

The Story Behind the Lisa (and Macintosh) Interface

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Cover message

Date: Mon, 17 Jun 1996 17:13:10 -0700
From: "Rod Perkins"
To: "Multiple recipients of list cpsr-history@cpsr.org"
Subject: Inventing the Apple Lisa; original paper.

Although the Macintosh receives the recognition for creating Apple's desktop metaphor, the development of Lisa user interface pre-dates the Mac. Many of the concepts developed for the Lisa were used in the Mac's design. Other Lisa features are creeping into the UI in 1996 as Apple implements multi-processing and protected memory. Although the Lisa was not a commercial success, without the early work done by the Lisa team, there would not be the Macintosh we know today.

I was among the first software engineers to work on the applications for the Lisa and its user interface. Myself, and two others from the Lisa "Filer" team wrote a paper in 1989 that described how the Lisa's UI was designed. The paper was to be a chapter in the book, "The Art of Human-Computer Interface Design", edited by Brenda Laurel, Addison-Wesley, 1990. However, as someone pointed out earlier, Apple was actively litigating against Microsoft at the time, so it was though better not to have the paper published.

The paper included screen shots that pre-dates the legendary visits to Parc by Steve and other people from Apple. No doubt the Parc visits provided inspiration but its was not "standard myth that Apple lifted the user interface of the Lisa and Mac in whole from the Star".

I included the text of the paper below.

Inventing the Lisa Interface

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Today's familiar Macintosh user interface is a direct descendent of the interface first developed and used on Apple's Lisa computer. Instead of a text-based system that presented the user with a blank screen and blinking cursor, the Lisa gave the user a picture of an electronic desktop, a picture that the user manipulated directly to tell the computer what to do. The electronic desktop with its windows, menu bar and icons wasn't part of the original design, rather it was the end result of a three year long process of refining goals and developing, testing and synthesizing many alternative ideas. In fact, the iconic desktop was first tried in 1980 and discarded! The final result, shown in figure 1, not only made computer easier to use, it made them fun!

We were three members of the software team that designed and implemented Lisa's system software and applications, all of whom contributed significantly to the appearance and operation of the final interface. Rod joined the team shortly after the start of the project in early 1979 and mocked-up many of the early ideas about the appearance and workings of windows and menus and worked on the LisaCalc application. Dan and Frank began working on Lisa in late 1980 and were responsible for what eventually became the Desktop Manager with its folders and icons.

Goals and Guiding Principles

First proposed in late 1978 by Steve Jobs, the new machine was to be designed for general office use - a high quality, easy-to-use computer for secretaries, managers, and professionals to extend individual performance without disrupting the office. The ease-of-use goal evolved during 1979 as the software team tried many ideas. The Lisa Marketing Requirements Document from early 1980, developed jointly by marketing and engineering, enumerated the following goals which remained in force for the rest of the project and are generally accepted today.

"Lisa must be fun to use. It will not be a system that is used by someone "because it is part of the job" or "because the boss told them to." For this reason, special attention must be paid to the friendliness of the user interaction and the subtleties that make using Lisa rewarding and job enriching.

"Lisa will be designed to require extremely minimal user training and "handholding." The system will provide one standard method of interacting with a user in handling text, numbers, and graphics...

"The system will adhere to the concept of "gradual learning"... A user must be able to do some important tasks easily and with minimal instruction or preparation... The more sophisticated features will be unobtrusive until they are needed.

"Errors will be handled consistently in as friendly a manner as possible, and the user will be protected from obvious errors..."

"... A "Set-up" program will allow the user to customize several system attributes in order to "personalize" interaction with the system... in order to make the system uniquely personal for the user without interfering with the interface standards...

"(It should allow) a user to put whatever he/she is doing on "hold" in order to answer the phone, look up an address, or respond to an asynchronous interrupt (time for a meeting, mail received on the network, etc.)...

"In addition, the use of graphics in general user interaction will set Lisa apart from its competitors and will go a long way toward making the system friendly, easy and enjoyable to use. "Intuitive icons" can be designed to indicate certain messages to the user... "

During the same period the the engineering team also developed several principles that would be used to achieve those goals. Commands would be visible on the screen, consistent across applications, and modeless. When possible, commands would be replaced by direct actions using the mouse. Data was to be displayed WYSIWYG (what you see is what you get - the screen and printed output should look the same) and easily movable between documents. The interface would be 'intuitive,' modeled on documents and other office-based objects instead of traditional and unfamiliar computer concepts, and, like the office, the desktop would not be limited to showing only one thing at a time.

The Beginnings of the Lisa

When we started the Lisa project in late 1978 our goal was to build a computer that would propel Apple in the business market of the 1980's. We had plans to build our own custom microprocessor that would be more powerful than the established Apple II computer and could provide greater flexibility for future machines. The Lisa hardware would have an Apple II style bitmap screen and graphics support for creating simple line drawings using Logo style instructions. The hardware would also scroll the screen one line at a time to give a smooth scrolling effect. "Soft" function keys (softkeys) and cursor keys appeared on the keyboard to be used by the applications. We wanted the Lisa hardware to be competitive with the specialized business equipment that existed in 1978 but with the added distinction of being a general purpose computer.

The early Lisa hardware limited the user interface that the Lisa applications would have. The graphics support would not allow us to distinguish the applications through their use of graphics. Fortunately we had envisioned word-processing and database as our first applications, both of which we felt would not rely heavily on graphics. The hardware did provide the softkeys and cursor keys which the applications used to control the computer. We wanted the applications to be distinctive in their use of these keys to provide a better interface to the user. Early prototypes of the Lisa applications were written on the Apple II until the new hardware could be used.

The Early User Interface

The first Lisa application was a Forms Editor that could create the forms used by the database. The Forms Editor could also be used to create simple line drawings such as a business organization chart. Even in this early

application familiar Lisa user interface concepts could be seen (Figure 2 - 7/79):

- * Direct manipulation. The user could create text, lines, boxes and data fields; move them on the screen; go back and edit them; all by using the cursor keys and a special selection key. The user would constantly receive feedback as things were drawn which we felt would increase their feeling of control.

- * Intuitive. The softkeys displayed whatever options that were currently available. The user simply pointed to the option desired instead of typing a command. There was no need for the user to remember complicated command sequences. Likewise, there were no hidden commands as all choices were clearly displayed on the screen. We also provided an arrow display to show what cursor movements were available. This display would be useful for drawing and while filling in a form.

- * Friendly. The Lisa would prompt the user instead of waiting for a command to be typed. The prompts could be answered in a special message area or choices would be enumerated in the softkey display for user selection. Any errors would be reported in a status panel or in the message area using clear, friendly English; not computer jargon. We prevented users from making common errors by not allowing inappropriate commands to be selected from the softkeys.

While consistent with the appearance of business equipment of 1979, the first Lisa interface was not very exciting to use. It showed that Apple was serious about being business-like but did not generate the same enthusiasm created by the emerging, highly graphic oriented, video game industry and similar programs for the Apple II. The progress on the first interface established the correct goals but left most of us dissatisfied with our hardware and softkey approach. Many shared feelings that Apple could get better leverage from the Lisa hardware especially from its bitmap display. As these sentiments were surfacing in late 1979, two major events occurred that helped to change the thinking behind the Lisa hardware and software: the announcement of the Motorola 68000 microprocessor and visits by a small group of Apple engineers to the Xerox research center in Palo Alto.

Outside influences

The Motorola 68000 had the performance to support both a higher resolution bitmap display and a highly interactive user interface. This power made the 68000 a natural replacement for our custom microprocessor and broadened the vision of what people thought possible with Lisa hardware. The Lisa software could make use of this powerful new platform to expand on its user interface concepts. We all thought the Lisa would be so fast that it would be waiting on the user most of the time! The idle time could then be used to drive a more elaborate user interface.

The visit to Xerox was prompted after a number of people read papers published by Xerox about their Smalltalk environment [Goldberg 1978]. Smalltalk made extensive use of a mouse rather than the keyboard to control the cursor. A high-resolution bitmap display allowed Smalltalk to prominently make use of graphics to aid the user. Smalltalk was a friendly yet powerful environment that used the concept of modeless commands which were reported to be less confusing for the user.

There were two Xerox visits. The first in December 1979 was originally to see a demonstration of other programs under development at Xerox but not Smalltalk specifically. However during that trip, the Apple group was able to receive an impromptu Smalltalk demonstration from Adele Goldberg, one of the originators of Smalltalk. Within a few weeks, a second Xerox visit was planned to see additional demonstrations as well as one more look at Smalltalk. We were very excited by what we saw at Xerox and sought to make the Lisa as exciting. Enthusiasm from that visit caused us to further re-think the Lisa's user interface.

A Shift in Thinking

In the months following the Xerox visits, we shifted to a more dynamic user interface built around our new hardware. We began experimenting with the mouse and changed our interface to include windows (Figure 3 - 5/80) similar to those we saw in Smalltalk.

We retained the softkey display from the earlier interface but it was now attached to the window. The softkeys retained the keyboard control which we felt to be important for a business oriented machine. The interface became aware of the mouse as we began to allow things to be drawn with either the mouse or the cursor keys. Likewise the user could select an option from either the keyboard or by pointing with the mouse. The decision to become completely mouse oriented was still hotly debated. A number of us felt we could not make radical changes to the interface because the Lisa was scheduled to be announced later in the year at the National Computer Conference of 1980.

The interface was moving towards a standard which we called the Lisa look and feel. All the applications would be similar in their appearance and use commands that would be common to each of them. We felt that this consistency reenforced our previously defined interface concepts because the user would interact with all the Lisa applications in the same manner. This consistency also made writing the applications easier because the software to create the interface could be shared by all the applications. The first Lisa hardware that used the 68000 began to appear in the Spring of 1980. For the first time we could interact with our interface and see what it actually looked like as well as how it felt to use it.

The Desktop Metaphor

We had developed a model to describe the typical Lisa user. This user was a business person whose day was constantly interrupted with spur of the moment requests to do one thing or another. From that user model we decided that the Lisa had to offer an environment which safely allowed several applications to be used simultaneously and would permit any of the user's work to be put on hold. It was the job of the user interface to depict this multi-tasked environment in a manner that would make sense to the user (Figure 4 - 8/80).

After numerous experiments, we developed a new interface which became known as the Lisa desktop metaphor. The interface had multiple windows on the screen to display the different kinds of work conducted by the user. We called the work within the windows documents, to use a concept already familiar to the user. We decided that the user should not have to worry about which application went with which document. Instead, users would

select the document containing what they wanted and the Lisa would determine which application was needed. Switching between different documents was as obvious as pointing at the window containing the desired work. We spruced up the window appearance to look more like a file folder as we sought to create an electronic equivalent of the user's real desktop. The Lisa desktop would have objects already familiar from a real desktop such as documents, folders, calculator, and other handy tools; everything short of an electronic paper-clip to mangle.

The Role of User Testing

Controversy surrounded a number of the decisions on the user interface; the introduction of the mouse being a good example. We were very concerned that our target users would not accept using the mouse. We had investigated alternatives to the mouse such as the softkeys and even a light pen but neither proved as efficient. Our own experience with the mouse agreed with the research conducted by Douglas Engelbart [citation who, at SRI, created the mouse], and by Xerox [Card 1978] that both discussed the virtues of the mouse. We knew that users would benefit by using the mouse but we had to make using it as easy as possible. We felt that a major obstacle to the acceptance of the mouse would be the number of buttons it would have. Factions developed to push their choice for the "correct" number of mouse buttons. What ensued became known as Button Wars; one of many wars that developed over interface issues.

Normally the user interface wars would end in a stalemate of opinions. It was during these times we found it was best to test our opinions on the users for which we were designing. We would use as test subjects people culled from new Apple employees who had no previous computer experience. The tests were conducted during the summer of 1980 by Larry Tesler and observed by psychologists as well as ourselves. Many of the observations were recorded for later review and served as a form of détente between the warring factions. We followed this process throughout the Lisa's development to test new Lisa concepts such as pull-down menus, the location of scroll bars, and many others. We felt this was an innovative approach because the user interface was being designed from the user's perspective.

In the case of the mouse button, we discovered that with our user interface the three-button mouse used in SmallTalk had a slight, but not significant, advantage for the experienced users. Similar results were observed for the two-button mouse. For beginners, the extra buttons were confusing as the users sought to remember which button to press. The extra buttons hindered learning the Lisa user interface whose goal was to make a new user productive within 30 minutes use. We decided on the one button mouse to make the user interface easier for the first-time user.

Arriving at an Interface

By the end of summer in 1980 the design of the Lisa user interface culminated with the release the Lisa User Interface Standards Document [citation] (Figure 5 - 9/80).

The document served as a guideline for what should be done as well as what should not be done in the user interface. The document also began to explore involving the hardware as part of the overall user interface. The scope of the user interface began to include items such as the keyboard

layout, how the machine was turned on and off, how the machine would be serviced, even whether there was a door on the disk drive. These issues became part of shaping user's perception of the entire machine and would entice them to use it. The interface would continue to evolve, but the release of this document signalled the birth of what we see today as the Lisa and Macintosh user interface. Only after the user interface standards were resolved did serious work begin on the applications. The earlier Forms Editor and word processor served as prototypes and provided the basis for other Lisa applications.

The Early Days of the Desktop Manager

With the basics of the interface defined, including overlapping windows, pull-down menus, scroll bars, grow boxes, and so on, work began on filling out the rest of the user model of the system. In late 1980, a small group of us got together to design the interface for the filing functions of the Lisa system. The kinds of questions we were trying to answer included:

- * "How is are documents created or destroyed?"
- * "How are they located?"
- * "How are they returned to their filing homes?"
- * "How should their attributes be displayed?"

In considering each of these questions, we were guided by the desire for consistency, ease of use, and efficiency.

Desktop Icons Rejected!

One of the first models considered used desktop icons for performing the basic filing functions. The interface to this point had only folder title tabs as document and folder icons (figure x).

The title tabs could be moved into and out of filing folders in a nested manner. Destroying an object was thought to be accomplished by moving it into a wastebasket icon. Diskettes were to appear on the screen as desk drawers which could be opened to reveal folder tabs.

Early in the discussion of this model a number of objections were raised. The Lisa had only a 12" display and some thought that it was too small to display full size documents and desktop icons simultaneously. There was concern that simple tasks, such as deleting a document by dragging it to a wastebasket, would be overly cumbersome as the user tried to locate the wastebasket buried under open documents. Locating documents in nested folders was also considered too unwieldy. The scenario of opening a series of nested folders, accumulating more and more desk clutter along the way while searching for a document, seemed to be less efficient than a real world paper filing system. Some suggested that people would spend an inordinate amount of time positioning icons and moving or resizing windows. Others argued that mimicking the office filing system would simply give people an electronic version of a system that already had many problems. With all these things considered, but without a detailed mockup, we rejected the iconic, direct manipulation filing human interface as too inefficient and set out to design something superior!

A Document Browser

Our initial attempts at producing a more efficient human interface centered around something resembling the browser from the Smalltalk programming environment. The Smalltalk browser is a window with a top portion composed of a few panes allowing the hierarchical selection of an object and a bottom pane in which the contents of the selected object are displayed. For our model we were interested in trying to avoid a strictly hierarchical filing system. The document browser top panes contained various attributes which could be selected to narrow the choice of objects. In this model documents could be located by type of document, keyword, author, etc. The paper prototype (figure x) seemed to work well for selecting an object, but became awkward when trying to perform other operations such as moving, copying, or creating something new. It also lacked a certain approachability. It's operation was not at all obvious when first encountered.

The 20 Questions Filer

In an attempt to make the system easier to manipulate for the first time user we tried a more prompting, hierarchical browser (figure x).

Selecting "Documents" from the Desktop menu brought up a dialog window which prompted the user to select a disk, folder, and document, with statements such as "Choose a folder from the list below". After making a selection, an "Action" menu would appear with the items "Pull", "Refile", "Cross-file", "Discard", etc. This system was fast and a bit easier to understand than the previous version, but still somewhat abstract.

We were running out of time on the project schedule and decided that despite the problems this was to be our filing interface. After many months of implementation, and some early user testing, a few of us were still not satisfied with the interface. Users seemed confused about the relationship of the selections in the top pane to the contents in the bottom pane. They also had difficulty performing operations such as moving documents from one folder to another. The system was fairly efficient, since the filing dialog could be brought up easily from a menu and few mouse clicks were needed, but it certainly wasn't fun.

"Son of DataLand"

In a clandestine effort, some of us decided to investigate the problem on our own time a little more (we were quite late into the schedule at this point). We decided to ask Bill Atkinson for some help with the interface. Bill had worked hard to help define many aspects of the global human interface and was eager to turn his attention to this problem. In vintage Bill Atkinson form, he asked for a little time to think about the problem and then returned a few days later with an idea and a smooth mock-up! While thinking about the problem, Bill recalled a trip to the M.I.T. Media Lab he had made earlier, in which he saw a futuristic data navigation system called "DataLand" [Negroponte 79]. In this system, a person sits in a chair with two hand controls and faces a large screen. The controls allow you to "fly" over some data space projected on a large screen in front of you, in this case the Boston area, and then to zoom in to very fine levels of

detail, or zoom out to see a huge geographical area. Bill adapted this idea to the filing problem by creating an enormous virtual desktop, perhaps a mile square, and then providing methods for very quickly moving around and zooming in or out (figure x). The idea was that icons would be used for documents, and that they would be organized spatially, with related documents placed near each other. The idea had incredible simplicity, but placed quite a burden on the user's memory when the number of documents became large and also didn't work well when multiple disks were on-line, representing several several flat filing spaces.

The IBM Contribution

We were drawn to the simplicity of DataLand, but thought that something more familiar might be more effective. We were slowly migrating back to using icons for the sake of simplicity and approachability. At about this time, Bruce Horn in the Macintosh group was working on some some mock-ups for the Macintosh Finder using icons. Bill did some searching and found an IBM Technical Report (need reference) that described an interface with icons for all the objects in an office. The "office" contained filing cabinets, a desk, a wastebasket, etc. Filing cabinets could be opened to reveal files, which could in turn be opened to locate documents. The desk contained drawers which also could be opened and a desktop for placing documents and other office objects. In considering this model, we created several mock-ups using an early version of LisaDraw, a structured graphics editor (figure x). Our model presented two levels of detail to the user. The first view was a forward look at the office as a whole. In this view you could see the filing cabinets and desk. To view documents it was necessary to place them on the desk. The view would then change to one looking down on the desktop with documents at full size. After experimenting with this model for some time we realized that having the two different views (or world swaps, as they came to be known) was confusing and inefficient.

Today's Desktop Model

Eliminating the two view model brought us very close to the final design. We quickly implemented a working prototype. The prototype presented a single desktop on which both small icons and full size documents were kept (figure x). Design discussions with Bruce Daniels and Larry Tesler helped to refine some of the ideas as well as comparisons with the Xerox Star. Revealing the new interface to the rest of the team drew mixed reactions. Some were thrilled with the new look and simplicity, while others were concerned about the lateness of the schedule and the break in the standard development process. Wayne Rosing, the engineering manager at the time gave the "go", and we raced to catch up with the rest of the Lisa team. After over a year of looking for something more efficient, we had come full cycle, back to the more approachable, iconic, direct manipulation interface!

Citations

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IBM technical paper on Desktop

Apple Computer Human interface guidelines

Mouse Paper by Card & Moran

{Small Talk paper reference}

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Interactions, vol 4, issue 1, pp 40-53, and available to order on-line here:
[https://secure.acm.org/pubs/citations/journals/interactions/1997-4-1/p40-
perkins/](https://secure.acm.org/pubs/citations/journals/interactions/1997-4-1/p40-perkins/)

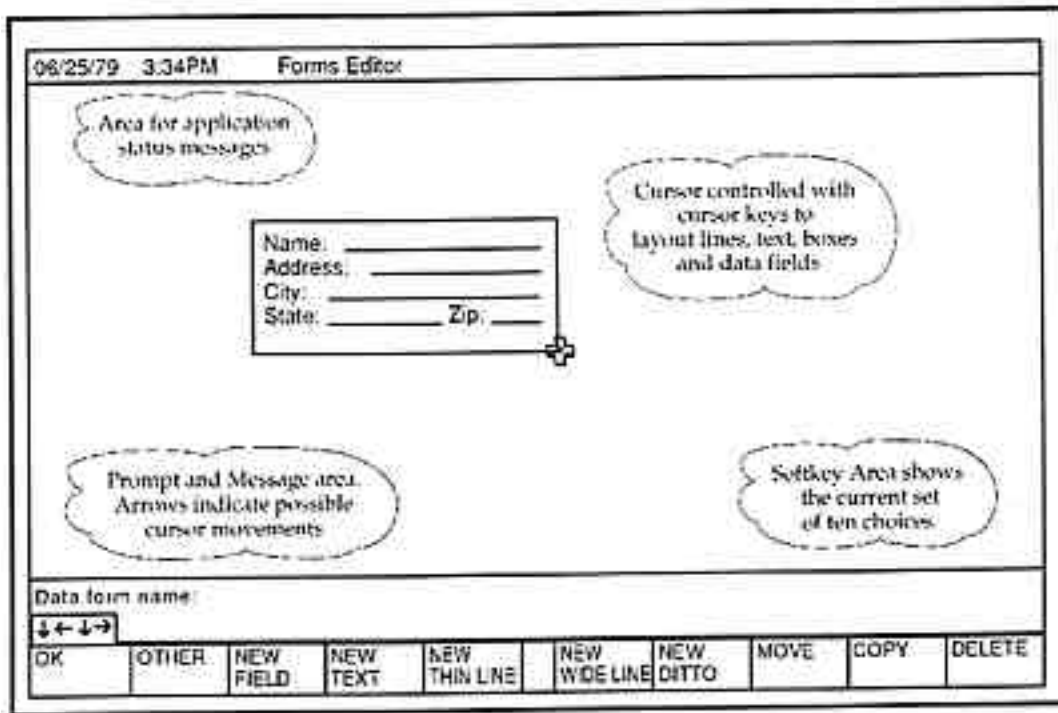
Pictures of Lisa UI Prototypes

(or, A Pictorial History of the "Apple Desktop Interface" 1979 - 2000)

July 1979 Prototype

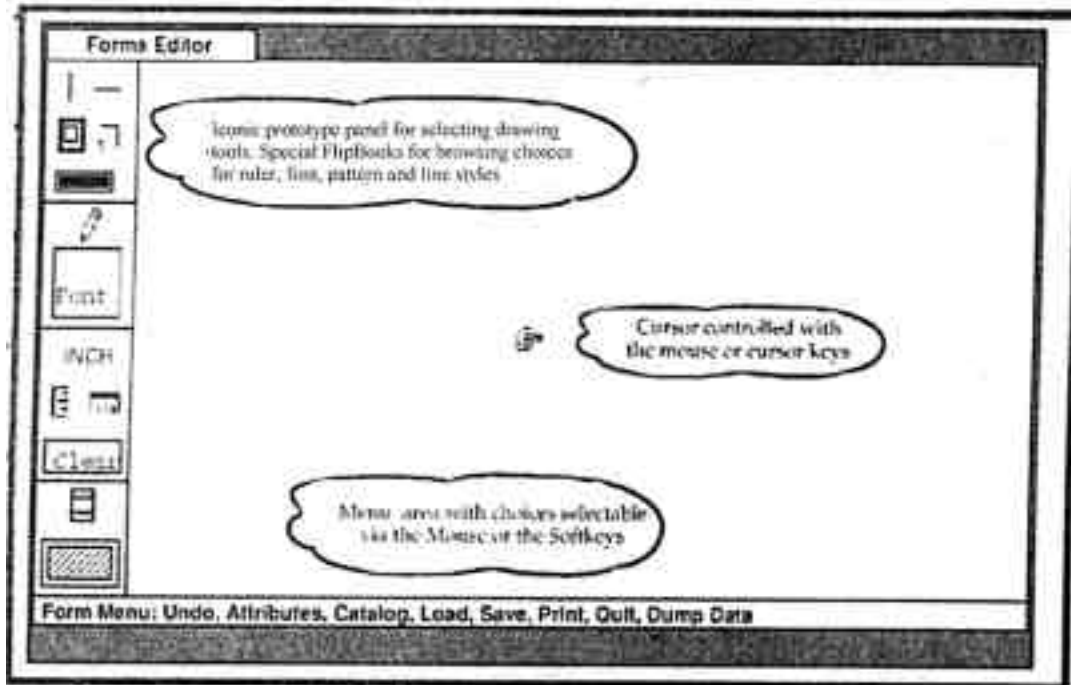
(Developed on an Apple][)

- * Area for application status messages
- * Cursor controlled with cursor keys to layout lines, text, boxes and data fields.
- * Prompt and Message ares. Arrows indicate possible cursor movements.
- * Softkey Area shows the current set of ten choices.



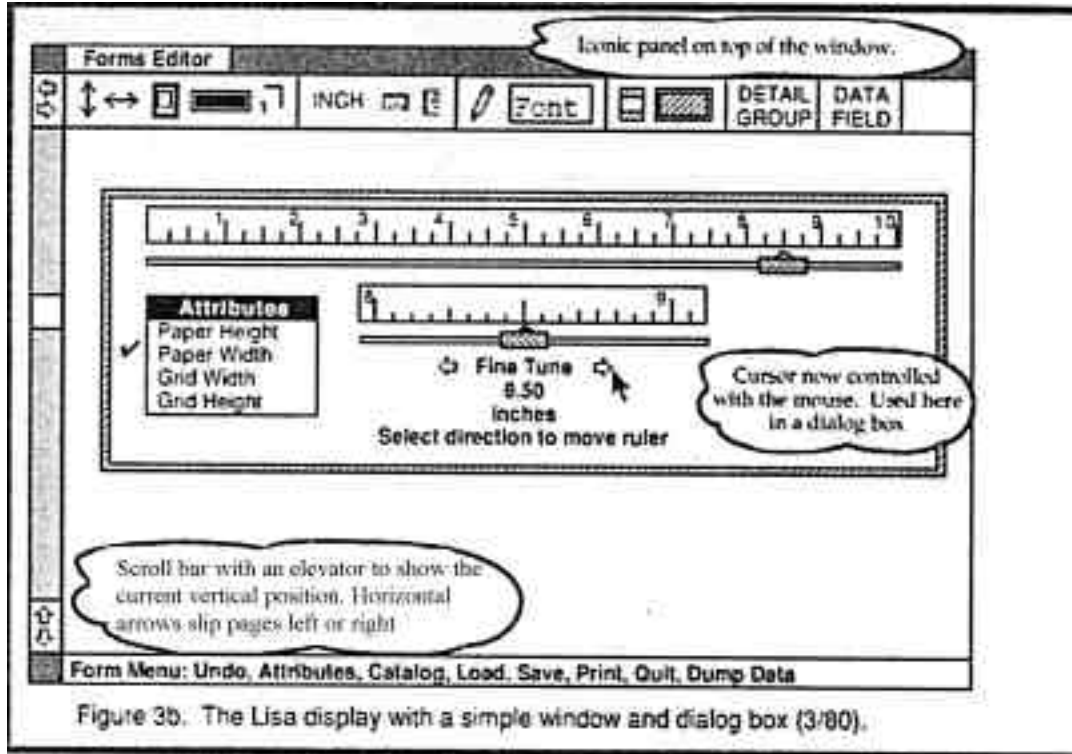
February 1980 Prototype

- * Iconic prototype panel for selecting drawing tools. Special FlipBooks for browsing choices for ruler, font, pattern and line styles.
- * Cursor controlled with the mouse or cursor keys.
- * Menu area with choices selectable via the Mouse or the Softkeys.



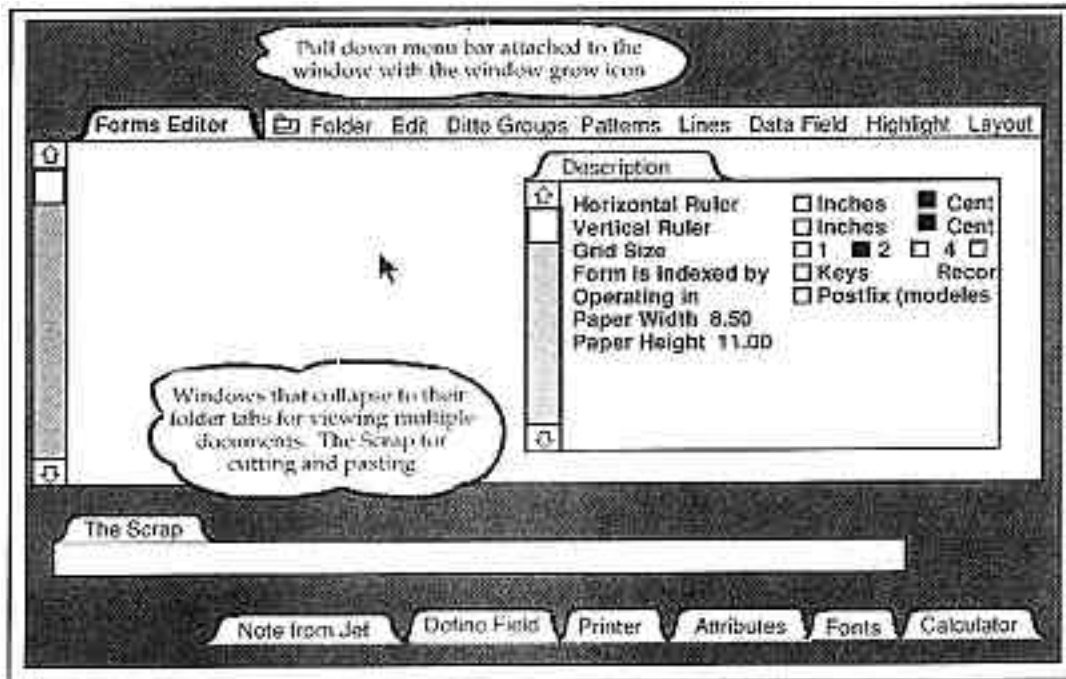
March 1980 Prototype

- * Iconic panel on top of the window.
- * Cursor now controlled with the mouse. Used here in a dialog box.
- * Scrollbar with an elevator to show the current vertical position. Horizontal arrows slip pages left or right.



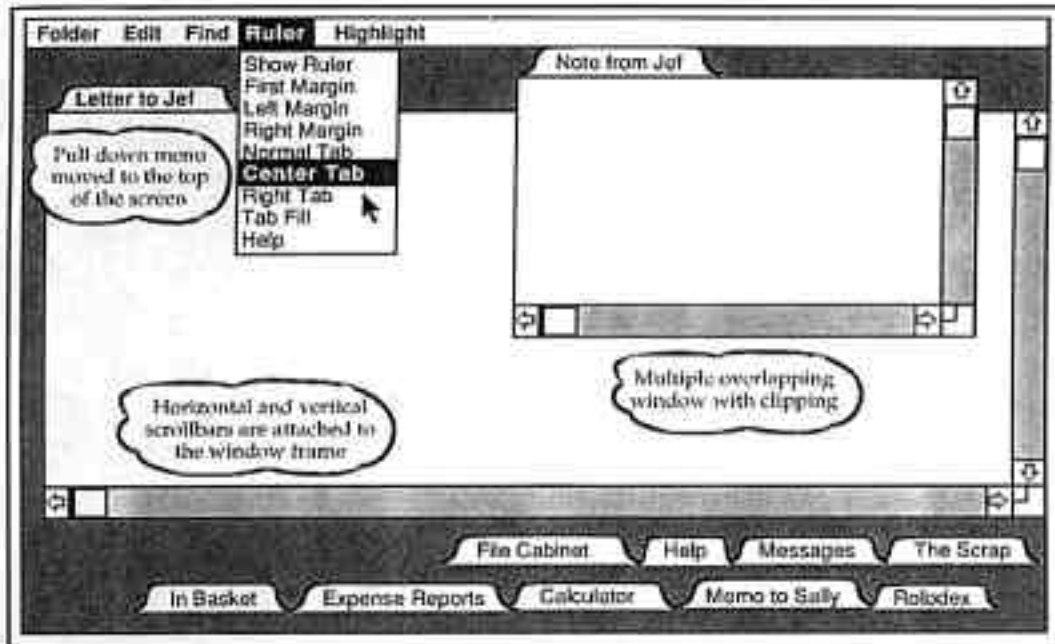
August 1980 Prototype

- * Pull down menu bar attached to the window with the window grow icon.
- * Windows that collapse to their folder tabs for viewing multiple documents.
The Scrap for cutting and pasting.



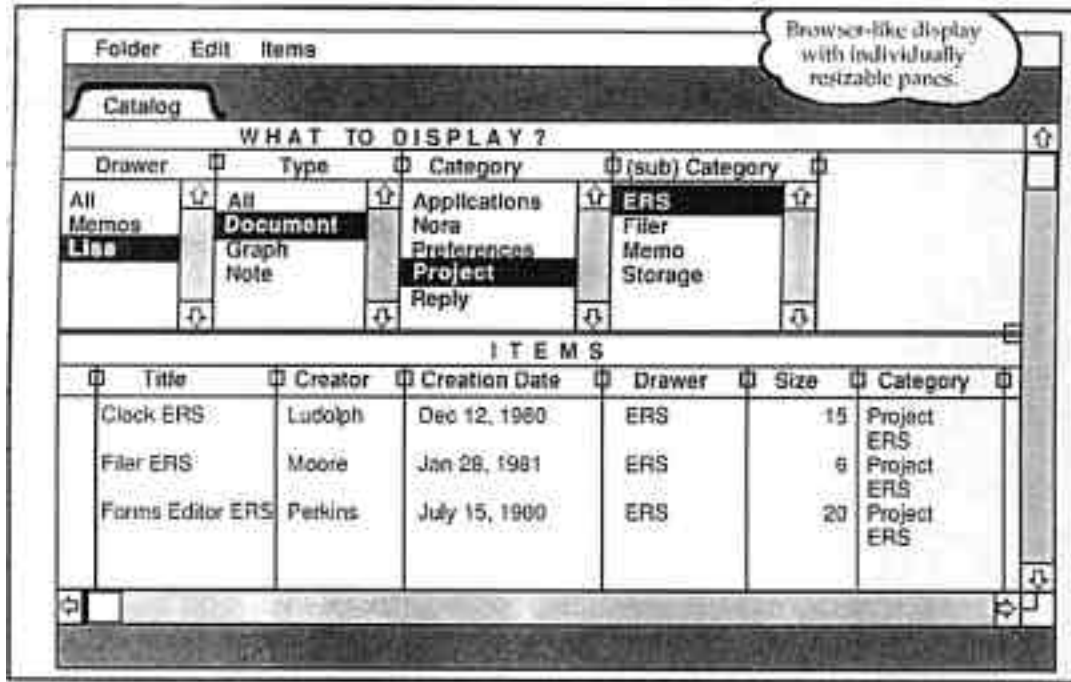
October 1980 Prototype

- * Pull down menu moved to the top of the screen.
- * Horizontal and vertical scrollbars are attached to the window frame.
- * Multiple overlapping window with clipping.



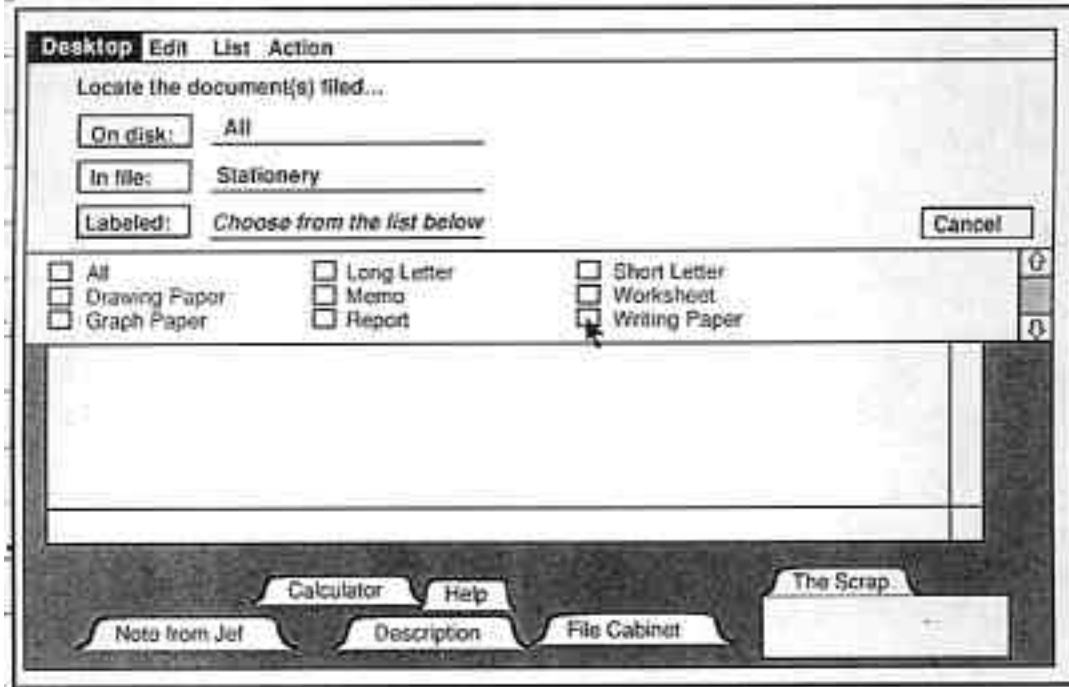
December 1980 Prototype

* Browser-like display with individually resizable panes.
 (Looks a lot like the NeXT-style "Browser View" coming in Mac OS X, doesn't it?)

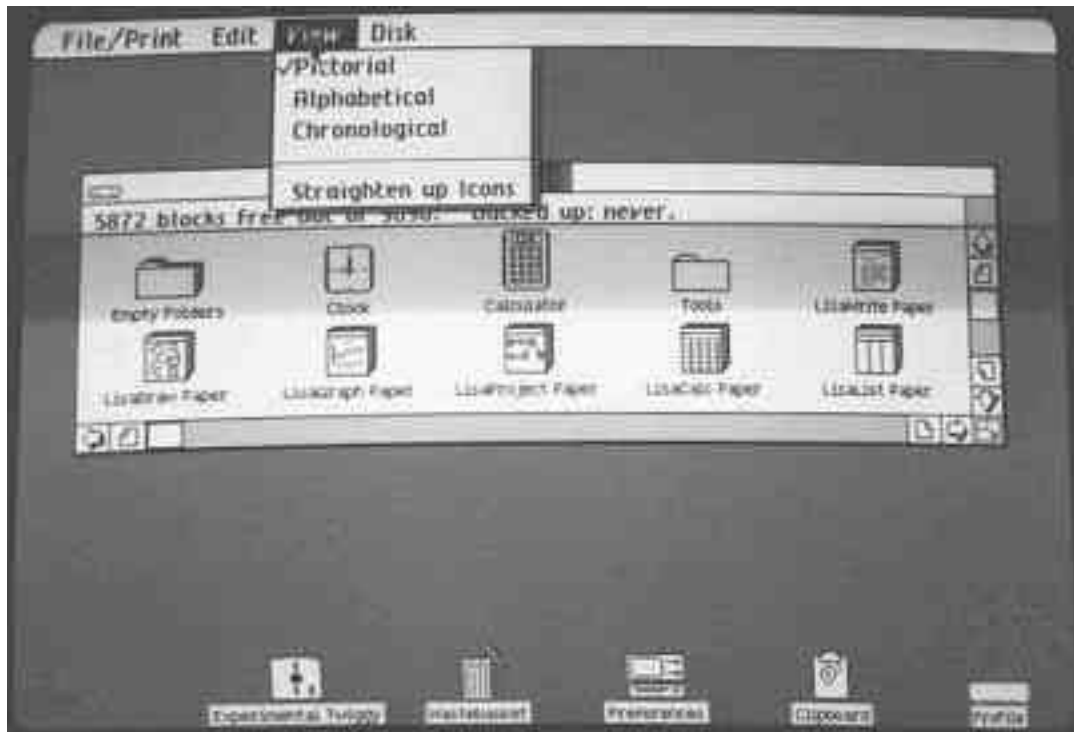


July 1981 Prototype

(Notice the dialog slides out from under the menubar. Remind of you the new feature in Mac OS X?)



Lisa Office System 1.0
(May 1983)



Lisa 7/7 Office System 3.1
(1984, Final Release)

(Notice the Desk menu holding both running apps and Desktop items with open items indicated by a checkmark. Lisa Office System was a cooperative multitasking environment with protected memory.)



Summer 2000: Mac OS X
(January 2000 MacWorld Keynote)



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"Lisa Office System 1.0" and "Lisa 7/7 Office System 3.1" photos Copyright© 1998 Tom Stepleton. Apple Lisa Web page

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