Heart Attack Risk Predictor

“ Heart Attack Risk Predictor is an mobile application designed to use On-Device Machine Learning with **TensorFlow Lite inference** ”

- Input is EHR Data and follows a ISO 13606 standard.

Two Scenarios

- Case 1: Pre-Diagnosis of a patient at Primary Health Care centre.
- Case 2: Self-Diagnosis of a Patient at Home.

Two Applications

- Heart Attack Risk Predictor [HARP] takes 22 EHR features based on Case 1.
- Heart Disease Predictor [HDP] takes 10 features based on Case 2.

Dataset

- EHR data taken from UCI machine learning repository
- Data collected from 4 databases as part of a research study based in Europe and US.
- Dataset has 920 observations and 76 features.
- Patient is asked to perform few simple exercises.
- Followed by non-invasive tests like ECG, Cardiac Fluoroscopy, Exercise thallium scintigraphy, Coronary Angiograms etc

Feature Engineering

- For **Feature Selection**, Chi-square test of Independence to get most significant features.
- For **Feature Extraction**, Principal Component Analysis to get most meaningful components based on eigenvalue-one criteria i.e. components with >= 1 were chosen.

Final Features

We have identified 22 features that are most significant and contribute to the disease condition of patient. Below are the selected features.

- Cholesterol
- Chest Pain
- Cigarettes
- Years of smoking
- Pain provoked by Exertion
- Relieved after Rest
- Resting ECG
- Exercise Protocol
- Exercise induced ST Depression
- Circum Flex
- Height of Peak
- Duration of Exercise
- Exercise Thallium Heart scan
- Time when ST depression occurred
- Distal left anterior Descending artery
- Proximal Right coronary artery
- Number of vessels coloured by fluoroscopy
- Proximal Left anterior descending artery
- Exercise induced Angina
- Maximum Heart rate achieved
- Slope of Peak exercise
- First obtuse marginal branch

Modelling

To check which algorithm generalizes better, we have performed below 4 experiments.

- **Experiment 1**: Original 76 features + Pre-processing Module + Classifier Module
- **Experiment 2**: Original 76 features + Pre-processing Module + PCA + Classifier Module
- **Experiment 3**: Original 76 features + Pre-processing Module + Feature Selection [22] + Classifier Module
- **Experiment 4**: Original 76 features + Pre-processing Module + Feature Selection [22] + PCA + Classifier Module

Classifier Module

- Logistic Regression
- Decision Tree Classifier
- Random Forest Classifier
- Support Vector Machines Classifier
- Naïve Bayes Classifier
- Multilayer Perceptron Classifier
- Gradient Boosting Classifier
- K-Nearest Neighbours
- Xtreme Gradient Boosting

Results

We have identified that **experiment 3** gives us best results among all experiments.

	ACCURACY(%)	PRECISION(%)	RECALL(%)	F1_SCORE(%)
k-Nearest	85.7	92.3	80.3	85.8
Decision Tree	86.3	88.3	86.5	87.3
Naive Bayes	86.3	87.5	87.4	87.4
Xtreme Gradient	87.2	89.5	86.8	88.0
Logistic Regression	87.3	88.9	87.6	88.1
MultiLayer Perceptron	89.5	91.0	89.6	90.2
Random Forest	90.5	92.6	89.8	91.1
Gradient Boosting	90.7	93.4	89.3	91.2
Support Vector	91.4	93.1	90.9	91.9
Stacked Model	92.0	93.1	92.1	92.5

- Created a Ensemble of models taking the TOP 5 performing models.
- Final Stacked model has better performance resulting in less **False Negatives** values.

Deployment

- According to stack overflow, 85-90% of the created models never make it to production.
- Collaboration among Software Engineers and Data Scientists to deliver a final product.

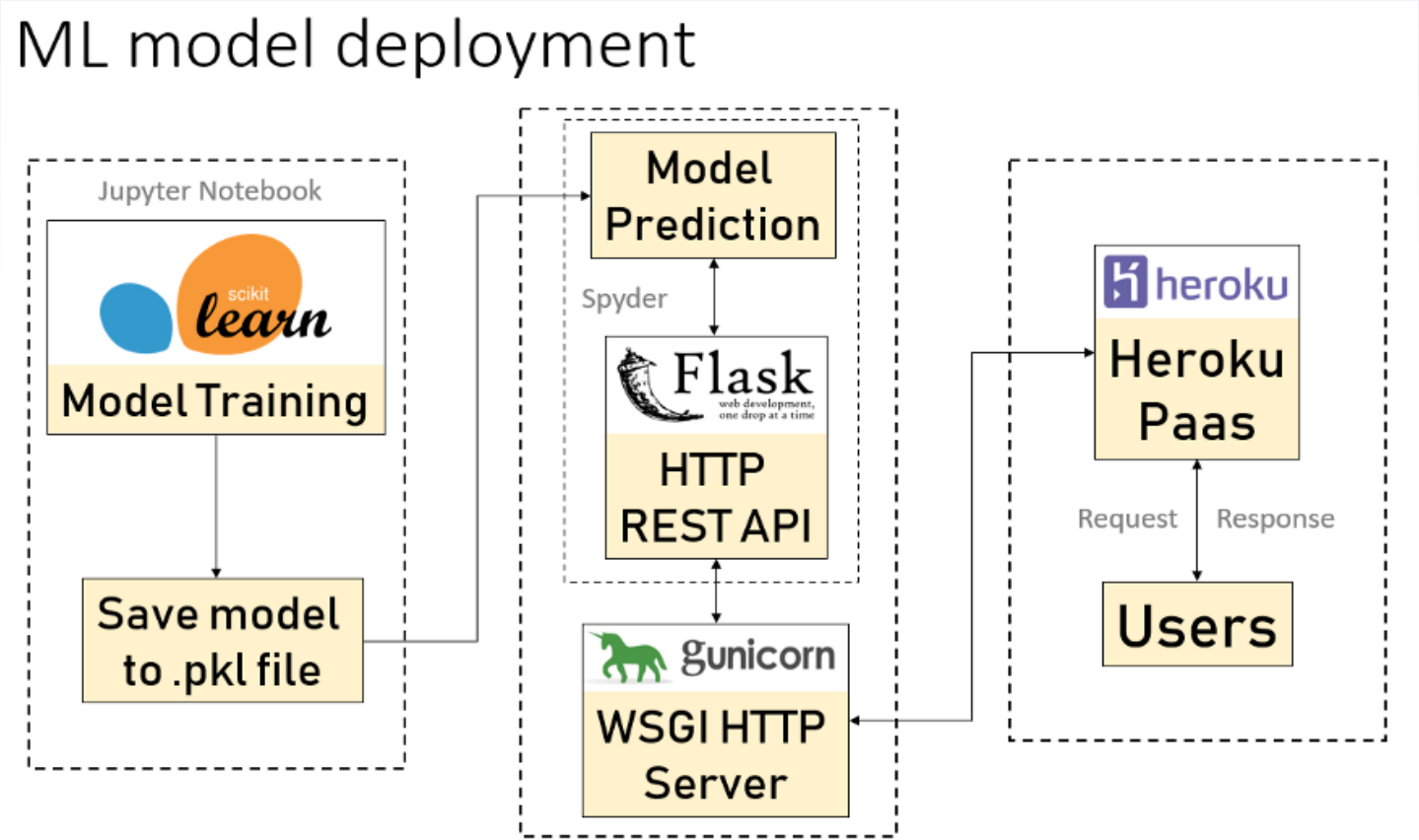
Initial Prototype

To enable usage of ML models on a platform, First prototype was built using **Flask web framework** and is designed to

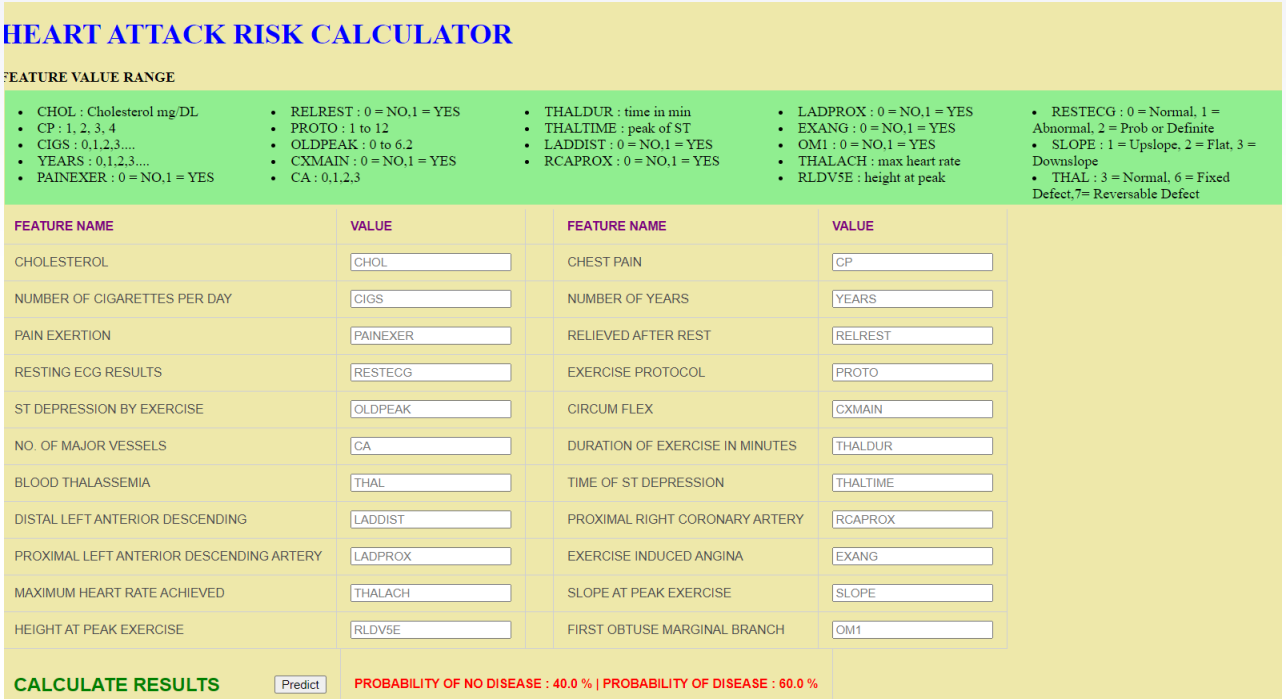
- Host the Model
- Acts as an API service
- Data collection

Deployed on AWS EC2 and on **Heroku** and to enable CI / CD for future improvements of the application.

Architecture



A Simple Flask Application

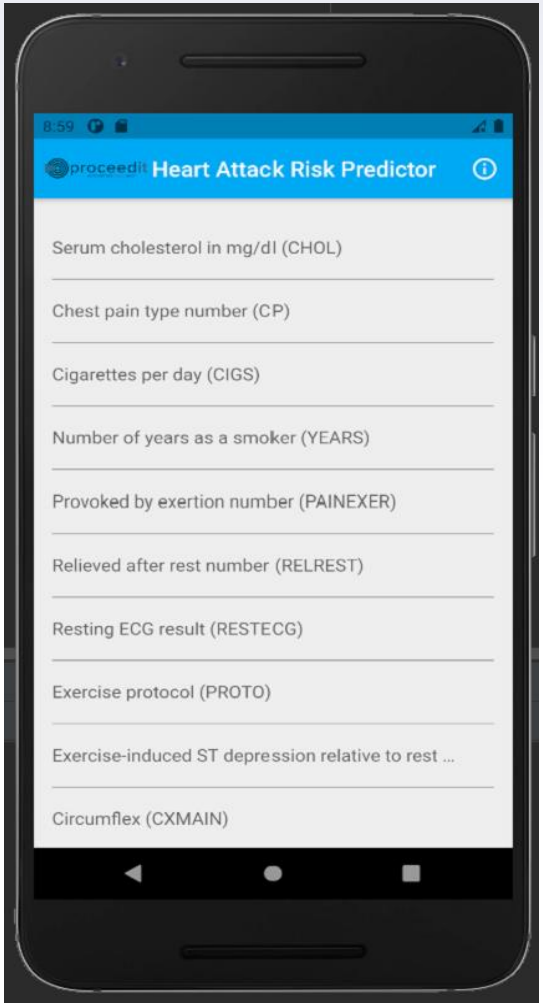


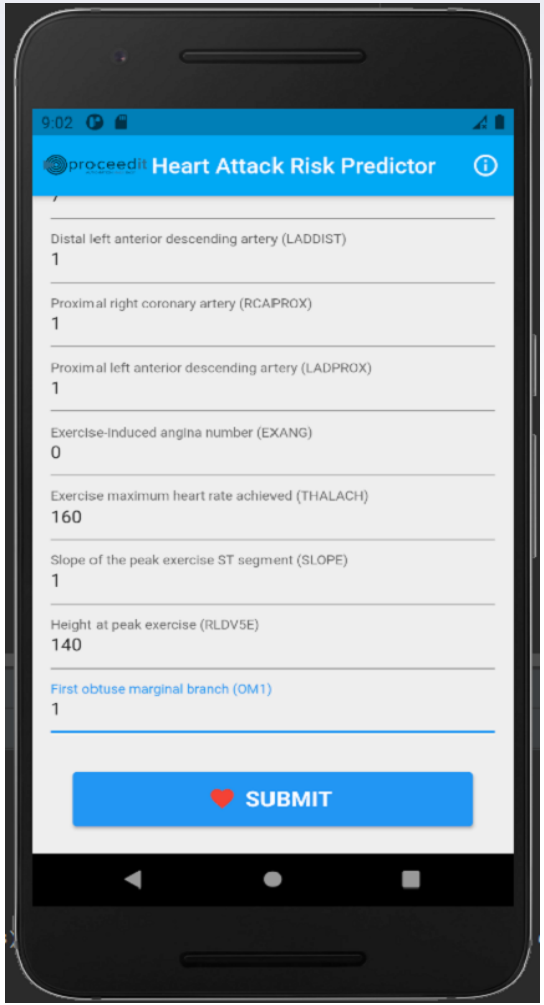
Connectivity

- With Internet

Screenshots 1

- Welcome Screen [Left]
- Inputting Data [Right]





Screenshots 2

- Info Panel
  [Left]

- Results Screen 2
  With Connection
  [Right]