Capstone Project Proposal:

Human Activity Recognition (HAR) using Smartphones Data

Project Overview

Over the last decade, fitness tracking has become a rising trend- especially owing to the convenience of using devices such as smartphones, fitness trackers and smart watches. Devices collect user data from sensors such as accelerometer, gyroscope, heartbeat monitor for calibrations and measurements. A key part of fitness tracking is understanding the state of motion of the user and autodetection of activity is a key feature that has started becoming a part of the key offerings.

Project Statement

In this project I aim to accurately predict the activity of a user based on Smartphone sensor data, i.e. using signals from the accelerometer which measures acceleration and gyroscope sensors which measures angular velocity. Based on the features extracted from the input signals, 6 different user activities can be identified – 3 static activities (standing, sitting, lying) and 3 dynamic activities (walking, walking up, walking down). This problem can be characterized as a multiclassification problem.

Datasets and Inputs

Data is downloaded from following source:
https://archive.ics.uci.edu/ml/datasets/human+activity+recognition+using+smartphones

The experiments have been carried out with a group of 30 volunteers who performed the following 6 activities:

- Walking
- Walking Up
- Walking Down
- Standing
- Sitting
- Laying

Using the smartphone's embedded accelerometer and gyroscope, 3-axial linear acceleration and 3-axial angular velocity are captured at a constant rate of 50Hz.

These sensor signals are pre-processed by applying noise filters and then sampled in fixed-width windows (sliding windows) of 2.56 seconds each with 50% overlap. i.e., each window has 128 readings. A 128-size vector is created from each window. From each 128 readings, 561 different features have been engineered by calculating variables from the time and frequency domain.

Solution Statement

To solve this multiclassification problem, I will identify suitable algorithms that can be used for the given dataset- i.e. different supervised learning classification models or a RNN (recurrent neural network) with LSTM (long-short term memory). I will then compare prediction results from the models and evaluate the results based on accuracy and confusion matrix. It would also be important to check for overfitting.

Evaluation Metrics

I will be evaluating the performance of the models compared based on two main metrics:

1) Accuracy score
2) Confusion-Matrix to check if the model is confused between two different activities and predicting incorrect activity label

Benchmark Model:

I will be using a Decision Tree Classifier as a benchmark.

Project Design

The project will be divided into 4 parts:

1) Data Exploration and Preparation: Downloading the data from the database, exploring the data/features through some visualizations. Splitting the data into testing/training sets and creating dataframes with required data and label columns.

2) Feature Extraction: Identify the more impactful/meaningful features out of 561 features in the dataset using one of the dimensionality reduction techniques that best fit our dataset. Reduce the training and testing data frames to only include these features.

3) Model Implementation: Training a benchmark model for baseline prediction accuracy scores. Choosing 2-3 other classification models and training them for predicting activity labels based either on the pre-processed signal data or the original inertial signals.

4) Model Comparison: Comparing the different models for performance based on the evaluation metrics selected and making a final recommendation.