Distributed Applets

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ABSTRACT
This video shows several examples of distributed active web content, that is, applets that can communicate with other applets running on different machines.

Keywords
Active objects; applets; distributed applications; groupware.

BACKGROUND
One of the most exciting recent developments in Web-browser technology is *active content*, where the browser downloads a program, executes it, and displays the program's user interface in a Web page. Sun's HotJava browser with Java applets pioneered active content, and now, the industry-standard browsers support active content, written in a variety of languages.

We have worked on *distributed applets*, that is, applets that can communicate with other applets located on different machines. We provide high-level support for distributed computation, thereby making it easy to write collaborative applications such as groupware and multi-player games.

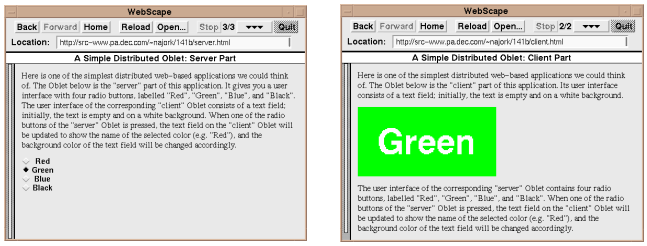
Our distributed applet technology is based on Obliq [5], an object-oriented scripting language that was specifically designed for constructing distributed applications in a heterogeneous environment. We call applets written in Obliq *Oblets* (**Ob**liq app**lets**) [2]. We have built a family of Web browsers that support Oblets [1, 4].

Obliq supports distributed computation by implementing all objects as *network objects*. The methods of a network object can be invoked by other processes, in addition to the process that created the object. The initial connection between two processes occurs when one process registers an object with a name server under a unique name, and another process subsequently imports the object from that name server. Once the connection is established, other network objects can be passed between processes just as simply as passing any other type of data.

For network objects, method calls and field accesses have the same syntax regardless of where the object resides. It might reside in the same process as the caller, or in a different process either on the caller's machine or on some other (possibly different type of) machine. Thus, from a programmer's perspective, there is no difference between local and remote objects. As a result, network objects provide a uniform way for communication among Oblets, regardless of whether the Oblets are on the same Web page or on different Web pages displayed by different browsers on different machines. Moreover, network objects communicate directly, without server intervention. Thus, Oblets do not impose any load on an HTTP server, nor does a heavily loaded server affect their performance.

This video shows four distributed applications we have built using this technology.

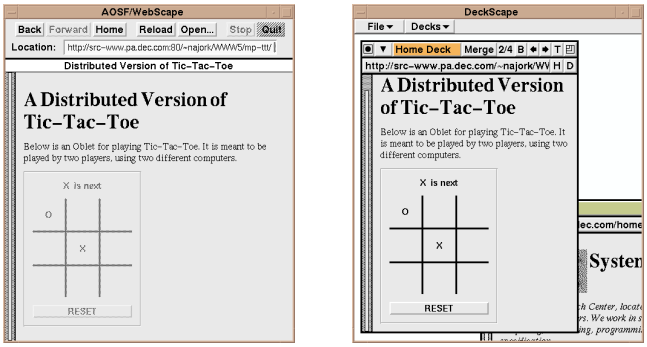
EXAMPLE 1: "HELLO WORLD"
This example show a simple distributed application that illustrates the fundamentals of Oblets. The application consists of two Oblets running on different machines. One Oblet, the server (left), allows a user to select one of four colors. The other Oblet, the client (right), displays the name of the chosen color inside a rectangle of that color.



The server Oblet's user interface consists of four radio buttons, labeled "Red," "Green," "Blue," and "Black." The client Oblet's user interface consists of a colored rectangle surrounding a string. When the user of the server Oblet clicks one of the radio buttons, a callback procedure attached to this button calls a method of the client Oblet, which changes the string and the color of the rectangle. Each Oblet consists of just 13 lines of code, only one of which is specific to distributed applications.

EXAMPLE 2: TIC-TAC-TOE
This example shows a tic-tac-toe Oblet that allows two users on different machines to play against each other. The following screen dump shows a snapshot of a game in progress. The left image shows the browser used by player "O," the right image shows the browser used by player "X".

The Oblet of player “O” is disabled, and the message line indicates that player “X” is next.

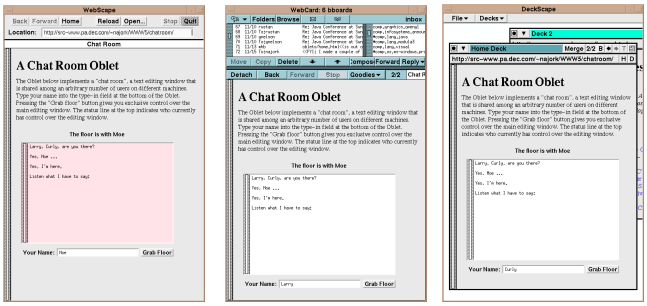


A user starts a game by visiting the tic-tac-toe Web page, which causes the tic-tac-toe Oblet to be loaded and invoked. Upon invocation, the Oblet attempts to import an opponent's tic-tac-toe Oblet from a dedicated name server. This call succeeds if there is indeed another player waiting for a game to begin. Otherwise, the Oblet exports itself to the name server, disables its game board, and waits for a second player to visit the Web page.

EXAMPLE 3: CHAT ROOM

This example shows an Oblet-based chat room application that allows several users to communicate through a shared text editor.

The Oblet's user interface has four parts: a status line at the top, an editing region in the middle, and a type-in field and a “Grab Floor” button at the bottom. When the user clicks on the “Grab Floor” button, the status line on all participating Oblets will indicate who owns the floor (using the contents of the type-in field of the Oblet now owning the floor), the editing region on all Oblets (other than the one owning the floor) will become passive, and the editing region in the Oblet owning the floor will become active and its color will change to pink. When the user who owns the floor types into the editing region, all of the participating Oblets will be notified of the updated text.

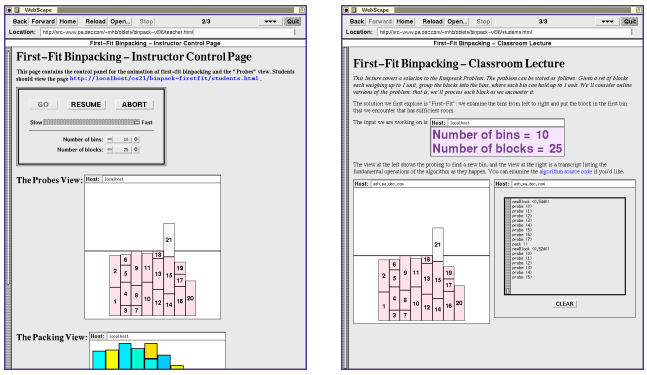


The three screen dumps above show the chat room Oblet running in different browsers. Each browser is running on a different machine. The participants in the chat room are Moe, Larry, and Curly (from left to right). Currently the floor is with Moe, as indicated by the status line over the editing region and by the color of the editing region in Moe’s browser.

EXAMPLE 4: ALGORITHM ANIMATION

The final example shows how we have used Oblets for building algorithm animations [3]. Embedding algorithm animations into Web pages allows us to use the text and multimedia capabilities of the Web for describing the algorithms, and the applets to implement the algorithm together with one or more animated, interactive views of it. The result is an “electronic textbook” on algorithms.

Moreover, the distributed nature of Oblets makes such a textbook suitable for “electronic classrooms” as well as remote learning environments. In such a setting, an instructor can control an animation, and students can all view the animation simply by pointing their Web browsers at the appropriate page or pages.



The screen dumps above are from a chapter on binpacking from a prototype collaborative electronic textbook. The instructor's screen (left) displays a Web page containing a control panel, a “Probes” view, and a “Packing” view. A student's screen (right) shows three views of the same algorithm, embedded into a different Web page. A “Glossary” view at the top shows the number of bins and blocks specified by the instructor in the control panel. Below that is the “Probes” view and a “Transcript” view. The student can scroll through the “Transcript” view and clear its contents. In other words, each student can control his views, but only the instructor can control the algorithm.

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