



UDACITY

**AWS Machine Learning Engineer Nanodegree
Capstone Proposal
Arvato Customer Acquisition Prediction Using
Supervised Learning**

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1 Domain Background



ARVATO is a company that provides financial services, IT services, and supply chain management services solutions to other businesses. It has a large base of global customers. It's solutions focus on automation and data analytics.[KGaa]

Arvato's customer base come from a wide variety of businesses, such as insurance companies, telecommunications, media education and e-commerce.

Arvato analytics is helping businesses to take important decisions and gain insights from data. It uses data science and machine learning to meet business goals and gain customer satisfaction.

Arvato is owned by Bertelsmann [KGab], which is a media, services and education company that operates in about 50 countries around the world.

In this project, Arvato is helping a mail-order company that sells organic products in Germany to build a model to predict which individuals are most likely to convert into becoming customers for the company by analyzing marketing campaign mailout data.

2 Problem Statement

The problem can be stated as: “ Given the existing marketing campaign demographic data of customers who responded to marketing mails, how can we predict whether a new person will be a potential customer for the mail-order company?”

A supervised learning algorithm will be used to train a model that will help the company make such predictions and decide whether is a person is a potential candidate to be a customer for the company or not.

3 Datasets and Inputs

There are two files of the dataset that we are concerned with:

- **Udacity_MAILOUT_052018_TRAIN.csv**: Demographic data for people in Germany that were targeted by the marketing mailing campaign. It contains data for 42,982 individuals.

This training dataset has 367 columns, 366 of them are demographic features and 1 label column **'RESPONSE'**

- **Udacity_MAILOUT_052018_TEST.csv**: The testing dataset, It contains data for 42,833 individuals and it has 366 columns of the demographic features, this dataset has no label columns and will be tested using kaggle api for **Udacity+Arvato: Identify Customer Segments** competition.

There are also two metadata files that contain a data dictionary for the demographic features in the previous dataset files.

- **DIAS Information Levels - Attributes 2017.xlsx**: An excel sheet that contains a top-level organization of demographic features, their description and some notes.
- **DIAS Attributes - Values 2017.xlsx**: An excel sheet that contains demographic features sorted alphabetically, their description, their values, and meaning of each value.

The dataset is a private dataset. It is used with permission from Arvato for use in the nanodegree project.

4 Solution Statement

In this project I will use the provided data to predict whether an individual will be a customer for the mail-order company or not. The general solution steps are:

- The data will be pre-processed. The data will be explored for missing values, invalid values outside the range defined in `DIAS Attributes - Values 2017.xlsx`. Then, categorical features will be encoded as numerical features. Finally, The features will be z-scaled and normalized to have similar ranges of values and accelerate learning convergence.
- A supervised machine learning algorithm will be used to train a model on the training dataset in `Udacity_MAILOUT_052018_TRAIN.csv`, using the column `'RESPONSE'` as a label for training.
Some of the candidate algorithms for model training are logistic regression, decision tree classifier, random forest and XGBoost.
- Hyperparameter tuning of model hyperparameters to obtain the best performance metric. I will use AWS Sage maker Hyperparameter Tuning Job for this task.
- The trained model will be tested using the test set from `Udacity_MAILOUT_052018_TEST.csv` and the results will be validated using kaggle api for the competition [Udacity+Arvato: Identify Customer Segments](#).

For full details of the technologies and techniques that will be used for the solution refer to Section 7 - [Project Design](#).

5 Benchmark Model

A benchmark model will be a simple Logistic Regression model trained using the default hyperparameters. Other proposed supervised learning model will be compared to this baseline model in terms of performance and training time.

6 Evaluation Metrics

Since this is a binary classification problem, the proposed classification metrics are:

- Accuracy score
- F1 Score.
- Area under the receiver operating curve (AUROC).

The choice of the classification metric will depend on the dataset analysis and exploration. If the dataset is highly skewed, then accuracy score will not be a good choice and we will use the other two for evaluation.

Some of the records from `Udacity_MAILOUT_052018_TRAIN.csv` will be used as a validation dataset and the performance metric will be compared against.

7 Project Design

In this project I will use [Amazon Web Services](#) and their [Sagemaker](#) Compute Instances for data cleaning, model training, hyperparameter tuning and generating predictions.

Amazon SageMaker is a fully managed cloud computing service that provides a machine learning engineer with the ability to prepare build, train, and make inferences for machine learning models quickly.

1. The dataset files in [Section 3 - Datasets and Inputs](#) will be uploaded to an [Amazon S3](#) bucket.
2. Data pre-processing, cleaning, exploration and feature engineering: The data will be checked for missing values. Invalid values will be spotted and fixed using the provided metadata file [DIAS Attributes - Values 2017.xlsx](#)

The pre-processing step will be completed inside an [Amazon Sagemaker Notebook Instance](#)

3. A baseline [Scikit-learn](#) logistic regression model will be trained on the dataset, the metric obtained will be recorded for future reference.
4. Candidate supervised learning models will be evaluated against the dataset and the best performing model will be selected.
5. Hyperparameter tuning will be done on the selected model using a [Sagemaker Hyperparameter Tuning job](#). This step will use regression on the hyperparameter search space to find the best and optimal hyperparameters to train the model.
6. Model training using the best hyperparameters obtained in the previous steps. I will use one of [Amazon Sagemaker built-in algorithm images](#) for model training using appropriate [compute instance](#).
7. Generating Predictions: The test dataset from [Udacity_MAILOUT_052018_TEST.csv](#) will be used by the final model trained in the previous step to generate predictions that can be evaluated using Kaggle API for the [Udacity+Arvato: Identify Customer Segments](#) competition.

References

- [KGaa] Bertelsmann SE & Co KGaA (www.bertelsmann.com). *Arvato - Bertelsmann SE & Co. KGaA*. en. Publisher: Bertelsmann SE & Co. KGaA, Carl-Bertelsmann-Straße 270, D-33311 Gütersloh, www.bertelsmann.com. URL: <https://www.bertelsmann.com/divisions/arvato/> (visited on 01/23/2022).
- [KGab] Bertelsmann SE & Co KGaA (www.bertelsmann.com). *Company - Bertelsmann SE & Co. KGaA*. en. Publisher: Bertelsmann SE & Co. KGaA, Carl-Bertelsmann-Straße 270, D-33311 Gütersloh, www.bertelsmann.com. URL: <https://www.bertelsmann.com/company/> (visited on 01/23/2022).