Estimate User Meaningful Places through Low-Energy Mobile Sensing

1 Motivation and Goal

Due to the increasing spread of location-aware smartphone applications, developers interest in user location estimation has grown in recent years. As users spend the majority of their time in few **meaningful places**, this work presents a new energy efficient method (i.e. that do not use energy hungry methods such as GPS and network positioning techniques) to estimate user presence in a meaningful place.

2 Method

People usually spend 85% of their time staying in a few places, a method that is able to establish user presence in the **two most attended meaningful places** is evaluated.
The proposed solution uses Decision Trees as Machine Learning supervised classification algorithm.

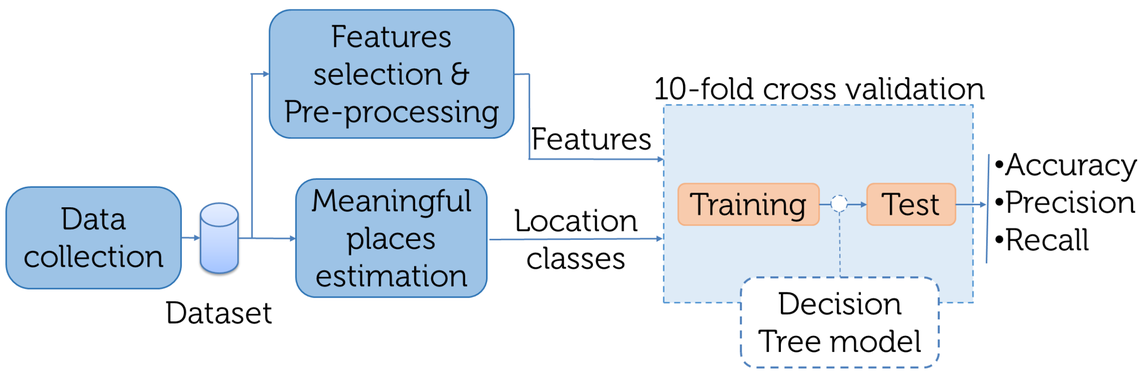


Fig. 1: Model that describes the estimation process performed for each user

3 Data collection

An ad-hoc Android application was designed and implemented to collect:

Category	Feature	Feature Class
Time information	Time	A
	Month	
	Day	
	Day of the week	
Notification information	Type	B
	Generating service	
	Sender-receiver relationship	
Device state	Battery level	C
	Charging state	
	Ringtone mode	D
User information	Current activity	E
	Absolute location	-

TABLE 1: Collected data

The absolute location is the predicted outcome of the algorithm

4 Meaningful places estimation

The two most attended meaningful places for each user were identified using the unsupervised machine learning algorithm known as K-means algorithm

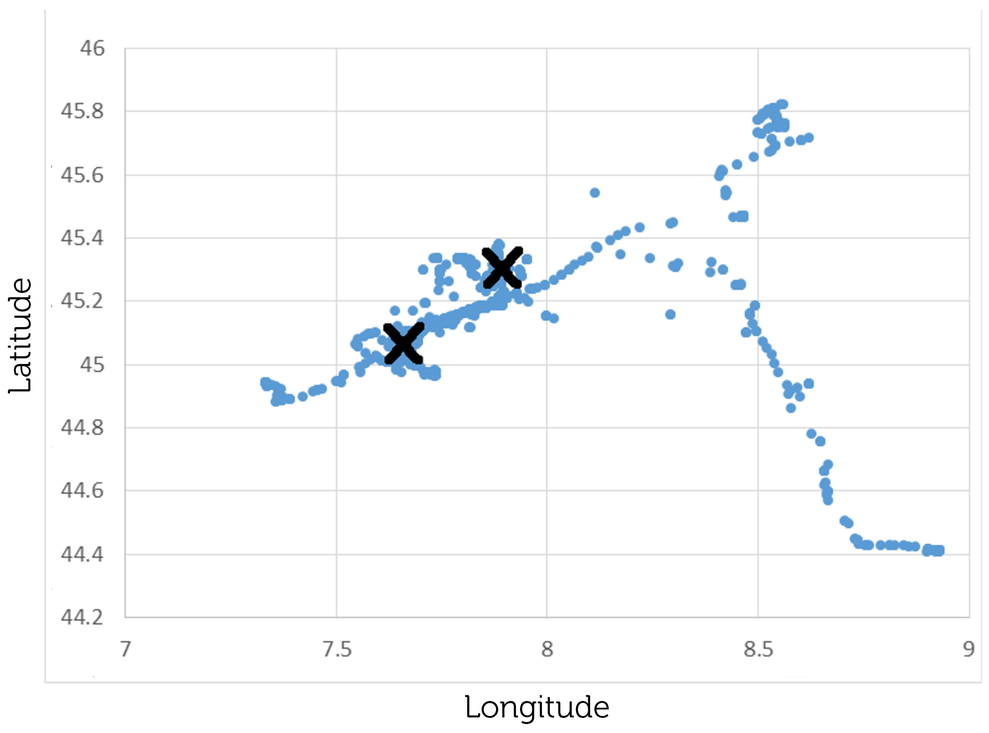
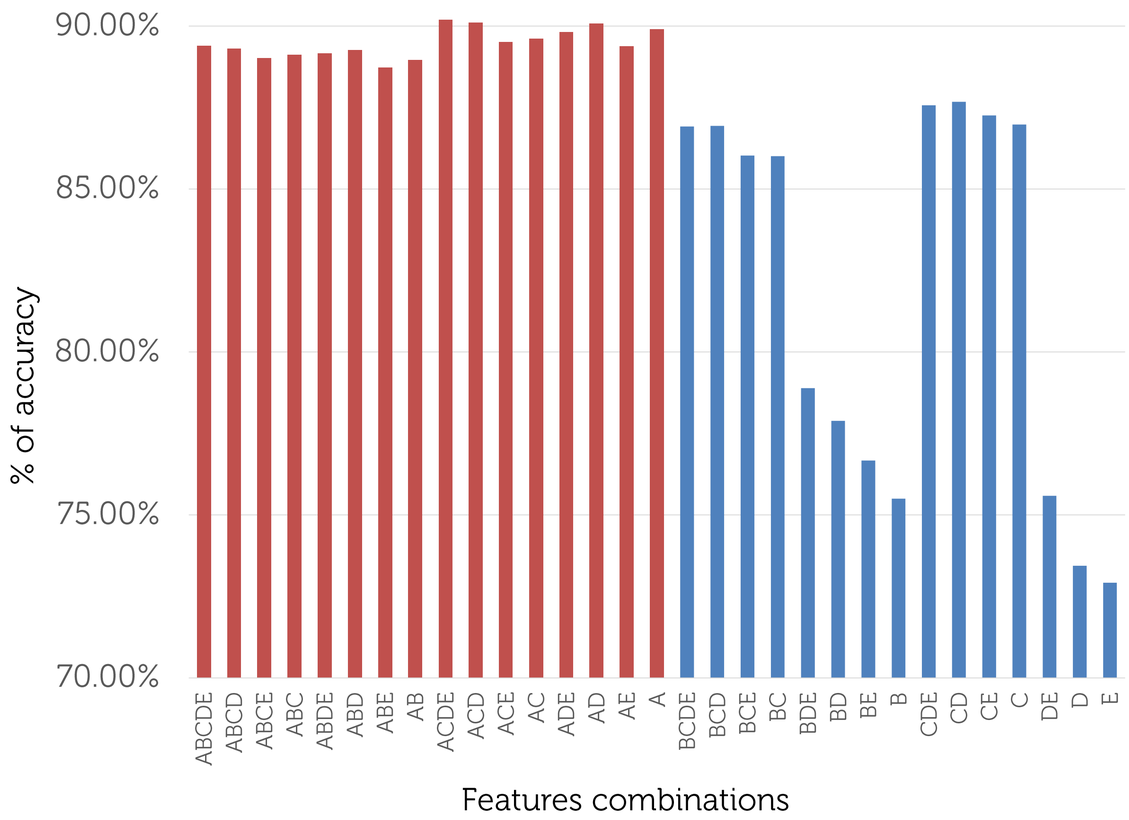


Fig. 2: Absolute locations recorded for the user #5

5 Cross validation

An off-line evaluation of our method was performed through a 10-fold cross validation process over the collected dataset using the Weka workbench.
The dataset used for experiments is composed of 27142 samples (with a mean of 1507 ± 970 samples
per user) labeled with user meaningful places; user presence in a meaningful place was estimated every time a new notification is received.

6 Results



- The most important features among the considered ones are related to time information.

- The "Current activity" (E) (i.e., the only feature that consumes extra energy), is not necessary: it can be removed bringing the proposed method to a zero-energy method.

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