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Extending the Gmail User-Interface to Leverage Prediction of Response Times and Hierarchical Recipients

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Abstract. Recent work has shown how the Gmail user-interface can be extended to make use of algorithms for predicting a flat list of email recipients. We build on this work by addressing how this user-interface be extended to make use of external algorithms for predicting (a) a hierarchical list of email recipients, and (b) the expected time to get a response from a recipient. We have augmented the existing view for sending messages to allow users to view predictions of response times and hierarchical recipients, and use one click to select a subgroup of predicted recipients. We have also added new folder-specific commands to the views for browsing folders that allow users to use one click to highlight, un-highlight, and select messages whose responses have not arrived or been sent within the predicted times. We have also developed a new configuration view for determining which predictions should be displayed and how often new training data should be used to change the prediction model. The user-interface is implemented as a Chrome extension that communicates with an external server to receive predictions and send training data. This architecture decouples the implementation of the user-interface and algorithms. However, our extension is intimately tied to the extended user-interface, as it reads and augments existing views and menus of Gmail.

Introduction

This work addresses intelligent support for predicting recipients of email messages (Roth, Ben-David et al. 2010, Bartel and Dewan 2012), and response times of these recipients (Tyler and Tang 2003, Bartel 2015). These two kinds of predictions are related in that choice of recipients can be a function of their response times. Hence, we address these two issues in an integrated manner, though the algorithms for these predictions, referenced above, have (so far) been independent of each other.

This paper does not address prediction algorithms, focusing instead on demonstrating a user-interface for leveraging research in these algorithms. Two previous efforts have partly addressed this issue. Gmail offers a user-interface that predicts a flat list of recipients based on the algorithm described in (Roth, Ben-David et al. 2010). Our group has previously developed a research test-bed (Hamlet, Korn et al. 2015) to experiment with predictions of hierarchical recipients and response times in which all lab subjects are given a common task involving collaboration with a built-in agent mimicking a set of other users. The test-bed, implemented from scratch, includes features of forums, social networks, and email, and is not tied to any specific client, providing only features needed in the experiment. This work combines aspects of these two efforts, demonstrating additions to the Gmail user-interface that can leverage algorithmic work in the two kinds of predictions.

Architecture and User-Interface

Extending an existing email client requires an architecture allowing addition of external user-interface elements. As Gmail is a browser-based user-interface, we were able to use the abstraction of Chrome extensions, which are zipped bundles of files such as HTML, CSS, JavaScript, and images that add functionality to the Google Chrome browser. Our Chrome extension, executing in the browser of a client computer, communicates with algorithms on a server for making recipient and response-time predictions (Figure 1). These are machine-learning algorithms that need training data to make the predictions. The extension sends these data periodically to the server. It is intimately tied to the extended user-interface, as it augments existing views and menus of Gmail - it reads the content of the loaded Gmail pages and injects functionality into them based on the data read. However, our architecture decouples the implementation of the user-interface and algorithms - the algorithms are oblivious to the ways in which the predictions are used in the user-interface, which in turn, is independent of the nature of the algorithms. Currently, our server sends hardwired synthesized data to demonstrate the capabilities of the user-interface and architecture.

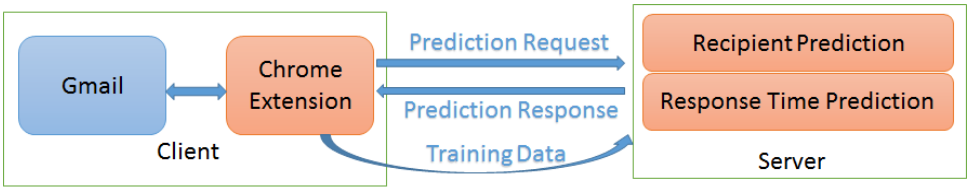

Figure 1. Extension Architecture

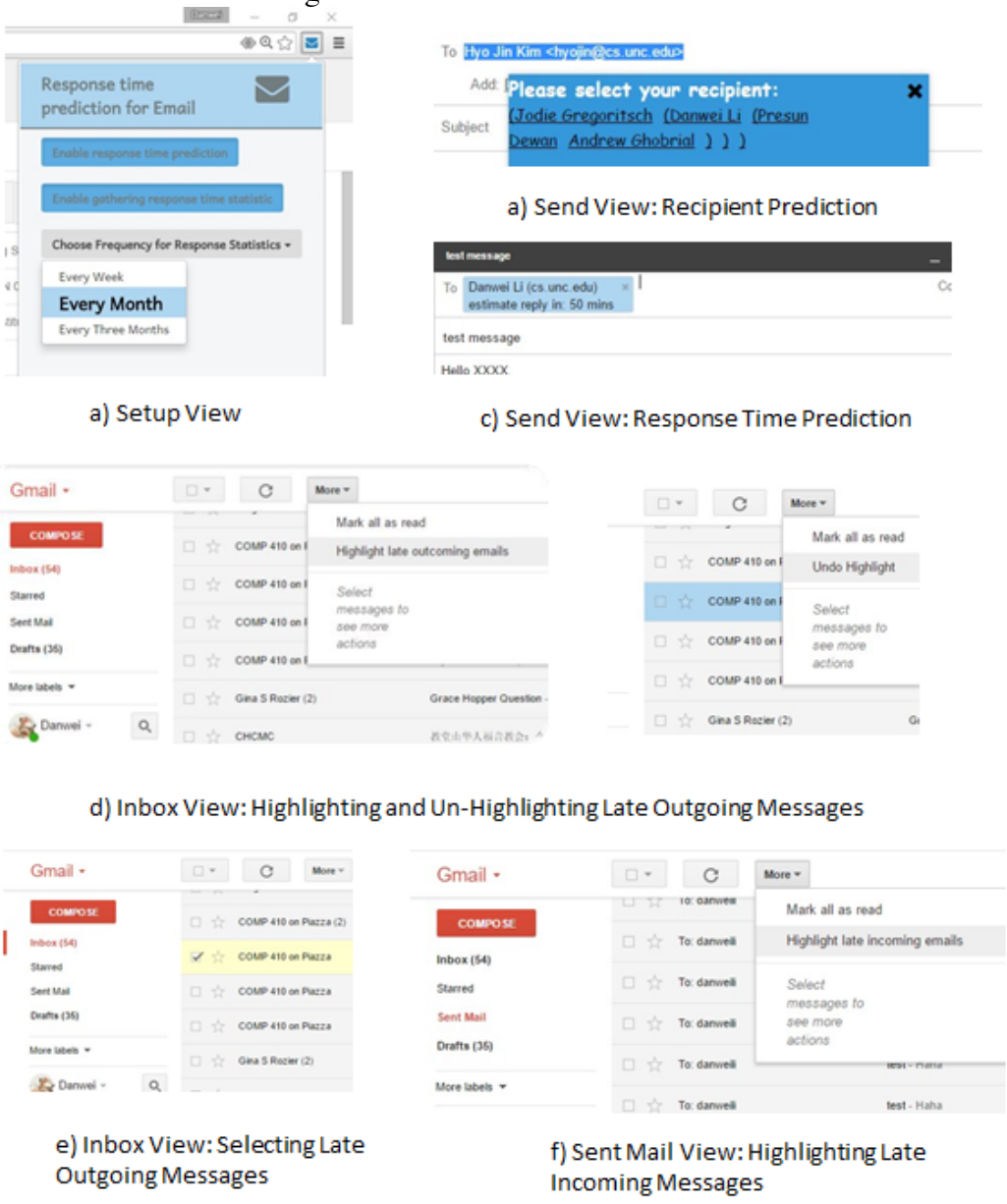

Figure 2. Preference View and Extended Send and Folder Views

Like other Chrome extensions, ours is visually represented by an icon in the Chrome browser. Clicking on it brings a pop-up window used to determine if response-time and recipient predictions are enabled, and how often training data are sent to the server (Figure 2(a)). Double-clicking on an input recipient

displays a pop-up window that shows the hierarchy of predicted recipients using nested parentheses (Figure 2(b)). Clicking on a parenthesis selects all recipients in the list enclosed by the selected parenthesis and its matching counterpart. Single-clicking on an input recipient displays the expected response time from that recipient (Figure 2(c)). Email receivers may be interested in knowing whether they have replied to emails in a timely manner. Selecting the *Inbox* or *Starred* email folders adds menu items to the existing *More* menu to (un) highlight messages that have not been replied to within the time predicted to the sender (Figure 2(d)). Conversely, it may also be beneficial for senders to know which of their sent emails have not received responses within the predicted times. Selecting the *Sent* folder adds *More* items to (un) highlight these emails (Figure 2(f)). Thus, response time predictions can become self-fulfilling prophecies! We have also extended the existing Gmail selection menu with folder-specific commands to allow users to select both kinds of messages in batch (Figure 2(e)) for existing Gmail operations such as marking as important, adding stars, adding to tasks, filtering messages such as these, and deleting. The existing "None" item in this menu can be used to unselect these messages.

This is, of course, a first-cut at implementing a user-interface with our goals and further work is needed to determine its usability and usefulness. For example, as far, as we can tell, adding folder-specific commands to folder-manipulation menus is an innovation, and thus needs more feedback from potential and actual users. Presentation and publication of this implementation provide a basis for such future work. In particular, we hope conference attendees and readers of this paper will give us feedback through direction interaction and/or email about the potential uses of our predictions of response times and hierarchical recipients, our notions of late sent and received messages, and our commands to select and (un) highlight such messages.

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