A major problem with current search engines is that the retrieval process is query-driven. Information about the user and her preferences is highly neglected. Considering the large variety of internet users, there is substantial room for improving retrieval systems using this additional information.

In the past few years, user adaptive information retrieval has received increased attention. Most of the work has focused on eliciting user’s preferences using query histories, demographics and click-through rates. Although such approaches might improve the search results in some cases, they do not address the full problem. Moreover, users might change their goals rapidly and therefore cause retrieval methods based on histories to fail.

In our work, the goal is to learn user’s preferences at query time by asking questions. This active probing system has to be carefully designed to ensure that the improvement in retrieval outweighs the cost of requesting the user to enter more information. Keeping this in mind, we are focusing on image search and content based image retrieval, where artists often spend hours of their time looking through thousands of images to find pictures of interest. Although this approach can be extended to other items, such as documents and videos, we feel that the existing image search engines are most in need of our suggested improvements.

Google’s image search engine returns an extremely high number of outliers for most keywords even on the first few pages. Moreover, Google’s retrieved images are neither ranked according to user preferences nor according to image content. Our work attempts to address these two shortcomings.

Our method proceeds as follows. After the user enters the query words, she is asked to give scores of 1-4 to, say, 10 images on Google’s first results page. Here, 1 indicates the highest satisfaction level, 2 and 3 indicate average and bad images and 4 indicates that the user does not want to see more of these images because of polisemy (e.g., “river bank” when querying “bank” with money in mind) or other forms of irrelevance (often arising from the fact that Google uses image tags to conduct the original search). Alternatively we can also ask the user to provide a ranked list for the images on this first page.

Once we have gathered the preference labels (ranks) for the images on the first page, we use semi-supervised learning with Gaussian processes for ranking to sort the remaining images retrieved by Google. The Gaussian process maps image features (colour and texture in our implementation, but other features could be considered) to a ranked list. After conducting this mapping, all the images for a particular query are ranked according to their visual content as well as the elicited preferences. We then present the images to the user using Google’s interface, but according to the new rank. This allows the user to probe quickly into deep results pages in accordance to the quality of the data on the first page and the user’s preferences.

Our system can also adapt using standard active learning techniques for Gaussian processes. In particular, it can determine which picture could be presented to the user in order to maximize the Gaussian process performance. The number of times this process is repeated is controlled by the user.

We have an implementation of these ideas that produces good results. To quantify the quality of these results, we have begun undertaking several user studies.

Although relevance feedback for information retrieval is not new, engaging the user in the task of ranking with semi-supervised and active preference learning methods is novel and can play a key role in the design of practical adaptive search engines.