



Towards the Design of Intelligent Notification Mechanisms for Mobile Applications

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Importance of Mobile Notifications

- An effortless way to be aware of newly available information in real-time.

- A way to initiate a remote communication.





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Issues with Mobile Notifications

Interrupt ongoing tasks



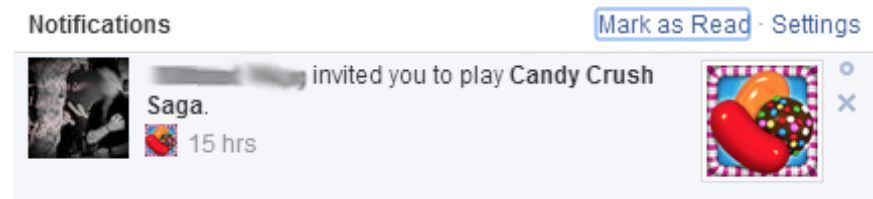
Arrive at socially inappropriate moments

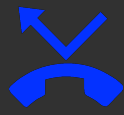


Interfere with our lifestyles



Not always provide useful content





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Managing Mobile Interruptions

A mechanism for intelligent notification scheduling which can deliver notifications at opportune moments by learning the user's interruptibility in different contexts.



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Limitations of Previous Approaches

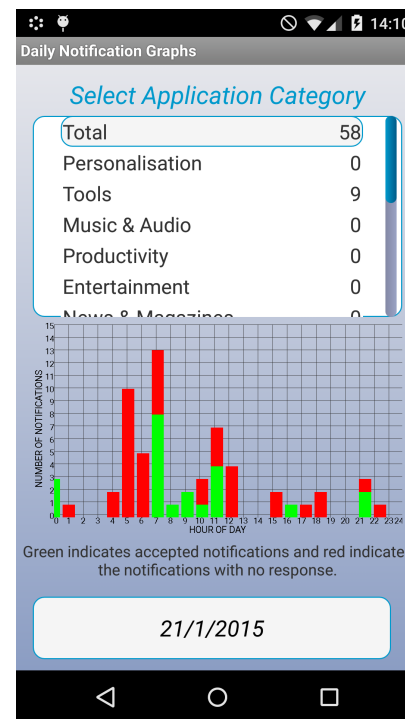
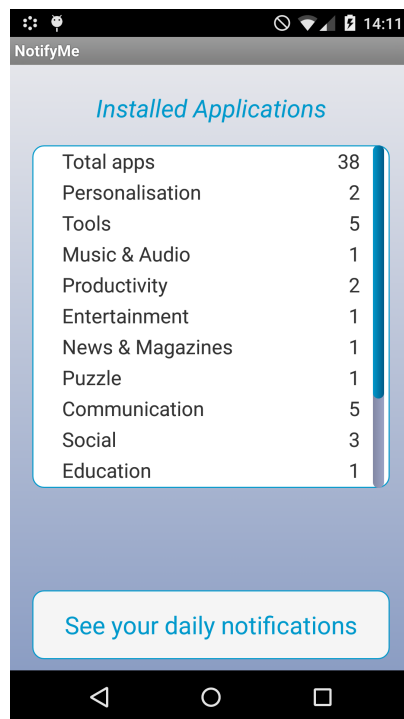
- ESM and synthetic notifications for data collection.

Missing: In-the-wild study.

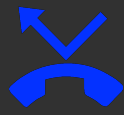
- Rely on the sensed context to infer general interruptibility.

Missing: Use of notification content.

Designing Content-driven Intelligent Notification Mechanisms for Mobile Applications



Mehrotra, Abhinav, Mirco Musolesi, Robert Hendley, and Veljko Pejovic. Designing Content-driven Intelligent Notification Mechanisms for Mobile Applications. In *UbiComp'15*, Osaka, Japan, September 2015.



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Data Collection

1. User's interaction with notifications in-the-wild.
 - Contextual information.
 - Notification data.
2. User preferences.
 - Where would you like to receive notifications with similar content?
 - When would you like to receive notifications with similar content?



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NotifyMe Dataset

Participants: 35

Study duration: 3 weeks

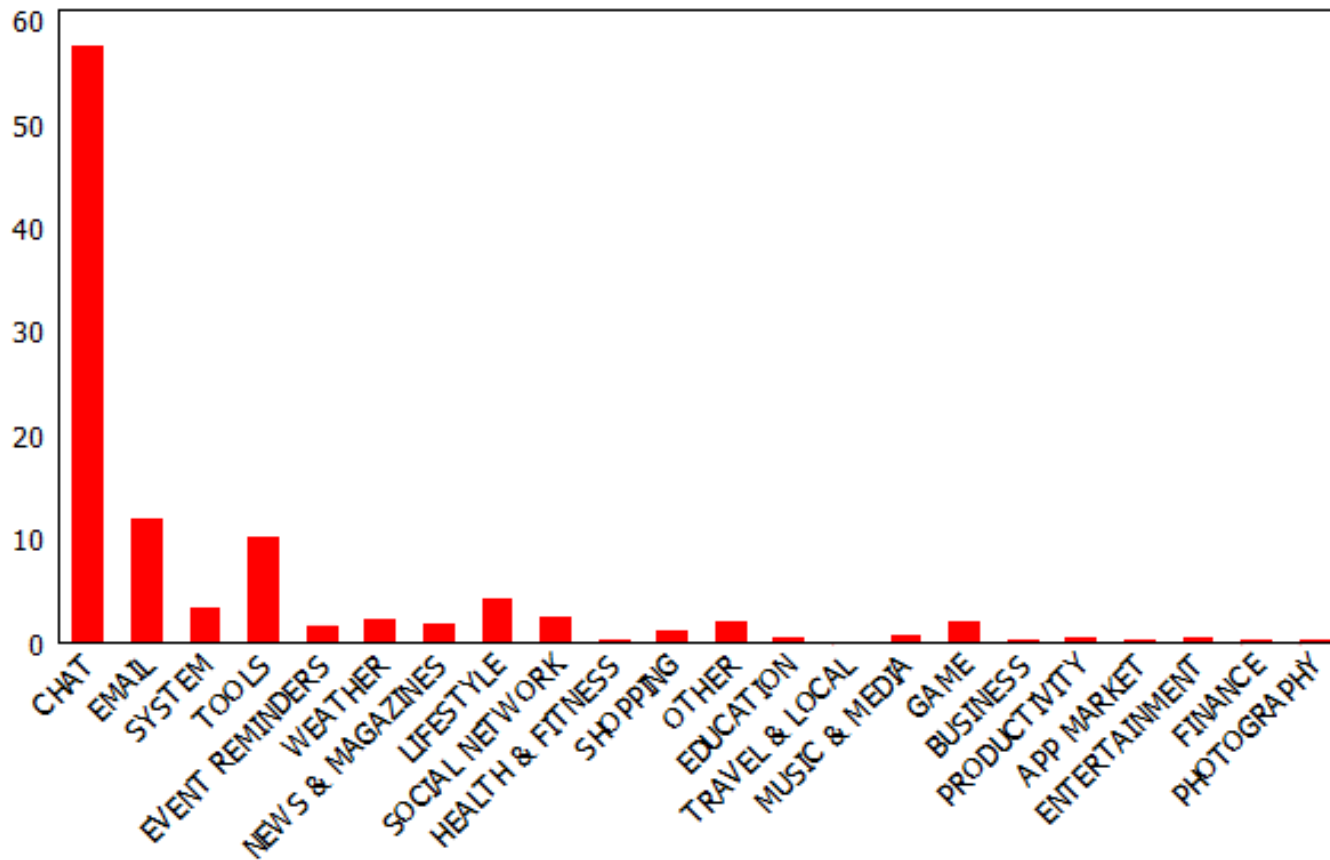
Notification samples: 70,000 (approx.)

Questionnaire responses: 4,069



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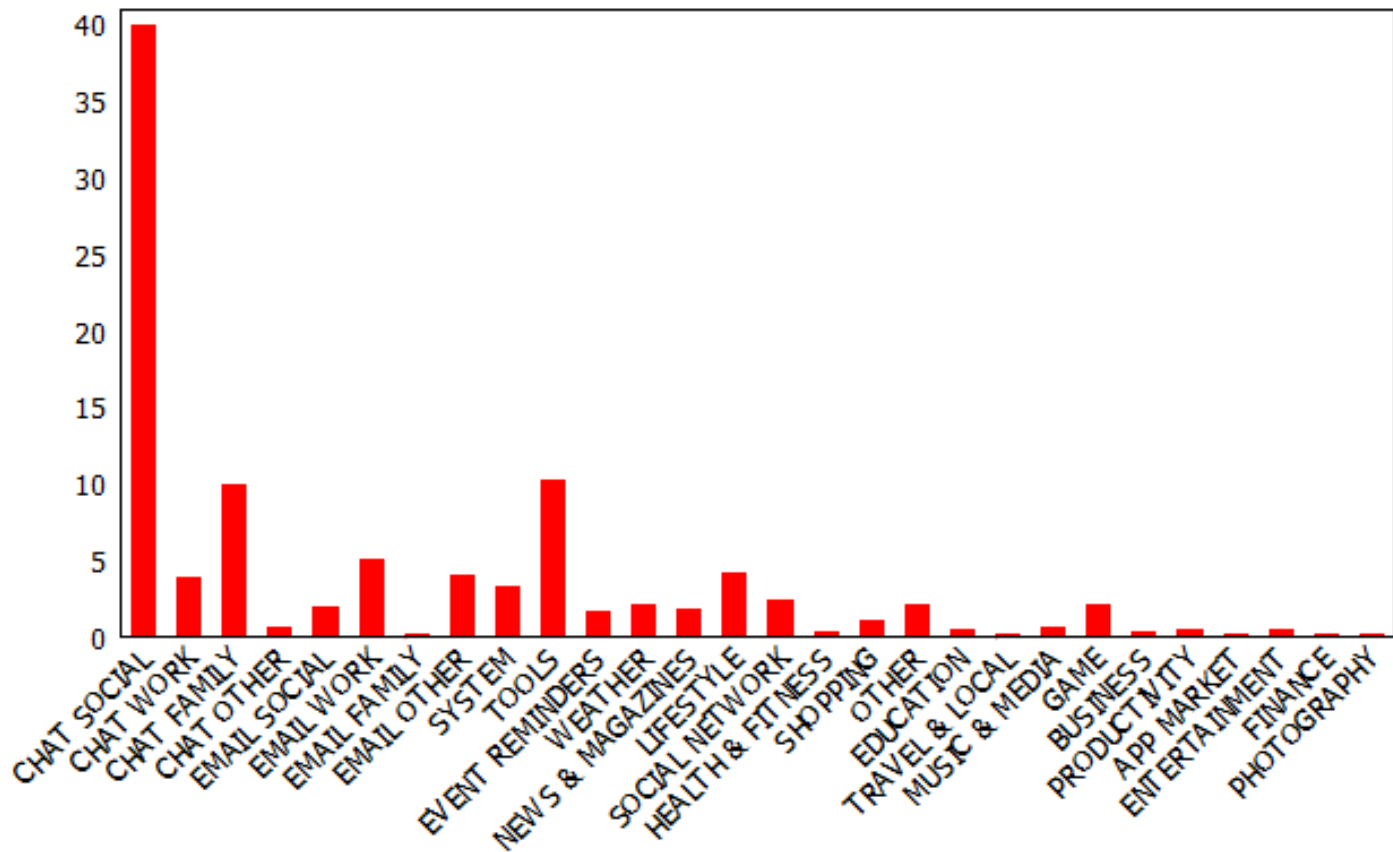
Classification of Notifications by Using the Information Type





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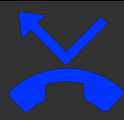
Classification of Notifications by Using the Information Type and Social Circle



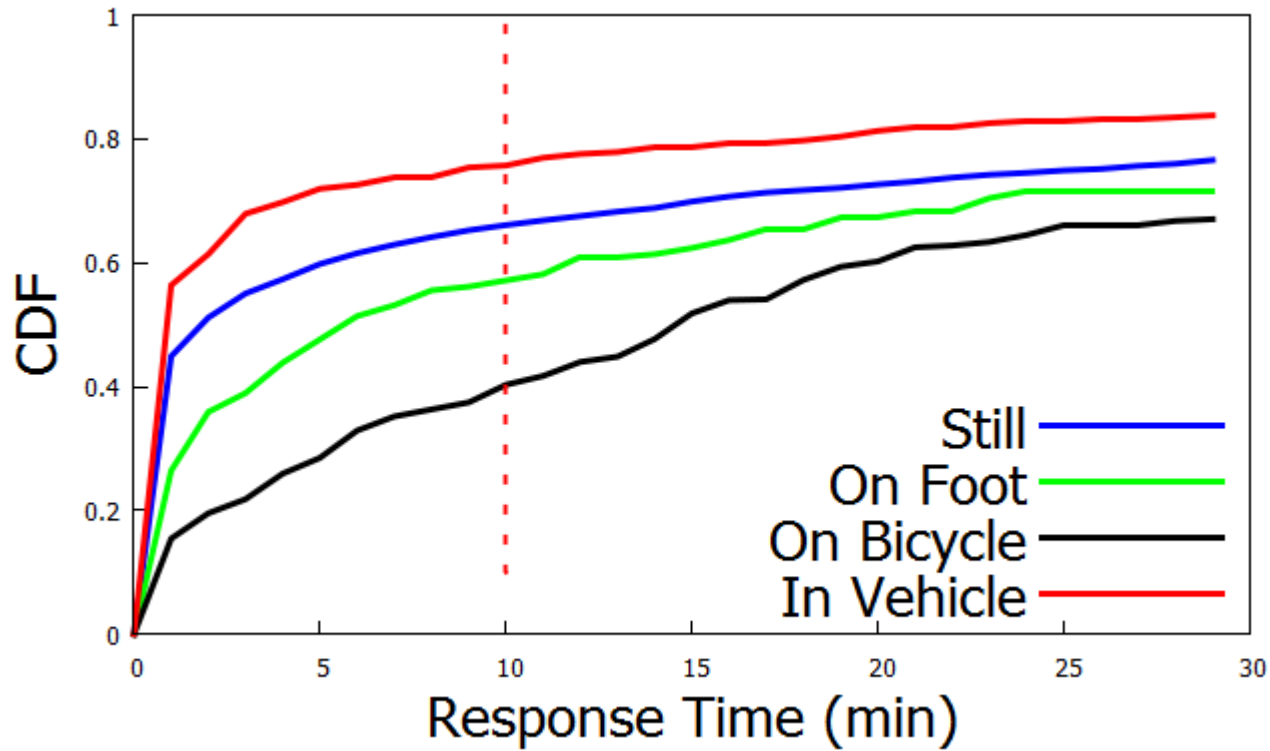


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Understanding Interruptibility



Impact of Context on Response Time

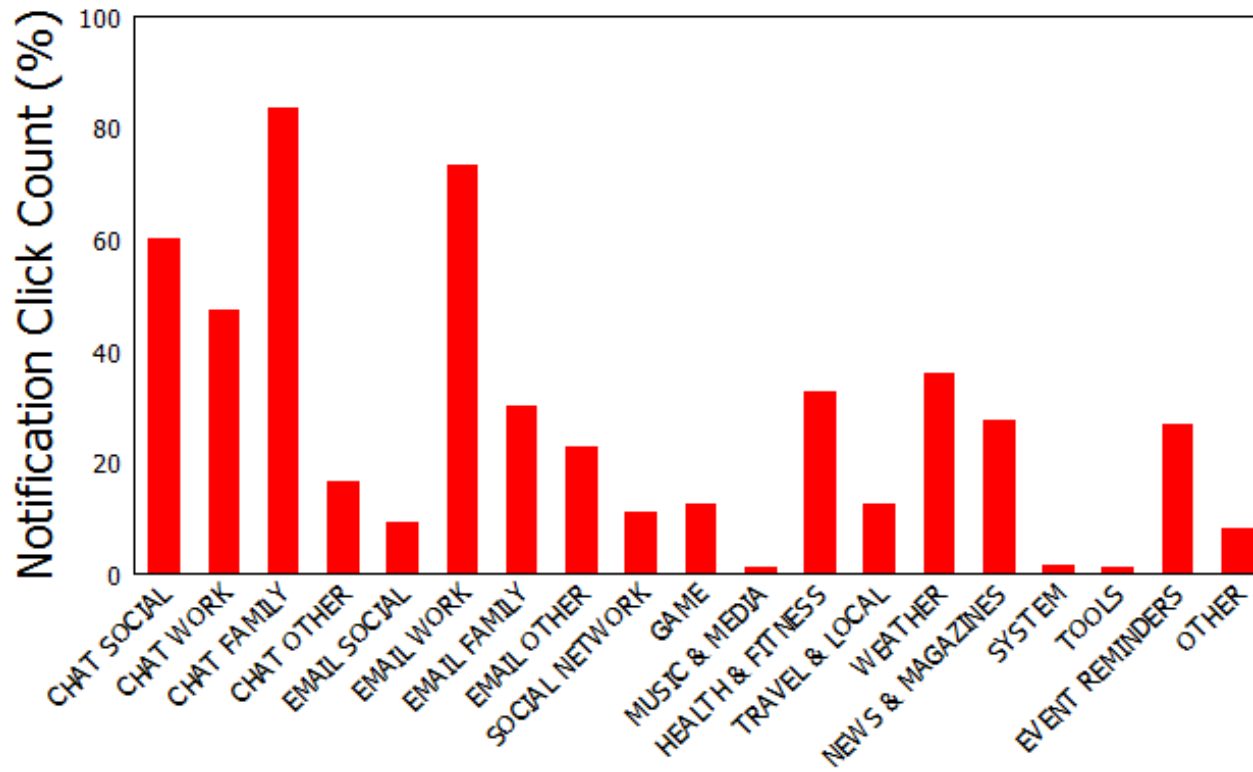


We find that the average response time of a notification does not vary with other context modalities.



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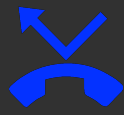
Impact of Content on Notification Acceptance





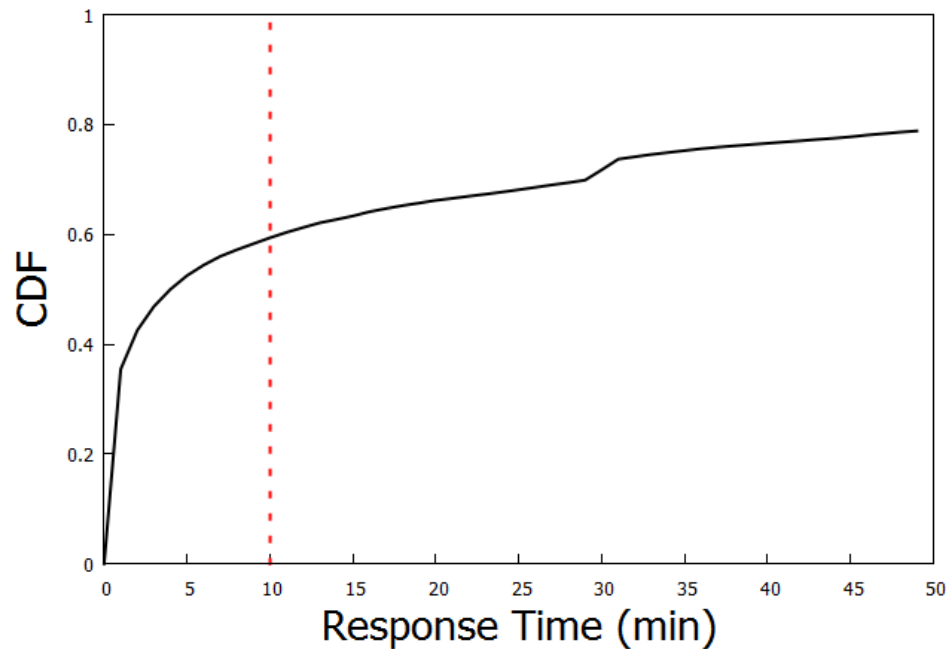
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Predicting an Opportune Moment to deliver a Notification



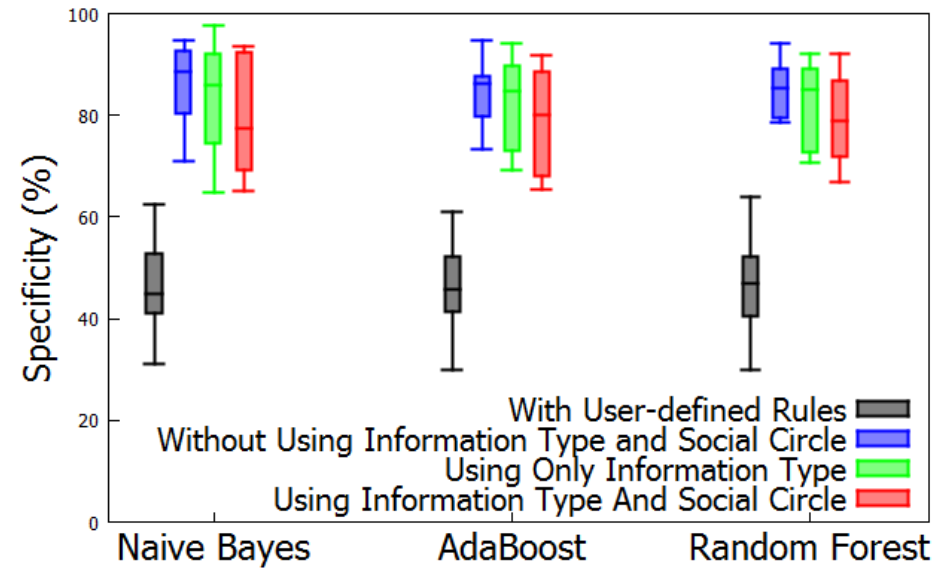
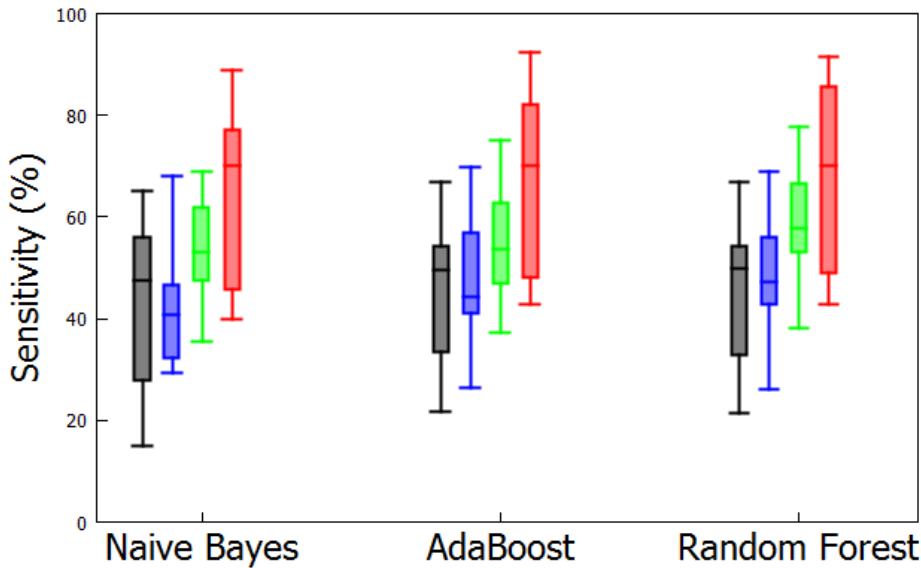
What defines an opportune moment?

- Positive response
- Quick response [how quick should it be?]





Prediction Results

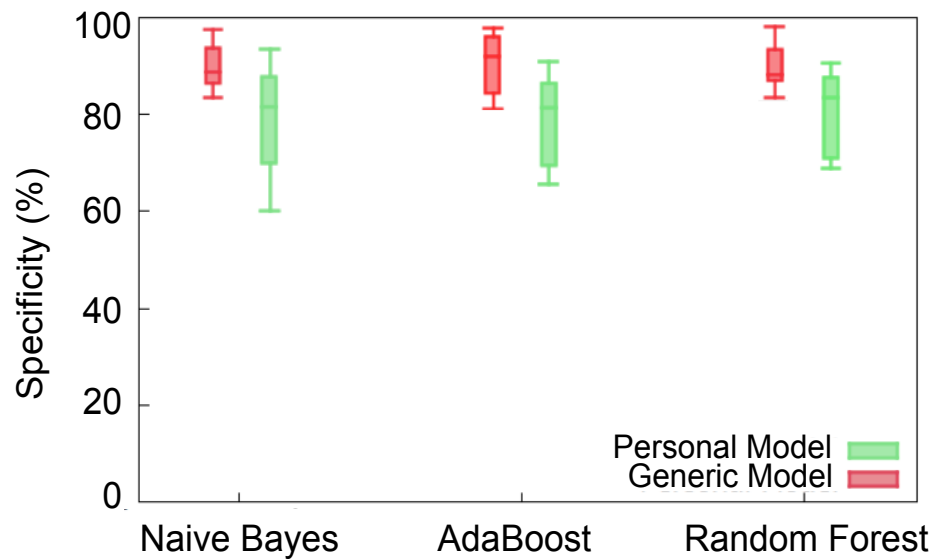
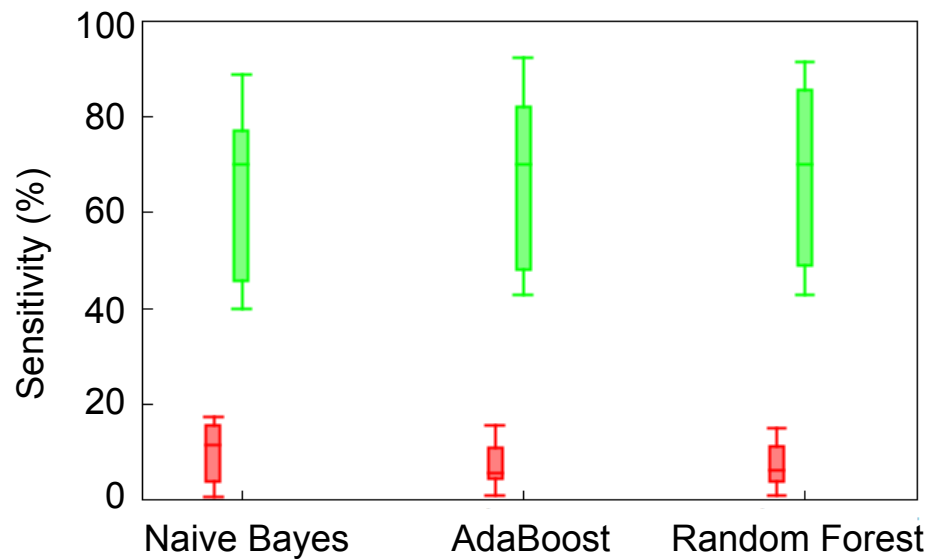


By using information type and social circle we were able to predict the acceptance of a notification within 10 minutes from its arrival time with an average sensitivity of 70% and a specificity of 80%.



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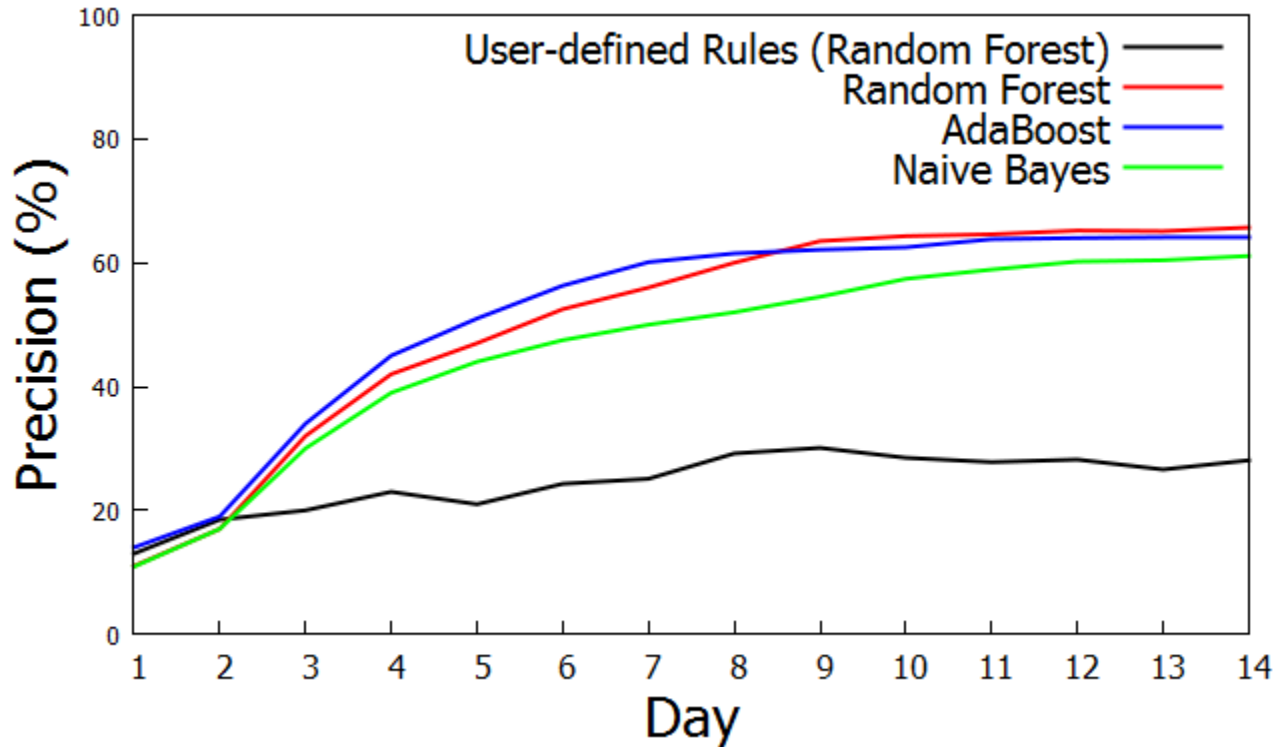
General vs Personal Behavioural Model





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Online Learning



The inference of a user's interruptibility can be performed locally in an online fashion, achieving more than 60% precision after nine days of training.



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Summary

- First *in-the-wild* study that uses both content and context to model interruptibility.
- The acceptance of a notification within 10 minutes from its arrival time can be predicted with an average sensitivity of 70% and a specificity of 80%.
- An online predictor can start making stable predictions after nine days of training.



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Thank You!



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Open Issues

- How to infer the user's willingness to receive a notification?
- How to detect notifications that contain non-useful content?
- How to capture other factors (such as level of engagement, action required to handle a notification and so on) that might influence the user's interruptibility?
- How the user reacts when notifications are stacked by an application.