

Project Name: Predicting Life Expectancy using Machine Learning - SB45648

PROJECT PLANNING & KICKOFF

► Project Scope Document

- Project Summary :**

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: Regional variations, Economic Circumstances, Sex Differences, Mental Illnesses, Physical Illnesses, Education, Year of their birth and other demographic 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.

- Project Requirements:**

To analyze the insights, the data set is required to build the model. IBM Watson Studio is used to work on Python Jupyter Notebook. Variables are analyzed to check the dependencies of on life expectancy. Build a suitable algorithm with best accuracy and predict life expectancy.

- Functional Requirement:**

Predicting Life Expectancy rate of a country on the basis of various features.

- Technical Requirements:**

Python, IBM Cloud, IBM Watson

- Software Requirements: NA**

- Project Deliverables:**

Machine Learning Model to predict Life Expectancy rate of country data insights.

- Project Team:**

Divyanshi Garg

- **Project Schedule:**

Assigned on 6 June 2020 and complete it in 1 month i.e. 5 July 2020.

SET UP THE DEVELOPMENT ENVIRONMENT

1. Where do you develop the code ?

IBM Watson & IBM Cloud

2. Where do you save it ?

IBM Cloud

3. How do you communicate with your team ? Slack Channel

4. Where do you document your work ?

ZOHO Writer

5. How do you share deliverables with your client ?

GITHUB Repository

- **GITHUB Account:**

SmartPracticeschool / IISPS-INT-2679-Predicting-Life-Expectancy-using-Machine-Learning

Predicting Life Expectancy using Machine Learning

Edit

Manage topics

-> 5 commits ↗ 1 branch ⚡ 0 packages ⚡ 0 releases ↳ 1 contributor

Branch: master ▾ New pull request

Create new file Upload files Find file Clone or download ▾

DG121018 Add files via upload ... Latest commit 08c4dc6 1 hour ago

Application Details - IBM Cloud_page-0001.jpg Add files via upload 1 hour ago

IBM Cloud_page-0001.jpg Add files via upload 1 hour ago

flows.json Add files via upload 22 hours ago

IISPS_INT_2679_Predicting Life Expectancy using Machine Learning.docx Add files via upload 3 days ago

Help people interested in this repository understand your project by adding a README.

Add a README

EXPLORE IBM WATSON CLOUD SERVICES

● IBM Cloud Account Link:

<https://cloud.ibm.com/>

The screenshot shows the IBM Cloud dashboard. On the left, there's a sidebar with various icons for Cloud Foundry apps, Services, Storage, Apps, and Developer tools. The main area has sections for 'Resource summary' (9 resources), 'For you' (news and articles like 'Get started with using AI and Cloud Object Storage in 15 minutes.'), 'Planned maintenance' (1 event: 'Disruptive update to Visual Recognition Service to update port configuration'), and 'Recent support cases'.

● Node-Red Application Link :

<https://node-red-avczu.eu-gb.mybluemix.net/red/>

This screenshot shows the details page for a Node-RED application named 'Node RED AVCZU'. It includes sections for 'Overview' (with a pie chart showing 128 Total MB allocation), 'Runtime cost' (\$0.00), 'Continuous delivery' (enabled), and 'Connections (3)'. The 'Activity feed' shows recent events: 'started Node-RED AVCZU app', 'updated Node RED AVCZU app', 'changed routes', and 'created Node RED AVCZU app'.

EXPLORE IBM WATSON SERVICES

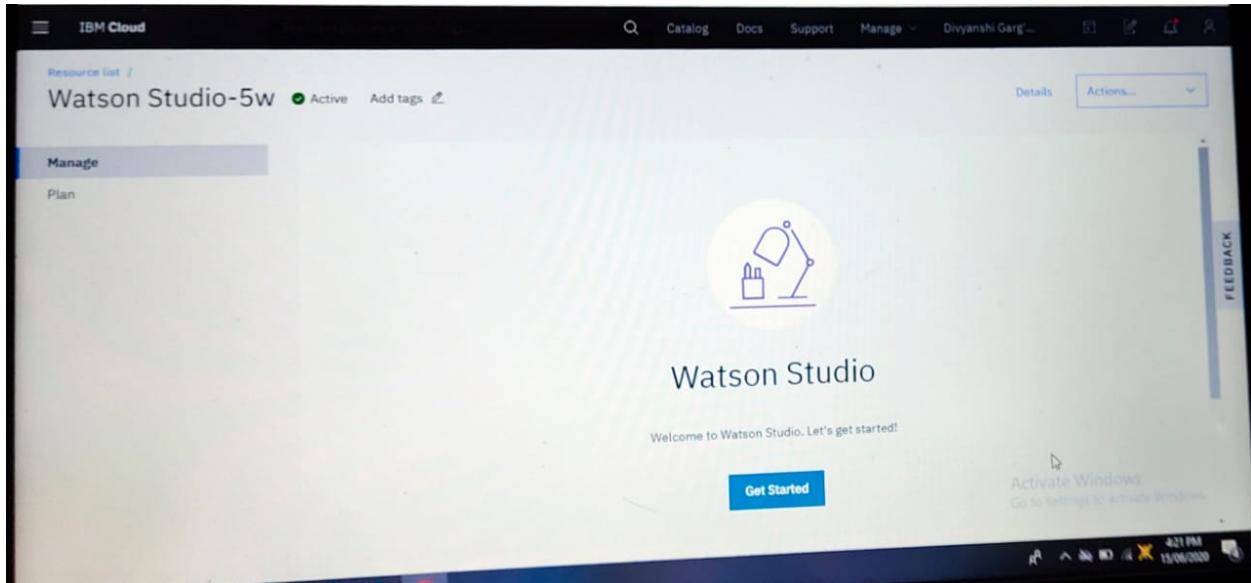
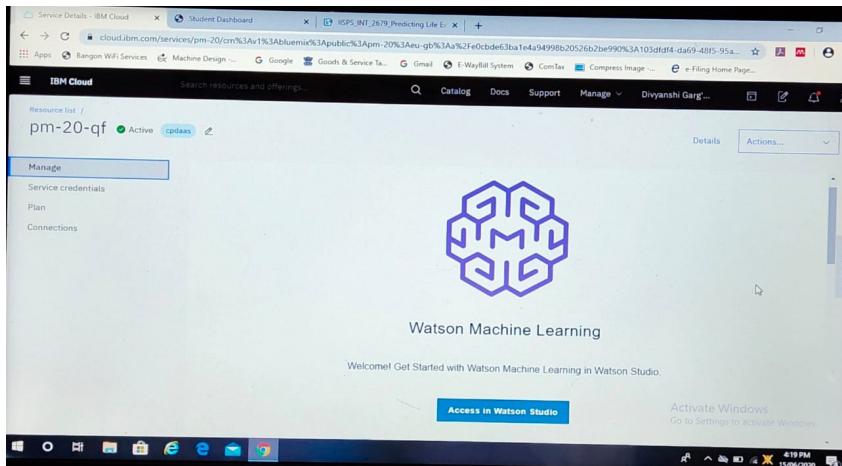
- **IBM Watson Use Cases & Explore IBM Watson ML :**



Welcome Divyanshi!

Start by setting up your deployment spaces
A deployment space is where you prepare data and assets for deployment.

Instance name	Service	Plan	Tool
Machine Learning-na	Machine Learning		
visual-recognition-n-visualrecogniti-159187016704	Visual Recognition		Launch tool



INTRODUCTION TO WATSON STUDIO

Service Details - IBM Cloud IBM Watson Studio SALARY PREDICTION - IBM Watson Studio

Apps Bangon WiFi Services Machine Design ... Google Goods & Service Ta... Gmail E-WayBill System ComTax Compress Image ... e-Filing Home Page...

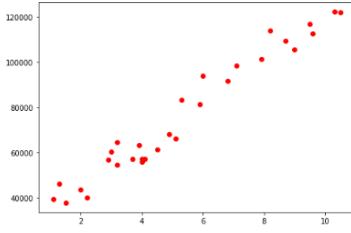
IBM Watson Studio Upgrade Diyanshi Garg's Account

In [34]: X=df.iloc[:,1:1].values
y=df.iloc[:,1:1].values

In [35]: import matplotlib.pyplot as pd
import seaborn as sns

In [52]: fig=pd.figure()
ax=fig.add_axes([0,0,1,1])
ax.scatter(x,y,color='r')

Out[52]: <matplotlib.collections.PathCollection at 0x7f9015a98390>



In [78]: from sklearn.model_selection import train_test_split
x_train,x,test,y_train,y_test=train_test_split(x,y,test_size=1/3,random_state=0)

In [79]: from sklearn.linear_model import LinearRegression

In [80]: object=LinearRegression()

Activate Windows Go to Settings to activate Windows.

4:49 PM 27/06/2020

Service Details - IBM Cloud IBM Watson Studio SALARY PREDICTION - IBM Watson Studio

Apps Bangon WiFi Services Machine Design ... Google Goods & Service Ta... Gmail E-WayBill System ComTax Compress Image ... e-Filing Home Page...

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In [84]: pd.scatter(x_train,y_train,color='red')
pd.plot(x_train,object.predict(x_train),color='blue')
pd.title('Salary vs Experience (Training set)')
pd.xlabel('Years of Experience')
pd.ylabel('Salary')
pd.show()



In [88]: pd.scatter(x_test,y_test,color = 'red')
pd.plot(x_train,object.predict(x_train),color='blue')
pd.title('Salary vs Experience (Test set)')
pd.xlabel('Years of Experience')
pd.ylabel('Salary')
pd.show()



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4:49 PM 27/06/2020

Service Details - IBM Cloud IBM Watson Studio SALARY PREDICTION - IBM Watson Studio

eu-gb.dataplatfrom.cloud.ibm.com/analytics/notebooks/v2/27408026-d7cc-48dd-86b6-64b2bd3a3e94/view?projectid=a9a9dfb0-ce48-409d-8779-0de0f747...

Apps Bangon WiFi Services Machine Design ... Google Goods & Service Ta... Gmail E-WayBill System ComTax Compress Image ... e-Filing Home Page...

IBM Watson Studio

My projects / MACHINE LEARNING / SALARY PREDICTION

In [88]:

```
pd.scatter(x_test, y_test, color = 'red')
pd.plot(x_train, object.predict(x_train), color='blue')
pd.title('Salary vs Experience (Test set)')
pd.xlabel('Years of Experience')
pd.ylabel('Salary')
pd.show()
```

Salary vs Experience (Test set)

In [89]: new_salary_pred = object.predict([[15]])
new_salary_pred

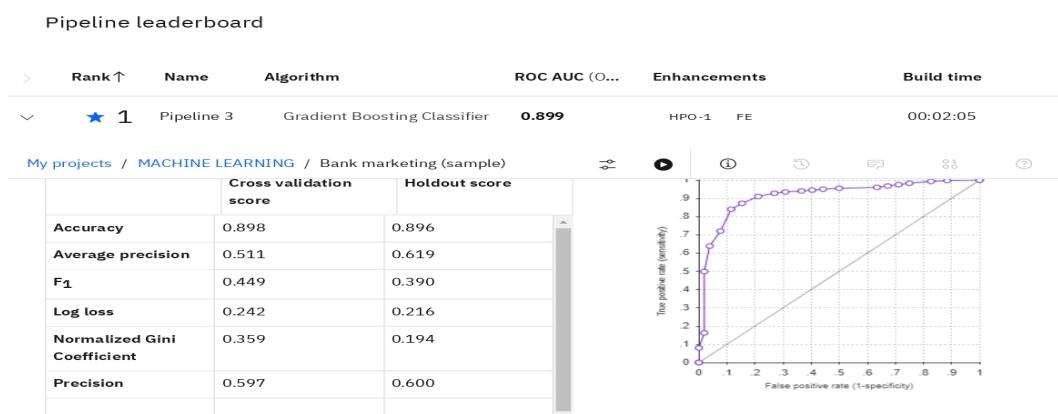
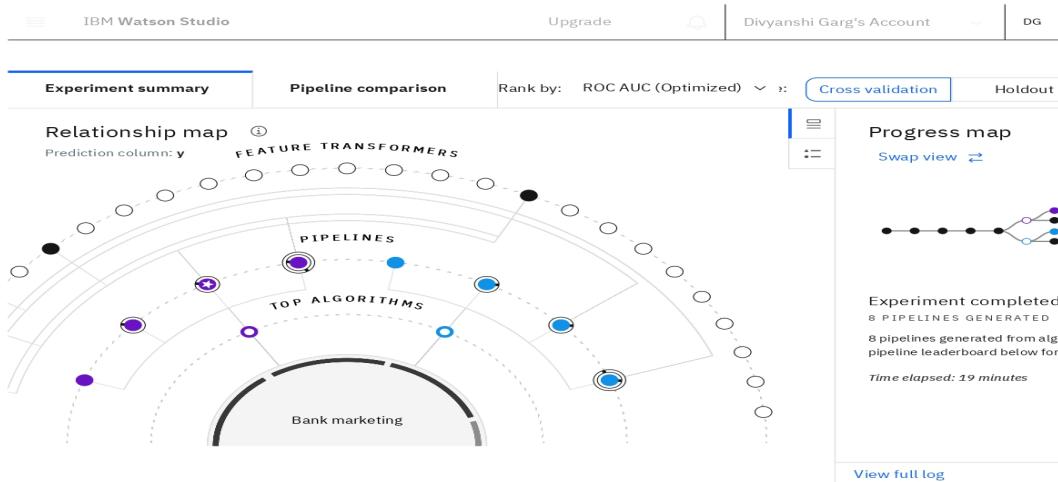
Out[89]: array([167005.32889087])

In [92]: from watson_machine_learning_client import WatsonMachineLearningAPIClient

In [94]: wml_credentials = {
 "apikey": "0f46c13pTr3Txyu-ctbk4mqv4pk62muae3DfCA_5",
 "iam_apikey_description": "auto-generated for key 19df97fa-8591-4f09-b790-e8a3c873bd40",
 "iam_apikey_name": "wdo-writer",
 "iam_role_crn": "crn:v1:bluemix:public:iam::::serviceRole:writer",
 "iam_serviceid_crn": "crn:v1:bluemix:public:iam:identity:a@e0cbd663ba1e4a94998b2052602be990::serviceId:ServiceId-f7b8caf6-b3c

Activate Windows
Go to Settings to activate Windows.

4:49 PM 27/06/2020



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BANK

Overview Implementation Test

Deployment

Name	BANK
Type	Web Service
Deployment ID	f7fb2fb6-cdf9-4941-99e8-9737e5aa72d2
Status	Ready
Asset type	Model
Asset name	Bank marketing (sample) - P3 GradientBoostingClassifierEstimator
Machine learning service	pm-20-qf
Created	Jun 15, 2020 6:18 PM
Last modified	Jun 15, 2020 6:18 PM

PREDICTING LIFE EXPECTANCY WITHOUT PYTHON

Resource list Create resource

Name	Group	Location	Offering	Status	Tags
Cloud Foundry apps (1)	Filter by group or org...	Filter...	Filter...	Filter...	Filter...
Cloud Foundry services (1)					
Services (5)					
Continuous Delivery	Default	London	Continuous Delivery	Active	-
Watson Studio-5w	Default	London	Watson Studio	Active	-
node-red-awczu-cloudant-15931685892...	Default	Chennai 01	Cloudant	Active	-
pm-20-qf	Default	London	Machine Learning	Active	cpda...
visual-recognition-n-visualrecogniti-159...	Default	Dallas	Visual Recognition	Active	-
Storage (1)					
Network (0)					
Cloud Foundry enterprise environments (0)					



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PREDICTING LIFE EXPECTANCY DEPLOY

Overview

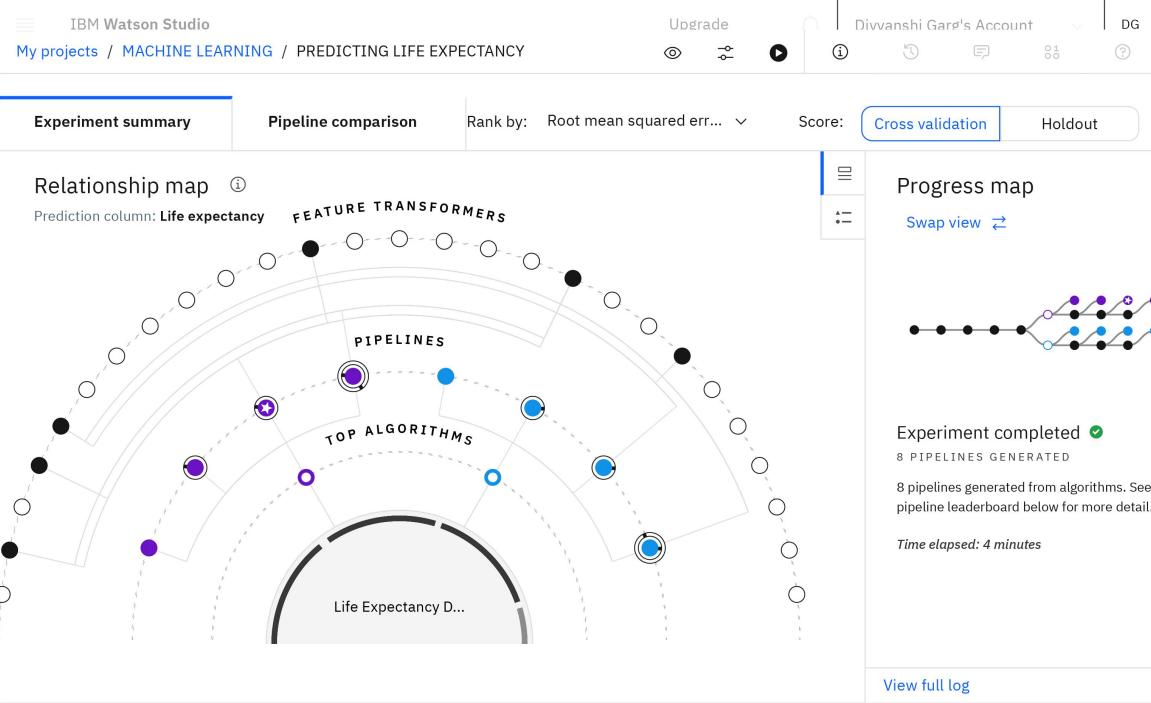


Deployment

Name	PREDICTING LIFE EXPECTANCY DEPLOY
Type	Web Service
Deployment ID	e909127e-0cc9-4c0e-854c-dffa6c64a14a
Status	Ready
Asset type	Model
Asset name	PREDICTING LIFE EXPECTANCY - P3 ExtraTreesRegressorEstimator
Machine learning service	pm-20-qf
Created	Jun 16, 2020 4:39 PM
Last modified	Jun 16, 2020 4:39 PM

Model

Name	PREDICTING LIFE EXPECTANCY - P3 ExtraTreesRegressorEstimator
ID	1b4cabce-e1de-414f-b893-86391bafedae
Version ID	22fb6178-5c90-40af-86c7-5634774f5e2e



Pipeline leaderboard

>	Rank ↑	Name	Algorithm	RMSE (Optimiz...)	Enhancements	Build time
---	--------	------	-----------	-------------------	--------------	------------

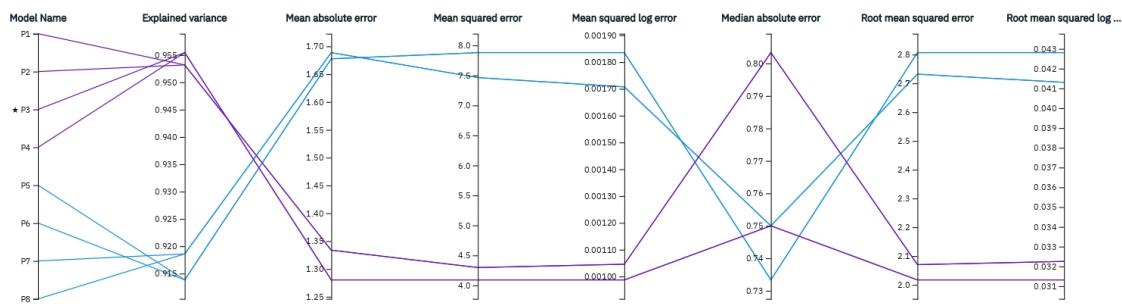
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Experiment summary Pipeline comparison Rank by: Root mean squared err... Cross validation Holdout

Metric chart ⓘ

Prediction column: Life expectancy



Pipeline leaderboard

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Experiment summary Pipeline comparison Rank by: Root mean squared err... Score: Cross validation Holdout

	Explained variance	0.955	0.952
MAE	1.280	1.282	
MSE	4.091	4.101	
MSLE	0.001	0.001	
MedAE	0.750	0.700	
RMSE	2.017	2.025	
RMSLE	0.031	0.031	
R²	0.955	0.952	

> 2 Pipeline 4 Extra Trees Regressor **2.017** HPO-1 FE HPO-2 00:00:38

> 3 Pipeline 1 Extra Trees Regressor **2.070** None 00:00:01

> 4 Pipeline 2 Extra Trees Regressor **2.070** HPO-1 00:00:12

> 5 Pipeline 7 Decision Tree Regressor **2.732** HPO-1 FE 00:00:41

> 6 Pipeline 8 Decision Tree Regressor **2.732** HPO-1 FE HPO-2 00:00:09

> 7 Pipeline 5 Decision Tree Regressor **2.807** None 00:00:01



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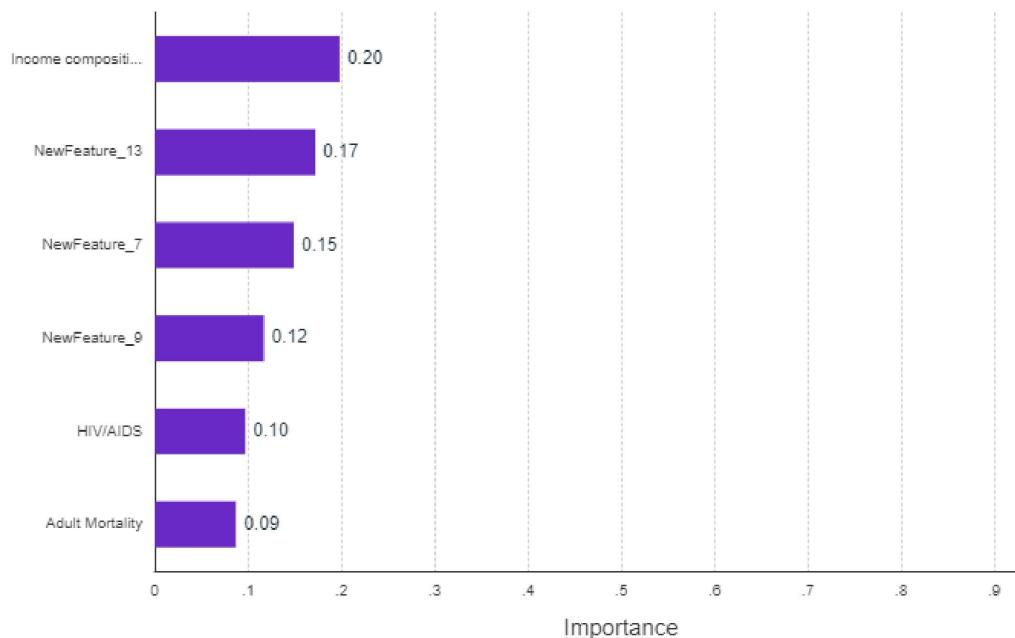
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/ PREDICTING LIFE EXPECTANCY



TARGET: LIFE EXPECTANCY





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TARGET: LIFE EXPECTANCY

	Holdout Score	Cross Validation Score
Root Mean Squared Error (RMSE)	2.025	2.017
R ²	0.952	0.955
Explained Variance	0.952	0.955
Mean Squared Error (MSE)	4.101	4.091
Mean Squared Log Error (MSLE)	0.001	0.001
Mean Absolute Error (MAE)	1.282	1.280
Median Absolute Error (MedAE)	0.700	0.750
Root Mean Squared Log Error (RMSLE)	0.031	0.031





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PREDICTING LIFE EXPECTANCY DEPLOY

Test



Enter input data

64	<input type="text" value="64"/>
thinness 5-9 years	<input type="text" value="64"/>
64	<input type="text" value="64"/>
Income composition of resources	<input type="text" value="64"/>
Schooling	<input type="text" value="64"/>

```
{  
  "predictions": [  
    {  
      "fields": [  
        "prediction"  
      ],  
      "values": [  
        [  
          65.78000030517578  
        ]  
      ]  
    }  
  ]  
}
```

[Predict](#)

SMARTBRIDGE

Let's Bridge the gap

Summer Internship report

Predicting Life Expectancy using Machine Learning

06/06/2020-4/07/2020

Submitted by: Divyanshi Garg

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- Purpose

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- A. Source code

INTRODUCTION

Overview

The life expectancy dataset for this project is collected from Kaggle. It is a platform for predictive modelling and analytics competitions. Statisticians and data scientist from all over the world post the data and compete to produce the solve dataset problem with best of model. The Machine Learning regression algorithm is applied to the dataset to get best results.

Problem Statement:

Predicting Life Expectancy Using Machine Learning

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: Regional variations, Economic Circumstances, Sex Differences, Mental Illnesses, Physical Illnesses, Education, Year of their birth and other demographic 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.

Purpose:

Built a machine learning model for the prediction of life expectancy.

LITERATURE SURVEY

Existing Problem:

Predicting life expectancy of people around the world on the basis of different set of attributes such as BMI, Country, Adult Mortality etc.

Proposed Solution:

To study at world level, it is required to classify population into groups on the basis of age, gender, region etc. For this and other complex statistics, the new technologies such as Artificial Intelligence, Machine Learning, Neural Networks are available.

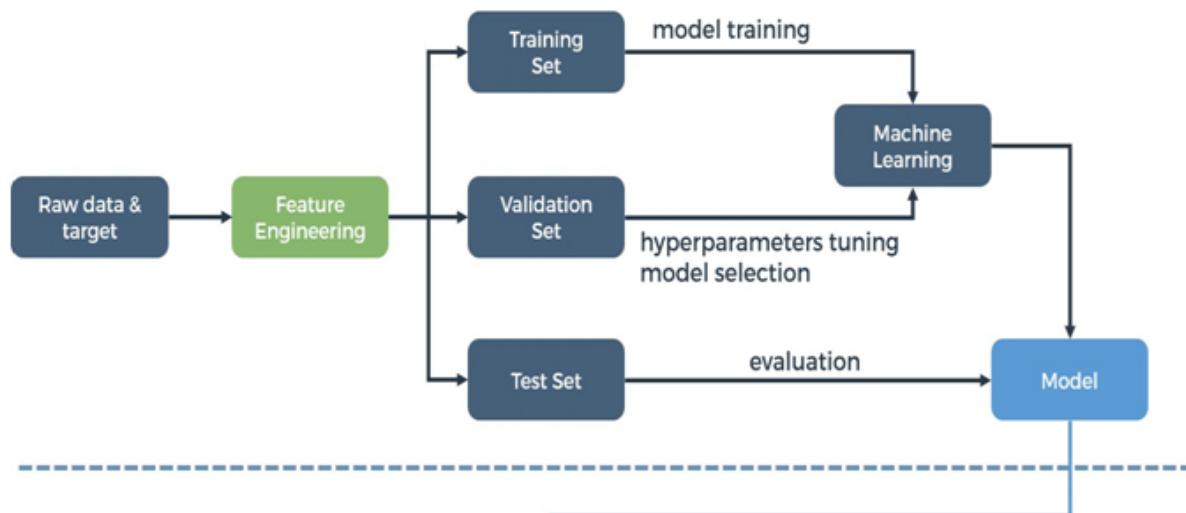
To calculate the life span of an individual a system is required that consider environmental, geographic, health and lifestyle attributes. With the help of Machine Learning, regression algorithm it's feasible to analyze the dataset and predict the life expectancy on individual. IBM Cloud platform made the process a much more easier to predict accurate and efficient results.

IBM cloud platform has an in-build AUTO AI that makes it easier for the user to get the results only with loading the dataset. Auto AI split the dataset into training and testing and apply regression to it. After applying regression, RMSE value is automatically calculated which reveal the accuracy of model.

THEORITICAL ANALYSIS

Block diagram

TRAINING



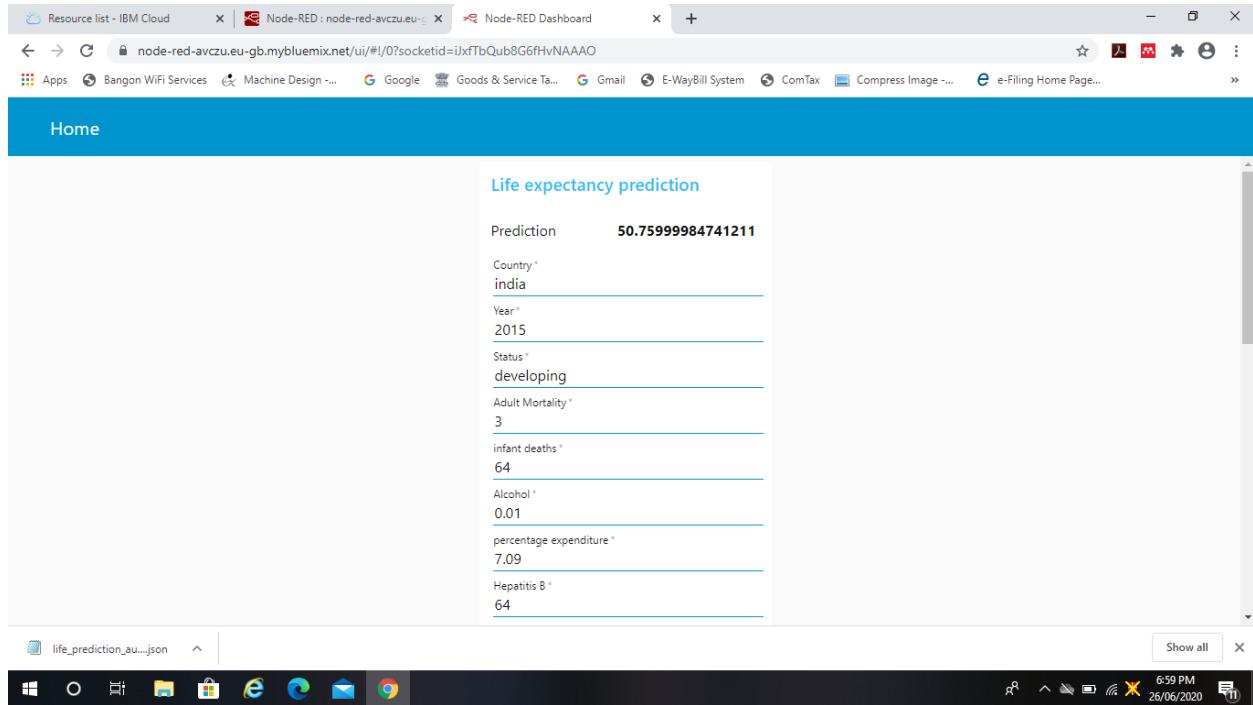
PREDICTING



Hardware and Software Designing

An Auto AI model is integrated with node-red flow to predict life expectancy. The node-red flow URL is shared below

<https://node-red-avczu.eu-gb.mybluemix.net/ui/#/0?socketid=0N8o0NQ1Ar8bb0cTAAAR>



The screenshot shows a web browser window with the title "Node-RED Dashboard". The main content area displays a "Life expectancy prediction" form. The predicted value is shown as **50.7599984741211**. The input fields and their values are:

- Country: india
- Year: 2015
- Status: developing
- Adult Mortality: 3
- Infant deaths: 64
- Alcohol: 0.01
- percentage expenditure: 7.09
- Hepatitis B: 64

The browser's address bar shows the URL: `node-red-avczu.eu-gb.mybluemix.net/ui/#/0?socketid=0N8o0NQ1Ar8bb0cTAAAR`. The taskbar at the bottom indicates the system is running at 6:59 PM on 26/06/2020.

Experimental Investigations

- Collect the dataset from Kaggle.

<https://www.kaggle.com/kumarajarshi/life-expectancy-who>

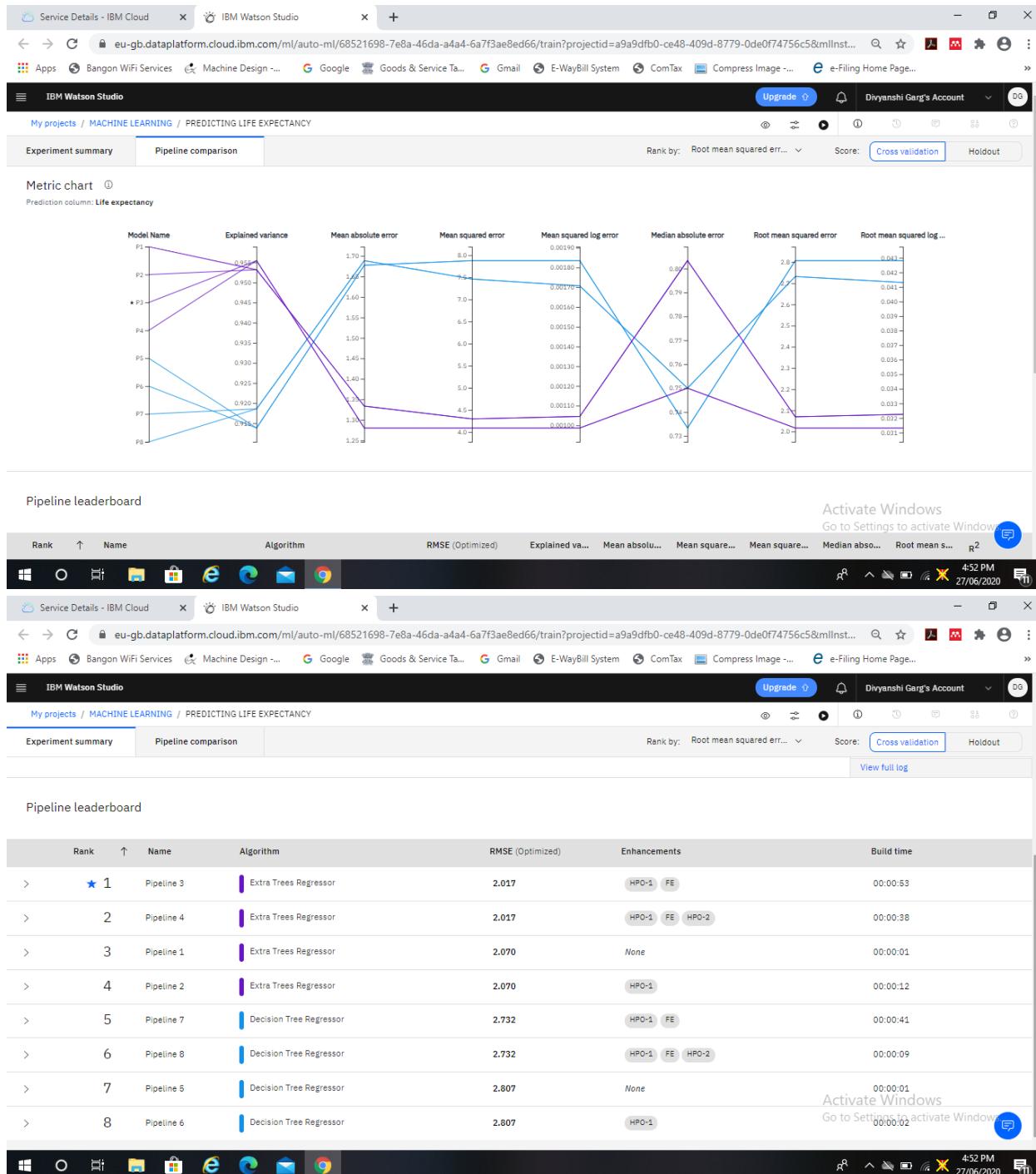
- Create a Machine Learning Service in IBM Cloud to build a model.

The screenshot shows the IBM Cloud Service Details interface for a service named 'pm-20-qf'. The service is listed as 'Active' and associated with the 'cpdaas' catalog category. The main content area features a large purple Watson Machine Learning logo. Below the logo, the text 'Watson Machine Learning' is displayed. A welcome message reads 'Welcome! Get Started with Watson Machine Learning in Watson Studio.' A prominent blue button labeled 'Access in Watson Studio' is centered. On the right side of the screen, there is a vertical sidebar with a 'FEEDBACK' button. The bottom of the window shows the Windows taskbar with various pinned icons and the system tray indicating the date and time as 27/06/2020 at 4:55 PM.

- Build an Auto AI model to predict life expectancy.

The screenshot displays the IBM Watson Studio interface for a project titled 'PREDICTING LIFE EXPECTANCY'. The central feature is a circular 'Relationship map' showing connections between 'FEATURE TRANSFORMERS', 'PIPELINES', and 'TOP ALGORITHMS'. The map is divided into three concentric rings. The top ring is labeled 'FEATURE TRANSFORMERS', the middle ring 'PIPELINES', and the bottom ring 'TOP ALGORITHMS'. A legend indicates that black dots represent 'Feature transformers', white dots 'Algorithms', and purple dots 'Pipelines'. To the right of the map, a 'Progress map' shows the status of experiments, stating 'Experiment completed' with 8 pipelines generated. Below the map, a 'Pipeline leaderboard' table lists various models based on their RMSE (Optimized) score, algorithm used, and build time. The table includes columns for Rank, Name, Algorithm, RMSE (Optimized), Enhancements, and Build time. The bottom of the window shows the Windows taskbar with pinned icons and the system tray indicating the date and time as 27/06/2020 at 4:52 PM.

- Compare the pipelines created by model and choose the one that best fits the model.



- Look for the RMSE and other values to know the accuracy of model.

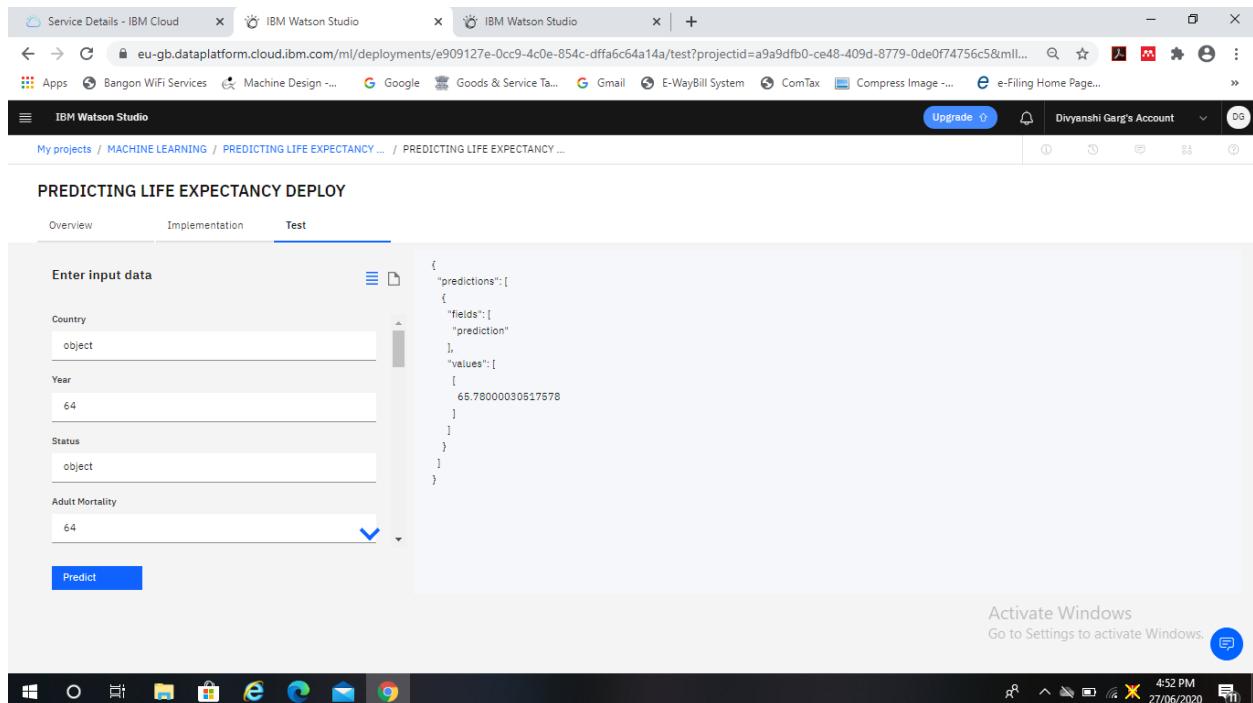
The screenshot shows the IBM Watson Studio interface. At the top, there's a navigation bar with tabs like 'Experiment summary' and 'Pipeline comparison'. Below that is a 'Pipeline leaderboard' section. It lists two pipelines: Pipeline 3 and Pipeline 4. Pipeline 3 has a rank of 1, an algorithm of Extra Trees Regressor, an RMSE of 2.017, and a build time of 00:00:53. Pipeline 4 has a rank of 2, an algorithm of Extra Trees Regressor, an RMSE of 2.017, and a build time of 00:00:38. A 'Model evaluation measures' table provides detailed metrics for both pipelines. To the right of the table is a 'Feature Importance' chart. The chart shows the importance of various features: Income composition (0.20), NewFeature_13 (0.17), NewFeature_7 (0.15), NewFeature_9 (0.12), and HIV/AIDS (0.10). The x-axis represents the importance score from 0 to 1.

Rank	Name	Algorithm	RMSE (Optimized)	Enhancements	Build time
1	Pipeline 3	Extra Trees Regressor	2.017	HPO-1 FE	00:00:53
2	Pipeline 4	Extra Trees Regressor	2.017	HPO-1 FE HPO-2	00:00:38

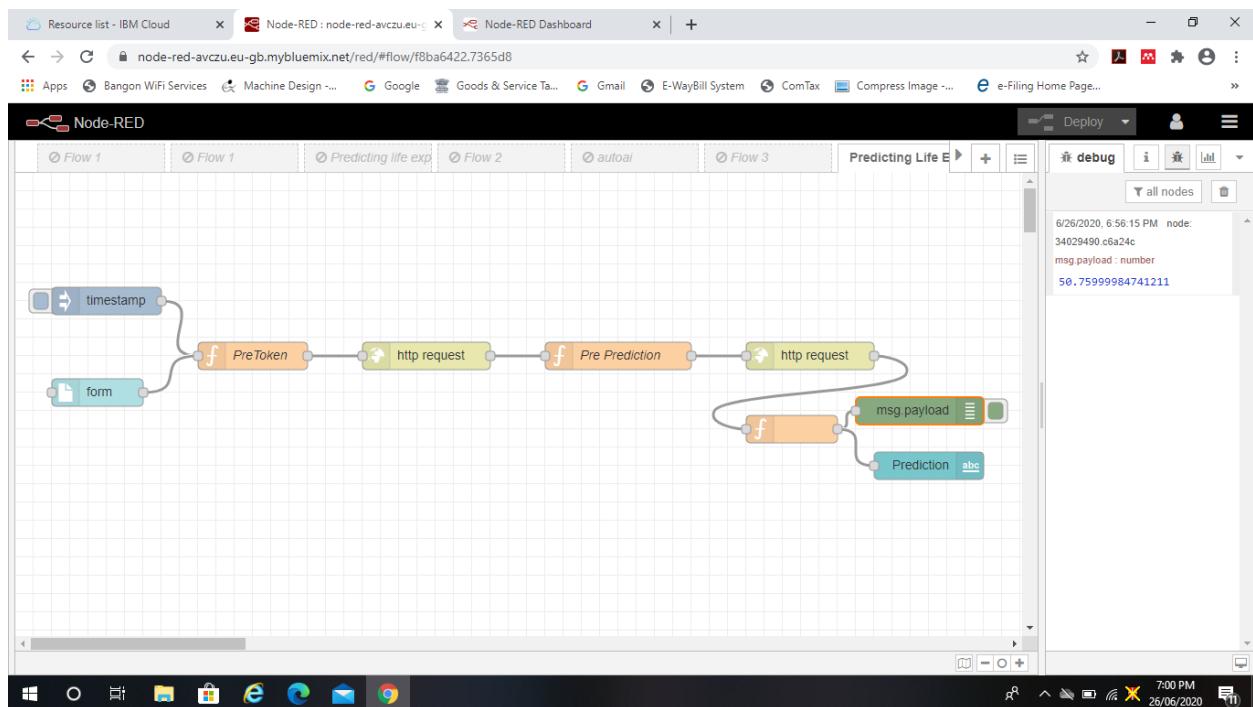
- Study the importance of attributes in prediction of life expectancy to know the influence of them on predicted results.

This screenshot shows the details for Pipeline 3. The pipeline has a rank of 1, an RMSE of 2.025, an algorithm of Extra Trees Regressor, and a build time of 00:00:53. The 'Feature Importance' section displays a chart with the same data as the previous screenshot: Income composition (0.20), NewFeature_13 (0.17), NewFeature_7 (0.15), NewFeature_9 (0.12), and HIV/AIDS (0.10).

- Test the model by assigning values to the attributes and look for prediction.



- Integrate Auto AI model with node-red flow.



- Get the output in User Interface.

The screenshot shows a Microsoft Edge browser window with three tabs open. The active tab is titled "Node-RED : node-red-avcuzu.eu...". The URL is <http://node-red-avcuzu.eu-gb.mybluemix.net/ui/#/0?socketid=UJxfTbQub8G6fHvNAAAO>. The browser's address bar also displays this URL. The page content is a "Life expectancy prediction" form. The "Prediction" field contains the value **50.75999984741211**. The form fields include:

Field	Value
Country *	india
Year *	2015
Status *	developing
Adult Mortality *	3
infant deaths *	64
Alcohol *	0.01
percentage expenditure *	7.09
Hepatitis B *	64

At the bottom left, there is a file download icon followed by the text "life_prediction_aau...json". At the bottom right, there is a "Show all" button and a close button. The browser's taskbar at the bottom shows various pinned and open application icons, and the system tray indicates the date and time as 26/06/2020 at 6:59 PM.

RESULTS

- Prediction of life expectancy on the basis of different distinct features.

The image shows two side-by-side browser windows. The top window is titled "PREDICTING LIFE EXPECTANCY DEPLOY" and displays a JSON prediction response. The bottom window is titled "Life expectancy prediction" and shows a form with input fields and a prediction result.

PREDICTING LIFE EXPECTANCY DEPLOY

Enter input data

```
{  
  "predictions": [  
    {  
      "fields": [  
        "prediction"  
      ],  
      "values": [  
        {  
          "65.78000030517578"  
        }  
      ]  
    }  
  ]  
}
```

Predict

Activate Windows
Go to Settings to activate Windows.

Life expectancy prediction

Prediction	50.7599984741211
Country*	india
Year*	2015
Status*	developing
Adult Mortality*	3
infant deaths*	64
Alcohol*	0.01
percentage expenditure*	7.09
Hepatitis B*	64

life_prediction_a...json

- Income composition is the most important feature that plays a vital role in predicting the life expectancy. Its importance is the highest among other features. It depicts that an individual with higher income tends to have a great lifestyle and so the life span.
- A positive correlation between 'Schooling' and 'LifeExpectancy' is observed. Education system of rich countries is well established and have high life expectancy rate.
- A positive correlation between 'GDP' and 'Life Expectancy' is observed. As the countries with good healthcare, education, infrastructure facilities are more likely to have high life expectancy rate.

Advantages

- Life expectancy predictions have the potential to be beneficial to individuals, health service providers and governments. It would make people more aware of their general health, and its improvement or deterioration over time. This may motivate them to make healthier lifestyle choices.
- Life expectancy can be estimated at any age, e.g. life expectancy at 65 years. Gives more weight to deaths at younger ages.
- Life expectancy has been used nationally to monitor health inequalities. The problems caused can be tackled with the joint efforts made by people and it is urgent for human beings to do the best to save the environment and find out solution to the difficulties caused by the larger and larger population on the planet.

Disadvantages

- At smaller geographies may be influenced by nursing homes in the area.
- A younger death does not necessarily have any more impact on the rate than an older death. It is quite possible that the death of a person aged 70 years may increase the rate to the same extent as an infant death.

Application

Life expectancy is one of the most important factors in end-of-life decision making. Good prognostication for example helps to determine the course of treatment and helps to anticipate the procurement of health care services and facilities, or more broadly: facilitates Advance Care Planning. Evidence based studies indicate the factors based on longevity of an individual.

Conclusion

Prognostication of life expectancy is difficult for humans. Our research shows that machine learning and natural language processing techniques offer a feasible and promising approach to predicting life expectancy. The research has potential for real-life applications, such as supporting timely recognition of the right moment to start Advance Care Planning.

Income Composition has most influenced the life span predictions. The accuracy of model found to be 95% which is a great percentage and from the results it can be concluded that the model best fits the dataset. On the other hand, the benefits both people and the world can get from the phenomenon of people living longer are irreplaceable and undeniable. It is the truth that longevity is a symbol of civilization and better life.

FUTURE SCOPE

Life expectancy inequality is forecast to continue to rise across districts, however, with present and future inequalities partly related to district deprivation and partly associated with variation within deprivation quintiles, especially within the deprived quintiles. Furthermore, I found that life expectancy varied more in the more deprived quintiles, perhaps because deprived communities are more vulnerable to factors that affect health and longevity, but vary independently of deprivation.

Most of the gains in longevity will be in those older than 65 years of age, and are, hence, highly relevant for planning pensions and health and social services. We also forecast that the closing of the female–male life expectancy gap will continue steadily. This narrowing will occur because death rates in middle-aged and old age are estimated to decrease more slowly in the future than they did in the past, perhaps partly due to accumulation of risks from smoking in middle-aged and old age individuals.

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APPENDIX

Source Code

<https://node-red-avczu.eu-gb.mybluemix.net/ui/#/0?socketid=0N8o0NQ1Ar8bb0cTAAAR>