A Preliminary Attempt of an Intelligent System Predicting Users' Correctness of Notifications' Sender Speculation

Introduction

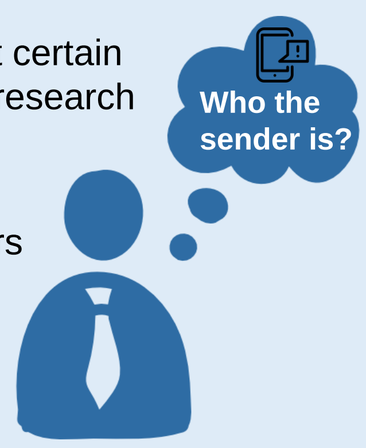
Background

For IM notifications, Lee et al. and Mehrotra et al. has shown that users are more attentive to the notifications from the people they are closer with.

Chang et al. showed that users would speculate the notification's source and may affected their attendance to it.

Research motivation

Nevertheless, such speculations can be difficult at certain moments. However, currently there has not been research attempt aimed to assist users at these moments.



Goal

1. Feasibility of predicting the moments when users would incorrectly speculate the sender of the incoming notification.
2. Identify features that are predictive of these moments.

Methods

Dataset

34 users with a total of 439 instances with features categorizing into three groups (Table 1)

Feature Category	Example
User actions	UseSamePackageAppMinute1, ExistScreenOnInMinute5, UseSameMsgCateAppMinute10, ExistActionInMinute30, UseMsgAppMinute60
Notification activity	ExistMessageNotiInMinute1, ExistNotiInMinute5, ExistSameCateNotiInMinute10, IsMore(text), ExistSamePackageNotiInMinute30
Phone context	DayOfWeek, IsVibrate, IsIndoor, IsMoving, proximity

Table 1

Model choice

To select the best model, we built 4 models with all features and selected the highest F1-score (Figure 1)

With Random Forest, 'within 10 minutes' outperformed those 'more than 10 minutes' time windows, 'within 10 minutes' were selected for future analyze. (Figure 2)

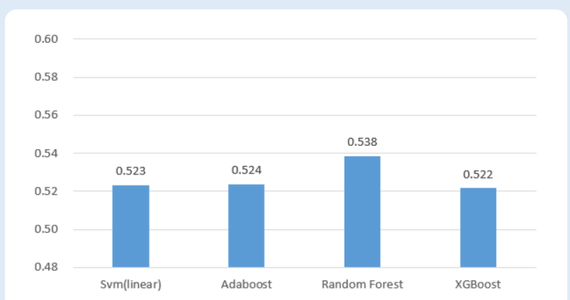


Figure 1

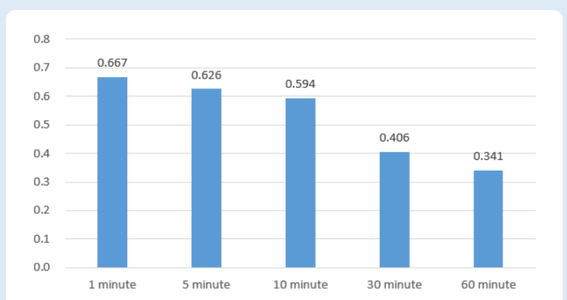


Figure 2

Feature selection

To achieve better performance, we then do feature selection. The improvement shows in Figure 3.

F1-score (0.676), with recall: 84.39%, and precision: 56.78%

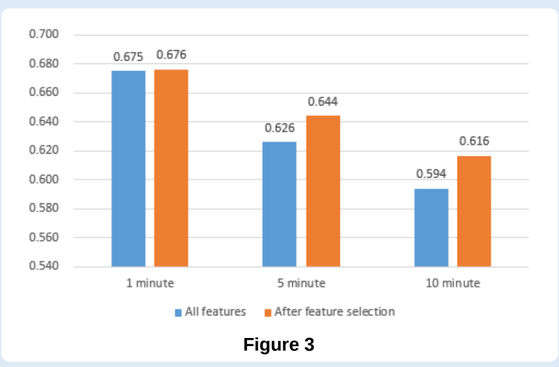


Figure 3

Selected Features

Recent Screen-On Event and Actions with the Phone

Users were more likely to associate the arriving notification with a specific sender when they were recently attended to the phone.

UseSameMsgCateApp was selected in all time windows

When the notification from the same kind of applications arrived, users were more likely to associate the notification with that activity, and perhaps also the people involved in that activity.

ExistMessageNoti was selected in 1 minute window

Users may receive numerous notifications in larger time windows, and thus their association with the previous senders was likely to be interfered by the occurrence of new notifications

Features related to recently used app

Users would need to recall the recently used app as another clue to help them speculate about the sender

Time window	Features	Score
1 minute	ExistScreenOnInMinute1	0.347
	ExistActionInMinute1	0.262
	ExistMessageNotiInMinute1	0.201
	UseSameMsgCateAppMinute1	0.19
5 minute	ExistScreenOnInMinute5	0.415
	ExistActionInMinute5	0.304
	UseSameMsgCateAppMinute5	0.195
	UseSameMsgPackageAppMinute5	0.0858
10 minute	ExistScreenOnInMinute10	0.348
	ExistActionInMinute10	0.318
	UseSameMsgPackageAppMinute10	0.151
	UseMsgAppMinute10	0.102
	UseSameMsgCateAppMinute10	0.081

Future improvement

Temporal patterns of notifications

The frequency of communication with certain contacts; The notification received at particular times.

Current context

Recent interaction with contacts; Perceive situation (e.g., expected to receive a notification).

Contact information

There are also other features we did not explore, such as the identity of the contacts the user interacts with, such as whether the sender of the current notification is the latest person the user interacts with.

Model did not achieve high precision

There were high portion of false positive, i.e. users being able to judge the sender while being recognized by the model as not able to. More investigation and research efforts are needed to improve the prediction.

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