# Investigations into History Tools for User Support

Alison Lee

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In the Memory of
My Grandparents

A man, viewed as a behaving system,
is quite simple. The apparent complexity
of his behaviour over time is largely
a reflection of the complexity of the environment
in which he finds himself.

Herbert A. Simon,
The Science of the Artificial,
MIT Press (1969).

# Table of Contents

# Abstract

*History tools* allow users to access past interactions kept in a *history* and to incorporate them into the context of their current operations. Such tools appear in various forms in many of today's computing systems, but despite their prevalence, they have received little attention as user support tools. This dissertation investigates, through a series of studies, history–based, user support tools. The studies focus on three primary factors influencing the utility of history–based, user support tools: design of history tools, support of a behavioural phenomenon in user interactions, and mental and physical effort associated with using history tools.

Design of history tools strongly influences a user's perception of their utility. In surveying a wide collection of history tools, we identify seven independent uses of the information with no single history tool supporting all seven uses. Based on cognitive and behavioural considerations associated with the seven history uses, we propose several kinds of history information and history functions that need to be supported in new designs of history tools integrating all seven uses of history.

An exploratory study of the UNIX environment reveals that user interactions exhibit a behavioural phenomenon, nominally referred to as *locality* . This is the phenomenon where users repeatedly reference a small group of commands during extended intervals of their session. We apply two concepts from computer memory research (i.e., working sets and locality) to examine this behavioural artifact and to propose a strategy for predicting repetitive opportunities and candidates. Our studies reveal that users exhibit locality in only 31% of their sessions whereas users repeat individual commands in 75% of their sessions. We also found that history tool use occurs primarily in locality periods. Thus, history tools which localize their prediction opportunities to locality periods can predict effectively the reuse candidates.

Finally, the effort, mental and physical, associated with using a history tool to expedite repetitive commands can influence a user's decision to use history tools. We analyze the human–information–processing operations involved in the task of specifying a recurrent command for a given approach and design (assuming that the command is fully generated and resides in the user's working memory and that users exhibit expert, error–free task performance behaviour). We find that in most of the proposed history designs, users expend less physical effort at the expense of more mental effort. The increased mental effort can be alleviated by providing history tools which require simpler mental operations (e.g., working memory retrievals and perceptual processing). Also, we find that the typing approach requires less mental effort at the expense of more physical effort. Finally, despite the overhead associated with switching to the use of history tools, users (with a typing speed of 55 wpm or less) do expend less overall effort to specify recurrent commands (which have been generated and appear in working memory) using history tools compared to typing from scratch.

The results of the three sets of studies provide insights into current history tools and point favourably towards the use of history tools for user support, especially history tools that support the reuse of previous commands, but additional research into history tool designs and usability factors is needed. Our studies demonstrate the importance of considering various psychological and behavioural factors and the importance of different grains of analysis.

# For The Record

Earlier versions of the following chapters were published or presented in 5 conferences, 1 workshop, and 1 book.

Chapter 1 is an abridged version of the paper appearing in Lee (1992a).

Chapter 2 is a revised version of a paper appearing in Lee (1990b).

Chapter 3 is a substantially revised version of a paper appearing in Lee (1990a).

Chapter 4 is a revised version of a paper appearing in Lee and Lochovsky (1990a).

Chapter 5 is a revised version of a paper appearing in Lee and Lochovsky (1990b).

The experiment in the section entitled "Accuracy of the Cognitive Models' Predictions" in Chapter 6 is a longer version of a short talk appearing in Lee (1992b).

The visual search experiment in Appendix D is a longer version of a poster appearing in Lee and Lochovsky (1991).

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