# The Proteus Bibliography: Representation and Interactive Display in Databases

*T. Lougenia Anderson** *Earl F. Ecklund, Jr.** *David Maier*** †

*Tektronix, Inc., Computer Research Laboratory

**Oregon Graduate Center

## Introduction

The study of database systems has largely overlooked the display of data, even though database applications typically contain more code for data display and entry than for data manipulation. Relational technology provides a facile abstraction of secondary storage; there is no analogous abstraction for user interfaces. With the advent of object-oriented database systems that support complex objects and multiple connectivity, a fixed format for displaying the results of queries is no longer adequate.

The PROTEUS (for *Polymorphic Representation of Objects for Tailored End-User Systems* project represents joint research between Tektronix and the Oregon Graduate Center. Its goal is to define tools to specify, store, and utilize object-oriented user interfaces in a DBMS. Thus, not only is the DBMS data to be stored as objects, but everything the user sees or manipulates is to be a database object, subject to external representation formats. In fact, the external representation formats are themselves database objects.

A second goal is to support interactive user interfaces, which means that PROTEUS must support both visual specifications (what the user sees) as well as behavioral specifications (how the user interacts with the interface). These specifications of the visual and behavioral aspects of the user interface should be given declaratively rather than procedurally, as can now be done for DBMS data definition and manipulation. We feel declarative specification makes construction and reuse of interfaces easier, allows tuning and minor modification without disproportionate amounts of programmer time, and allows optimization and physical independence of interfaces. Also, customization (often cited as one of the most important features of a successful user interface) should be

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accomplished through the DBMS language by changing the underlying user-interface-defining objects.

In PROTEUS, a representation is a mapping between an internal database object, such as Employee, and some displayable form for the object. Each internal object will have many different representations, in order to satisfy the needs of different applications. For example, one representation for Employee might display only an employee's name and social security number in reverse video, while another representation might display all employee fields in a specified order. Each representation mapping is itself an object that can be reused in defining new user interfaces. Also, new representations can be added to the database to meet the demands of evolving applications. Of course, representations are "two way streets", since the user must also be able to update an internal object through its representation.

Thus PROTEUS represents the confluence of three existing currents of conceptual development: visual (graphical) interfaces, display specifications, and representation mappings. Visual database interfaces involve displaying information in or about a database in such a manner that the user can refer to both the values and the structure of the data. Display specifications describe the display media for an application, with both layout and behavioral aspects being represented in the description. Representation mappings address format independence between stored representation of data and the display presentation of the same data (which may depend on the context of the application).

We are preparing an extensive annotated bibliography on the subject. The following references reflect the contents of our bibliography database in July, 1986. We are attempting to be complete in the literature search that is providing the input to this database, but omissions or oversights are likely to occur. Part of our purpose in presenting this note is to solicit input in the form of comments and additional references as we finalize the annotated bibliography. Since the omission of some appropriate references will have been due to lack of access to the papers, we would be especially grateful if correspondents who provide an additional reference will forward a copy of the paper when able to do so. Correspondence should be sent by e-mail to lougiea@tektronix.csnet, or by post to

Dr. T. L. Anderson
Computer Research Lab
Tektronix, Inc., M/S 50-662
P.O. Box 500
Beaverton, Oregon 97077

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