Activity Detection on the Apple IOS Smartphone

By

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Approval

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Certificate of Originality

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I also declare that the intellectual content of this thesis is the product of my own work, except for the assistance from others in the project's de- sign and conception or in style, presentation and linguistics which has been acknowledged.

Author Name**: Muhammad Sarmad Hafeez**

Signature**: _____**

Acknowledgment

I would also like to thank my parents for all that they have done for me over the last 28 years. I would also like to thank Dr. Tauseef for being my mentor. Not to miss my collegues, Afnos, Zubs , Saira and Tidda for their help and motivation in this thesis . Without these guys nothing like this could have been remotely possible.

Muhammad Sarmad Hafeez

Dedication

I dedicate this thesis to my lab members. Samad , Khurram, Doctor and Aamir Bhai.

Abstract

Collection of Data using smartphone sensors is an upcoming field for research. An efficient application that can monitor health by extracting data of the sensors in a smartphone would change the paradigm of health monitoring. Although this field is relatively new but the work done in this is area is very vast and diverse. Some researchers are using this data collected from smartphone sensors to detect health and fitness level of individuals. Others are using the same data to predict social behavior of the user. Many techniques are used to first classify the activity then some other machine learning algorithms are used to predict future actions. Although there are many applications in both IOS and android based smartphones that perform the similar function. But the application proposed (in this MS dissertation) would be much better as it would be developed for an academic purpose.

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Chapter 1

1 Introduction

Collecting data by external body sensors and then making decisions based on that data is an interesting research topic. Originally wearable external body sensors were attached to detect physical activities and attributes of the user. But with the passage of time more advanced sensors are embedded within smartphones making them more suitable for monitoring physical activities of the user. Studying physical activities can be further correlated to both health and social side of the user.

Moreover, gathering data of physical activities may also result in given suggestions and motivations that may result in encouraging healthier life style in terms of both social and physical perspectives. Hence, this research project can also result in helping millions of smartphone users. In combating obesity and social isolation. The social change this thesis and its resulting application suggests is the idea of using a smartphone for the betterment of health of the using individual in times where smartphones are considered to be responsible for human inactivity.

1.1 Basic sensors embedded in modern smartphones

Modern day smartphones are embedded with sensors like camera, micro- phone, gyroscope, compass, GPS, accelerometer etc. These sensors are backed by some powerful processors to process the mammoth amount of data com- ing from these sensors. A lot of such phones are also supported by a large battery. The battery is to power up the processor and also the sensors. All these features make smartphone the perfect

replacement for, wearable exter- nal sensors. Last but not the least, smartphones are used by about 2billion people on the planet. An app made has the potential to help 1/3 of the worlds population. There are two basic operating systems for which apps are developed. The android and IOs operating systems. Android is an open source mobile operating system and is used by number of companies such as Samsung, LG, Huawei, Q-Mobile etc. Whereas IOs on the other hand has only dedicated devices for apple mobile phones. So the apps developed for android have more diversity in processors, ram, memory, number of sensors. Not to miss the difference in hardware design and architecture.

Figure 1. Mobile Device

1.2 Utilization of the collected data

The data collected from the sensors is mostly from a few. As sensors like camera and microphone are not granted access due to privacy concern of the users. The sensors mostly used are accelerometer and gyroscope. Compass and GPS are used in traces. Just to make location based decisions i.e, the user is moving upstairs or downstairs etc. The data collected from these sensors can be used for both monitoring social behaviour of the user as well as fitness/health.

1.3 Steps of process

The basic four stages for building a smartphone application that monitors health or social behaviour using the data acquired from the sensors.

1.3.1 Creating an app

Creating a smartphone application needs specialized skills i.e, mastery of the relevant tool as well as expertise of the language used in the tool.

Android applications can be developed in number of tools such as: Tita- nium, Eclipse, Pearl etc. And X-Code for IOs development. The languages include Objective-C, Swift, and Java etc. Learning a new language for appli- cation development and then mastering the tool for application development is considered to be the most tedious task of the entire research project.

1.3.2 Activity Detection

There are two ways of sensing activity. First approach is called triggered sensing i.e, as the name suggests the user turns on the application whenever he/she feels like doing some good physical work such as jogging, walking etc. This type of sensing is very optimal for battery life and processing power. But has the tedious task of turning on and off the application every time you are about to do some notable physical work or complete it, respectively.

Second technique is called continuous sensing. This type of sensing is more frequently used in smartphone applications as it covers the complete picture of the entire time slot.

In this sensing the sensors are sensing contin- uously but only record the data when they detect ambulation. This type of sensing is very expensive for battery and also on the processor. But it gives better performance and also is user friendly because the user has to enter one time information.

There are number of activities that can be detected by using smartphone sensors depending on the sensors. The activities are listed in the table below.

Table 1. Human Activities Classification

Sr. No.	Activity
1.	Walking
2.	Running
3.	Cycling
4.	Driving
5.	Climbing Stairs
6.	Descending Stairs
7.	Being Inactive (sitting, lying, sleeping)

1.3.3 Classification of data

The data obtained from sensors is in very raw form i.e, the data obtained from gyroscope and accelerometer are just wave forms sometimes single and sometimes of all three axis (XYZ). The decision of mapping this decision on any one of the activities is by far the most pivotal decision of the entire research project. The wave form can be detected and placed in the following forms.

In a technique the First Fourier Transform (FFT) is taken of the waveform and then passed through a specially designed filter that calculates average time between local maximas and then decision is taken on the calculation of these time spans.

Another technique is smoothing the waveform by taking its correlation with itself. And then comparing it to the previously obtained data and taking the decision by the best

match. This happens by taking stacks of data of every activity and applying a classifier for that activity recognition.

The famous machine learning algorithms that are used for classifier are: C4.5 Decision Tree, Naive Bayes, K-Nearest Neighbour (KNN) and Support Vector Machine (SVM) [1]. These classifiers are tested on the data and the one with the best performance is chosen.

1.4 Research Method

Our proposed approach is to develop a classier while adhering to best ma- chine learning practices. We collect a large data set for classier training and verification. We target the recognition of 7 different activities, which include walking, running, climbing stairs, descending stairs, cycling, driving and remaining inactive. Cell phone physical sensor readings were collected while performing all these activities, while the cell phone was kept in different orientations. The data set so collected was pre-processed to extract a number of features from the data that have not been explored in previous studies. The most informative features were chosen for further use by ranking features according to information gain. The data set was partitioned into 10 sets for 10-fold cross validation.

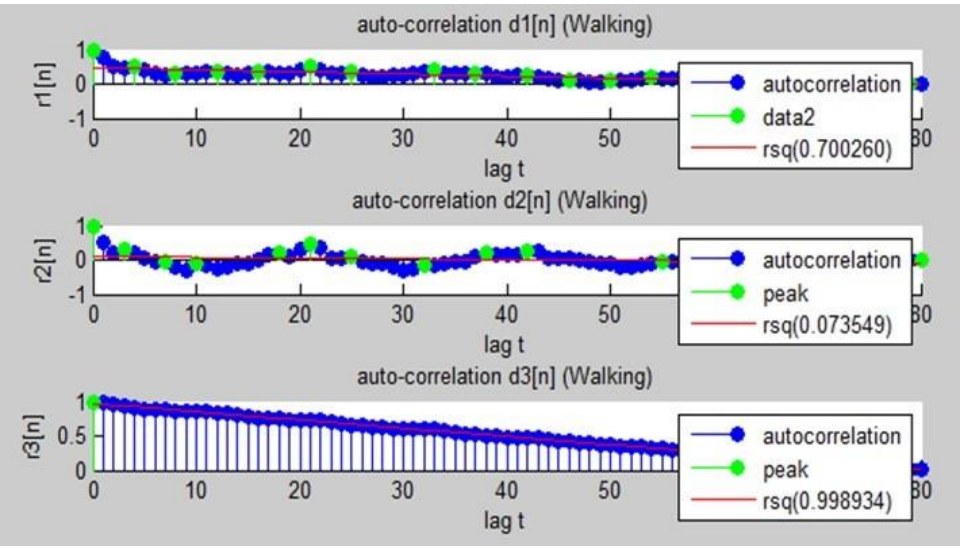

Figure 2. Different Correlation maps for walking

Various classification algorithms were trained using the training set and then evaluated using the test set, iterating over all 10 data sets. The best performing classier was chosen for implementation in the Android app.

Chapter

2

2 Background and Motivation

2.1 Background

External body sensors were the only viable option for physicians and medical experts in order to gather data for the subject person. Because embedded sensors can create complications beyond the scope of the advantages offered by the study. Hence as shown in figure below external sensors were used to collect data from human body.

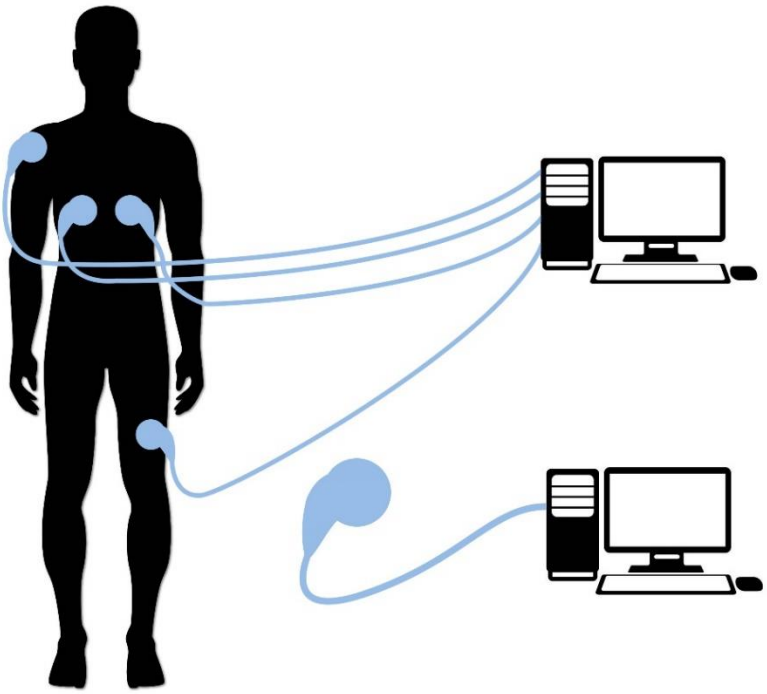

Figure 3. Collection of Data

But this method had a lot of draw backs such as:

Access

Not every individual had access to such procedures as external body sensors and its decrypting machines. Only few privileged labs working more strictly in bio technology had the liberty to work in this field.

Portability

The sensors (with wires) and machines storing/decrypting its data were highly stationery having absolute or no room for mobility of the entire setup. The portability of this setup had absolutely no practicality as the power setup draws is AC with multiple sockets and the system as a whole has too much mass and size to be moved around.

Time

The sensors were hence connected and data collected for a very brief span of time to the subject. Resulting in gathering fraction of the time from overall activity performed by the individual.

Due to all these factors the field of collecting human activity data and then linking this data to the health and fitness of the subject was little uncovered. Even with the dawn of wireless sensors the performance degradation the issue of a processor missing on the chip and wear ability were mammoth enough for not making a break through.

This interesting research problem to calculate and use activity of the user of the smartphone is not entirely multidisciplinary but it can sure pass as one because technology is used to perform health based tasks.

Then with the dawn of cellular phones aka mobile phones in general and 3rd generation cell phones aka smart phones nearly all the shortcomings of the previous issue were addressed. All the subjects willingly have the phone with them all the time, solving the times constraint issue.

Moreover the smartphones also solved the issue, of processing and data storage. As the chip board on that contains the sensors also has the ability to store, process and transmit the data receive. The lithium ion battery solves issues of power and portability to some extent, however it should be noted that the issues of power and portability are still there but as compared to previous era, considered resolved.

2.2 Motivation

According to an estimate there are about 500 million iPhone users in the world. If completed this application would have potential to make 500 million lives, healthier.

This field is also an address to the growing concern of using technology for the betterment of human healthcare in specific and the world in general.

The dawn of this new field termed as smartphone health monitoring can be realized that the Apple iOS based iPhone Version 5 and above use a separate processor to handle data coming from these sensors the chip is called M7 chip. Although this chip is more of a

compliment of making in brand hardware and firmware however, this also shows the concentration of the largest tech company in the world.

2.3 Problem Statement

Activity Detection On The Apple IOS Smartphone

Description: We propose to build a mobile phone application for the Apple IOS operating system. This application is going to monitor the phones carrier physical activity using the embedded sensors on the phone.

2.4 Advantages and Areas of Application

The application would report the level of activity to calories burned. Hence, giving the user a precise value of calories utilized. This information is very helpful and would encourage users to adapt a healthier lifestyle, ultimately increasing the level of fitness and decreasing the level of obesity in users. Areas of application for the proposed app are personal health and physical fitness. However in academia this application falls under activity recognition and app development domains.

The applications mentioned above are merely tip of the iceberg, once the data is extracted from sensors and translated to hidden variables. Then this field may

2.5 Prior State of the Art

There are number of applications on both play store (online android app centre) and apple app store (online IOS app centre) that claim to do exactly what we are proposing in this research proposal. A few of them with their drawbacks are shown below. [9]

2.5.1 Nike +

The most famous application that does monitoring of health/fitness is the Nike + series. The Nike + series includes Nike + Running, Nike + Training, Nike + Workout etc. All of these are available for android as well as iPhone. But like most of the commercially developed applications this one also has a patent and not a research paper to compare results. Other then it being strictly commercial the Nike + applications are heavily dependent on user interaction. As the application performs triggered sensing the application needs to be

turned on before starting any activity. It also has the constraint to a certain phone placement e.g, in hand, front pocket and shoulder strap etc. [5]

2.5.2 Footsteps

An android based mobile phone application that detects footsteps of the user. This application is also developed for commercial purpose and does not have any academic research or documentation associated to it. Although it performs continuous sensing but it limited to a single activity.

2.5.3 Moves

Moves is in the list of Top 10 mobile applications that monitors displace- ment of the person from one place to another. This application is more of a transportation calculator rather than activity monitoring. With continuous sensing the application takes the decision that wether the user is walking, cycling, riding a bus, driving a car etc. This application also doesnt has a research paper backing its results.

2.5.4 Humans

Human is the closest thing to the application we are proposing. The differ- ence between proposed application and human is not only of the number of activities recorded. Although both the applications have continuous sensing and would translate the activities to calories burned but they would have different classifiers.

Human also has a great percentage of false positive in its detection. And it also does not have an academic paper published on it.

2.6 Limitations of the Prior Art

The ever increasing trend of cell phones and the swelling percentage of smart- phones have changed the techniques of health monitoring. The most basic way to monitor health is by using smartphone sensors is to measure activity of the user. Previous ones like the work carried out by Bao and Intille [2], this approach requires wearable external sensors. Other approaches that use cell phone sensors such as our approach either required calibration or re- quire users to keep their phones in a particular way. Kwapisz, Weiss

and Moore [8] require the phone to be in a front pocket. The physical activity section of this applications focus only on few main activities walking, sitting and running, like Footsteps only focuses on walking. Few of the applications require triggering of the application whenever the activity starts, this adds huge amount of work on the user hence making the user experience tedious and unfriendly.

2.7 Proposed Approach

We propose to build an IOS based smartphone application. Which would do continuous sensing and would require only one time interaction to hold record of gender, age, height and weight. The application would detect seven activ- ities which are walking, running, climbing stairs, descending stairs, driving, cycling and being inactive. The recognised activities would then be mapped on no. of calories burned taken from average calories burned by the same gender while performing same activities. This classification would be done by using C4.5 Decision Tree, Nave Bayes, K-Nearest Neighbour (KNN) and Support Vector Machine (SVM) classifiers. The most optimal would be cho- sen.

2.8 Literature work

Although I have reviewed around 30 relevant research papers but few of them which I consider worth mentioning are given below: [5,11,13]

2.8.1 Activity Recognition from User-Annotated Ac- celeration Data

The basic contribution of this paper is to develop algorithms that detect activity. These activities are detected using on-body wearable sensors. The algorithms take the most basic decisions like is the user in ambulation or sitting idle. Although this paper isnt very latest but it sure is a classic as it gave the basic idea and highlighted the benefits of monitoring health by calculating activity of the sensors. [14,4]

2.8.2 Activity Recognition using Cell Phone Accelerom- eters

This paper is brief and up to the point. They also have detected on six activities also with very low true positives, especially when coming downstairs and going upstairs are

compared. But this paper gave birth of the idea of using smartphone sensors for activity detection and then using them for health monitoring. [6,7]

2.8.3 BeWell : A Smartphone Application to Monitor, Model and promote Wellbeing

It wouldnt be wrong to say that BeWell is the best effort application created to detect activity and monitor the behaviour of the person. Although this application concentrates more on the social behaviour and very less on health and it also takes in account sleeping habits etc by using sensors such as microphones. But still this is the best application created so far for activity detection. This state of the art application also utilizes cloud infrastructure. The data taken from the sensors is sent to the cloud for storage and finally all the data taken from all the users is stored on the cloud. So this application also brings in the field of mobile cloud relationship to the research problem of detecting activity using smartphone sensors.

2.8.4 A Survey of Mobile Phone Sensing

This survey paper is a one stop guide to entire introduction of mobile phone sensing. One of the most notable authors of this survey is the creator of the BeWell application (mentioned above) Tanzeem Choudory. Dr. Choudory is known as the founder of the field of activity monitoring using smartphone sensors.

The survey starts with describing sensors and their types. Then areas of application which also include transportation and environmental monitoring other than health and social networking. It also explains the effects of sensing scales and sensing paradigm used. Moving on it describes the sensing types and interpretation of sensor data. [15,10,12,3]

Chapter

3

3 Functionality of Activisit

3.1 Chosen Mode

The chosen mode was programming on an iOS based machine that carried sensors i.e, an iPhone. The variety was mammoth to be chosen from i.e, there were phones that had android operating system, blackberry operating system and windows phone. Different RAM (Random Access Memory), a large range of computing power best described in MIPS (Million Instructions Per Second). But the deal maker/breaker was the efficiency of the sensors. Hence, iPhone was chosen in general and in specific iPhone-4S with iOS version 7.0.3.

3.2 Sensors Used

Out of all the sensors available only few were used in the actual application to gather data. The reasons of rejection and the name of the sensors mentioned are below:

3.2.1 Camera

Intialy it was decided that the camera would be used to take images and then process those images using techniques of image processing knowing. This suggestion was nullified by the concern of privacy of an app accessing the camera of the phone user. Resulting in no use of the camera in the entire project.

3.2.2 Microphone

As microphone would not have been a good sensor to develop sense of health and fitness of the user. After the establishment of camera privacy issue microphone was also ruled out as a sensor embedded within the phone.

3.2.3 GPS

Global Positioning Sensor most commonly used as a tracking tool and has the efficacy to perform the desired task. But due to its power hungriness and the fact that it is used to measure a greater shift in location, this sensor idea was also dropped in final mobile application.

3.2.4 Gyroscope

The sensor used to check the balance of the device. Although this was not used directly in the app, but was used in order to trouble shoot a problem given later.

3.2.5 Accelerometer

The main sensor that was gathering all the data for the application to be processed and then translated into variables that lead to fitness and ultimately health of the subject. The readings are recorded on all three axis and then the data is analyzed on all three axis using techniques such as means, variances, correlations, cross correlations, standard deviations etc etc.

3.2.6 Compass

The sensor that tells direction and the movement of the subject also depicts the direction that the subject may travel in the future. This was one of the two sensors basically used in the finalized app.

3.2.7 Speaker

As the speaker could not be used to monitor health and fitness in the application it was not used in the data gathering application.

3.3 Challenges Faced

Although there were number of challenges faced while performing this state of the art research project. The challenges varied from having an apple developer account (iOS) to implementing variables extracted and then finalizing the algorithms to be inculcated within the application. But the largest of them all was to solve the location problem of the phone.

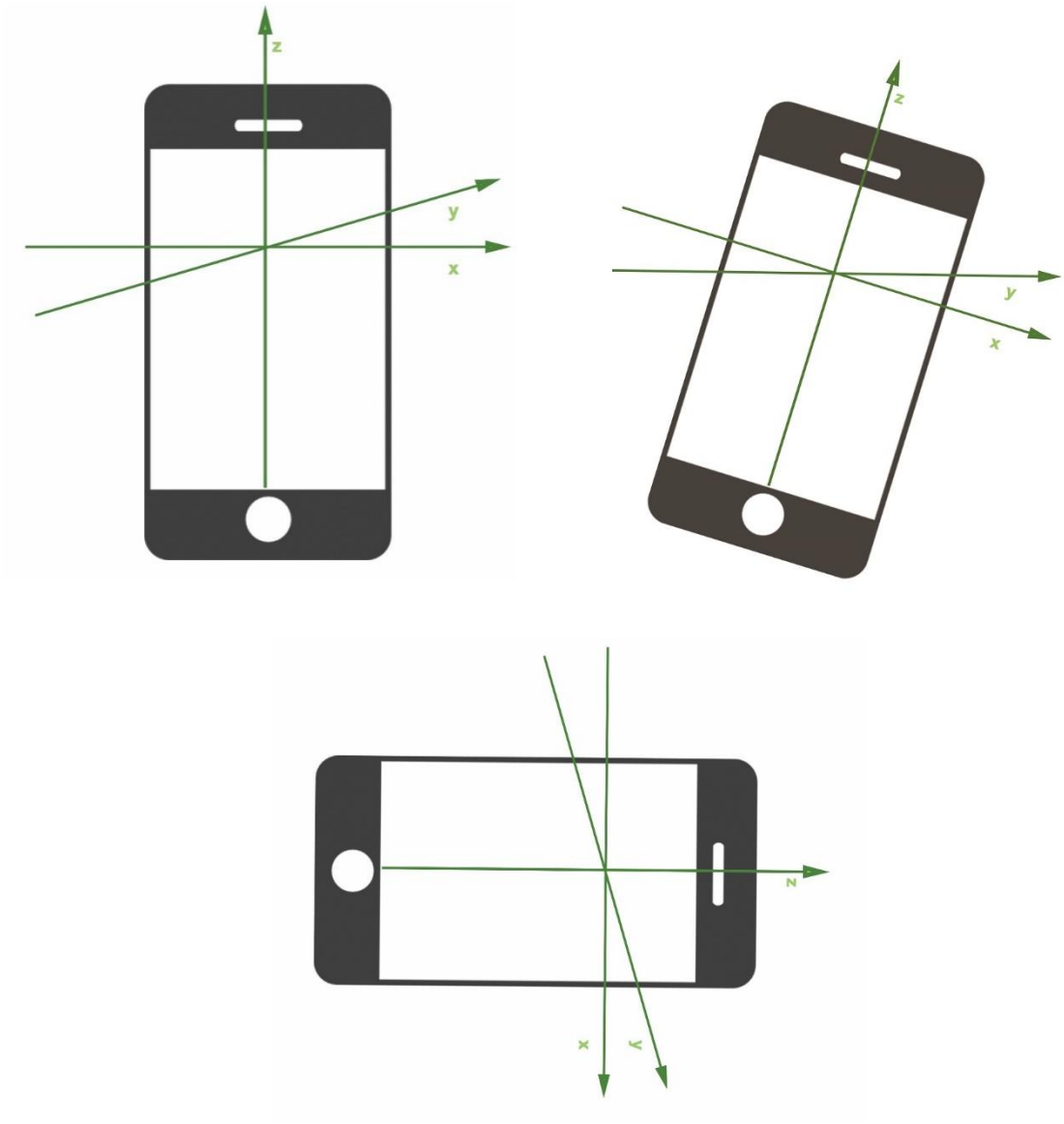

Figure 4. Orientations of Mobile Phone

The location problem is very basic in nature. The problem can be simply defined as the location and position of the phone that is recording data on its sensors. The phone can have number of positions as shown in the figures (3.1, 3.2, 3.3 and 3.4) respectively. Also it can be placed in shirt front pocket, trouser front pocket, trouser back pocket, can be held in hand and carried in bag. In order to solve these problems. Two unique solutions were adapted.

3.3.1 Solution to Location Problem

The location problem was solved on a data gathering level. Multiple sessions were used to collect sample data and in it the phone was placed on all different places. Including front shirt pocket, trouser back and front pockets, phone was held in hand also in carrying bags. And then means of all these signals were used to find the appropriate mean and threshold for the data.

3.3.2 Solution to Position Problem

As shown earlier by figure 3.1-3.4 phone could have multiple positions. So the data collected by all the locations was auto-correlated.

So it was empirically thought that the graph-3.5 is the representation of z-axis i.e, with little or no variation. And the graph with only up and down movements is y-axis and the graph with all the front movement and little or no movement is x-axis. Hence the coordinates are rotated to meet the true axis and notion was achieved giving more comprehensive and better data.

3.4 Data Gathered

In order to make this application applicable to both genders. Both the genders were given task of collecting data samples. In total 114 samples of data were collected performing 7 different activities and putting phone in 4 major locations. The data received was then transformed in matlab using true axis technique as mentioned earlier, to overcome the problem told before. The data shared is also shared by other faculty of the SEECS as it can be used for secondary purposes as well.

3.5 Parameters Found

Naturally the data achieved was used and all plausible techniques were applied to the data, to get most favorable results. The parameters found were mean, variance, correlation, auto correlation, standard deviation, local minima, local maxima, universal maxima and universal minima. It should be noted that all of these tasks were performed. The final result was a Comma Separated Variable (CSV) file (attached as annexure). This CSV file was then sent to Weka Tool in order to find the most significant parameters.

3.6 Machine Learning and Code

The tool used to assess the parameters was a one very reliable and preferred by data scientists. Using this tool and coding it to evaluate different machine learning algorithms such as K-Nearest Neighbor (KNN), Decision tree algorithm, Naïve Bayes, Support Vector Machine (SVM) and others. By finding out the algorithms using True Positive, False Positive, True Negative and False Positive rates as shown in the Table below:

Sr. No.	Activity	True Positive	False Positive
1.	Walking	0.850	0.015
2.	Running	1.000	0.000
3.	Climbing Stairs	0.915	0.037
4.	Descending Stairs	0.905	0.020
5.	Cycling	0.915	0.020
6.	Driving	1.000	0.000
7.	Inactive	1.000	0.000
Weighted Avg.		0.925	0.011

As by using the data in the table it is clearly evident that decision tree algorithm having a name of C.45 decision tree algorithm is best for the data type present and it should be inculcated within the app.

The resulting distance and activity are mapped on calories consumed by the individual determining his/her health. For mapping these activities the following formulas are used:

3.7 Specifications of the App. Developed

Hence the application developed was constructed on X-Code (8.2) tool using objective-C language and the designed entire work, from start till end, is made for user approach. The ipa file of the application is also attached as Annexure in the accompanying disk. The screenshot of the application named “Activist” is below:

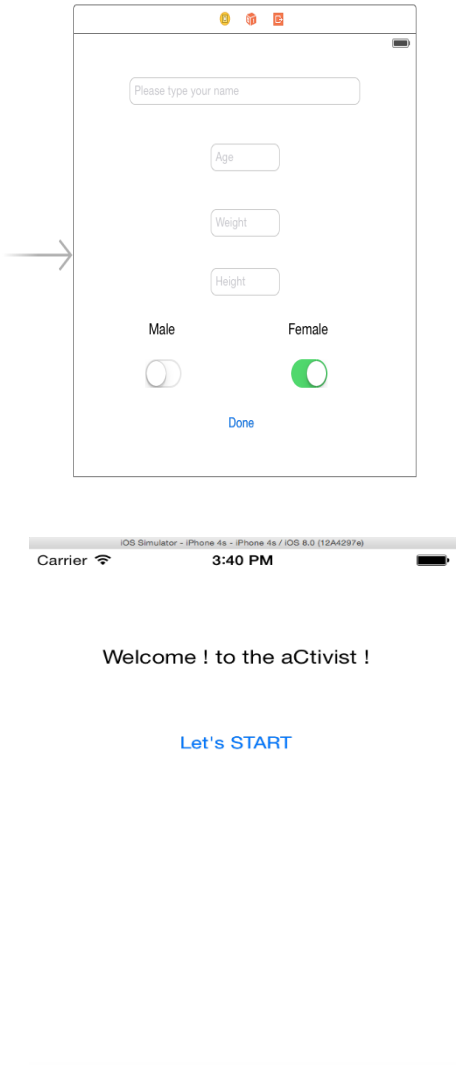

Figure 5. Application Screenshot

The tasks of data gathering was performed myself and one of the female colleagues at the lab.

References

1. Alvina Anjum and Muhammad Usman Ilyas. Activity recognition us- ing smartphone sensors. In Consumer Communications and Networking Conference (CCNC), 2013 IEEE, pages 914–919. IEEE, 2013.
2. Ling Bao and Stephen S Intille. Activity recognition from user-annotated acceleration data. In Pervasive computing, pages 1–17. Springer, 2004.
3. Tomas Brezmes, Juan-Luis Gorricho, and Josep Cotrina. Activity recog- nition from accelerometer data on a mobile phone. In Distributed com- puting, artificial intelligence, bioinformatics, soft computing, and ambi- ent assisted living, pages 796–799. Springer, 2009.
4. JBJ Bussmann, WLJ Martens, JHM Tulen, FC Schasfoort, HJG Van Den Berg-Emons, and HJ Stam. Measuring daily behavior using ambu- latory accelerometry: the activity monitor. Behavior Research Methods, Instruments, & Computers, 33(3):349–356, 2001.
5. Graeme S Chambers, Svetha Venkatesh, Geoff AW West, and Hung Hai Bui. Hierarchical recognition of intentional human gestures for sports video annotation. In Pattern Recognition, 2002. Proceedings. 16th In- ternational Conference on, volume 2, pages 1082–1085. IEEE, 2002.
6. F Foerster, M Smeja, and J Fahrenberg. Detection of posture and mo- tion by accelerometry: a validation study in ambulatory monitoring. Computers in Human Behavior, 15(5):571–583, 1999.
7. Dean M Karantonis, Michael R Narayanan, Merryn Mathie, Nigel H Lovell, and Branko G Celler. Implementation of a real-time human movement classifier using a triaxial accelerometer for ambulatory moni- toring. Information Technology in Biomedicine, IEEE Transactions on,10(1):156–167, 2006.
8. Jennifer R Kwapisz, Gary M Weiss, and Samuel A Moore. Activity recognition using cell phone accelerometers. ACM SigKDD Explorations Newsletter, 12(2):74–82, 2011.
9. Nicholas D Lane, Mashfiqui Mohammod, Mu Lin, Xiaochao Yang, Hong Lu, Shahid Ali, Afsaneh Doryab, Ethan Berke, Tanzeem Choudhury, and Andrew Campbell. Bewell: A smartphone application to monitor, model and promote wellbeing. In 5th international ICST conference on pervasive computing technologies for healthcare, pages 23–26, 2011.
10. Sian Lun Lau and Klaus David. Movement recognition using the ac- celerometer in smartphones. In Future Network and Mobile Summit,2010, pages 1–9. IEEE, 2010.
11. Seon-Woo Lee and Kenji Mase. Activity and location recognition using wearable sensors. IEEE pervasive computing, 1(3):24–32, 2002.
12. Jonathan Lester, Tanzeem Choudhury, Gaetano Borriello, Sunny Con- solvo, James Landay, Kate Everitt, and Ian Smith. Sensing and modeling activities to support physical fitness. In Proc. of Ubicomp Workshop: Monitoring, Measuring, and Motivating Exercise: Ubiquitous Comput- ing to Support Fitness), Tokyo, Japan, 2005.

13. Paul Lukowicz, Holger Junker, Mathias St¨ager, Thomas von Bueren, and Gerhard Troster. Wearnet: A distributed multi-sensor system for context aware wearables. In UbiComp 2002: Ubiquitous Computing, pages 361–370. Springer, 2002.
14. Merryn J Mathie, Adelle CF Coster, Nigel H Lovell, Branko G Celler, Stephen R Lord, and Anne Tiedemann. A pilot study of long-term mon- itoring of human movements in the home using accelerometry. Journal of telemedicine and telecare, 10(3):144–151, 2004.
15. Jun Yang. Toward physical activity diary: motion recognition using simple acceleration features with mobile phones. In Proceedings of the 1st international workshop on Interactive multimedia for consumer elec- tronics, pages 1–10. ACM, 2009.

Code Scripts

```
auto = autocorr(VarName5);
max1 = 0;

% for n = 1:length(auto)-5
%     max1(n) = auto(n:n+5);
% end

plot(auto);

x=x_accel;
[Rxx]=autom(x);

y=y_accel;
[Ryy]=autom(y);

z=z_accel;
[Rzz]=autom(z);

function [rundata2]= Basic Functions Functions Functions(x_accelerometer, y_accelerometer, z_accelerometer)
```

```
%N=length(x_accelerometer)
x_accelerometer=x_accelerometer(16:96)
y_accelerometer=y_accelerometer(16:96)
z_accelerometer=z_accelerometer(16:96)

% %% ==================== Part 1: Basic Functions ====================
try

%


%
%
   A=[x_accelerometer y_accelerometer z_accelerometer]

   m1= mean(x_accelerometer)
   m2= mean(y_accelerometer)
   m3= mean(z_accelerometer)

   mean1=abs(m1)
   mean2=abs(m2)
   mean3=abs(m3)
```

```
B=[mean1; mean2; mean3]

vectsum=sum(B)


if(mean1 > 6.5)

  z=x_accelerometer

  A(:,1) = []

elseif(mean2>6.5)

  z=y_accelerometer

  A(:,2) = []

else

   z=z_accelerometer

   A(:,3) = []

end


 O=cov(A)

 [V,D]=  eig(O,'nobalance')

 P=V

 D=D

 [P2,D2]=sortem(P,D)

 T=P2'

 signals=A*T
```

```
   x_accel=signals(:,1)
   y_accel=signals(:,2)
   z_accel=z
%
    m1= mean(x_accel);
    m2= mean(y_accel);
    m3= mean(z_accel);

    s=std(x_accel);
    s1=std(y_accel);
    s2=std(z_accel);
%
%    RMS  = sqrt(mean(x_accelerometer .^2));
%    RMS1 = sqrt(mean(y_accelerometer .^2));
%    RMS2 = sqrt(mean(z_accelerometer .^2));
% %
   fprintf('Program paused. Press enter to continue.\n');
   pause;
catch
   disp('Error: data_analysis() - Could not load basic variables.');
   rundata = -1;
```

```
    return;
end

[peaks1, locs1] = pkpicker( Rxx, -inf, inf)
total_peaks = length(peaks1)
distancebetweenpeaks1=diff(locs1)
Med1=median(distancebetweenpeaks1)

[peaks2, locs2] = pkpicker( Ryy, -inf, inf)
total_peaks = length(peaks2)
distancebetweenpeaks2=diff(locs2)
Med2=median(distancebetweenpeaks2)

[peaks3, locs3] = pkpicker( Rzz, -inf, inf)
total_peaks = length(peaks3)
distancebetweenpeaks3=diff(locs3)
Med3=median(distancebetweenpeaks3);
```

0.306458	2.145205	9.346964	-0.59748	-0.66964	9.552809
0.459687	2.145205	9.346964	-0.15234	-0.01583	9.599766
0.459687	2.145205	9.193734	-0.15299	-0.05034	9.450503
0.306458	1.991976	9.346964	-0.01254	0.149134	9.560608
0.153229	1.991976	9.193734	0.146904	0.131678	9.406236
-0.15323	1.838747	9.040505	0.444293	0.275414	9.212055
-0.76614	2.298434	9.653421	1.11503	0.018376	9.890131
-1.0726	2.298434	9.959879	1.403354	0.095417	10.18106
-0.61292	2.298434	10.5728	0.878426	0.151515	10.80036
-0.45969	1.991976	9.500193	0.572904	0.168134	9.699302
-0.30646	2.145205	8.42759	0.302868	-0.25356	8.69276
-0.15323	2.451663	7.814674	0.053019	-0.71901	8.15987
-0.15323	2.451663	7.814674	-0.07273	-0.73078	8.158672
-0.15323	2.298434	8.887277	-0.25254	-0.34348	9.171053
-0.15323	2.298434	9.80665	-0.38098	-0.09919	10.06587
0.306458	2.451663	11.03248	-0.93347	0.039682	11.26709
0.459687	3.064578	11.18571	-0.98974	-0.39426	11.55803
1.072602	0.919373	11.18571	-1.70041	1.693245	11.01623
2.451663	-0.30646	9.959879	-2.98171	2.467559	9.50391
1.838747	0.306458	9.040505	-2.11157	1.690204	8.825539
0.612916	0.919373	7.661446	-0.60834	0.796816	7.675525
0.306458	1.225831	7.508216	-0.05716	0.334007	7.606251
0.153229	1.532289	7.661446	0.357117	-0.11602	7.805648
0.153229	1.532289	7.967903	0.598138	-0.20142	8.090768
0.459687	1.685518	9.193734	0.584576	-0.37385	9.3325
0.612916	1.838747	11.33894	0.742248	-0.36762	11.47354
1.072602	1.991976	12.25831	0.398661	-0.53449	12.44749
0.459687	2.451663	11.49217	0.919559	-0.92899	11.68689
0.459687	2.298434	11.95186	0.752498	-0.62526	12.14017
0.459687	-0.76614	9.653421	-0.1145	2.13038	9.45702
-0.61292	-0.15323	8.274361	0.900801	1.588027	8.095117
-0.91937	1.532289	8.580819	1.469019	0.06756	8.640661
-0.91937	0.306458	9.500193	1.213606	1.343363	9.376319
0.153229	0.306458	8.887277	0.064747	0.923652	8.845551
0.153229	1.072602	7.661446	0.131392	-0.11927	7.735646
0.306458	1.37906	7.508216	-0.0083	-0.5963	7.616652
1.225831	1.838747	9.346964	-0.89449	-1.3419	9.468293
1.532289	1.991976	10.72602	-1.24078	-1.66454	10.81912
1.685518	1.991976	11.95186	-1.42082	-1.70488	12.0304
1.37906	2.298434	12.10508	-0.91368	-1.73363	12.24244
1.685518	0.459687	11.6454	-1.7755	0.016852	11.64109
1.685518	0.612916	8.734048	-1.43712	-0.17051	8.798059
1.532289	1.072602	7.967903	-0.9042	-0.39277	8.124902

0.919373	0.766145	8.580819	-0.35661	0.420471	8.646313
0.766145	0.153229	8.42759	-0.37849	1.0701	8.387274
0.306458	1.072602	7.201759	0.580272	0.316964	7.257586
-0.15323	1.532289	6.742072	1.282896	0.049049	6.795491
0.153229	1.685518	7.814674	1.218418	-0.09781	7.901866
0.766145	1.838747	10.72602	0.948665	-0.11759	10.86746
0.919373	1.838747	11.95186	0.774465	-0.09879	12.10221
1.685518	2.451663	11.49217	0.135043	-1.12581	11.81676
1.072602	3.217807	11.18571	0.721604	-1.58286	11.55849
0.919373	0.306458	10.87925	-0.61084	1.107681	10.84884
0.153229	0.306458	9.193734	-0.02108	1.260917	9.113276
-0.45969	1.37906	9.193734	0.915835	0.62505	9.241669
-0.15323	0.919373	9.80665	0.446881	1.07365	9.781958
0.766145	-0.15323	9.040505	-0.81571	1.525332	8.907816
0.612916	0.153229	7.661446	-0.57328	0.972599	7.604096
0.153229	1.991976	7.201759	0.526056	-0.72734	7.419637
0.306458	2.298434	7.967903	0.486336	-1.09782	8.211118
1.072602	2.451663	9.80665	-0.18132	-1.45314	10.05918
0.306458	2.75812	10.26634	0.642398	-1.46704	10.51351
0.153229	2.298434	10.5728	0.578319	-0.92685	10.76554
0.919373	2.451663	11.33894	-0.10459	-1.12109	11.58273
1.532289	0.153229	13.17769	-1.76463	1.284753	13.08657
1.532289	-0.45969	8.887277	-1.92257	1.376138	8.715096
1.685518	0.612916	7.967903	-1.5683	0.318073	8.008955
0.306458	1.37906	7.814674	0.097501	0.177853	7.938748
0.612916	0.766145	8.42759	-0.2852	0.64099	8.455456
0.306458	0.919373	8.580819	0.32123	0.45547	8.617365
0.306458	1.685518	7.661446	0.715532	-0.51991	7.800663
0.306458	2.145205	9.193734	1.039582	-0.85061	9.349669
1.072602	1.991976	10.26634	0.351543	-0.92964	10.46558
1.685518	1.685518	11.6454	-0.34976	-0.68865	11.86173
1.37906	2.145205	11.18571	-0.09276	-0.97525	11.43084
-0.30646	3.371036	11.33894	1.688845	-1.49822	11.61605
-0.15323	1.685518	12.87123	1.078941	0.574474	12.92435
-0.91937	-0.61292	8.887277	1.069945	2.437793	8.550847
-1.22583	0.459687	8.274361	1.561367	1.442326	8.103138
-0.91937	1.225831	9.193734	1.386417	0.811081	9.181103
-0.15323	1.225831	9.653421	0.55532	0.659856	9.693859
0.306458	0.153229	8.274361	-0.3284	1.130975	8.197286
0.153229	1.685518	7.201759	0.016875	-0.66083	7.368364
0.153229	1.991976	7.661446	-0.04514	-1.07833	7.843747
1.225831	2.298434	10.41957	-1.24044	-1.50223	10.56208
1.532289	2.298434	11.95186	-1.65943	-1.56021	12.05361

0.919373	2.451663	11.79863	-0.97281	-1.55937	11.9451
0.919373	2.911349	11.79863	-0.1513	-1.92894	12.03267
0.153229	-0.15323	11.33894	-1.11044	1.286517	11.21295
-0.30646	-0.30646	7.967903	-0.58282	1.587097	7.79851
-0.45969	0.612916	7.508216	0.173984	1.123314	7.461112
-1.37906	1.225831	8.121132	1.252606	1.462127	8.102495
-1.0726	0.766145	8.734048	0.749244	1.611531	8.652321
-1.37906	1.225831	8.580819	1.395448	1.132656	8.590968
-1.22583	1.838747	8.580819	1.579198	0.251067	8.715343
-1.0726	1.685518	9.346964	1.106644	0.011326	9.493809
-0.76614	1.225831	10.41957	0.193534	0.039261	10.51751
-0.45969	0.919373	11.03248	-0.64446	0.023517	11.06148
-0.15323	0.919373	10.72602	-1.17621	-0.15667	10.70086
-0.30646	1.072602	9.959879	-0.96683	-0.26232	9.971962
-0.76614	0.919373	10.5728	-0.74688	0.196824	10.61224
-0.45969	-1.0726	10.87925	-1.89753	1.811655	10.62249
-0.91937	-1.22583	9.653421	-1.38291	2.020062	9.462735
-1.22583	-0.76614	9.040505	-0.75968	1.713485	8.96143
-1.0726	-1.0726	9.500193	-1.09003	1.675477	9.410592
-1.22583	-0.91937	9.346964	-0.80842	1.460159	9.323521
-1.22583	-0.45969	9.653421	-0.34988	0.952348	9.688815
-1.37906	-0.61292	10.87925	-0.30568	0.852402	10.94603
-0.61292	-1.37906	11.6454	-0.99123	-0.06207	11.7007
-0.15323	-1.53229	11.18571	-0.88232	-0.77758	11.2298
0.153229	-0.91937	9.500193	-0.01168	-1.09744	9.482504
0.306458	-0.45969	9.346964	0.718225	-1.12101	9.268142
0.919373	0.153229	10.5728	1.87266	-1.35282	10.35933
1.225831	0.153229	10.87925	2.187355	-1.27606	10.6523
1.37906	0.612916	9.80665	2.502736	-0.73813	9.572845
0.612916	1.225831	9.346964	2.217969	0.639061	9.160584
0.459687	0.766145	9.500193	1.340912	0.751743	9.417473
0.459687	0.766145	9.193734	0.822738	0.879846	9.158166
0.612916	1.37906	8.887277	0.742694	1.346581	8.882358
0.612916	2.298434	8.580819	0.596681	2.115951	8.628769
0.459687	2.145205	8.580819	0.005667	1.818332	8.668178
0.306458	1.532289	8.734048	-0.47359	0.950427	8.808963
0.153229	1.532289	8.580819	-0.69914	0.650411	8.665449
0.459687	2.298434	9.040505	-0.48682	1.046667	9.267813
0.919373	2.145205	10.41957	-0.05643	0.451316	10.66807
0.919373	2.145205	10.87925	0.050133	0.142434	11.12576
0.153229	2.604892	10.72602	-0.66211	0.265929	11.01578
-0.45969	3.064578	10.5728	-1.28277	0.422601	10.93448
-0.30646	0.919373	12.25831	-0.36994	-1.99538	12.12794

0.153229	-0.45969	10.11311	0.610545	-2.65062	9.752496
-1.22583	1.072602	8.274361	-1.21115	-1.27919	8.247119
-1.22583	0.766145	9.346964	-0.94363	-1.72221	9.251968
-0.91937	0.153229	9.80665	-0.29575	-2.06717	9.626965
-0.76614	0.459687	8.274361	-0.29168	-1.23865	8.224597
-0.91937	1.072602	7.661446	-0.65807	-0.4355	7.750532
-0.91937	1.991976	8.42759	-0.92733	0.51699	8.643511
-0.76614	2.298434	8.887277	-0.79229	1.105364	9.110648
-0.15323	2.145205	10.5728	0.114682	1.35588	10.70317
-0.91937	2.145205	10.41957	-0.44736	1.086445	10.61292
-1.22583	1.991976	10.41957	-0.52157	0.723638	10.64154
-1.22583	1.685518	11.33894	-0.14343	0.190185	11.52642
-0.76614	-0.30646	11.6454	1.29853	-1.63817	11.48592
0.459687	-0.45969	9.193734	2.101346	-1.12248	8.903469
0.459687	0.766145	8.887277	1.486897	-0.13021	8.806484
-0.30646	0.766145	8.734048	0.697334	-0.44537	8.733833
-0.30646	0.612916	8.887277	0.620313	-0.48902	8.878589
-0.91937	1.072602	7.661446	-0.46318	-0.11241	7.776008
-1.22583	1.838747	8.121132	-1.19973	0.517235	8.314419
-1.0726	1.838747	9.193734	-1.12161	0.618859	9.349611
-1.0726	1.532289	11.49217	-0.89461	0.29102	11.60531
-0.61292	1.37906	12.10508	-0.31527	0.340013	12.18998
-1.22583	1.991976	10.72602	-0.74501	0.991113	10.90784
-1.53229	2.145205	10.72602	-0.6862	1.11835	10.96703
-0.91937	-0.30646	9.500193	-0.5035	-1.38441	9.435185
-1.53229	0.612916	9.346964	-0.85833	-0.48182	9.440361
-1.22583	0.153229	9.653421	-0.54137	-1.11763	9.652591
-1.0726	0.153229	8.121132	-0.38726	-0.90622	8.133605
-0.91937	0.612916	7.508216	-0.13602	-0.28895	7.582364
-0.91937	1.532289	7.814674	-0.04704	0.732704	7.982683
-0.76614	1.37906	8.734048	0.215469	0.687557	8.846085
0.306458	0.919373	11.49217	1.680195	0.46753	11.40033
0.766145	1.072602	12.10508	2.137337	0.921689	11.9521
0.306458	1.225831	11.49217	1.474776	1.066139	11.41731
0.612916	-1.0726	11.49217	2.262274	-1.10339	11.28099
0.306458	-1.37906	9.653421	1.728848	-1.54335	9.476995
1.225831	-0.61292	9.040505	1.994344	-0.53215	8.907776
0.919373	0.153229	9.040505	1.147764	-0.02373	9.015628
0.306458	-0.15323	8.121132	0.477445	-0.50425	8.09864
-0.15323	0.153229	7.661446	-0.31561	-0.3492	7.650043
-0.76614	1.225831	7.354988	-1.49896	0.426955	7.331869
-0.45969	1.225831	9.346964	-1.42188	0.600128	9.311166
-0.76614	1.532289	10.5728	-1.91961	0.840448	10.5037

-0.30646	1.072602	12.25831	-1.28934	0.65116	12.22392
-0.30646	1.225831	12.25831	-1.06958	0.774592	12.2523
-0.45969	0.919373	13.33092	-0.76503	0.269261	13.34586
0.153229	-0.91937	11.49217	0.729792	-1.51801	11.40621
-1.22583	-0.76614	8.121132	-0.64341	-1.65948	8.054475
-1.68552	0.919373	8.274361	-1.32394	-0.15302	8.388984
-0.15323	-0.30646	9.653421	0.513185	-1.15958	9.575905
-0.30646	-0.15323	8.121132	0.262284	-0.80743	8.0839
-0.45969	1.532289	7.201759	-0.20771	1.006043	7.305429
-0.15323	1.532289	8.121132	0.161865	1.463274	8.133683
-0.45969	1.838747	10.26634	-0.06295	1.815477	10.28057
-0.45969	1.991976	11.18571	-0.05577	1.421112	11.2817
-0.15323	1.532289	13.02446	0.538839	0.332282	13.09989
-0.15323	-0.76614	12.41154	1.234757	-2.74817	12.06564
-0.15323	-1.37906	10.11311	1.323083	-3.02282	9.659827
0.612916	0.153229	8.274361	1.275324	-0.92143	8.147926
-0.61292	0.766145	7.354988	-0.37871	-0.33865	7.402728
-0.45969	0.612916	7.814674	-0.331	-0.15506	7.843628
-0.76614	0.766145	7.814674	-0.85831	0.130152	7.841521
-1.22583	1.37906	8.274361	-1.72045	0.765412	8.265816
-1.37906	1.685518	9.346964	-2.02523	1.159397	9.309284
-1.0726	0.612916	12.87123	-1.23375	0.569997	12.85876
-1.0726	0.919373	13.02446	-0.90103	0.733096	13.04925
-0.91937	2.298434	12.56477	-0.64207	1.81459	12.66083
-0.61292	-0.76614	10.72602	0.655409	-1.38848	10.66081
-1.53229	-1.0726	8.274361	-0.35095	-2.01231	8.233522
-2.75812	0.306458	7.508216	-1.85355	-0.7709	7.74884
-1.37906	-0.61292	9.500193	-0.23431	-1.75366	9.455206
-0.30646	-0.61292	9.040505	0.794797	-1.44524	8.91515
-0.30646	0.766145	7.661446	0.685767	0.26025	7.670765
-0.30646	1.685518	7.661446	0.767143	1.363493	7.69318
-0.45969	1.225831	9.346964	0.930147	1.053807	9.332953
-0.61292	1.225831	11.95186	1.186877	1.209239	11.91026
-0.61292	0.919373	12.41154	1.180387	0.971839	12.36647
-0.91937	0.306458	12.41154	0.717946	0.222644	12.42661
-0.15323	-1.53229	11.95186	1.374672	-1.75604	11.8425
0.153229	-1.53229	8.887277	1.310484	-1.71101	8.758433
0.153229	-0.45969	8.274361	0.775269	-0.84449	8.208875
-0.76614	0.153229	7.814674	-0.40508	-0.36817	7.834537
-0.76614	0.459687	8.42759	-0.65748	0.325953	8.442988
-1.0726	0.919373	8.734048	-1.43889	1.510606	8.598079
-1.0726	1.072602	9.040505	-1.58746	1.935644	8.818442
-1.0726	1.072602	9.80665	-1.23594	2.048058	9.630642

-0.91937	0.766145	11.79863	-0.60662	1.744266	11.71449
0.306458	1.072602	11.18571	1.223122	1.224417	11.10717
-0.30646	1.532289	11.49217	1.047866	0.628811	11.53336
-0.76614	-0.91937	9.346964	0.011963	-2.16566	9.171027
-0.91937	-0.45969	9.653421	-0.33041	-1.78807	9.536182
-1.0726	-0.15323	9.959879	-0.66547	-1.18707	9.925783
-1.68552	-0.91937	9.040505	-1.62777	-1.28395	9.006597
-1.53229	-0.61292	8.121132	-1.45629	-0.74447	8.124122
-0.61292	1.072602	7.661446	-0.08275	1.016957	7.693039
-0.61292	1.532289	8.274361	0.189141	1.85234	8.229318
0.612916	1.532289	10.11311	1.663799	1.822864	9.945224
0.459687	1.532289	11.03248	1.855602	1.852732	10.83508
0.306458	1.532289	11.6454	1.914422	1.523186	11.49226
0.919373	-0.30646	11.79863	2.172662	-0.94804	11.5986
0.919373	-0.76614	10.87925	1.661374	-1.84431	10.65968
1.225831	-0.30646	8.887277	1.492335	-1.41093	8.738562
0.919373	-0.30646	8.274361	0.819998	-1.46625	8.159776
0.306458	0.306458	7.661446	-0.01506	-0.73374	7.638518
-0.61292	0.766145	8.121132	-1.64378	0.105855	8.012628
-0.61292	0.766145	8.734048	-1.96664	0.396765	8.556935
-0.61292	1.532289	11.33894	-2.46285	1.41803	11.10039
-0.61292	1.532289	12.87123	-2.34467	1.703269	12.64885
-0.15323	1.37906	12.87123	-1.27282	1.749867	12.76369
-0.61292	1.991976	12.10508	-0.66822	1.948534	12.10923
-0.61292	-0.45969	9.959879	0.161816	-0.83243	9.953243
-1.99198	0.153229	8.42759	-1.23607	-0.61976	8.550073
-1.99198	0.459687	8.734048	-1.21446	-0.47405	8.874866
-0.76614	-0.45969	9.500193	0.097637	-1.43014	9.433828
-0.76614	-0.30646	8.42759	-0.02016	-1.14578	8.389991
-0.61292	0.919373	6.895301	0.046889	0.30316	6.976531
-0.45969	1.532289	7.661446	0.3441	0.961688	7.75975
-0.15323	1.225831	10.26634	0.98895	0.621464	10.27422
0.153229	1.37906	11.49217	1.479663	0.830795	11.45057
-0.15323	1.685518	11.03248	1.081859	1.229154	11.04078
-0.15323	0.766145	11.79863	1.054796	0.249506	11.77468
-0.30646	-0.61292	10.87925	0.717653	-1.21733	10.80883
-0.45969	-0.30646	9.653421	0.320026	-0.98396	9.613697
-0.30646	0.612916	8.887277	0.080604	-0.17382	8.911596
-0.45969	0.612916	8.580819	-0.19585	-0.18432	8.610755
-0.76614	0.919373	7.967903	-0.63754	0.19163	8.029728
-0.91937	1.225831	7.508216	-0.88117	0.611216	7.587567
-0.91937	1.838747	7.814674	-0.95926	1.319168	7.914228
-0.61292	1.838747	10.26634	-0.46672	1.374951	10.3463

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-0.61292	0.459687	13.02446	0.399717	-0.60203	13.02694
-0.91937	-0.91937	8.887277	-0.14593	-1.83885	8.790422
-1.83875	-0.91937	7.508216	-1.23795	-1.76266	7.480647
-2.45166	-1.0726	8.121132	-1.88806	-1.89536	8.121375
-1.37906	-1.22583	9.346964	-0.7933	-2.02795	9.275145
-0.30646	-0.15323	8.887277	0.347023	-0.74593	8.855745
-0.15323	1.37906	8.274361	0.690827	1.05035	8.29517
-0.15323	1.37906	8.580819	0.864374	1.29106	8.552297
-0.45969	0.919373	9.346964	0.715572	1.079829	9.313658
-0.61292	1.072602	9.653421	0.637369	1.366503	9.614631
-1.0726	-0.15323	12.718	0.388363	0.223845	12.7562
-1.37906	-0.76614	14.55675	0.076876	-0.62184	14.62857
-0.15323	-1.68552	13.48414	1.0226	-1.90658	13.41662
-0.15323	-1.99198	10.41957	0.645581	-2.3573	10.32401
-0.76614	-0.61292	7.354988	-0.2808	-0.90546	7.359333
-1.53229	0.306458	7.04853	-1.13291	0.095205	7.12959
-1.0726	0.306458	8.121132	-0.64828	0.25693	8.167674
-0.15323	0.459687	9.040505	0.24814	0.723189	9.021139
-0.61292	0.612916	8.42759	-0.27947	0.947856	8.414219
-0.45969	1.532289	8.734048	-0.1693	1.978343	8.654497
-0.45969	1.37906	10.11311	0.08866	1.885673	10.04114
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-0.15323	1.072602	13.33092	0.88469	0.99298	13.30859
0.306458	-0.61292	9.653421	0.882238	-1.07079	9.577745
-0.91937	-0.45969	8.274361	-0.56921	-0.99505	8.258782
-1.68552	0.766145	7.814674	-1.30411	0.225714	7.921201
-1.22583	0.153229	8.734048	-1.0007	-0.5028	8.749601
-0.76614	-0.15323	8.42759	-0.61752	-0.7476	8.408002
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-1.0726	1.072602	8.42759	-0.63026	0.715975	8.509723
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-1.0726	0.459687	11.95186	0.037002	0.037989	12.00857
-1.0726	0.306458	11.95186	0.172459	-0.20006	12.00089
-0.30646	-1.83875	11.18571	1.056556	-2.34526	11.04439
-0.30646	-0.61292	8.580819	0.694742	-1.03459	8.517452
-0.30646	0.306458	8.734048	0.548703	-0.08869	8.727112
-0.91937	-0.15323	8.887277	-0.05774	-0.53975	8.919515
-1.0726	-0.15323	8.887277	-0.30836	-0.43681	8.9371
-1.22583	0.612916	7.967903	-0.77452	0.404508	8.037556
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-1.0726	-1.53229	9.040505	0.112066	-2.04536	9.001836
-1.53229	-0.30646	8.42759	-0.61392	-1.01184	8.489133
-0.91937	0.153229	8.887277	-0.0672	-0.50816	8.921304
-0.61292	-0.30646	9.040505	0.297124	-0.85594	9.021052
-0.91937	0.153229	7.661446	-0.20319	-0.28276	7.710074
-0.91937	1.072602	7.814674	-0.3218	0.768015	7.89756
-0.76614	1.072602	8.734048	-0.06439	0.94015	8.78254
-1.0726	0.766145	11.49217	0.009431	0.719861	11.54509
-1.0726	0.766145	12.25831	0.134414	0.746609	12.30562
-1.37906	0.612916	12.41154	-0.05374	0.409605	12.49613
-1.22583	0.153229	12.41154	0.267295	-0.13973	12.46922
-0.30646	-1.83875	9.500193	1.467803	-1.91117	9.376648
-0.30646	-1.0726	8.580819	1.13373	-1.2572	8.485808
-0.61292	0.306458	8.580819	0.303386	-0.04727	8.60266
-0.61292	-0.45969	9.346964	0.550655	-0.65879	9.338923
-0.45969	-0.15323	8.887277	0.388672	-0.16696	8.890419
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-0.61292	1.225831	7.814674	-0.61605	1.297695	7.802815
-0.91937	1.37906	10.5728	-0.92576	1.575382	10.54477
-0.91937	0.919373	12.10508	-0.70913	1.234782	12.09115
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-0.91937	0.153229	11.49217	-0.10397	-0.24844	11.52676
-1.99198	-0.45969	8.274361	-1.12586	-1.28065	8.350849
-1.99198	0.306458	7.967903	-1.25791	-0.66487	8.09475
-1.22583	0.459687	9.193734	-0.31659	-0.51209	9.266944
-0.91937	-0.30646	9.653421	0.291556	-1.21427	9.621239
-0.45969	0.153229	8.121132	0.574515	-0.47902	8.101114
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-0.91937	1.072602	8.580819	0.164342	0.579539	8.675443
-1.37906	1.37906	11.18571	0.052439	0.862389	11.32154
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-0.76614	-1.68552	10.87925	1.118238	-2.1581	10.76468
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-0.91937	0.153229	9.80665	0.084089	-0.15937	9.849196
-1.0726	0.459687	8.580819	-0.4366	0.108561	8.648111
-0.91937	0.919373	7.661446	-0.67691	0.653981	7.713776
-0.91937	1.991976	8.121132	-1.17281	1.691998	8.156449
-0.91937	1.685518	9.80665	-0.80013	1.556968	9.838305
-0.91937	0.459687	12.10508	0.083959	0.494315	12.1383
-1.22583	1.838747	10.5728	-0.74919	1.373065	10.68743
-1.83875	2.298434	11.18571	-1.23439	1.267486	11.43038
-0.76614	-0.45969	9.959879	0.75322	-1.11076	9.909407
-1.53229	-0.15323	8.734048	-0.1681	-1.25108	8.778469
-2.1452	1.685518	7.967903	-1.4875	0.158845	8.288092
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-1.22583	0.153229	8.887277	0.112266	-0.88746	8.928026
-1.53229	1.37906	7.967903	-0.75041	0.221446	8.192987
-1.37906	1.532289	8.121132	-0.6084	0.507748	8.341135
-1.22583	1.532289	10.11311	-0.0913	0.646193	10.28103
-1.0726	1.225831	11.18571	0.451998	0.542543	11.28161
-1.37906	1.532289	10.87925	0.052855	0.665082	11.05273
-1.22583	2.604892	11.18571	-0.31628	1.586488	11.4364
-0.61292	0.919373	11.03248	1.081823	0.436702	11.02613
-0.30646	-0.15323	9.80665	1.716008	-0.35591	9.654865
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-1.99198	1.225831	8.580819	-0.78343	-1.02529	8.79978
-1.22583	0.153229	10.26634	0.801398	-1.2662	10.23124
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-1.22583	1.225831	7.967903	-0.39221	0.082371	8.144458
-1.22583	1.225831	8.580819	-0.36769	0.24999	8.742888
-1.22583	1.685518	10.26634	-0.55352	0.74749	10.43437
-1.0726	1.838747	11.18571	-0.52262	1.072899	11.32375
-0.91937	1.838747	11.33894	-0.41732	1.157258	11.45794
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-1.53229	0.459687	9.193734	0.47717	-0.89053	9.277027
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-1.53229	1.225831	7.967903	-0.61088	-0.58488	8.162278
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-1.22583	1.37906	10.11311	-0.3635	0.325517	10.26846
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-1.99198	0.612916	9.80665	0.422763	-0.46251	10.00607
-1.99198	1.072602	9.346964	-0.17253	-0.18783	9.613487
-1.99198	0.919373	9.346964	-0.01221	-0.13419	9.600041
-1.0726	0.766145	9.80665	-0.6936	0.724533	9.843871
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-0.91937	1.685518	11.03248	-1.57192	0.224766	11.08514
-1.22583	1.838747	11.33894	-1.25057	-0.10364	11.48393
-0.91937	-1.0726	10.26634	0.872058	1.943498	10.14178
-1.22583	-0.15323	8.580819	0.782588	0.695696	8.605822
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-0.61292	1.37906	10.72602	-1.62851	-0.48173	10.69771
-0.76614	1.225831	10.87925	-1.57269	-0.39925	10.85426
-0.91937	1.532289	10.5728	-1.40357	-0.75148	10.60389
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0.153229	1.838747	12.10508	-0.95612	-0.2222	12.20549
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-1.83875	0.306458	9.500193	1.018431	1.57757	9.497507
-1.0726	-0.15323	9.193734	0.197214	1.883555	9.061568
-1.0726	0.459687	8.274361	0.278746	1.030687	8.28775
-1.22583	1.37906	7.354988	0.572436	-0.14227	7.55992
-0.91937	1.37906	8.274361	0.10014	-0.27883	8.433524
-0.61292	1.532289	10.5728	-0.53619	-0.51154	10.67513
-0.15323	1.838747	11.6454	-1.10047	-0.98488	11.69781
-0.15323	1.225831	12.41154	-1.39197	-0.59417	12.38071
-0.30646	0.612916	11.95186	-1.26814	0.022227	11.90411
-0.30646	-0.61292	10.11311	-1.20488	1.244481	9.987195
0.153229	0.459687	7.967903	-0.8913	0.138579	7.931497
-0.15323	1.225831	8.580819	-0.2903	-0.38435	8.6559
-0.45969	0.766145	8.580819	0.02647	0.144739	8.625955
-0.61292	1.072602	8.42759	0.390786	-0.1527	8.507315
-0.61292	1.685518	7.661446	0.686059	-0.84376	7.793059
-0.45969	2.145205	8.274361	0.688826	-1.31302	8.430881
-0.76614	2.145205	9.500193	0.923002	-1.12489	9.6605
-0.61292	1.37906	11.79863	0.344657	-0.21936	11.88773
-0.61292	1.532289	11.95186	0.221022	-0.16093	12.06216
-0.76614	2.604892	9.959879	0.281607	-1.22585	10.24645

-0.76614	0.459687	10.11311	0.330866	1.132647	10.08369
-1.68552	0.153229	9.346964	1.252136	1.411997	9.309598
-1.83875	0.153229	9.959879	1.319585	1.617275	9.911951
-1.68552	0.306458	10.11311	1.053329	1.520113	10.08908
-0.91937	0.153229	8.580819	0.264914	1.310787	8.527065
-0.91937	0.306458	7.508216	0.22101	0.835152	7.521047
-1.22583	1.37906	7.508216	0.478673	-0.38951	7.70694
-1.22583	0.919373	9.193734	0.122102	-0.04727	9.319631
-0.76614	1.225831	10.5728	-0.55289	-0.54713	10.64277
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-0.15323	1.37906	12.718	-1.4944	-0.76924	12.68258
0.766145	-0.30646	9.959879	-2.22648	0.752034	9.713768
1.225831	0.153229	9.193734	-2.33073	0.358679	8.971618
-0.45969	0.612916	7.661446	-0.24184	0.363098	7.687288
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-1.22583	1.225831	7.354988	1.113866	0.06193	7.473729
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-1.37906	1.991976	9.346964	1.648239	-0.51842	9.500003
-0.91937	1.225831	11.33894	0.835173	0.163801	11.41031
-1.22583	1.685518	11.18571	0.996836	-0.29941	11.33051
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-1.0726	-0.76614	9.80665	-0.41568	2.037496	9.673864
-2.1452	-0.91937	8.42759	0.763505	2.359137	8.38588
-2.75812	0.306458	7.354988	1.75789	1.168162	7.572464
-1.37906	0.306458	9.193734	0.207738	1.16649	9.225866
-0.91937	0.306458	9.346964	-0.24458	0.987032	9.341887
-1.22583	1.072602	7.814674	0.305638	-0.07716	7.976397
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-0.61292	1.532289	9.80665	-0.67503	-0.90256	9.880469
-0.15323	1.838747	11.49217	-1.40429	-1.40808	11.4682
-0.30646	1.532289	12.718	-1.53297	-1.15495	12.66907
-0.76614	0.153229	12.87123	-1.33809	0.335332	12.82092
-0.45969	-1.53229	10.87925	-1.54397	2.039531	10.69457
0.306458	-1.0726	8.887277	-1.74319	1.466619	8.66247
0.459687	0.306458	8.887277	-1.28923	0.149584	8.809339
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-0.61292	0.459687	7.967903	0.267404	0.070571	7.999873
-1.0726	1.37906	7.04853	1.179974	-0.8612	7.11337
-1.0726	1.685518	7.04853	1.382549	-1.30442	7.075327
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-0.76614	-0.30646	9.500193	-0.37329	1.374146	9.429048
-1.68552	0.306458	9.193734	0.558291	1.242115	9.252302
-1.99198	0.766145	9.653421	0.842325	1.103075	9.788626
-1.68552	-0.30646	8.42759	0.43691	1.922569	8.370903
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-1.68552	1.685518	7.354988	0.996083	-0.35468	7.658969
-1.53229	1.685518	8.121132	0.726606	-0.46295	8.390434
-1.0726	1.532289	10.87925	-0.22891	-0.55638	11.02246
-0.76614	1.532289	11.79863	-0.74727	-0.90989	11.86407
-1.0726	1.532289	11.18571	-0.45397	-0.9391	11.29294
-1.22583	1.838747	11.33894	-0.26037	-1.10613	11.49626
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-0.30646	0.612916	9.346964	-1.09281	-0.01468	9.308106
-1.22583	0.766145	8.734048	0.047704	0.269636	8.84863
-1.22583	0.766145	8.734048	0.289939	0.198058	8.8459
-1.0726	1.072602	7.508216	0.502466	-0.33296	7.636159
-1.0726	1.37906	7.04853	0.644805	-0.78963	7.189908
-1.37906	1.991976	8.42759	0.868044	-1.40122	8.612614
-2.1452	2.145205	11.49217	1.307632	-1.41416	11.72877
-1.83875	1.685518	12.10508	0.822746	-0.86826	12.30139
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-2.29843	1.991976	11.95186	0.941343	-0.65359	12.27943
-1.83875	0.306458	9.346964	0.556433	0.984065	9.463755
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-2.45166	0.306458	8.887277	0.878855	1.274595	9.093474
-1.83875	0.306458	9.040505	0.120471	1.193618	9.152399
-1.53229	0.612916	7.661446	0.028998	0.561197	7.817003
-1.68552	1.532289	7.508216	0.263374	-0.50186	7.825661
-1.99198	1.685518	8.121132	0.384617	-0.73974	8.489203
-1.99198	1.685518	10.26634	-0.14898	-0.79313	10.56198
-2.1452	2.145205	11.33894	-0.24533	-1.33533	11.65899
-1.83875	1.685518	11.49217	-0.70138	-0.89883	11.70436
-1.99198	1.685518	11.18571	-0.50673	-0.68023	11.45467
-1.37906	-0.30646	11.49217	-1.48971	1.458566	11.38943
-0.91937	-0.30646	9.040505	-1.30247	1.378171	8.892364
-0.45969	0.766145	8.887277	-1.42996	0.331236	8.810645
-1.68552	0.766145	8.887277	-0.09785	0.574271	9.059375
-1.99198	0.766145	8.887277	0.36058	0.531542	9.11735
-1.53229	0.919373	7.967903	0.271236	0.059959	8.161096

-1.68552	1.991976	7.201759	0.864995	-1.18613	7.517922
-1.53229	2.298434	8.274361	0.653893	-1.59995	8.550341
-1.99198	2.298434	11.18571	0.637803	-1.44449	11.48379
-1.99198	1.991976	11.6454	0.403785	-1.04902	11.92844
-1.83875	2.75812	11.18571	0.222581	-1.64198	11.54828
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-1.83875	-0.15323	9.040505	0.160249	1.569575	9.090982
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-2.75812	0.459687	8.274361	1.193265	1.215249	8.566381
-2.1452	-0.15323	8.734048	0.475748	1.889033	8.781469
-1.83875	0.766145	7.814674	0.13141	0.579304	8.042651
-1.99198	1.532289	7.661446	0.14726	-0.40103	8.051777
-1.99198	1.838747	8.580819	-0.22598	-0.82509	8.958101
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-1.83875	1.838747	12.10508	-1.50509	-0.90879	12.25577
-1.0726	1.838747	11.49217	-2.06983	-0.99349	11.45994
-1.53229	1.991976	11.03248	-1.38512	-1.03901	11.18184
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-1.22583	1.225831	8.887277	-0.50593	-0.03686	9.040558
-1.37906	0.612916	8.734048	-0.1667	0.55158	8.844718
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-1.53229	1.225831	7.04853	0.727495	-0.34003	7.272378
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-1.0726	-0.15323	9.500193	-0.48775	1.700126	9.396771
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-1.0726	2.451663	10.5728	-0.83696	-1.67529	10.74421
-1.0726	1.072602	10.5728	-0.6695	-0.34408	10.6545
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-1.0726	-0.45969	9.346964	-0.19886	1.427177	9.308661
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-1.53229	0.306458	8.887277	0.172818	0.8524	8.981596
-1.22583	0.306458	7.967903	-0.01818	0.691554	8.037754
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-0.45969	1.838747	10.72602	-1.34482	-1.07201	10.75556
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-0.91937	2.451663	11.79863	-0.86022	-1.54606	11.95547

-0.61292	-0.91937	11.33894	-1.47875	1.829839	11.14708
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-0.61292	1.072602	7.814674	0.264833	-0.32926	7.900426
-0.91937	1.37906	7.967903	0.791292	-0.67903	8.071388
-0.45969	1.37906	9.040505	0.442307	-0.83451	9.107788
-0.61292	1.37906	10.26634	0.639544	-0.80523	10.32558
-0.45969	1.37906	11.49217	0.456881	-0.76334	11.54953
-0.15323	1.532289	11.03248	0.12811	-0.87943	11.10393
-1.53229	2.298434	11.03248	1.497898	-1.18936	11.21107
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-2.1452	1.37906	8.274361	1.746589	0.040228	8.480363
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@relation features

@attribute meanX numeric

@attribute meanY numeric

@attribute meanZ numeric

@attribute Standard_deviationX numeric

@attribute Standard_deviationY numeric

@attribute standard_deviationZ numeric

@attribute goodness_of_fitX numeric

@attribute goodness_of_fitY numeric

@attribute goodness_of_fitZ numeric

@attribute 'meadian peakX' numeric

@attribute 'meadian peakY' numeric

@attribute 'meadian peakZ' numeric

@attribute activity {walking,running,'going up stairs','going down stairs',driving,cycling,resting}

@data

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-1.0905,1.1463,9.6447,0.91477,0.96806,1.8829,0.95163,0.88632,0.9996,7,8.5,12,walking

-0.4045,1.2423,8.9571,3.5398,4.3555,7.0543,0.004903,0.030415,0.88758,6,5,6,running

-5.4813,1.0859,4.9383,9.0637,10.2385,7.6806,0.57231,0.009898,0.30866,6,6,6,running

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-0.44442,0.99175,9.7382,0.79731,0.97481,1.908,0.44226,0.80343,0.99947,4.5,4,11.5,walking

1.143,1.8694,9.2933,1.2985,0.98302,1.5388,0.87926,0.96444,0.99952,10.5,10,10,walking

0.90014,1.6762,9.4458,1.2794,1.1499,1.8523,0.77471,0.95447,0.99928,6,8,12,'going up stairs'

-1.8225,0.4009,9.7341,0.99329,1.0321,1.9957,0.98848,0.068801,0.99876,11,12,13,'going up stairs'

-5.5385,2.9069,5.5779,8.635,9.3354,7.9158,0.25401,0.05071,0.26081,6,6,6,running

0.46349,1.5994,9.5217,0.86146,0.8103,2.9158,0.61933,0.81986,0.99566,7,5,12,'going down stairs'

-4.4682,0.80936,6.1144,9.5111,11.5682,8.3034,0.13173,0.001733,0.40266,6,6,6,running

0.67353,0.55861,9.8429,1.285,1.1771,1.291,0.11311,0.055946,0.99991,4,4,3,driving

5.7119,-0.61924,8.0918,1.2033,0.65953,0.9157,0.9994,0.87574,0.99991,3,4,3,driving

-0.24954,2.2842,9.3448,0.8606,1.3556,1.9769,0.00911,0.93945,0.99757,12,12,12,'going up stairs'

-3.1412,2.0784,9.0241,1.3323,1.1765,1.7753,0.98457,0.96639,0.99892,13,7,12,'going up stairs'

0.51426,2.0539,9.4015,0.94143,1.1297,2.0239,0.63129,0.95194,0.99811,5,9.5,13,'going up stairs'

2.7365,1.2852,9.4158,0.7026,0.61242,1.4085,0.9984,0.87564,0.99988,4,4,3,driving

1.9582,1.9433,9.4048,0.56392,0.93499,1.1912,0.99612,0.85182,0.99984,16,17,15,driving

0.013551,2.5913,9.2323,0.84878,1.1068,2.4716,0.081811,0.98731,0.99168,6,5.5,12.5,'going down stairs'

-0.42466,2.0062,9.4477,0.7588,0.93394,2.8248,0.43523,0.98157,0.9943,7,3.5,12.5,'going down stairs'

-0.91643,-0.1827,9.8376,0.78767,1.1039,2.9185,0.90374,0.19935,0.99226,4,4,11,'going down stairs'

-5.4905,2.32,4.5634,7.7565,8.4522,6.9075,0.61955,0.0675,0.3912,6,6,6,running

-4.0894,0.98123,7.2341,11.0408,11.6477,9.167,0.055474,0.001627,0.31822,5,6,6,running

6.6419,-5.3442,1.4644,3.4167,3.5639,3.9399,0.9788,0.87039,0.087068,7,7,7,cycling

-4.3397,-5.6646,3.0786,4.7925,2.7989,4.5256,0.88813,0.98864,0.30992,9,8,6,cycling

-1.1884,2.7106,9.1113,0.32516,0.43167,0.68135,0.99942,0.99989,0.99999,7,6,?,driving

5.1466,-4.8002,5.4582,2.9676,3.8725,3.5577,0.99624,0.83902,0.98888,7,6,7,cycling

0.17877,0.37456,9.8152,0.058761,0.078347,0.036116,0.98998,0.995,1,3,?,?,resting

-0.58717,2.2488,9.3005,0.063787,0.083072,0.080794,0.99971,1,1,?,?,?,resting

-0.52973,1.83,9.5637,0.72045,1.0756,2.5903,0.20399,0.94158,0.99443,5,4,7,'going down stairs'

-0.74621,2.1141,9.2822,0.77114,1.1112,3.447,0.88224,0.95918,0.97886,5,9,11,'going down stairs'

-2.4757,1.2784,9.3911,1.3274,1.0204,2.762,0.98909,0.95215,0.99548,10,3,12,'going down stairs'

-6.1968,-8.759,0.97588,1.5917,1.7941,1.1222,0.99793,0.99966,0.62986,11,11,4,walking

-1.5571,-0.62375,9.8283,0.68782,0.87976,1.8924,0.99187,0.54726,0.99857,9,7.5,11,walking

-0.47829,-0.082372,9.7978,0.68749,1.0282,1.8859,0.74602,0.022568,0.99922,5,4,10,walking

-1.6299,0.81743,9.6219,0.73242,1.1154,1.6022,0.98142,0.15468,0.99932,12.5,8,13.5,'going up stairs'

0.19279,2.0378,9.4449,1.1914,1.2486,2.3893,0.18147,0.95444,0.99799,8,12,13.5,'going up stairs'

-1.0144,1.9203,9.3709,1.1218,1.3609,2.1109,0.81562,0.97105,0.99879,7.5,7,14,'going up stairs'

-0.53253,2.2926,9.4826,0.85508,1.1535,2.6868,0.77643,0.96613,0.99509,3,3,9.5,'going down stairs'

-1.5041,0.96877,9.6564,0.7641,1.0096,1.9323,0.98194,0.76712,0.99882,6,6,10,walking

0.67287,1.7288,9.438,0.78032,1.1792,1.8478,0.87307,0.87644,0.99862,4,13,13.5,'going up stairs'

-0.33519,1.3293,9.6841,0.63581,1.1956,1.7713,0.24657,0.43606,0.99826,3.5,13,?,'going up stairs'

-5.8804,2.8268,4.2086,9.1564,10.6224,6.7786,0.34493,0.022493,0.39048,6,6,6,running

0.046729,1.8909,9.4252,0.67935,1.1387,1.9023,0.069256,0.93423,0.99886,4,14,16,'going up stairs'

-6.4315,2.3736,3.9963,9.5274,10.4658,7.4805,0.41954,0.020639,0.25807,6,6,6,running

-1.4609,0.7629,9.6638,1.2164,1.0221,1.9828,0.94216,0.59139,0.99921,11,7,12,'going up stairs'

-0.93664,1.3003,9.689,0.59809,1.1643,2.0092,0.9711,0.78378,0.99881,7,10.5,12,'going up stairs'

-0.64672,1.7509,9.3853,0.44445,1.2796,1.9319,0.9048,0.82744,0.99743,4.5,13,?,'going up stairs'

3.1268,-3.6188,7.5136,3.0226,3.3757,3.3341,0.97056,0.91102,0.98229,8,6,7,cycling

5.1466,-4.8002,5.4582,2.9676,3.8725,3.5577,0.99624,0.83902,0.98888,7,6,7,cycling

-1.2258,1.1884,9.6576,0.62781,1.0326,1.857,0.98874,0.88457,0.99893,5,11,11,walking

-1.165,0.76125,9.6177,1.518,1.5895,2.8782,0.6599,0.14729,0.99687,6,7,12,'going up stairs'

-1.201,2.0632,9.4128,0.83265,0.81213,2.6399,0.88196,0.99329,0.9951,6,8,12,'going down stairs'

-1.0832,1.346,9.594,0.79836,1.1219,3.0325,0.96931,0.91567,0.99672,6.5,3,12,'going down stairs'

-0.70325,1.0063,9.7529,0.63449,1.1079,2.0073,0.85675,0.62457,0.99794,4,9,11,'going up stairs'

-0.57094,1.7726,9.5254,0.71544,1.1021,1.968,0.73153,0.95772,0.99862,6,7,13.5,'going up stairs'

-0.20473,1.4602,9.5916,0.77679,0.80806,2.795,0.22189,0.83322,0.99184,3,4,12,'going down stairs'

-0.036584,1.6076,9.5739,0.89148,1.2296,2.2782,0.010137,0.90384,0.99871,5,7.5,13,'going up stairs'

-1.4271,0.86114,9.6715,0.89679,1.0292,1.9129,0.91275,0.64932,0.9987,7,14,14,'going up stairs'

-0.38021,1.8833,9.4754,0.81791,0.80413,2.5678,0.17374,0.98548,0.99455,7,10,12,'going down stairs'

-1.0264,1.8858,9.4149,1.3374,0.91422,1.0388,0.73736,0.78787,0.99992,5,4,23,driving

-2.2866,1.6278,9.2692,1.0813,1.0271,2.9118,0.99439,0.98308,0.99537,8,3,11,'going down stairs'

-1.0183,1.3719,9.5856,1.0855,0.94135,3.2748,0.89521,0.9701,0.98984,4,6,10,'going down stairs'