run the node-red app (it will appear as a "form" to the user)

4 EXPERIMENTAL INVESTIGATIONS

IBM DASHBOARD:



Resource summary

12
Resources

Cloud Foundry apps	● 1 ✓ 1
Cloud Foundry services	1
Services	✓ 4
Storage	✓ 1
Apps	2
Developer tools	2

Planned maintenance

Clear skies!
You can view your scheduled maintenance events here.

For you

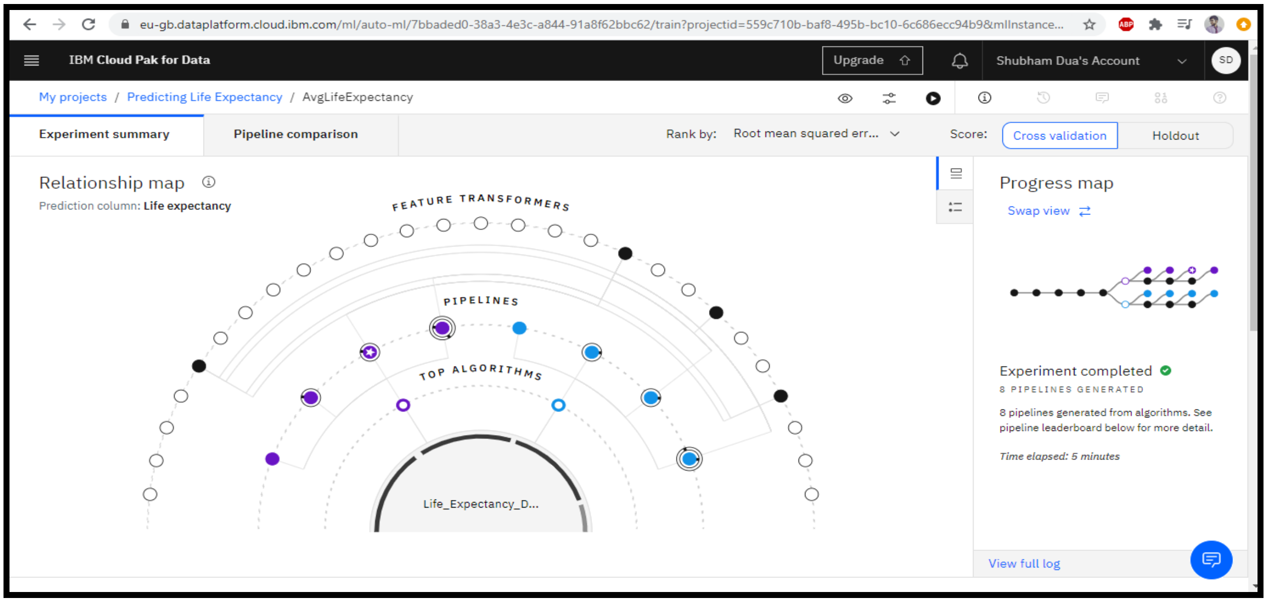
Get started with using AI and Cloud Object Storage in 15 minutes.

News

IBM and Influential Launch AI-enabled Social Targeting Solution To Help Brands Identify Suitable Influencers

Recent support cases

AUTO AI EXPERIMENT:


eu-gb.dataplatform.cloud.ibm.com/ml/auto-ml/7bbaded0-38a3-4e3c-a844-91a8f62bbc62/train?projectid=559c710b-baf8-495b-bc10-6c686ecc94b9&mlInstance...
IBM Cloud Pak for Data
Upgrade
Shubham Dua's Account
SD
My projects / Predicting Life Expectancy / AvgLifeExpectancy
Experiment summary
Pipeline comparison
Rank by: Root mean squared err...
Score: Cross validation
Holdout
Relationship map
Prediction column: Life expectancy
FEATURE TRANSFORMERS
PIPELINES
TOP ALGORITHMS
Life_Expectancy_D...
Progress map
Swap view
View full log

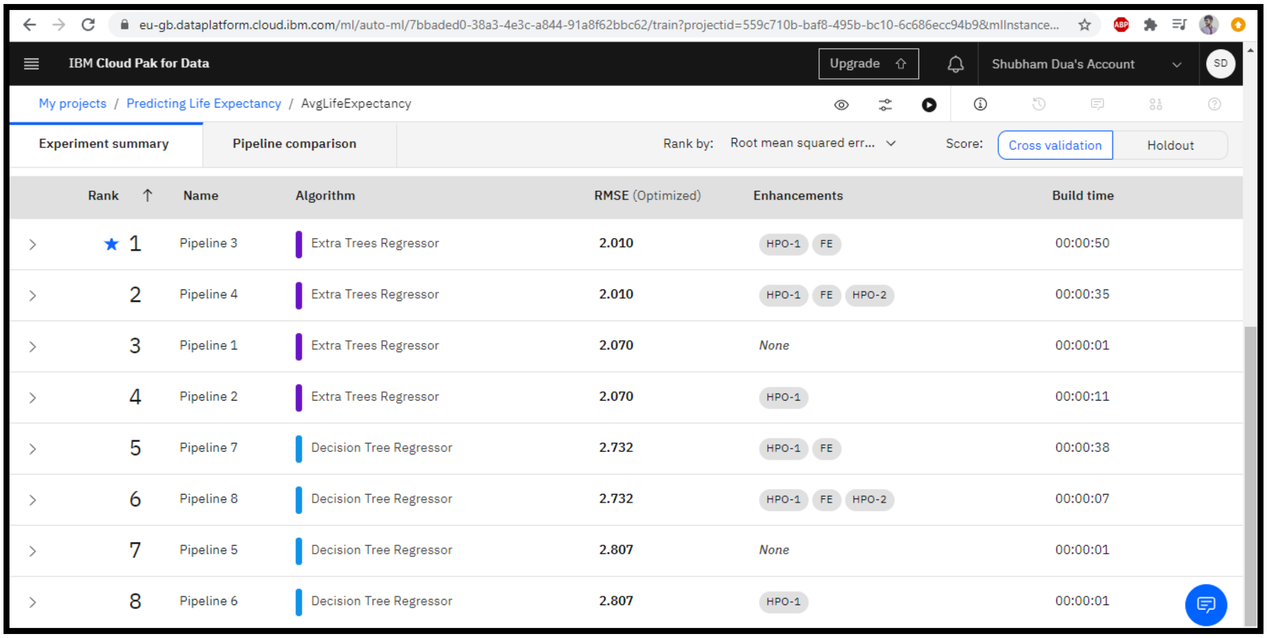
Experiment completed

8 PIPELINES GENERATED

8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

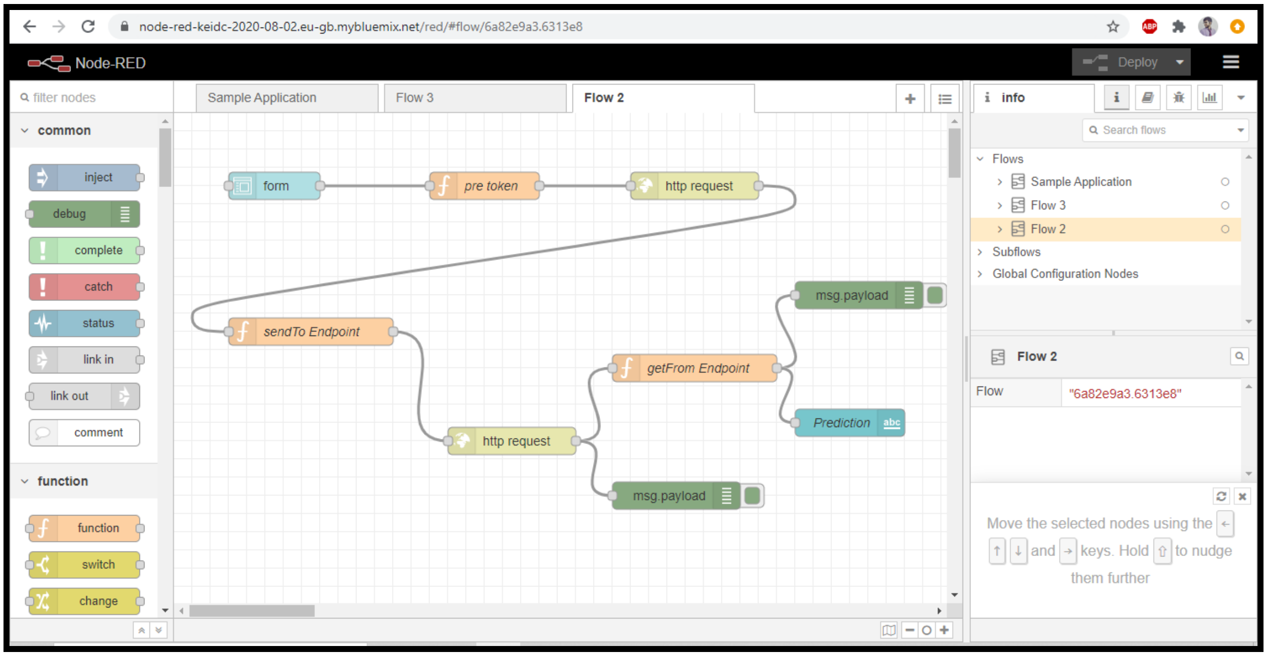
Time elapsed: 5 minutes

PIPELINES created by the AUTO AI EXPERIMENT:


eu-gb.dataplatform.cloud.ibm.com/ml/auto-ml/7bbaded0-38a3-4e3c-a844-91a8f62bbc62/train?projectid=559c710b-baf8-495b-bc10-6c686ecc94b9&mlInstance...
IBM Cloud Pak for Data
Upgrade
Shubham Dua's Account
SD
My projects / Predicting Life Expectancy / AvgLifeExpectancy
Experiment summary
Pipeline comparison
Rank by: Root mean squared err...
Score: Cross validation
Holdout

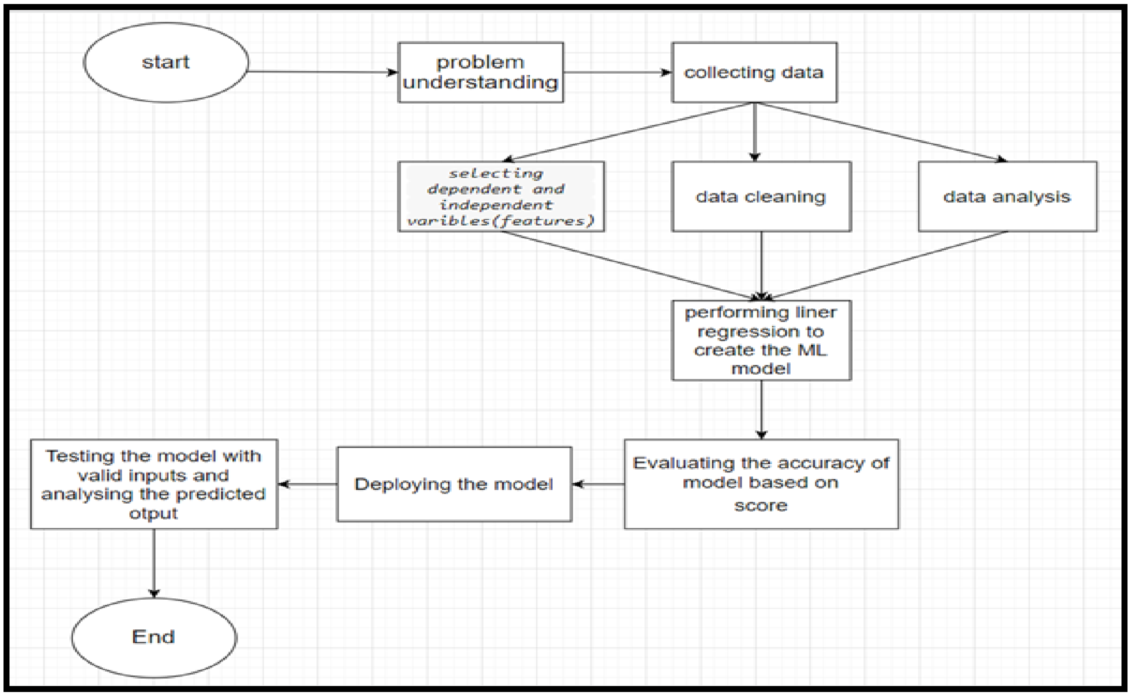
Rank ↑	Name	Algorithm	RMSE (Optimized)	Enhancements	Build time
★ 1	Pipeline 3	Extra Trees Regressor	2.010	HPO-1 FE	00:00:50
2	Pipeline 4	Extra Trees Regressor	2.010	HPO-1 FE HPO-2	00:00:35
3	Pipeline 1	Extra Trees Regressor	2.070	*None*	00:00:01
4	Pipeline 2	Extra Trees Regressor	2.070	HPO-1	00:00:11
5	Pipeline 7	Decision Tree Regressor	2.732	HPO-1 FE	00:00:38
6	Pipeline 8	Decision Tree Regressor	2.732	HPO-1 FE HPO-2	00:00:07
7	Pipeline 5	Decision Tree Regressor	2.807	*None*	00:00:01
8	Pipeline 6	Decision Tree Regressor	2.807	HPO-1	00:00:01

NODE-RED FLOW:



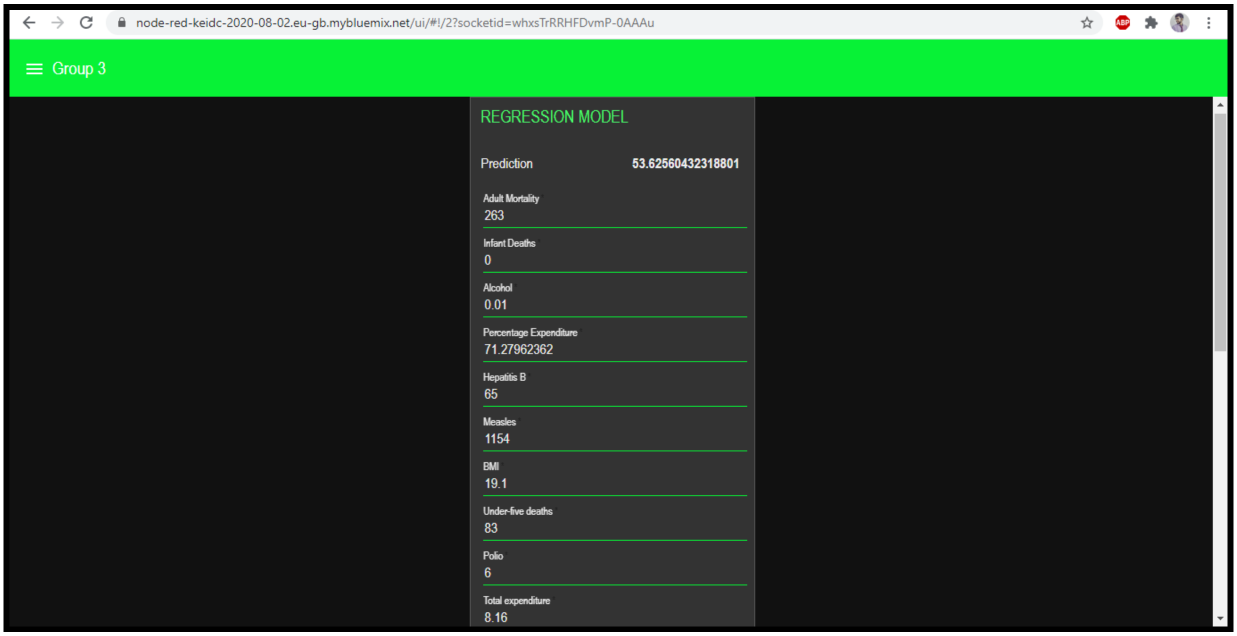
Move the selected nodes using the ← ↑ ↓ and → keys. Hold ⇧ to nudge them further

5 FLOWCHARTS


start
problem understanding
collecting data
selecting dependent and independent varibles(features)
data cleaning
data analysis
performing liner regression to create the ML model
Evaluating the accuracy of model based on score
Deploying the model
Testing the model with valid inputs and analysing the predicted otput
End

6 RESULTS

Based on the given data, the auto-AI model or ML model understands the data, and analyzes the factors that affect the results we require, that is, life expecatnacy. It will predict the output based on the features that we trained. Then when we give any input, based on the trained model, it will validate the features and give the accurate value as predicted output . So the results we get are approximations, they are not 100% accurate, but they are a pretty good indicator of one's life expectancy.



node-red-keidc-2020-08-02.eu-gb.mybluemix.net/ui/#!/2?socketid=whxsTrRRHFDvmP-0AAAu

Group 3

REGRESSION MODEL

Prediction 53.62560432318801

Adult Mortality
263

Infant Deaths
0

Alcohol
0.01

Percentage Expenditure
71.27962362

Hepatitis B
65

Measles
1154

BMI
19.1

Under-five deaths
83

Polio
6

Total expenditure
8.16

7 ADVANTAGES & DISADVANTAGES

ADVANTAGES -

- The life expectancy predictor will give important insights and help people achieve good quality of life in future. The country can plan and improve various healthcare facilities.
- This model can also help us increase our average lifespan since we now know what all factors positively and negatively affect the life expectancy of a person belonging to a particular country.
- This project/idea is useful for insurance companies as they consider age, lifestyle choices,family medical history, and several other factors which can be determined with the help of this datset.

DISADVANTAGES -

- First, this dataset and this model is not very easily accessible to all people. Only those people with a stable Internet connection can afford to access this dataset and model.
- This model can only be used by people who have a good knowledge of how to analyze this data (in order make changes to their own lifestyle).
- Only those people with access to mobile health monitoring and tracking devices will know how much of their lifestyle has to be changed.
- The input provided by the user should in the given range to predict good results.
- A major drawback is that even then, not all results are accurate, and there can easily be errors while analysis and redictions are done using the data.

8 APPLICATIONS

- This will help in suggesting a country which area should be given importance in order to efficiently improve the life expectancy of its population.
- It will be easier for a country to determine the predicting factor which is contributing to lower value of life expectancy and can be used in various organization to improve the quality of service.
- The project can be used as a basis to develop personalized health applications.
- The governments can plan and develop their health infrastructure by keeping the most correlated factors in mind.
- The project can help governments to keep track of their country's health status so they can plan for the future accordingly.
- This project/idea is useful for insurance companies as they consider age, lifestyle choices,family medical history, and several other factors which can be determined with the help of this datset.

9 CONCLUSIONS

Thus, we have developed a model that will predict the life expectancy of a person living in a specific region. Various factors like adult mortality, alcohol consumption, population, mortality rate (under the age of 5 years), thinness (through 1-19 years), HIV, Hepatitis B, GDP, literacy level and many others play an important role in the predictions made by this model. The user can interact with the system via a simple UI made by the node-red app.

10 FUTURE SCOPE

- We can connect the model to a database which can predict the life expectancy of not only human beings but also of different species of animals present on the earth.
- A model with countrywise bifurcation can be made, which will help to segregate the data demographically.
- Big data and machine learning can benefit public health researchers with analyzing thousands of variables to obtain data regarding life expectancy. We can use demographics of selected regional areas and multiple behavioral health disorders across regions to find correlation between individual behavior indicators and behavioral health outcomes.
- The accuracy of the model can be increased. This can be done by training more data. Also, the website can be added with many more features to improve the user experience. The user input can be connected to the database for future purposes.

11 BIBLIOGRAPHY

1. https://cloud.ibm.com/
2. https://www.kaggle.com/kumarajarshi/life-expectancy-who
3. https://bookdown.org/caoying4work/watsonstudio-workshop/jn. html
4. https://developer.ibm.com/tutorials/how-to-create-a-node-red-starter-application/
5. https://github.com/SmartPracticeschool/lISPS-INT-2459-Predicting-Life-Expectancy-using-Machine-Learning

12 APPENDIX

A. Source Code

Importing required libraries and reading the dataset -

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
import warnings
warnings.filterwarnings('ignore')

# @hidden_cell
# The following code contains the credentials for a file in your IBM Cloud Object Storage.
# You might want to remove those credentials before you share your notebook.
credentials_1 = {
    'IAM_SERVICE_ID': 'iam-ServiceId-57ffe881-6074-44f9-ba71-d4a2ac29d1ff',
    'IBM_API_KEY_ID': 'EA1WL8YcHjlSBRFeDtR07CIUBlagQa_Q0YSVNgXcjQ1Z',
    'ENDPOINT': 'https://s3.eu-geo.objectstorage.service.networklayer.com',
    'IBM_AUTH_ENDPOINT': 'https://iam.cloud.ibm.com/oidc/token',
    'BUCKET': 'predictinglifeexpectancyusingmach-donotdelete-pr-wiiomeiwazafry',
    'FILE': 'Life_Expectancy_Data.csv'
}

import types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your
credentials.
# You might want to remove those credentials before you share the notebook.
```

```
client_75dedf163fee4ba8ab75cb70eb672d9d = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='EA1WL8YcHjlSBRFeDtR07CIUBIagQa_Q0YSVNgXcjQ1Z',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.eu-geo.objectstorage.service.networklayer.com')

body =
client_75dedf163fee4ba8ab75cb70eb672d9d.get_object(Bucket='predictinglifeexpectancyusing
mach-donotdelete-pr-wiiomeiwazafry',Key='Life_Expectancy_Data.csv')['Body']
# add missing __iter__ method, so pandas accepts body as file-like object
if not hasattr(body, "__iter__"): body.__iter__ = types.MethodType( __iter__, body )

my_data = pd.read_csv(body)
my_data.head(10)

len(my_data)

my_data.info()

my_data.columns
```

Data preprocessing -

```
my_data.isnull().sum()

my_data = my_data.fillna(my_data.mean())
my_data.isnull().sum()

my_data.Status.unique()

my_data.groupby('Status')['Country'].count()
my_data.groupby('Status')['Life expectancy '].mean()

status_dummy = pd.get_dummies(my_data['Status'])
my_data.drop(['Status'], inplace=True, axis=1)
my_data = pd.concat([my_data, status_dummy], axis=1)

my_data.groupby('Country')['Life expectancy '].mean().sort_values()
my_data.drop(['Country'], inplace=True, axis=1)
my_data.drop(['Year'], inplace=True, axis=1)
my_data.head()

my_data.columns
```

Correlation between features -

```
sns.set(rc={'figure.figsize':(20,25)})
#Create correlation matrix for all variables in the dataframe
mat = np.triu(my_data.corr())
sns.heatmap(my_data.corr(), cmap='inferno', linewidths=3, linecolor='black', annot=True,
square=True , mask=mat)
```

Train/Test split -

```
X_data = my_data.drop('Life expectancy ', axis=1)
X_data.head()

y_data = my_data['Life expectancy ']
y_data.head()

X_train, X_test, y_train, y_test = model_selection.train_test_split(X_data, y_data, test_size=0.3,
random_state=101)

print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

Creating and training the regression model -

```
model = linear_model.LinearRegression(fit_intercept=True, normalize=True, copy_X=True,
n_jobs=None)
model.fit(X_train, y_train)
```

Making predictions -

```
y_pred = model.predict(X_test)

sns.set(rc={'figure.figsize':(6,6)})
plt.scatter(y_test, y_pred)

print("Training score:", model.score(X_train, y_train))
print("Testing Score:", model.score(X_test, y_test))

print('Intercept =', model.intercept_)
print('Coefficients = ', model.coef_)

print('Mean Squared Error: ', mean_squared_error(y_test, y_pred))
print('Root Mean Squared Error: ', np.sqrt(mean_squared_error(y_test, y_pred)))
print('R2 score: ', r2_score(y_test, y_pred))
```

Deploying the model -

```
!pip install watson-machine-learning-client
client = WatsonMachineLearningAPIClient(wml_credentials)
model_props = {client.repository.ModelMetaNames.AUTHOR_NAME: "Shubham",
          client.repository.ModelMetaNames.AUTHOR_EMAIL: "shubhamdua02@gmail.com",
          client.repository.ModelMetaNames.NAME: "LifeExpectancy_RegressionModel"}

model_artifact = client.repository.store_model(model, meta_props=model_props)
published_model_uid = client.repository.get_model_uid(model_artifact)
published_model_uid

deployment = client.deployments.create(published_model_uid,
name="LifeExpectancy_RegressionModel")

scoring_endpoint = client.deployments.get_scoring_url(deployment)
scoring_endpoint
```