# A Web Site Navigation Engine

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## 1. INTRODUCTION

Often users navigating (or "surfing") through a Web site "get lost in hyperspace", when they lose the context in which they are browsing, and are unsure how to proceed in terms of satisfying their original goal [4]. The unresolved problem in Web site usability, of assisting users in finding their way, is termed the *navigation problem.* (See [3] for a survey and critique on the navigation problem.) This problem is becoming even more acute with the continuing growth of Web sites in terms of their structure, which is becoming more complex, and the vast amount information they intend to deliver. In contrast users are not willing to invest time to learn this structure and expect delivery of the relevant content without delay.

Although global search engines such as AltaVista, Fast and Google are successful in directing users to the appropriate Web sites, finding the information on the actual sites is often very problematic due to the navigation problem discussed above. As a result, site-specific search is becoming increasingly important as evidenced by a recent Forrester survey [1], which reported that most Web site managers consider search to be a critical factor of their site's functionality. However, as reported in [1] current site-specific search engines fail to deliver all the relevant content, return too much irrelevant content and do not rank the pages returned according to the user's information needs. One of the reasons for the failure of current site-specific search engines is that they are not able to pick up the "scent of information" [5], that is, they fail to detect the hyperlinks that, when followed, lead to the information that the user is looking for. Moreover, Hearst [2] argues that next generation site-specific search engines should support the user's tasks by helping to cut down the relevant routes the user should follow given an information need.

To tackle these problems we are developing a navigation system for semi-automating user navigation which builds *trails* of information, i.e. sequences of linked pages, which are relevant to the user query. (We will assume that a query is simply a set of keywords representing the user's goal at the start of the navigation session.) The preferred trails are presented to the users in a tree-like structure which they can interact with. This is in sharp contrast to a search engine which merely outputs a list of pages which are relevant to the user query without addressing the problem of which trail the user should follow. We discuss the architecture of the navigation system and give a brief description of the navigation engine and user interface. The navigation system is being developed by NavigationZone Limited, which is a recent startup company currently located in the Computer Science Department at UCL. We are about to release the first alpha version of the system, which is implemented to execute within Microsoft Internet Explorer.

## 2. ARCHITECTURE OF THE NAVIGATION ENGINE

The architecture of the navigation system is shown in Figure 1. The *user interface* executes within a Web browser such as Microsoft Internet Explorer or Netscape Navigator. It obtains the preferred trails for navigation, given a user query, from the *navigation engine* and requests pages for display from the Web site via a proxy.

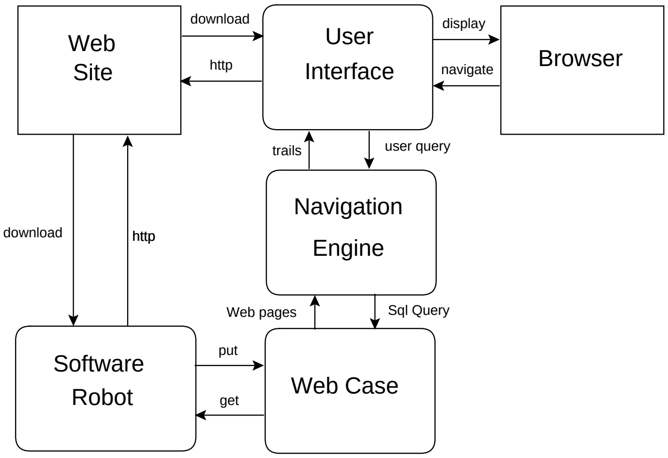


**Figure 1: Navigation engine architecture**

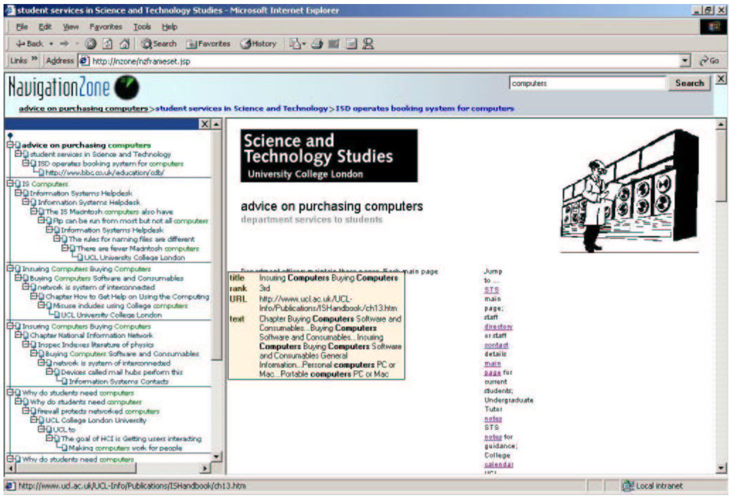
The navigation engine consists of two main modules: (i) the information retrieval module, and (ii) the best trail module. The information retrieval module does conventional information retrieval over Web pages combined with a novel page ranking algorithm that takes into account the potential of a Web page as a starting point for navigation. The best trail module computes the preferred trails for navigation given the input query. The algorithm is adaptive in the sense that it dynamically searches for the preferred trails by mimicking a user navigation session and scoring the trails as they are expanded according to the topology of the Web site. (See [3] for some detail of the algorithmic process used by the navigation engine to compute the preferred trails given a user query.)

The navigation engine interacts with a *Web case*, which is a relational database for storing the details of the pages of the Web site in preprocessed form. The *software robot* is an offline process which is responsible for the creation of the Web case.

## 3. USER INTERFACE

The user interface includes two main mechanisms: (i) the *navigation tool bar* and (ii) the *navigation tree window*. The navigation tool bar contains a sequence of hyperlinks, where the hyperlink for the Web page currently being displayed is underlined. The hyperlinks to its right show the best trail found from the current page, providing a recommendation mechanism, and the hyperlinks to its left refer to the pages that the user previously visited, thus providing a history mechanism. Putting the cursor over a hyperlink causes a popup to appear which displays the title of the page, its URL, a summary of the page's content and other useful information pertaining to the page (cf. [6]). In addition, all hyperlinks are clickable and cause the navigation tool bar to be updated accordingly. The navigation tree window displays the preferred trails given the user query, organised in the form of a tree structure with the trails being ranked from the most preferred, according to their score. The user interacting with the navigation tree window can select any Web page on one of the preferred trails causing the page to be displayed. The navigation tool bar, the navigation window and the browser window are all synchronised according to the current page. The mechanisms of the user interface provide the user with guidance and context throughout a navigation session, given the input query. The user interface can be embodied in a Web site as a navigation mechanism complementing or replacing a Web site search engine.

For the alpha release of the system we have created a Web case for the Web site of University College London (UCL), whose domain name is ucl.ac.uk. Below we show two screen shots for the query "computers". The first one, shown in Figure 2, is the output from our navigation engine, and the second one, shown in Figure 3, is the output from UCL's local search engine. The results from the navigation engine help the user to find the context within the Web site of the information pertaining to "computers" by displaying the trails which are relevant to this query. For example, the first trail indicates that the Information Systems Division (ISD) at UCL provides computing services for students, while the second trail implies that ISD provides a help desk facility including Macintosh support. The search engine's results do not provide this contextual information. The best it can do for this type of query is provide a good starting point for the user to initiate a navigation session.


student services in Science and Technology Studies - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
Links Address http://nzone/nzframeset.jsp Go
NavigationZone
computers Search

advice on purchasing computers > student services in Science and Technology > ISD operates booking system for computers

- advice on purchasing computers
  - student services in Science and Technology
    - ISD operates booking system for computers
      - http://www.bbc.co.uk/education/cdb/
- IS Computers
  - Information Systems Helpdesk
    - Information Systems Helpdesk
      - The IS Macintosh computers also have
        - Ftp can be run from most but not all computers
          - Information Systems Helpdesk
            - The rules for naming files are different
              - There are fewer Macintosh computers
                - UCL University College London
- Insuring Computers Buying Computers
  - Buying Computers Software and Consumables
    - network is system of interconnected
      - Chapter How to Get Help on Using the Computing
        - Misuse includes using College computers
          - UCL University College London
- Insuring Computers Buying Computers
  - Chapter National Information Network
    - Inspec Indexes literature of physics
      - Buying Computers Software and Consumables
        - network is system of interconnected
          - Devices called mail hubs perform this
            - Information Systems Contacts
- Why do students need computers
  - Why do students need computers
    - firewall protects networked computers
      - UCL College London University
        - UCL to
          - The goal of HCI is Getting users interacting
            - Making computers work for people
- Why do students need computers

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| title | Insuring **Computers** Buying **Computers** |
| rank | 3rd |
| URL | http://www.ucl.ac.uk/UCL-Info/Publications/ISHandbook/ch13.htm |
| text | Chapter Buying **Computers** Software and Consumables...Buying **Computers** Software and Consumables...Insuring **Computers** Buying **Computers** Software and Consumables General Information...Personal **computers** PC or Mac...Portable **computers** PC or Mac |

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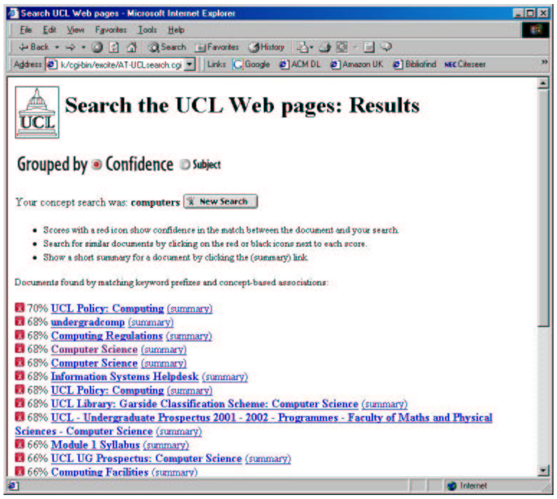
http://www.ucl.ac.uk/UCL-Info/Publications/ISHandbook/ch13.htm

**Figure 2: Navigation engine results for query "computers"**


Search UCL Web pages - Microsoft Internet Explorer
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Address k/cgi-bin/excite/AT-UCLsearch.cgi
Links Google ACM DL Amazon UK Bibliofind NEC Citeseer
UCL

Search the UCL Web pages: Results

Grouped by ● Confidence ○ Subject

Your concept search was: **computers** New Search

- Scores with a red icon show confidence in the match between the document and your search.
- Search for similar documents by clicking on the red or black icons next to each score.
- Show a short summary for a document by clicking the (summary) link.

Documents found by matching keyword prefixes and concept-based associations:

70% UCL Policy: Computing (summary)
68% undergradcomp (summary)
68% Computing Regulations (summary)
68% Computer Science (summary)
68% Computer Science (summary)
68% Information Systems Helpdesk (summary)
68% UCL Policy: Computing (summary)
68% UCL Library: Garside Classification Scheme: Computer Science (summary)
68% UCL - Undergraduate Prospectus 2001 - 2002 - Programmes - Faculty of Maths and Physical Sciences - Computer Science (summary)
66% Module 1 Syllabus (summary)
66% UCL UG Prospectus: Computer Science (summary)
66% Computing Facilities (summary)

**Figure 3: UCL search engine results for query "computers"**

## 4. REFERENCES

[1] P. Hagen, H. Manning, and Y. Paul. Must search stink? The Forrester report, Forrester, June 2000.

[2] M. Hearst. Next generation web search: Setting our sites. *Bulletin of the technical Committe on Data Engineering*, 23:38–48, 2000.

[3] M. Levene and G. Loizou. Web interaction and the navigation problem in hypertext. In A. Kent, J. Williams, and C. Hall, editors, *Encyclopedia of Microcomputers*. Marcel Dekker, New York, NY, 2001. To appear.

[4] J. Nielsen. *Designing Web Usability: The Practice of Simplicity*. New Riders Publishing, Indianapolis, Indiana, 2000.

[5] P. Pirolli. Computational models of information scent-following in a very large browsable text collection. In *Proceedings of ACM Conference on Human Factors in Computing Systems*, pages 3–10, Atlanta, Georgia, 1997.

[6] H. Weinreich and W. Lamersdorf. Concepts for improved visualization of web link attributes. *Computer Networks and ISDN Systems*, 33:403–416, 2000.