Architecture Design

ADULT CENSUS INCOME PREDICTION

Document Control

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Abstract

Machine Learning is a category of algorithms that allows software applications to become more accurate in predicting outcomes without being explicitly programmed. The basic premise of machine learning is to build models and employ algorithms that can receive input data and use statistical analysis to predict an output while updating outputs as new data becomes available. These models can be applied in different areas and trained to match the expectations of management so that accurate steps can be taken to achieve the organization's target. In this project, we will estimate the amount of insurance premium on the basis of personal health information. Taking various aspects of a dataset collected from people, and the methodology followed for building a predictive model.

1. Introduction

1.1 What is Architecture Design?

The goal of Architecture Design (AD) is to give the internal design of the actual program code for the `Insurance Premium Prediction`. AD describes the class diagrams with the methods and relation between classes and program specification. It describes the modules so that the programmer can directly code the program from the document.

1.2 Scope

Architecture Design (AD) is a component-level design process that follows a step-by-step refinement process. This process can be used for designing data structures, required software, architecture, source code, and ultimately, performance algorithms. Overall, the data organization may be defined during requirement analysis and then refined during data design work. And the complete workflow.

1.3 Constraints

We only predict the expected estimating cost of expenses customers based on some personal health information.

2. Technical Specification

2.1 Dataset

The dataset containing verified historical data, consisting of the aforementioned information

Architecture Design

There are 32561 rows and 15 columns in the given datasets . By Using these data we are build a model that should Predict that the Income census of an Adult person basicalt this is a binary class classification problem.

```
1  df=pd.read_csv(r"D:\AdultCensusIncomePrediction\notebooks\data\adult.csv")
2  df.head()
```

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	age	workclass	fnlwgt	education	education-num	marital-status	occupation	relationship	race	sex	capital-gain	capital-loss	hours-per-week	country	salary
0	39	State-gov	77516	Bachelors	13	Never-married	Adm-clerical	Not-in-family	White	Male	2174	0	40	United-States	<=50K
1	50	Self-emp-not-inc	83311	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband	White	Male	0	0	13	United-States	<=50K
2	38	Private	215646	HS-grad	9	Divorced	Handlers-cleaners	Not-in-family	White	Male	0	0	40	United-States	<=50K
3	53	Private	234721	11th	7	Married-civ-spouse	Handlers-cleaners	Husband	Black	Male	0	0	40	United-States	<=50K
4	28	Private	338409	Bachelors	13	Married-civ-spouse	Prof-specialty	Wife	Black	Female	0	0	40	Cuba	<=50K

The data set consists of various data types from integer to floating to object as shown in Fig

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```
1  df.info()
```

Select Cell Language Mode

Python

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 32561 entries, 0 to 32560
Data columns (total 15 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   age             32561 non-null  int64
 1   workclass       32561 non-null  object
 2   fnlwgt          32561 non-null  int64
 3   education       32561 non-null  object
 4   education-num   32561 non-null  int64
 5   marital-status  32561 non-null  object
 6   occupation      32561 non-null  object
 7   relationship    32561 non-null  object
 8   race            32561 non-null  object
 9   sex             32561 non-null  object
 10  capital-gain    32561 non-null  int64
 11  capital-loss    32561 non-null  int64
 12  hours-per-week  32561 non-null  int64
 13  country         32561 non-null  object
 14  salary          32561 non-null  object
dtypes: int64(6), object(9)
memory usage: 3.7+ MB
```

Various factors important by statistical means like mean, standard deviation, median, count of values and maximum value, etc. are shown below for numerical attributes

```
In [10]: # Let us look at the statistical information about the dataset(min, max, mean, count etc.)
         merged_data.describe()
```

Out[10]:

	Item_Weight	Item_Visibility	Item_MRP	Outlet_Establishment_Year	Item_Outlet_Sales
count	11765.000000	14204.000000	14204.000000	14204.000000	14204.000000
mean	12.792854	0.065953	141.004977	1997.830681	1308.865489
std	4.652502	0.051459	62.086938	8.371664	1699.791423
min	4.555000	0.000000	31.290000	1985.000000	0.000000
25%	8.710000	0.027036	94.012000	1987.000000	0.000000
50%	12.600000	0.054021	142.247000	1999.000000	559.272000
75%	16.750000	0.094037	185.855600	2004.000000	2163.184200
max	21.350000	0.328391	266.888400	2009.000000	13086.964800

Preprocessing of this dataset includes doing analysis on the independent variables like checking for null values in each column and then replacing or filling them with supported appropriate data types so that analysis and model fitting is not hindered from their way to accuracy. Shown above are some of the representations obtained by using Pandas tools which tell about variable count for numerical columns and model values for categorical columns. Maximum and minimum values in numerical columns, along with their percentile values for median, play an important factor in deciding which value to be chosen at priority for further exploration tasks and analysis. Data types of different columns are used further in label processing and a one-hot encoding scheme during the model building.

2.2 Logging

We should be able to log every activity done by the user

- The system identifies at which step logging require.
- The system should be able to log each and every system flow.
- The system should be not be hung even after using so much logging. Logging just because we can easily debug issuing so logging is mandatory to do.

2.3 Deployment

For the hosting of the project, we will use Render.

3. Technology Stack

Front End	HTML/CSS
Backend	Python/ Flask
Deployment	Render

4. Proposed Solution

We will use performed EDA to find the important relation between different attributes and will use a machine-learning algorithm to estimate the cost of expenses. The client will be filled the required feature as input and will get results through the web application. The system will get features and it will be passed into the backend where the features will be validated and preprocessed and then it will be passed to a hyperparameter tuned machine learning model to predict the final outcome.

5. Architecture

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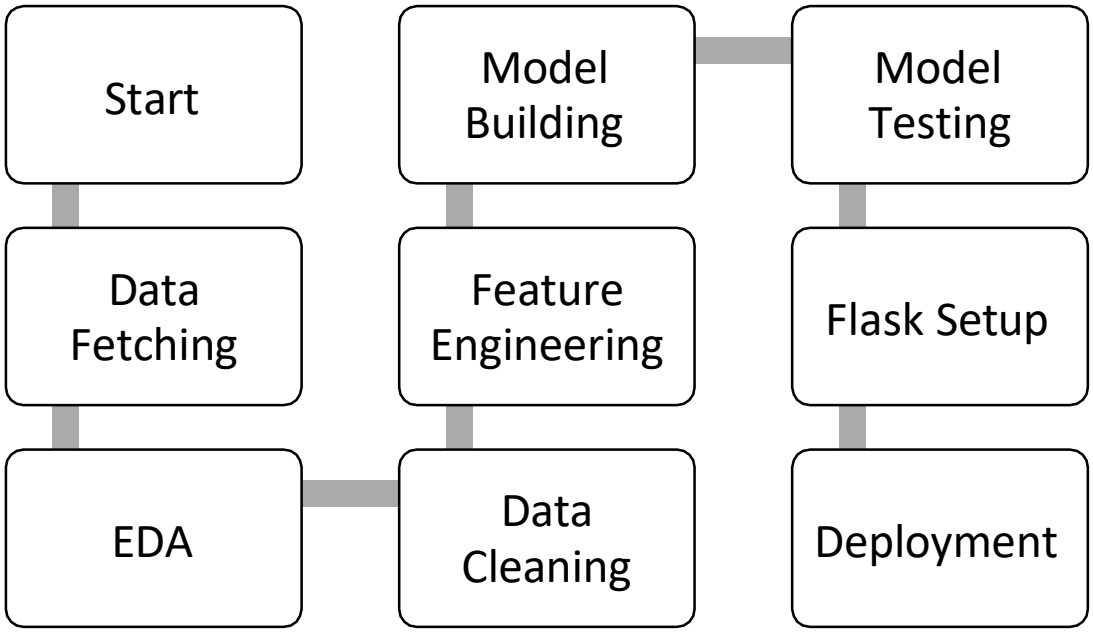

5.1 Data Gathering

Data source: https://www.kaggle.com/datasets/overload10/adult-census-dataset

Dataset is stored in .csv format.

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5.2 Raw Data Validation

After data is loaded, various types of validation are required before we proceed further with any operation. Validations like checking for zero standard deviation for all the columns, checking for complete missing values in any columns, etc. These are required because the attributes which contain these are of no use. It will not play role in contributing to the estimating cost of the premium.

5.3 Exploratory Data Analysis

Visualized the relationship between the dependent and independent features. Also checked relationship between independent features to get more insights about the data.

5.4 Feature Engineering

After pre-processing standard scalar is performed to scale down all the numeric features. Even one hot encoding is also performed to convert the categorical features into numerical features. For this process, pipeline is created to scale numerical features and encoding the categorical features.

5.5 Model Building

After doing all kinds of pre-processing operations mention above and performing scaling and encoding, the data set is passed through a pipeline to all the models, Logistic Regression, Decision tree, Random Forest, Gradient boost, KNN and XGBoost classification using EvalML. It was found that Gradient boosting classifier performs best with the 84.87050875217524 accuracy value.

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5.6 Model Saving

Model is saved using pickle library in pickle` format.

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5.7 Flask Setup for Web Application

After saving the model, the API building process started using Flask. Web application creation was created in Flask for testing purpose. Whatever user will enter the data and then that data will be extracted by the model to estimate the premium of insurance, this is performed in this stage.

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5.8 GitHub

The whole project directory will be pushed into the GitHub repository.

5.9 Deployment

The project was deployed from GitHub into the Heroku platform.

6. User Input / Output Workflow.