Statement of Purpose

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My primary research objective and interest is in the area of Human Computer Interaction. I am currently studying computer science at Stanford University, with HCI as the specialization. I believe that the most important HCI investment for the next decade would be in the management of vast amounts of data. Through my research, I want to make it easier for people to organize, manage, and make sense of data. I plan to continue research after my Ph.D., as a faculty in academia.

1 Research

While I always had a passion for building software tools, initially I focused mostly on the system building aspect of it. It was only during CS 376 (Research Topics in Human Computer Interaction), a course taught by Prof. Scott Klemmer at Stanford University, I started thinking about research seriously. As part of the course, I did a research project called Redprint[1], which later got accepted at UIST as a demo paper[2]. After Redprint, I got involved with two more very interesting research projects which I will discuss in detail, in the following sections.

1.1 Redprint

Joel Brandt's thesis work at Stanford, explored the roles that code examples play during software development. As part of this work, he built Blueprint[3], a search interface integrated into the Adobe Flex Builder development environment that makes it easier for programmers to locate and use instructive code examples.

Blueprint helped programmers a lot as they could find task specific code examples from within the IDE. However, when I tried to closely observe the programmers using a Blueprint kind of IDE (a custom IDE I had built for experimental purposes), it was surprising to see that they still visited search engines like Google during coding. The interesting part though, was that their search queries were different this time. They were looking to find API (Application Program Interface) documentation and samples to understand the APIs used in the borrowed code.

My Redprint work extends Blueprint to provide API specific "Instant Example" and "Instant Documentation" display interfaces within the development environment. These display interfaces do not require the programmer to enter any search query; there is a continuously running background search that looks at the cursor position in the editor window and updates these interfaces with the related API's documentation and sample code. This significantly reduces the cost of searching and the time to develop software.

1.2 Visual/Design Search, Style Based Search

Current search engines are largely text based, and the text vocabulary that they use is a poor match for the style based concerns. Search engines return pages based on content match with the keyword query; they cannot be used for searches along stylistic attributes such as 'pages with funny backgrounds'.

I am working on a system that will allow users to query on stylistic attributes. The search query could be either language-keyword based or it could be based on examples i.e. a user can select a design and ask the system to show other examples in the corpus that are similar (or dissimilar) to the designs in the query. For example, a user can select a header element in a web page, and query the system for other pages with similar (or dissimilar) headers. I am also thinking of a search interface that can allow users to create abstractions (user can draw nested rectangular boxes and affix known semantic labels to them (header, logo, image, etc.)) to describe a design layout and use that as a query. The system could search for pages that mimicked the layout exactly, with similar content blocks positioned in similar relative locations.

I am using a machine learning technique to solve this problem. Given a set of training examples consisting of web design's tree representation and a style label distribution, the labels are used to learn the parameters of the system via a back-propagation neural network which is applied recursively to each node in the binary tree representation of the web page. Once these parameters are learned, the system can predict the style distribution for any given Web page. Example-based querying can be implemented on top of this representation.

This work is a part of the Bricolage[4] project, being led by Ranjitha Kumar, a Ph.D. student at Stanford, advised by Prof. Scott Klemmer.

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[1] http://projects.abhardwaj.org/redprint/
[2] http://dl.acm.org/citation.cfm?id=2046408
[3] http://hci.stanford.edu/research/opportunistic/
[4] http://hci.stanford.edu/research/bricolage/

1.3 Data Wrangler

Data Wrangler[5] is an interactive system for creating data transformations. It combines direct manipulation of visualized data with automatic inference of relevant transforms, enabling analysts to iteratively explore the space of applicable operations and preview their effects.

I am collaborating with Sean Kandel (a Ph.D. student at Stanford, advised by Prof. Jeff Heer), who is the primary investigator for this project. My work focuses on building a high level language, which abstracts the low level script/sql query and allows users to express the transformations in a much more simple and intuitive way. Since the direct manipulation techniques don't scale well for large data cleaning tasks (because it requires a lot of human effort like drag, drop, mouse clicks, etc..), this high level scripting language can be used for describing the specification. It involves some classic HCI problems like threshold and ceiling trade-off, how to provide a path of least resistance, etc.

2 Teaching

Currently, I am TAing CS 247 (HCI Interaction Design Studio), a graduate course in HCI, taught be Prof. Jeff Heer. In the Fall, I TAed CS 249A (Object Oriented Programming from Modelling and Simulation perspective), taught by Prof. David Cheriton.

3 Related Courses

To get a good understanding of the topics related to HCI, I took the HCI sequence offered at Stanford - 'Intro to HCI', 'HCI Interaction Design Studio' and 'Research Topics in HCI'. One other course that I found very useful, was 'Designing Computer Science Experiments, Klemmer and Levis' – it helped me understand the experiment design aspect of computer science research. I attend Stanford HCI seminar regularly, for keeping myself updated about the interesting research problems in the area of HCI.

4 Industry

I spent about 3 years, working in the industry. Last summer, I interned at Oracle, where I worked on the user interaction for iPhone and Android based clients for their OPAM (Oracle Privileged Account Management) workflow. I also wrote OPAM client SDK. This work manifested into a patent application which has already been submitted, and is pending approval. Prior to coming to Stanford, I worked for a little more than 2 years at BMC Software as a Product Developer for their Marimba products. Some of my key contributions include – Intel AMT (Active Management Technology, a.k.a vPro) integration and a Java SDK for programming AMT, x64 architecture support for Marimba, and auto relay mechanism for WOL (Wake on LAN) to work across WAN.

5 Conclusion

Having spent some time in industry and then two years at Stanford for my Masters, I now want to pursue a Ph.D., as it would allow me to do a much focused research. In my research, I want to go beyond building prototypes, and build production quality software systems such that they are used by other people for their daily work. As Prof. John Ousterhout suggests, designing for production use forces us to think about important issues that could be ignored otherwise, and measurements of usage allow us to evaluate our ideas more thoroughly.

At Stanford, Scott Klemmer and Jeff Heer are working on the research problems related to different aspects of management of vast amounts of data.

Most of Scott's research are in the area of leveraging the online information to increase the quality of people's creative work - especially interface design and programming. This opens many sub-areas of research which I would love to explore.

I am also interested in Jeff's research, especially related to investigating the factors involved in making sense of data – especially visualization tools.

I would love to work with either Scott or Jeff at Stanford.

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[5]http://vis.stanford.edu/wrangler/