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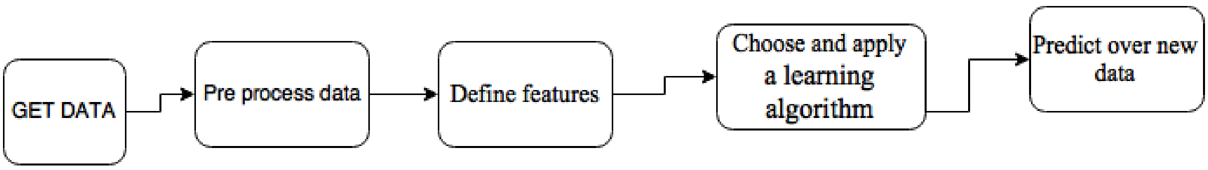
FLIGHT DELAY PREDICTION DOCUMENTATION

Can an app be created to predict flight delays due to weather related issues?

The following paper tries to model solutions to predict flight delays due to weather related issues. The proposed models for flight delay prediction uses supervised machine learning techniques. The goal of this research is to be able to predict departure delays 2-24 hrs in advance. The paper analyzes the performance of the following algorithms on the flight delay prediction model namely – Simple Logistic Regression, Naive Bayyes classification and Support Vector Machines. The end goal is to choose the best performing algorithm and implement it to predict the delay of flights in advance. The objective of this research is to answer the question mentioned above with concrete results and explanation of the chosen solution.

The working model of the paper is explained with the aid of the following diagram



Step 1:- Get Data

The dataset for this model was collected from the following websites for the month (April – June) for the year 2013.

1. http://gallery.cortanaintelligence.com/Experiment/Binary-Classification-Flight-delay-prediction-3?share=1.

2. https://www.ncdc.noaa.gov/cdo-web/datasets.

3. http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=236&DB_Short_Name=On-Time.

4. https://www.wunderground.com/.

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In order to maintain the accuracy of the dataset for the flight and weather, the datasets were cross checked for accuracy by validating the information from the above mentioned websites.

Step 2:- Pre-Process Data

The dataset obtained from the above sources was combined and a fresh dataset was created. The initial dataset contained 18 features combined of (flight + weather). We have chosen to work on a small cluster of data to optimize accuracy and get a better feel of the performance of the algorithm. Since, our main objective is to apply machine learning and the saying goes "There is no fixed size of dataset for better performance in Machine learning. The more, the merrier". So, our initial goal is to work on 344 datapoints and analyze the results. We can always add more data in our dataset in case of redundancy or conflicting results.

To select the most useful features for the prediction model, we used the Weka software.

- Check for Missing values in the database using the Weka Software.

  To check for missing values in the dataset, the dataset is loaded in the Weka software. Then each column is checked in the Weka to identify any missing values. The dataset used in the current experiment doesn't contain any missing values.

Step 3:- Get Features

- Identify the most important features for the classification algorithms using Weka.

  <u>Algorithm 1:- Simple Logistic Regression</u>

  Available Features:-

  1. Month
  2. Day
  3. Time
  4. Timegroup
  5. Airportid
  6. Temperature (temperature of the origin airport).
  7. DewPoint (of the origin airport)
  8. humidity (of the origin airport)
  9. Pressure (of the origin airport)
  10. WindSpeed (of the origin airport)

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11. destination airport ID
12. desttemperature (of the destination airport)
13. destdewpoint (of the destination airport)
14. destinationPressure (of the destination airport)
15. destwindspeed (of the destination airport)
16. Prediction (Yes/No).

Our first algorithm that we wanted to experiment was Simple Logistic Regression classification. We wanted to Weka to help us select the best features available for the Simple Logistic Regression Classification Model. Weka returned us with the following results.

=== Run information ===

Evaluator: weka.attributeSelection.ClassifierSubsetEval -B weka.classifiers.functions.SimpleLogistic -T -H "Click to set hold out or test instances" -E acc -- -I 0 -M 500 -H 50 -W 0.0
Search: weka.attributeSelection.BestFirst -D 1 -N 5
Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11
Instances: 344
Attributes: 16

Month
Day
Time
Timegroup
Airportid
Temperature
DewPoint
humidity
Pressure
WindSpeed
destination airport ID
desttemperature
destdewpoint
destinationPressure
destwindspeed

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Prediction
Evaluation mode: evaluate on all training data

=== Attribute Selection on all input data ===

Search Method:
    Best first.
    Start set: no attributes
    Search direction: forward
    Stale search after 5 node expansions
    Total number of subsets evaluated: 127
    Merit of best subset found: 0.299

Attribute Subset Evaluator (supervised, Class (nominal): 16 Prediction):
    Classifier Subset Evaluator
    Learning scheme: weka.classifiers.functions.SimpleLogistic
    Scheme options: -I 0 -M 500 -H 50 -W 0.0
    Hold out/test set: Training data
    Subset evaluation: classification error

Selected attributes: 1,3,4,7,8,13,14 : 7
        Month
        Time
        Timegroup
        DewPoint
        humidity
        destdewpoint
        destinationPressure

The next step was to run the Simple Logistic Regression on the selected attributes as suggested by Weka. We ran the Simple Logistic Regression on the whole dataset first and then wanted to compare the results with the Simple Logistic Regression on the selected attributes of the dataset.

<u>Results are displayed as below:-</u>

1. Whole dataset (70% training set; 30% test set; 16 features)

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=== Run information ===

Scheme: weka.classifiers.functions.SimpleLogistic -I 0 -M 500 -H 50 -W 0.0
Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11
Instances: 344
Attributes: 16
Month
Day
Time
Timegroup
Airportid
Temperature
DewPoint
humidity
Pressure
WindSpeed
destination airport ID
desttemperature
destdewpoint
destinationPressure
destwindspeed
Prediction
Test mode: split 70.0% train, remainder test

=== Classifier model (full training set) ===

SimpleLogistic:

Class 0 :
0.84 +
[Timegroup] * -0.46

Class 1 :
-0.84 +
[Timegroup] * 0.46

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Time taken to build model: 0.19 seconds

=== Evaluation on test split ===

Time taken to test model on training split: 0 seconds

=== Summary ===

Correctly Classified Instances	63	61.165 %
Incorrectly Classified Instances	40	38.835 %
Kappa statistic	0.2429	
Mean absolute error	0.4498	
Root mean squared error	0.4802	
Relative absolute error	88.9816 %	
Root relative squared error	94.5167 %	
Total Number of Instances	103	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.761	0.509	0.547	0.761	0.636	0.258	0.733	0.701	no
	0.491	0.239	0.718	0.491	0.583	0.258	0.733	0.697	yes
Weighted Avg.	0.612	0.360	0.642	0.612	0.607	0.258	0.733	0.699	

=== Confusion Matrix ===

```
  a  b   <-- classified as
 35 11 |  a = no
 29 28 |  b = yes
```

---

2. Selected attributes (70% training set; 30% test set; 7 features)

=== Run information ===

Scheme: weka.classifiers.functions.SimpleLogistic -I 0 -M 500 -H 50 -W 0.0

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Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11-weka.filters.unsupervised.attribute.Remove-R2,5-6,9-12,15
Instances: 344
Attributes: 8
Month
Time
Timegroup
DewPoint
humidity
destdewpoint
destinationPressure
Prediction
Test mode: split 70.0% train, remainder test

=== Classifier model (full training set) ===

SimpleLogistic:

Class 0 :
3.04 +
[Month] * -0.11 +
[Time] * 0 +
[Timegroup] * -0.58 +
[DewPoint] * -0 +
[humidity] * 0.12 +
[destdewpoint] * -0.02 +
[destinationPressure] * -0.1

Class 1 :
-3.04 +
[Month] * 0.11 +
[Time] * -0 +
[Timegroup] * 0.58 +
[DewPoint] * 0 +
[humidity] * -0.12 +
[destdewpoint] * 0.02 +
[destinationPressure] * 0.1

Time taken to build model: 0.14 seconds

=== Evaluation on test split ===

Time taken to test model on training split: 0 seconds

=== Summary ===

Correctly Classified Instances	69	66.9903 %
Incorrectly Classified Instances	34	33.0097 %
Kappa statistic	0.3512	
Mean absolute error	0.4598	
Root mean squared error	0.4846	
Relative absolute error	90.9621 %	
Root relative squared error	95.3704 %	
Total Number of Instances	103	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.783	0.421	0.600	0.783	0.679	0.364	0.723	0.725	no
	0.579	0.217	0.767	0.579	0.660	0.364	0.723	0.673	yes
Weighted Avg.	0.670	0.308	0.693	0.670	0.669	0.364	0.723	0.696	

=== Confusion Matrix ===

```
  a  b   <-- classified as
 36 10 |  a = no
 24 33 |  b = yes
```

So, comparing the results from the classification model, we can see that using the features selected by Weka gives us a ~5% boost in the prediction accuracy. We shall be using the 7 features as suggested by Weka for the Simple Logistic Regression classification program which will be mentioned later.

Algorithm 2:- Naive Bayyes Classification

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Our second proposed classification algorithm is the Naive Bayyes algorithm. As mentioned above, we wanted to get the best features for our Naive Bayyes model and Weka provided us with the following suggestions.

=== Run information ===

Evaluator: weka.attributeSelection.ClassifierSubsetEval -B weka.classifiers.bayes.NaiveBayes -T -H "Click to set hold out or test instances" -E acc
Search: weka.attributeSelection.BestFirst -D 1 -N 5
Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11-weka.filters.unsupervised.attribute.Remove-R2,5-6,9-12,15
Instances: 344
Attributes: 8
Month
Time
Timegroup
DewPoint
humidity
destdewpoint
destinationPressure
Prediction
Evaluation mode: evaluate on all training data

=== Attribute Selection on all input data ===

Search Method:
Best first.
Start set: no attributes
Search direction: forward
Stale search after 5 node expansions
Total number of subsets evaluated: 43
Merit of best subset found: 0.305

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Attribute Subset Evaluator (supervised, Class (nominal): 8 Prediction):
    Classifier Subset Evaluator
    Learning scheme: weka.classifiers.bayes.NaiveBayes
    Scheme options:
    Hold out/test set: Training data
    Subset evaluation: classification error

Selected attributes: 3,4,6 : 3
    Timegroup
    DewPoint
    Destdewpoint

So, our chosen attributes for the Naive Bayyes Classification Model are Timegroup,DewPoint and Destdewpoint. We wanted to run a test on the Naive Bayyes classification model on the selected attributes. The results are mentioned below.

=== Run information ===

Scheme: weka.classifiers.bayes.NaiveBayes
Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11-weka.filters.unsupervised.attribute.Remove-R2,5-6,9-12,15-weka.filters.unsupervised.attribute.Remove-R1-2,5,7
Instances: 344
Attributes: 4
    Timegroup
    DewPoint
    destdewpoint
    Prediction
Test mode: split 70.0% train, remainder test

=== Classifier model (full training set) ===

Naive Bayes Classifier

	Class	
Attribute	no	yes

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```
                (0.52)  (0.48)
===============================
Timegroup
  mean         1.5363  1.9394
  std. dev.    0.6789  0.5689
  weight sum      179     165
  precision         1       1

DewPoint
  mean        -5.8049 -5.4939
  std. dev.    6.1858   6.314
  weight sum      179     165
  precision    0.6167  0.6167

destdewpoint
  mean        13.1389 14.8783
  std. dev.    7.6673  8.2039
  weight sum      179     165
  precision     0.678   0.678



Time taken to build model: 0 seconds

=== Evaluation on test split ===

Time taken to test model on training split: 0 seconds

=== Summary ===

Correctly Classified Instances          70               67.9612 %
Incorrectly Classified Instances        33               32.0388 %
Kappa statistic                          0.3664
Mean absolute error                      0.4594
Root mean squared error                  0.4733
Relative absolute error                 90.8908 %
Root relative squared error             93.1475 %
Total Number of Instances              103
```

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=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.761	0.386	0.614	0.761	0.680	0.375	0.719	0.730	no
	0.614	0.239	0.761	0.614	0.680	0.375	0.719	0.670	yes
Weighted Avg.	0.680	0.305	0.695	0.680	0.680	0.375	0.719	0.696	

=== Confusion Matrix ===

```
  a  b   <-- classified as
 35 11 |  a = no
 22 35 |  b = yes
```

<u>Algorithm 3:- Support Vector Machine Classification</u>

Our third proposed classification algorithm is the Support Vector Machine classification algorithm. We ran our dataset through Weka and wanted to come up with the best available features for our Support Vector Machine Classification Model. Results are displayed as below:-

=== Run information ===

Evaluator: weka.attributeSelection.ClassifierSubsetEval -B weka.classifiers.functions.SMO -T -H "Click to set hold out or test instances" -E acc -- -C 1.0 -L 0.001 -P 1.0E-12 -N 0 -V -1 -W 1 -K "weka.classifiers.functions.supportVector.PolyKernel -E 1.0 -C 250007" -calibrator "weka.classifiers.functions.Logistic -R 1.0E-8 -M -1 -num-decimal-places 4"
Search: weka.attributeSelection.BestFirst -D 1 -N 5
Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11-weka.filters.unsupervised.attribute.Remove-R2,5-6,9-12,15
Instances: 344
Attributes: 8

Month
Time
Timegroup

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DewPoint
humidity
destdewpoint
destinationPressure
Prediction
Evaluation mode: evaluate on all training data

=== Attribute Selection on all input data ===

Search Method:
Best first.
Start set: no attributes
Search direction: forward
Stale search after 5 node expansions
Total number of subsets evaluated: 31
Merit of best subset found: 0.308

Attribute Subset Evaluator (supervised, Class (nominal): 8 Prediction):
Classifier Subset Evaluator
Learning scheme: weka.classifiers.functions.SMO
Scheme options: -C 1.0 -L 0.001 -P 1.0E-12 -N 0 -V -1 -W 1 -K weka.classifiers.functions.supportVector.PolyKernel -E 1.0 -C 250007 -calibrator weka.classifiers.functions.Logistic -R 1.0E-8 -M -1 -num-decimal-places 4
Hold out/test set: Training data
Subset evaluation: classification error

Selected attributes: 1,2,3,5,6,7 : 6
Month
Time
Timegroup
humidity
destdewpoint
destinationPressure

The next step was to run the Support Vector Classifier on the dataset based on the selected attributes. The results are displayed as below:-

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=== Run information ===

Scheme: weka.classifiers.functions.SMO -C 1.0 -L 0.001 -P 1.0E-12 -N 0 -V -1 -W 1 -K "weka.classifiers.functions.supportVector.PolyKernel -E 1.0 -C 250007" -calibrator "weka.classifiers.functions.Logistic -R 1.0E-8 -M -1 -num-decimal-places 4"
Relation: r-weka.filters.unsupervised.attribute.Remove-R14-weka.filters.unsupervised.attribute.Remove-R10-weka.filters.unsupervised.attribute.Remove-R11-weka.filters.unsupervised.attribute.Remove-R2,5-6,9-12,15-weka.filters.unsupervised.attribute.Remove-R4
Instances: 344
Attributes: 7
Month
Time
Timegroup
humidity
destdewpoint
destinationPressure
Prediction
Test mode: split 70.0% train, remainder test

=== Classifier model (full training set) ===

SMO

Kernel used:
Linear Kernel: K(x,y) = <x,y>

Classifier for classes: no, yes

BinarySMO

Machine linear: showing attribute weights, not support vectors.

```
        0.3218 * (normalized) Month
 +      0.0813 * (normalized) Time
 +      2.8137 * (normalized) Timegroup
 +     -0.1539 * (normalized) humidity
```

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+ 1.1437 * (normalized) destdewpoint
+ 0.9435 * (normalized) destinationPressure
- 2.6875

Number of kernel evaluations: 10243 (73.184% cached)

Time taken to build model: 0.03 seconds

=== Evaluation on test split ===

Time taken to test model on training split: 0 seconds

=== Summary ===

Correctly Classified Instances	69	66.9903 %
Incorrectly Classified Instances	34	33.0097 %
Kappa statistic	0.3405	
Mean absolute error	0.3301	
Root mean squared error	0.5745	
Relative absolute error	65.3019 %	
Root relative squared error	113.082 %	
Total Number of Instances	103	

=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.696	0.351	0.615	0.696	0.653	0.343	0.672	0.564	no
	0.649	0.304	0.725	0.649	0.685	0.343	0.672	0.665	yes
Weighted Avg.	0.670	0.325	0.676	0.670	0.671	0.343	0.672	0.620	

=== Confusion Matrix ===

```
  a  b   <-- classified as
 32 14 |  a = no
 20 37 |  b = yes
```

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Step 4:- Choose and Apply a Learning Algorithm

The results of the classification algorithms are mentioned below. Each of the algorithms were run on 70% training set and 30% test set in Weka.

Algorithm	Accuracy (%)	Error (%)	Completion Time
Simple Logistic Regression	66.9903	32.0388	0.14 seconds
Naive Bayyes	67.9612	32.0388	0 seconds
Support Vector Machines	66.9903	33.0097	0.03 seconds

The above results suggest that Naive Bayyes is our best bet but we wanted to have an open mind and create a prediction program for all the three algorithms. Our preferred programming language is Java and we are building a simple classifier program for the above algorithms.

We chose java and decided to come up with desktop software for now. Java has a write once, run everywhere policy. This makes our program platform independent. Our preferred IDE is eclipse.

The code for each of the above algorithms is in a separate folder in the GITHUB account of the team and also is attached below at the end of the paper.

Conclusion:-

The aim of this research was to answer the question if an app can be created to predict flight delays in advance based on weather related issues. Based on our above research, we can firmly say that Yes, an app can be created to predict flight delays based on weather data of the past. We applied Machine learning and data mining for this project. Machine learning is one of the fastest growing areas of research in our modern era and is being implemented by some of the top notch companies namely- Google, Microsoft, Facebook, NASA.

We wanted to go a step further and come up with a way to estimate the time of delay along with the prediction (yes/no). To achieve that we first identify if a flight is likely to be delayed based on the weather data. After that we wanted to apply K-means clustering to group together data of the similar type of that specific weather data. We look at the amount of time in departure delays in the dataset of the previous data. Then we take the mean of the departure delay times of the group formed by K-means clustering and suggest it as an approximate time of delay for that particular date.

Java code for Naive Bayes Classifier algorithm

Jar files required – weka.jar

```
import java.io.FileNotFoundException;
import java.io.FileReader;
import java.io.BufferedReader;
import java.io.IOException;
import java.util.Random;

import weka.classifiers.evaluation.*;
import weka.classifiers.bayes.NaiveBayes;
import weka.classifiers.bayes.net.*;
import weka.core.Instance;
import weka.core.Instances;
import weka.core.converters.ConverterUtils;


public class JavaWeka {

	public static void main(String[] args) {
		// TODO Auto-generated method stub

		  ConverterUtils.DataSource source1;
		       try {
			      source1 = new
ConverterUtils.DataSource("traindata.arff");
			       Instances train = source1.getDataSet();
			        // setting class attribute if the data format does not
provide this information
			        // For example, the XRFF format saves the class
attribute information as well
			        if (train.classIndex() == -1)
			            train.setClassIndex(train.numAttributes() - 1);

			        ConverterUtils.DataSource source2 = new
ConverterUtils.DataSource("testdata.arff");
			        Instances test = source2.getDataSet();
			        // setting class attribute if the data format does not
provide this information
			        // For example, the XRFF format saves the class
attribute information as well
			        if (test.classIndex() == -1)
			            test.setClassIndex(train.numAttributes() - 1);

			        NaiveBayes naiveBayes = new NaiveBayes();
			        naiveBayes.buildClassifier(train);
```

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By Surajit Das, Mohsen Adam, Jamal Derrick.

NASA SPACE APP CHALLENGE 2016.

```
                            Evaluation eval = new Evaluation(train);
                            eval.evaluateModel(naiveBayes,test);


System.out.println(eval.toSummaryString("\nResults\n####\n",true));
                            System.out.println(eval.fMeasure(1)+ "" +
eval.precision(1)+ "" +eval.recall(1));


                    } catch (Exception e) {
                          // TODO Auto-generated catch block
                          e.printStackTrace();
                    }
      }

}
```

Output-

```
Results
####

Correctly Classified Instances          65               62.5    %
Incorrectly Classified Instances        39               37.5    %
Kappa statistic                          0.245
K&B Relative Info Score               1013.5341 %
K&B Information Score                   10.1229 bits      0.0973 bits/instance
Class complexity | order 0             103.8896 bits      0.9989 bits/instance
Class complexity | scheme              101.6568 bits      0.9775 bits/instance
Complexity improvement     (Sf)          2.2328 bits      0.0215 bits/instance
Mean absolute error                      0.4585
Root mean squared error                  0.4909
Relative absolute error                 91.8479 %
Root relative squared error             98.2601 %
Total Number of Instances              104

0.58064516129032260.6279069767441860.54
```

Java code for Support Vector Machine

Jar files required – JAVAML, WEKA, LibSVM

```
import java.io.File;
import java.io.IOException;

import libsvm.LibSVM;
import net.sf.javaml.classification.Classifier;
import net.sf.javaml.core.Dataset;
```

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By Surajit Das, Mohsen Adam, Jamal Derrick.

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```
import net.sf.javaml.core.Instance;
import net.sf.javaml.tools.data.FileHandler;


public class SVMweka {

	public static void main(String[] args) throws IOException {
		// TODO Auto-generated method stub

		 Dataset data = FileHandler.loadDataset(new
File("traindata.csv"),3,",");


		/*
		 * Contruct a LibSVM classifier with default settings.
		 */
		Classifier svm = new LibSVM();
		svm.buildClassifier(data);

		/*
		 * Load a data set, this can be a different one, but we will use
the
		 * same one.
		 */
		Dataset dataForClassification = FileHandler.loadDataset(new
File("testdata.csv"),3,",");
		/* Counters for correct and wrong predictions. */
		int correct = 0, wrong = 0;
		/* Classify all instances and check with the correct class values
*/
		for (Instance inst : dataForClassification) {
		    Object predictedClassValue = svm.classify(inst);
		    Object realClassValue = inst.classValue();
		    if (predictedClassValue.equals(realClassValue))
		        correct++;
		    else
		        wrong++;
		}
		System.out.println("Correct predictions  " + correct);
		System.out.println("Wrong predictions " + wrong);


	}

}
```

Output:-

```
Correct predictions  72
Wrong predictions 33
```

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Java code for Simple Logistic Regression

```
import java.io.BufferedReader;

import java.io.File;

import java.io.FileNotFoundException;

import java.io.FileReader;

import java.io.IOException;

import java.util.ArrayList;

import java.util.Arrays;

import java.util.List;

import java.util.Scanner;


/**

public class SLR {


	/** the learning rate */

	private double rate;


	/** the weight to learn */

	private double[] weights;


	/** the number of iterations */

	private int ITERATIONS = 3000;


	public SLR(int n) {

		this.rate = 0.0001;
```

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```
		weights = new double[n];
	}

	private static double sigmoid(double z) {
		return 1.0 / (1.0 + Math.exp(-z));
	}

	public void train(List<Instance> instances) {
		for (int n=0; n<ITERATIONS; n++) {
			double lik = 0.0;
			for (int i=0; i<instances.size(); i++) {
				double[] x = instances.get(i).x;
				double predicted = classify(x);
				int label = instances.get(i).label;
				for (int j=0; j<weights.length; j++) {
					weights[j] = weights[j] + rate * (label - 
predicted) * x[j];
				}
				// not necessary for learning
				lik += label * Math.log(classify(x)) + (1-label) 
* Math.log(1- classify(x));
			}
			System.out.println("iteration: " + n + " " + 
Arrays.toString(weights) + " mle: " + lik);
		}
	}

	private double classify(double[] x) {
```

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```
            double logit = .0;
            for (int i=0; i<weights.length;i++)  {
                  logit += weights[i] * x[i];
            }
            return sigmoid(logit);
      }

      public static class Instance {
            public int label;
            public double[] x;

            public Instance(int label, double[] x) {
                  this.label = label;
                  this.x = x;
            }
      }

      public static List<Instance> readDataSet(String file) throws
FileNotFoundException {
            List<Instance> dataset = new ArrayList<Instance>();
            Scanner scanner = null;
            try {
                  scanner = new Scanner(new File(file));
                  while(scanner.hasNextLine()) {
                        String line = scanner.nextLine();

                        String[] columns = line.split("\\s+");
```

```
                    // skip first column and last column is the label
                    int i = 1;
                    double[] data = new double[columns.length-2];
                    for (i=1; i<columns.length-2; i++) {
                        data[i-1] = 
Double.parseDouble(columns[i]);
                    }
                    int label = Integer.parseInt(columns[i]);
                    Instance instance = new Instance(label, data);
                    dataset.add(instance);
                }
            } finally {
                if (scanner != null)
                    scanner.close();
            }
            return dataset;
        }


        public static void main(String... args) throws FileNotFoundException 
{
            List<Instance> instances = readDataSet("editedata.txt");
            SLR logistic = new SLR(3);
            logistic.train(instances);
            String month,day,time,origin,destination;
```

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```
Scanner input = new Scanner(System.in);


System.out.println("Enter the month of travel");

month = input.nextLine();


System.out.println("Enter the day of travel");

day = input.nextLine();


System.out.println("Enter the time of travel");

time = input.nextLine();




System.out.println("Enter the origin airport code of travel");

origin = input.nextLine();


System.out.println("Enter the destination airport code of 
travel");

destination = input.nextLine();


String csvFile = "fdata.txt";

BufferedReader br = null;

String line = "";

String cvsSplitBy = ",";



try {
```

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```
Scanner x = new Scanner(new File(csvFile));
      while(x.hasNext())
        {
              String
month1,day1,time1,timegroup,airportid,temperature,dewpoint,humidity,windspeed,dest
inationairportid;
              month1 = x.next();
              day1 = x.next();
              time1 = x.next();
              timegroup = x.next();
         airportid = x.next();
           temperature = x.next();
           dewpoint = x.next();
           humidity = x.next();
           windspeed = x.next();
           destinationairportid = x.next();

   if(month.compareTo(month1)==0)
   {
    if(day.compareTo(day1)==0)
    {
          if(time.compareTo(time1)==0)
          {


          if(origin.compareTo(airportid)==0)
          {
```

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```
if(destination.compareTo(destinationairportid)==0)
                                    {
                                          System.out.println(month1 + "\t" + day1
+"\t"+ time1 + "\t"+ timegroup+"\t"+ airportid+"\t"+temperature
+"\t"+dewpoint+"\t"+humidity+

      "\t"+windspeed+"\t"+destinationairportid);

                                          int t1 = Integer.parseInt(timegroup);
                                          int m1 = Integer.parseInt(month1);
                                          Double tmp =
Double.parseDouble(temperature);

                                          System.out.println(t1 + "" + m1 + " " +
tmp);

                                          double[] z = {m1,tmp,t1};

                                             System.out.println("Done");
                                             System.out.println("prob(1|x) = " +
logistic.classify(z));

                                           double res = logistic.classify(z);

                                           if(res>0.5)
                                           {
                                             System.out.println("Flight might
delay");
```

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```
                                                        }

                                                        else
                                                           System.out.println("Flight is on
time");

                                                }

                                        }

                                        }

                                }

                                }

                                   }

                                   x.close();
                        }

                                   catch (FileNotFoundException e) {
```

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```
                        e.printStackTrace();
                } catch (IOException e) {
                        e.printStackTrace();
                } finally {
                        if (br != null) {
                                try {
                                        br.close();
                                } catch (IOException e) {
                                        e.printStackTrace();
                                }
                        }
                }

                System.out.println("Done");



        }


        }
```

```
        Output from the Simple Logistic Regression program

Enter the month of travel

4

Enter the day of travel

7

Enter the time of travel
```

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```
1552

Enter the origin airport code of travel

10140

Enter the destination airport code of travel

11259

4      7      1552   1      10140  23.3   -11.1  0.09   7.2    11259

14 23.3

Done

prob(1|x) = 0.9606277435328205

Flight might delay***

Done



Enter the month of travel

4

Enter the day of travel

3

Enter the time of travel

852

Enter the origin airport code of travel

10140

Enter the destination airport code of travel

11259

4      3      852    1      10140  6.1    -1.7   0.58   3.6    11259

14 6.1

Done
```

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```
prob(1|x) = 0.02986981914996907

Flight is on time***
```

References:- https://github.com/tpeng/logistic-regression