Creating A Visual Interface for Navigating Large UDDI Business Registries

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Abstract

This paper introduces a framework of a 2D visual interface for interactive navigating of UDDI Business Registries to discover appropriate services for the service requester among the available Web Services. By creating a 2D interactive visual interface, users are able to visually navigate through the large information hierarchies that are usually used to present the UDDI Business Registries, instead of using the traditional keywords or click-through searching methodologies which are often inefficient and less obvious.

Several visualization techniques can be employed to achieve this objective, Image-Map used in this case. A simplified web-based UDDI business registry prototype with visual interface has been developed by using some open source technologies, such as, MySQL for backend data source layer, Apache HTTP server with PHP for business logic layer and dynamic Image-Map visualization with XHTML and client side scripting language JavaScript for presentation layer.

Keywords: Web service, UDDI Business Registry, graph visualization, information hierarchy, and graphic user interface.

1. Introduction

1.1 Web Services

A Web Service (WS) is defined as a software application identified by a URL, whose interfaces and bindings are capable of being defined, described and discovered as XML artifacts. A web service supports direct interactions with other software agents using XML based messages exchanged via internet-based protocols [1]. The idea behind web service is to break down web accessible application into smaller services, which can be accessed via Internet. They are self-describing and provide well-defined services to user.
The Architecture:

A typical architecture of Web Services is a service-oriented architecture which consists of three entities and three operations [2]. (See Figure 1)

- *Service provider* creates web service and its services definition and then publishes them by registering the services with a service registry based on a standard, namely the Universal Description, Discovery and Integration (UDDI) specification.
- *Service registry* maintains a registry of published web service descriptions.
- *Service requester* can find the required service via the UDDI interface and then may use the information provided to directly bind to the particular service.
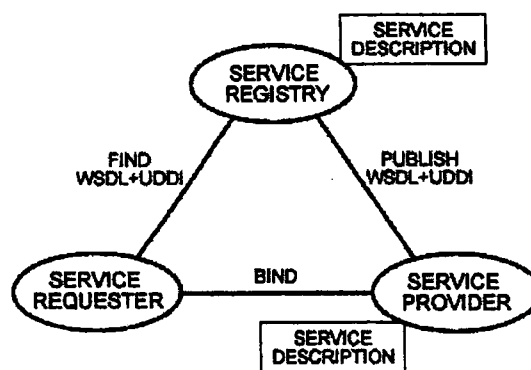

Figure 1 The Architecture of Web Services

Technologies:
The framework of Web Services is essentially founded upon three major technologies, i.e., communication protocols, service description and service discovery.

- *Simple Object Access Protocol* (SOAP) which enables communication among web services [3].

- *Web Services Description Language* (WSDL) which provides a formal, computer-readable description of web services [4].
- *Universal Description, Discovery and Integration* (UDDI) directory which is a registry of web services description [5].

1.2 UDDI and its Business Registry

UDDI Business Registry is a core element of the infrastructure that supports web services. It enables business to describe its business and services, discover other businesses that offer desired services and integrate with these other businesses. It also provides a place for a company register its business and services that it offers. People or businesses that need a service can use this registry to find a business that provides the desired service.

According to the specification, UDDI Business Registry offers two kinds of interfaces, i.e., a web-based user interface and a programmatic interface. In this paper, we focus on discovering business and services through web-based user interface of a UDDI Business Registry.

2. Problems

As mentioned above, UDDI Business Registry is a cornerstone of the web services infrastructure. Without this component, it would be impossible for a service requester to quickly discover the right businesses, which provide services that best fit the needs, out of the millions that are currently online. While the current web-based UDDI Business Registry can effectively assist the businesses in registering themselves and discovering the other desired businesses through internet, they usually do not provide a 2D graphic user interface that gives users a sense of information space when users exploring the service registry to discover the desired businesses and services. For instance, the SAP UDDI business registry, which is one of the top leading registries currently online, employs click-through browsing methodology that provides users a series of textual link lists located in several pages. Each list in a page shows only one level of information hierarchy. (See Figure 2)

The hierarchical structure of the current web-based UDDI Business Registries is built on some Standard Industrial Classifications (SIC), such as, North American Industry Classification System (NAICS) [6] and United Nations Standard Products and Services Code (UNSPSC) [7]. If users are not familiar with these classifications, it could be a nightmare for user to
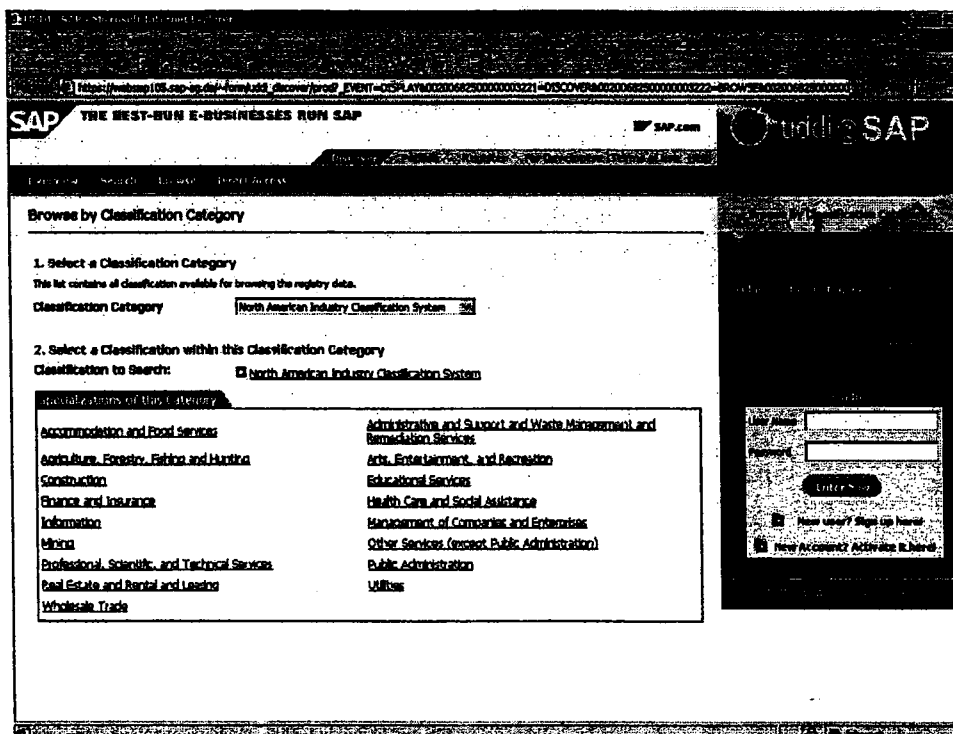

Figure 2   A typical example of a traditional navigation interface

find their desired business and services through browsing the Registry. Under the traditional navigation scheme, users have to click through many pages to move down and up the classification hierarchy finding appropriated business or service they expect. The entire business and service classification hierarchy structure is broke into many small pieces in different level and it becomes very difficult for user to percept the overall structure of the classification hierarchy without previous classification knowledge and only by reading those textual lists. Therefore, the effectiveness of this navigation mechanism in terms of click-rates and human cognitive process are lower. Also, this navigation mechanism lack of the sense of information space, the network loading for navigation is heavier.

Several relational visualization techniques can be used to enhance the display of UDDI business registry classification hierarchy structure and address the above problem. For instance, *Image-Map, OFDAV* [8], *HT-Browser* [9] *and Dynamic Zooming* techniques are employed to generate high-quality graphical user interface, in terms of readability, understandability and comprehension, for the navigation of UDDI business registries. We extended a 1D interactive space (a series of textual lists) to a 2D interactive space (a navigational interactive visualization). Further more, the Image–Map technique provides click-free environment that reduces the click-through rate to zero during the UDDI classification navigation. This is because Image-Map supports the rollover function that only requires the movement of mouse pointer for viewing different parts of UDDI classification hierarchy.

3. Design and Implementation

3.1 The framework of simplified UDDI business registry

The UDDI Business Registry is the implementation of the specification developed by UDDI organization. The UDDI Business Registry is operated as a distributed service and contains several components. Currently, *IBM, Microsoft* and *SAP* operate registry nodes, which are the companies run the instance of the public UDDI Business Registry. The components of a simplified web-based UDDI business registry and interconnections among them can be described in Figure 3.

- **Visualization Interface**
  A navigational visual presentation automatically displays a sequence of the subset of classification hierarchy according to viewer's orientation. It adapts some visualization techniques, such as Image-Map in this case, to
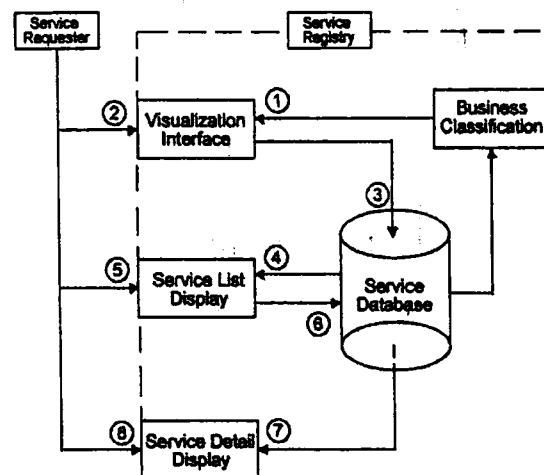

Figure 3   A framework of simplified UDDI business registry

Where:

(1) display visualized standard business classification
(2) service navigation
(3) query selected businesses or services
(4) retrieve service list and display
(5) select a particular business or service
(6) query selected business or service
(7) retrieve a service detail and display
(8) further action taken

allow viewers to interactively navigate through the entire classification hierarchy by swapping subset of the hierarchy. It also addresses the "small window" problem in large information space.

- **Business Classification**
  A standard industrial classification (SIC) is a standard which agreed by most business entities around the world. There are several classification standards, such as North American Industry Classification System (NAICS) and United Nations Standard Products and Services Code (UNSPSC). The standard NAICS is used for implementing the prototype in this paper. The visualization interface is generated based on this classification standard.

- **Service List Display**
  An XHTML web page generates by server side scripting language or other programming language at web server according to user's request. The registry accepts a request from presentation layer, sends a query to the UDDI business registry database and retrieves the appropriate business services class list from the

database in correspond to mouse-click on a particular graphic leaf node in the visual interface. It then displays a list of available business or services with a link to its details. The requester will view the details of a particular business or service if clicking the link.

- Service Detail Display
An XHTML web page is generated by web server in corresponding user's request similar to the service list display. Instead of displaying a list of business or service class, it shows business or service detail information according to requester's particular interests and demand by clicking the detail link.

- Service Database
A relational database is employed to store the business and service information including the data fields and attributes associated with particular business or service that is available in UDDI business registry.

3.2 The Implementation

Since we only focus on design of web-based user interface for the exploration and searching business services through the UDDI business registry, the implementation of the prototype is much simpler than the reality. The brief summary of implementation is shown as follows.

- Presentation Layer
A graphic user interface provides direct interactions between users and UDDI business registry system. The XHTML, DHTML and JavaScript are used to implement this prototype at the presentation layer in order to minimize the client side request, that is a web browser is only required for a user to interact with the UDDI registry in the purpose of browsing and searching.
With technique of DHTML and JavaScript, an interactive visual user interface is created, namely Image-Map Browser (IM-Browser) in this case, for dynamically displaying a sequence of interactive graphs, i.e., image files. These graphs are the sub-graphs of the entire hierarchy that presents the industry classification used in UDDI business registry. The Image-Map Browser allows user to navigate through the information hierarchy and search the desired business or services just by clicking on some appropriate graphical leaf nodes. Under this scheme, a large visual information hierarchy is created in corresponding to the contents and structures of standard Industry Classification. However, since the window size for displaying

is limited, the entire visual structure is unable to display on single screen. The large visual classification hierarchy has to be divided into several smaller images, which are the subset of the standard industry classification. Then we apply the rollover feature to all leaf nodes in each sub-graph to achieve the swapping between sub-graphs (images) by moving the mouse pointer to a particular leaf node which is the parent node of the sub-graph the user want to view.

- Business Logic Layer
A business logic control layer, which accepts the request from presentation layer, passes the request to backend database and then retrieves the data from the database and sends the responds information back to presentation layer. There are several technologies existing to address this issue, such as ASP, JSP and Java Servlets with various supported web server. In terms of the popularity, a well-known Apache HTTP Server [10] with server side scripting language PHP [11] are adapted to implement the business logic layer in this prototype.

- Data Source Layer
A data storage entity maintains the information used by UDDI Business Registry. Normally, a relational database management system is needed to serve the requirement. Many Relational Database Management Systems (RDBMS) will fit this role, such as Oracle, SQL Server, and DB2 etc. An open source RDBMS, namely MySQL [12], is used to implement as data source in this prototype due to its popularity, scalability and well-integrated with PHP and Apache Web Server.

4. An Example

A simple example session is presented here in order to illustrate how users are able to dynamically navigate through the large registry hierarchy structure of the web-based UDDI business registry by using interactive Image-map Browser (IM-Browser), e.g., the user intents to find the services that any Travel Agency provides in this case.

The IM-Browser is divided into two frames, i.e., the left frame, which displays the visual information hierarchy of standard Industry Classification (SIC) and the right frame, which displays either SIC Code descriptions corresponding to the image that displayed in left frame or searching results for a particular target business or services. For instance, a root level SIC is shown in Figure 4.

When the mouse pointer moves over to each leaf node at root level, both visual and text SIC information
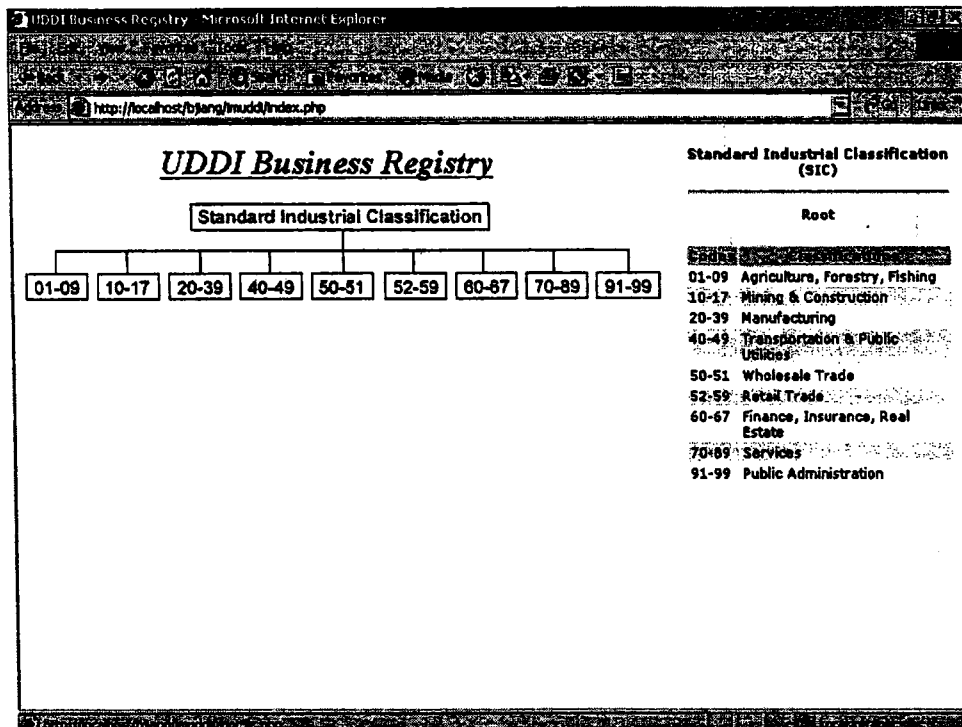
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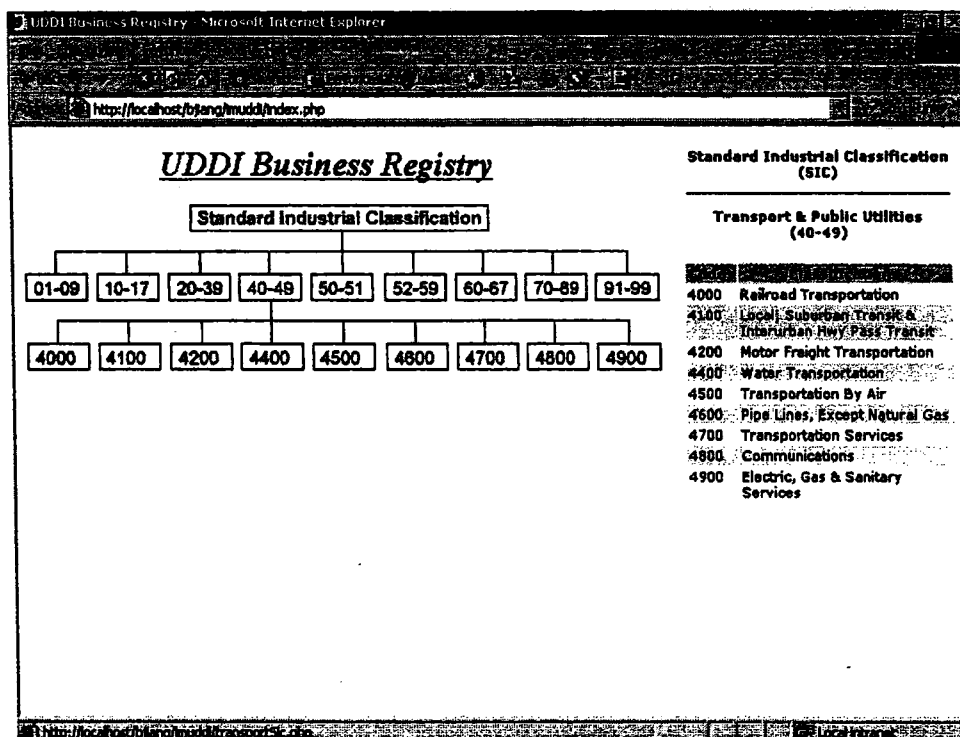Figure 4 The root level (first level) of SIC information hierarchy

Figure 5 The Transportation & Public Utilities level (second level) of SIC information hierarchy
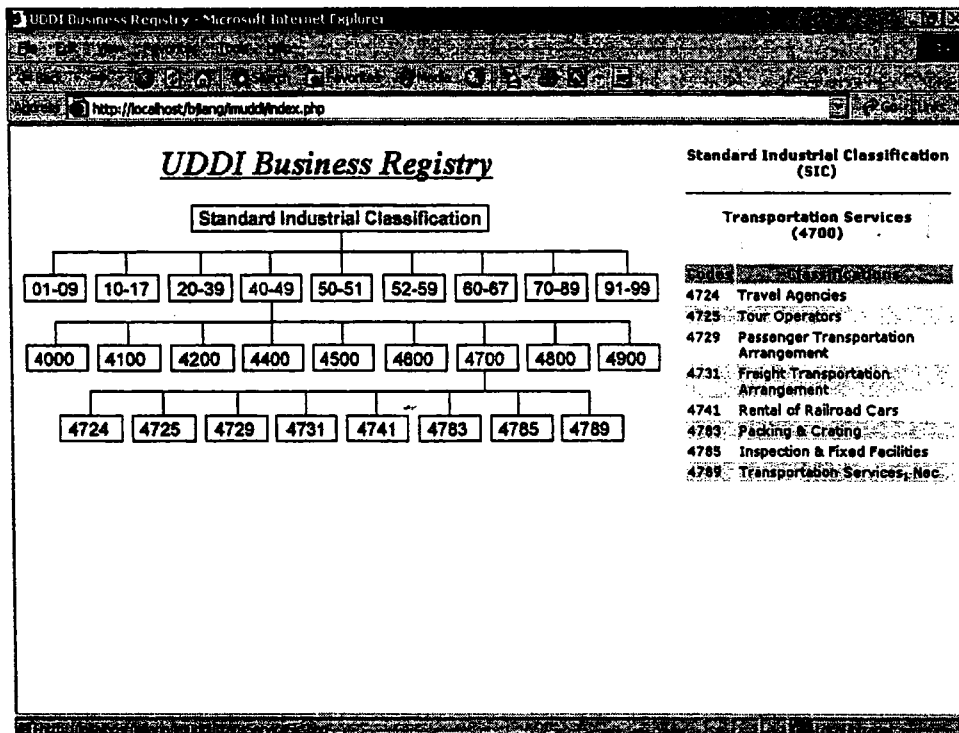
Figure 6   The Transportation Services level (third level) of SIC information hierarchy
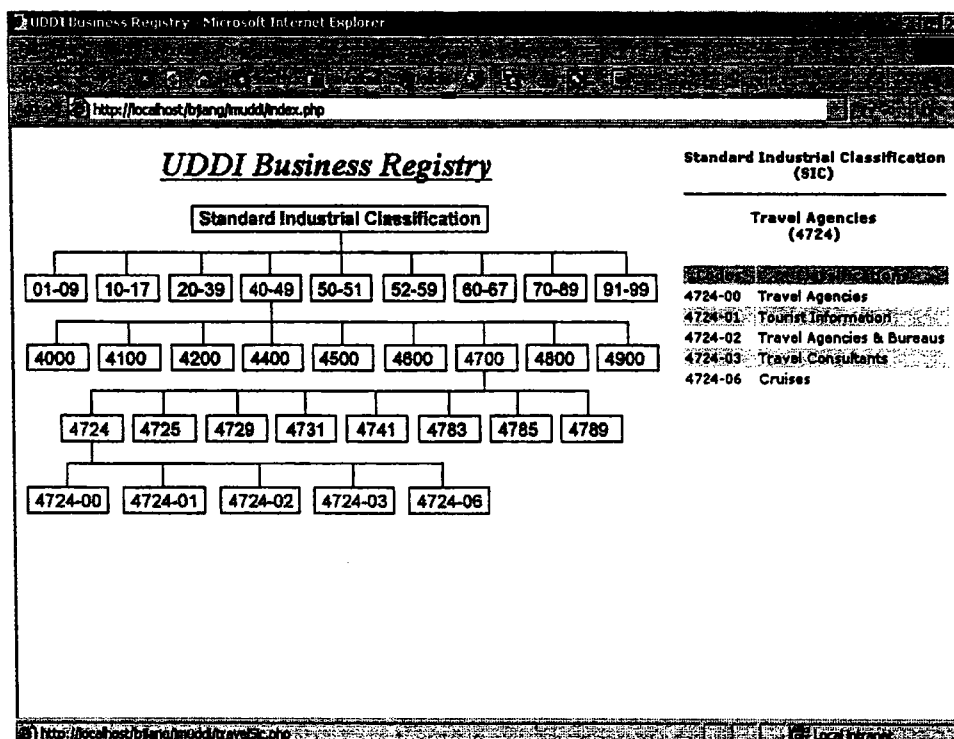

Figure 7   The Travel Agencies level (leaf level) of SIC information hierarchy

of this node will be displayed in corresponding frame. For instance, the mouse pointer moves over the leaf node representing "Transportation & Public Utilities" class, the SIC code is 40-49 (See Figure 5). The same idea applies to third level of SIC information hierarchy, namely Transportation Services (See Figure 6).

At the lowest level of SIC information hierarchy (see Figure 7), each leaf node is associated with a PHP file which will dynamically generate a list of related target business or services from the backend database, the travel agencies (SIC Code 4724-00) in this case, if users clicking on a particular leaf node.

Therefore, service requesters are able to select and find their desired services, which the target business provides, by just clicking on related link to view the details of business or services. Then the binding action may be taken if the further invoking process required.

5. Discussion

The framework presented in this paper can be used to browse and search desired business services for service requesters. Our prototype provides a 2D visual interface for interactive navigation of large business classification hierarchy through the UDDI business registry rather than traditional click–through approach, we provide a 2D space for navigation. Although the idea and the demo prototype look simple, the goal of interactive visualization navigation through the large information hierarchy is different from conventional methodologies in the sense of efficiency and information space.

The implementation of this prototype is simplified rather than a fully functional UDDI Business Registry in this paper. Many other visualization techniques with fully functional programming language could be introduced to implement better prototype, for instance, OFDAV, HT-Browser and Dynamic zooming technique with object-oriented programming language, such as Java with JWSDP [13]. Therefore, the further research is under way.

6. Conclusion

The new framework of 2D interactive visualization navigating through a large information hierarchy in UDDI Business Registry is introduced in this paper. It provides a visualized navigation interface for users to find desired business or services by browsing and searching through the SIC information hierarchy with the sense of information space.

The traditional browsing and searching methodologies provide only a series of textual lists located in several pages, which is inefficient and less

obvious. Therefore, the interactive visualization technique, namely Image-Map in this case, is used to address the above problem. Some other visualization techniques are mentioned in this paper, such as OFDAV, HT-Browser and dynamic zooming. The further research works will be based on those techniques to improve the current UDDI Business Registry in terms of usability and efficiency.

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