

## The Electronic Classroom Via the World Wide Web

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### Abstract

The use of computer-based instruction in engineering curricula is changing due to the rapid expansion of the Internet-based World Wide Web (WWW, or the Web) and the growing availability of electronic interactive Web browsers. The utility of Web servers and browsers as a personal communication mechanism offers numerous opportunities for innovative instructional methodologies. In its simplest form, servers disseminate course material such as syllabi and homework assignments and solutions. In more sophisticated arrangements, the Web client/server relationship provides self-paced interactive tutorials or proctors regular examinations. Web-based utilities provide opportunities to enhance the faculty-sponsored student services. For example, instructional help is available to the student on a demand basis. Web-based tools function as other computer-based instructional tools with immediate feedback to the student and individualized tracking ability for the faculty. There are limitations. Internet response time can be unpredictable and the requirements of a sophisticated personal computer raises the startup costs for students. Interfaces to application programs and operating systems are still difficult to use, but this situation is improving rapidly. A senior elective at The University of Memphis, *Software Design with Ada: ELEC 4274*, is taught with the Web as one of the primary tools of dissemination, instruction, and testing. Preliminary results indicate a high-level of student interest in the Web-based tutorials and exams.

### The Ubiquitous Web

The world wide web (WWW), or simply, the Web, is fast becoming the communication medium of choice among Internet users. The seamless integration of graphics, audio, and textual display and file utilities makes the Web a natural choice for dissemination and transfer of multi-media information. Loosely defined, the Web is client/server model running high-level applications and communications protocol built upon a broad-band communication backbone (usually the Internet). The exchange of information (files, images, sound, etc. ) is governed by communication protocols, such as the Hyper Text Transfer Protocol (HTTP), and the presentation is specified by interpretive languages like the Hyper Text Markup Language (HTML).

The growth of the Web has been and continues to be dramatic. The loose coupling between client and servers makes for rapid, and sometimes, uncontrolled growth. The wide availability of public domain and other inexpensive servers and clients has led to wide acceptance and use in the academic community. The modes of use in the academic community is also starting to flourish, including those uses as teaching and learning tools.



## Web Interactive Modes

Technically, the Web is a set of servers and browsers that communicate via HTTP transferring HTML documents between the servers and browsers. A more practical definition is that the Web is a loosely coupled collection of information file servers that process file requests from clients, also known as browsers. Popular browsers, such as Netscape and Mosaic, communicate via several Internet protocols, such as ftp, gopher, and http. This presentation focuses on the HTML aspects of Web-based instructional tools.

The primary purpose of the HTTP/HTML Web systems is the exchange of multi-media information contained in files that are accessible via the Web-server. The power in the HTTP/HTML Web systems is that HTML documents are locally interpreted, i.e., each browser produces a locally generated display image of the HTML document obtained from the server. HTML documents, which may contain audio, graphic, and text files are transmitted as an as needed basis. Browsers interpret the various file formats with helper applications that display the appropriate information. Examples include the JPEG and GIF image formats or the QuickTime video format. A typical example of an HTML Web document is the author's "Home Page" as shown in Figure 1.

The HTTP environment has two modes of interaction between browsers and user-defined programs. The Common Gateway Interface (CGI) is a mechanism that governs communication between the browsers and programs maintained on the server. The CGI interface allows users on remote machines to run executable programs through the browser on the host server. Another emerging executable standard for browsers and the Web is the development of a local, browser-interpreted programming language. The first extension of the local interpretation concept is the *Java* virtual machine language. *Java* is a powerful, interpretive language that creates moderately-sized programs that are downloaded from a server to a browser. The browser runs the *Java* program locally (i. e., inside the browser). The *Java* language was released in late January 1996. The *Java* language is a syntactic derivative of C++ and a semantic relative of *Ada*. In fact, an *Ada* compiler, *AdaMagic* that produces *Java* byte-codes is now available from InterMetrics Corporation.

## Web Courseware

Web-based tools offer a broad spectrum of communication support for instructional use, ranging from simple information dissemination to total course instruction. At the low end, the Web can display and disseminate course information such as syllabi, homework assignments, and lecture notes in a raw form. A good example is an introductory engineering course at Vanderbilt University, ES 130 [1]. The level of sophistication increases as the amount of interaction between the recipient and the information server increases, i.e., as the Web moves from a demonstration tool to an instruction device. For example, a Web browser can display a series of lecture notes for review by students (if sufficient resources are available, the browser could display the lecture itself ) [2]. This arrangement is certainly beneficial to the student because it is self-paced with opportunities for review. Another level of sophistication is the addition of periodic quizzes or questions throughout the lecture, thereby simulating (in a crude way) a Socratic teaching style. The level and sophistication of the interaction is only limited by the complexity of the hypertext document and the hyperlink pathways in the document.

In addition simple file display, the CGI and *Java* interfaces allow for a more general purpose interaction between the server and the browser. The CGI allows for the browser to run programs maintained by the server. For example, a Web browser can serve as a front end to popular engineering tools, such as Mathematics, SPICE, or *Matlab*. Input and output from the engineering tool is passed through the CGI



**interface** between the server and browser. Practice sessions, quizzes, homeworks can be built around other software tools, using the **CGI** gateway. The *Java* language allows for the opportunity for the browser to run a program locally. These programs, popularly known as **applets**, can be used for moderately-sized **demonstrations** or interactions.

### A Case Study

A senior elective at The University of Memphis, *Software Design with Ada: ELEC 4274*, is taught with the Web as the primary tool of information dissemination and as a secondary tool for instruction and testing. The course syllabus, homework list and other course information was distributed electronically via the Web server. The home page for the course is shown in Figure 2. The home page for the course also served as a repository for other Web services and information regarding course topics. The most successful aspects of the Web was the use of the *Lovelace* tutorial for *Ada*. The standard *Lovelace* tutorial is an interactive, self-paced modular tutorial with simple quizzes following each module. For this course, the tutorial was modified so that quiz results were automatically forwarded to the course grade database. The use of tutorial was well-received by the students as a teaching tool. Class time normally spent on teaching the basics of the *Ada* language was spent on language subtleties and design issues.

### Future Trends

The future for Web-based instructional and educational tools is very promising. Its main advantage is that it will be the primary communications media in the short term for Internet users. Its will clearly dominate in the broadband academic environment as well as in local, closed networks. The modes of multi-media display will continue to expand and features such as “realtime” audio and video will be commonplace. The two modes of user-defined executable action, local (*Java*) and server (**CGI**), will be exploited in the near term. Both modes represent different strengths. Larger, more complex tools will continue to be server-based, whereas small to medium sized programs will be downloaded for local use.

The Web and associated browsers will be the preferred communication devices in the future. The technology has some clear pedagogical and instructional benefits and but there are dangers in attempting to expect too much **educational** change with these tools. For example, real-time audio/video capabilities of Web servers/browsers can augment “distance learning” programs, but will not relieve or change underlying problems, challenges, or difference associated with distance learning. Clearly, Web technology, however, will augment current student-to-teacher communication. Its primary instructional strength will be self-paced review and instruction. Textbooks will produce hypertext companions. Efforts at complete computer-based instructional programs, however, will not be advanced by the use of the Web. The limitations of computer-based instruction are not relieved by the Web. Regardless, Web use and the use of Web-based **courseware** will continue to grow.

### References

- [1] Engineering Science 130 Home Page, <http://ciee.vuse.vanderbilt:8080/es130/home130.html>
- [2] A Short Course in Information Theory, <http://131.111.48.24/pub/mackay/info-theory/>
- [3] Dr. Michael Bartz, <http://www.ee.memphis.edu/~mjbartz/>
- [4] ELEC 4274/6274 Resource Page, <http://www.ee.memphis.edu/~mjbartz/Ada/>


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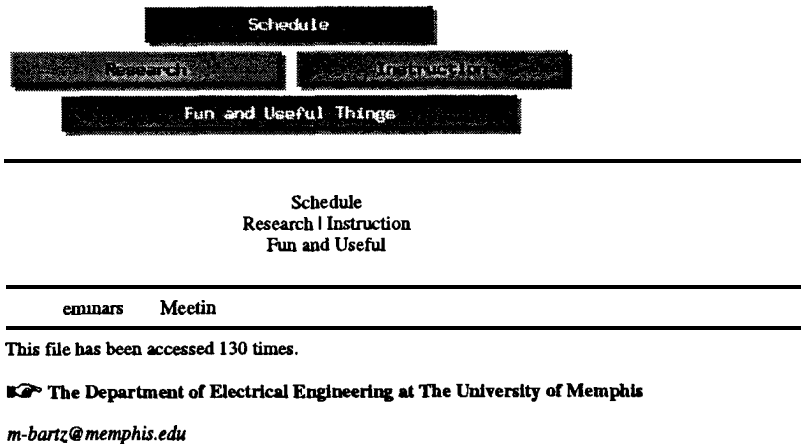



Figure 1: The Author's Home Page [3].

Welcome to

## *ELEC 4274/6274 Resource Page*

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- THE PROJECT
  - Course Syllabus
  - Answers to Exam 1
  - Assignments
  - A Basic Unix Tutorial
  - Another UNIX tutorial
  - Development Tools
  - The Lovelace Tutorial (with quiz)
  - Getting started with GNAT
  - Examples of programs and makefiles
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 [Return to The University of Memphis Ada Home Page](#)



This home page is continually under development. Send problems or comments concerning this page to [m-bartz@memphis.edu](mailto:m-bartz@memphis.edu)

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Figure 2: The Ada course home page [4].

