THE WORLD WIDE WEB: HTML, CGI AND JAVA APPLICAIONS IN ANIMAL BREEDING

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SUMMARY

Effective use of the World Wide Web can substantially improve the rate of information dissemination, thus increasing the rate of technical development. Animal breeders have only begun to use some of the features and capability of the web. However, several innovative ideas have recently been proposed and new capabilities have been added to Web services. In this paper I propose three goals for Web content in animal breeding. We, as a virtual community, should try to achieve these goals within eighteen months. By doing so we will not only begin to more effectively us the potential of the Web but we will provide guidance and experience to help us with future Web content development. The three goals are 1) develop an online database of variance components estimates of livestock species, 2) develop a distributed pre-print/reprint/e-print archive of animal breeding literature, and 3) develop a world wide breeding simulation game.
Keywords: computers, Internet, World Wide Web

INTRODUCTION

Faster than any other communications technology, ever, the *world wide web* has become a ubiquitous tool for informing and entertaining us. Since its inception and development in 198? as a scientist's project at CERN, the physics research center in Geneva, Switzerland, the Web has sustained a ferocious rate of growth with one estimate at over 650,000 as of January 1997 (Gray, 1996).

We, as both scientists and consumers, are constantly bombarded with universal resource locations (URL), the addresses that guide us to databases, technical publications, software products, advertisements, propaganda and other Web content. Those of us that have even minimal experience with the Web know that the information available for harvest oscillates from the mundane to the bazaar, to the outrageous, to the extremely important and useful.

But I do not want this writing to be yet another vituperation about the many uses of the Internet and Web services. In fact, I believe we academic animal breeders/geneticists have mostly been relatively complacent in adopting the role of World Wide Web information provider, even though we clearly have lead this area when compared to all disciplines in the animal sciences.

For a complete listing of technical animal breeding URL see http://chuck.agsci.colostate.edu. But society at large seems to have excepted the Web as an integral medium while the amount of animal breeding content is still limited to the most basic types of services. It is important for us to recognize that researchers are information specialists. As such we have an obligation to embrace this medium and show leadership in providing Web content. We have an opportunity to substantially improve the rate of dissemination of information in our field. The objective of this paper is to: 1) provide a better understanding of the technology's capabilities, and 2) propose three goals for content we should achieve in the next 18 months. Achieving these goals for content will substantially improve our application of this technology.

THREE GOALS FOR CONTENT

Goal 1: Variance Components On Line.

The first goal for content is described in (Newman et al. 1997). The developers propose to construct a database of variance components estimates in various species of livestock. The estimates will include those from both published and unpublished studies. The database will use forms for the submission of estimates. Currently a search engine has not been proposed to be included as part of the web site. It is anticipated that the database would be large and a search engine would allow for efficient searches to be performed. There are several good freely available copyleft (copyright retained but freely distributed) or public domain database management systems that could be easily made to work. In a typical configuration the search engine is fed search criteria by a Common Gateway Interface (CGI) script that processes hypertext markup language (HTML) forms input (Figure 1).

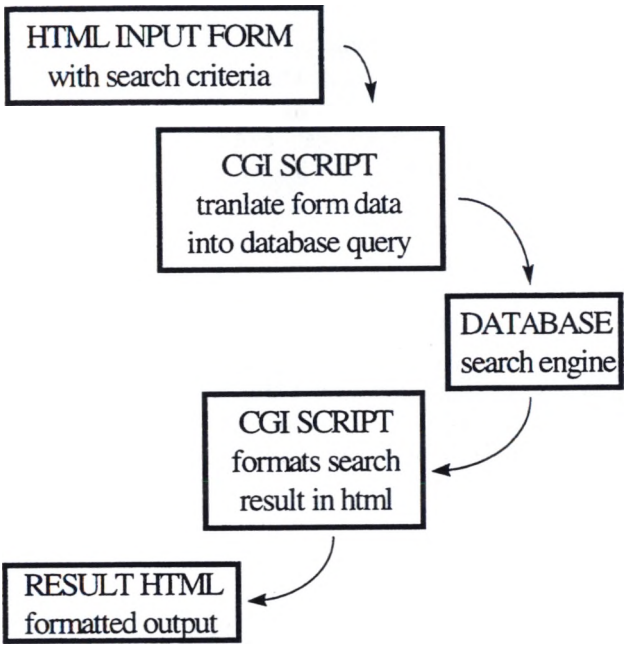
Figure 1. Sequence of processing a web based query to a database search engine using CGI.

In fact the entire software environment can be freely obtained for this type of information service. For example, the *NCSA httpd* hypertext server daemon (NCSA, 1997) or the *Apache httpd* hypertext server daemon (Apache, 1997) are very high quality copyleft packages for serving html documents. Either of these servers will operate on most UNIX environmnents including the freely distributed Linux (Linux.org, 1997). Linux supports several database management environments (Runtime Systems, 1997) and includes CGI development tools including the Perl WWW library (Christiansen and Torkington, 1997).

Goal 2: Preprint and Reprint Distribution

Since nearly the beginning preprint or e-print archives have been a popular feature of the Weband are maintained by many disciplines. These archives provide access to manuscripts in progress for topics such as physics (LANL, 1997), Monte Carlo Markov Chain based methods (Brooks, 1997), and economics (Blume and Parks, 1997). However, here I am proposing that we go beyond the current state of preprint archives. I propose we use a distributed server

model that provides access to not only work in progress but also historical work and other services.



Most Web server daemons (httpd) support personal account serving. In this configuration all account holders on the machine that has the httpd operating can establish there own services. The convention is to offer this service through a special directory on the user's account called *public_html*. Documents place in this directory are visible through a user service enabled httpd. If the server is a Unix system, such as Linux, then both Unix, DOS/Windows/Windows95/NT, and Macintosh users can take advantage of this service. Linux using the freely available *Samba* (1997) daemon can use the UNIX system as a file server in their WINS domain. For Macintosh users, the Linux file system can be available through support of APIX file system feature built into the Linux kernel. Non-Unix users can access the UNIX file system, saving files into their personal public_html directory without even knowning they are working from a UNIX environment.

In this environment maintaining URL to historical work and work in progress is relatively trivial. Because manuscripts, proposals, progress logs, and schedules can easily be maintained in content development tools there would be no burden on each us of to distribute our work as it becomes available. We would not only be able to share our most recent findings, we could

see and be prepared to understand the changes in direction taken for a college's project. Adopting this open approach to investigation would permit a substantial increase in the rate of information sharing and dissemination to our clients and students while at the same time improving the rate of technological development.

Un-reviewed dumping of work on the Web could be counterproductive. To a large extent the quality of animal breeding research depends on the constant critical evaluation of our efforts by peers. Therefore, it is important to build on top of animal breeding URL a peer review system. This system should take advantage of the dynamic nature of content providing to limit the burden on reviewers, and at the same time provide immediate information about the quality of the content.

A single URL should be established to coordinate the dissemination of the work to be studied and allow readers to make comments, either anonymously or known. Summaries of papers and other work would not only include abstracts but also an average rating of the work and the number of times it has been rated. A scale would need to be established that accounts for the technical merit and the presentation. Work in progress would also be rated and "change log" entries could be updated when modifications are made. Not only would this system allow for the rapid dissemination of the most recent results, but it would allow for critical evaluation that would help guide the final analysis

Goal 3: A Web Based Breeding Simulation Game

The third goal is the implementation of a Web based breeding simulation game. At the time of this writing a pre-alpha prototype of the beef cattle breeding game can be accessed at http://www.cowlab.org with a full production mode implementation scheduled for middle 1998. The objective of the game is to provide a realistic simulation of the effects of breeding decisions and their consequences on the economic health of the enterprise. The intended audience is not only students enrolled in undergraduate courses in animal breeding but also high school students, secondary school students, 4H members, FFA members, graduate students, farmers, ranchers and anyone interested.

To play the game the contestant enrolls with the Web server by paying a nominal fee. The player is given a line of credit (in game dollars) with which to purchase a breeding herd. Breeding females are purchased from a computer controlled order buyer market and breeding bulls are purchased from an auction market. There are several breeds to choose from and the player can decide to produce either commercial or registered stock. Measurements on twelve quantitative traits with a total of sixteen genetic components are provided for selection. In addition, five qualitative traits are provided.

To help ensure the games viability it will be implemented as a quasi-commercial effort. Sponsors are being sought to provide financial support for the implementation. Sponsors will receive advertising space on some pages that can be hyperlinked to URL of their choosing. It is

hoped that additional revenue can be generated by selling sponsorship of certian portions of the game. For example, the game has an artificial insemination stud that purchases bulls and distributes semen to players. A sponsor can choose to purchase the stud and name it.

Revenue generated by the game will be used to keep the cost to the players down by providing the technical support and hardware necessary to support an anticipated 10,000 players. Many innovative design features had to be incorporated to allow for efficient operation within the complex requirements specified for the game's deign. For example, the game makes extensive use of the Java language (Sun Microsystems, 1996), an object oriented programming language with special enhancements to allow for interaction and communication in Web applications. One of the tasks for which Java is used is to manage and submit bid information for the purchase of breeding bulls. The user is presented with a window produced by a Java applet (small applications program). In another window the user can select a button next to the identification number of a bull of interest. The applet requests the current bid price on the bull from a remote bid server (running a bid management daemon). If the user wants to place a bid on the bull he/she enters the amount to bid in a textbox in the applet window and presses a "submit bid" button. This configuration allows the user's computer to perform all the formatting work and places a minimal load on the bid server. The bid server daemon does not necessarily run on the same machine as the httpd and it is responsible for only sending and receiving bid information packed into a minimum number of bytes. Thus, the bid server is highly available and creates as little network traffic as possible.

IMPLICATIONS

By achieving these three goals we can begin to bring our use of the World Wide Web into the next generation of applications. These three applications represent innovative uses of the web that will not only provide important services to each other and our clients, but will also provide information as to what the web is capable of.

To successfully implement these applications will require commitment from a large critical mass of us. These applications require the recognition of all animal breeders that the Web is an important tool in our discipline and it is worth the effort to develop the skills required to use it.

The Animal Geneticists Discussion Group (Golden, 1996) and other efforts such as the Directory of Animal Breeders (Schaffer, 1997) have demonstrated the power of this medium in animal breeding. It is now time to build the next generation of Web services.

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