Implementing Metaphor Graphics in an M Environment

by Arthur C. Lee

This article briefly introduces the ideas behind metaphor graphics, a concept for constructing visual analogy to represent information. With the advent of tools available to M developers for constructing graphical user interfaces (GUIs), metaphor graphics can be implemented in a fairly straightforward manner. One example of metaphor graphics in an M environment represents and displays information from an M database. There are other aspects of metaphor graphics that are not so easily handled, however.

Cole addressed the issue of representing information using the concept of metaphor graphics.[1] He made a very good point when he stated that information is not the same thing as data. His paper tackled this issue most incisively. Metaphor graphics is a powerful tool that can be used when attempting to represent in a concise manner the multiple features or attributes of records stored in a database. Such representation cannot be made using simplistic tools such as bar graphs or pie charts. Metaphor graphics attempts to address the following points:

- People are imperfect processors of information. They do not reason via formal logic but rather solve problems using mental models and pattern recognition.
- Digital representation of the analog world can be surprisingly unhelpful. Simply making data available is not helpful if those data cannot be brought to bear on the problem at hand.
- Graphic representation can help bring data to bear in problem solution.
- An alternative type of graphic exists: metaphor graphics. By creating a visual metaphor we recontextualize data, and thus create a picture of the problem (or create a picture of the data that can be grasped more easily).

With metaphor graphics, one can start building computer tools that aid in visualizing the information present in a database. Such tools are not meant as substitutes for human reasoning but rather should be perceived as companions to it. Metaphor graphics can be used to develop tools that can effect cooperative computation.

Imagine that a mail-order business keeps a database of daily sales orders. Each record from such a database for any given day may have the following items:

- Customer name;
- Customer gender;
- Street address;
- City;
- State;
- ZIP code;
- Item(s) ordered;
- Total purchase amount; and
- Discounts, if any.

In reality, a sales order transaction contains much more information, such as credit card number or authorization code for bank deposit. Imagine, then, trying to read through just thirty transactions from a day's sales file:

FEMALE	FLORENCE	OR	97439	104.75	YES
MALE	LOS ANGELES	CA	90024	140	NO
MALE	PT TOWNSEND	WA	98368	84.19	NO
MALE	MEDFORD	OR	97504	94.85	NO
MALE	YAKIMA	WA	98901	98.56	NO
MALE	VANCOVER	WA	98665	47.37	YES
FEMALE	ALBANY	CA	94706	26.25	YES
MALE	SANTA ROSA	CA	95404	16.45	NO
FEMALE	SAN FRANCISCO	CA	94111	27	NO
MALE	LOS ANGELES	CA	90046	34.45	YES
MALE	PORTLAND	OR	97201	26.95	NO
FEMALE	LA JOLLA	CA	92037	47.98	NO
MALE	BELLEVUE	WA	98004	100.81	NO
MALE	LAGUNA NIGUEL	CA	92656	15.4	YES
MALE	SANTA CLARA	CA	95051	13.45	NO
FEMALE	LOS ANGELES	CA	90043	37.4	YES
MALE	DANVILLE	CA	94506	82.25	NO
FEMALE	SAN DIEGO	CA	92110	37.5	YES
MALE	LEMOORE	CA	93245-3723	74.35	NO
MALE	BERKELEY	CA	94707-2454	32.35	YES
FEMALE	FORT JONES	CA	96032-0423	22.35	NO
MALE	STUDIO CITY	CA	91604-2223	73.25	NO
MALE	BEALE AIR FORCE BAS	CA	95903	16.35	NO
MALE	BIG BEAR LAKE	CA	92315-6119	26.45	NO
MALE	MANHATTAN BEACH	CA	90266	58.85	NO
MALE	ESCONDIDO	CA	92025	25.35	YES
FEMALE	LOS ANGELES	CA	90027	46.4	YES
MALE	MORGAN HILL	CA	95037	24.45	YES
FEMALE	SAN FRANCISCO	CA	94116	31.4	YES
MALE	SANTA MONICA	CA	90403	21.45	NO

The table contains just a fragment from an actual daily sales file for a mail-order business. How quickly and accurately can one spot the sales of more than $100? What percentage of the sales were to men? These are only two of many questions management needs to answer in order to position the company to succeed.

The problem is not that there is too much information, although the table format may look that way. The problem is that the data are represented in the wrong format for easy extraction. The data need to be represented in a manner that is more informative. Then, what is the optimal representational form for describing the contents of this database? We know that human beings have a remarkable ability to quickly acquire and retain visual information. If a representation could be found that is visual, sensitive to the context, and easily determined, it could be a cognitive companion to the user trying to make sense of and analyze the data being represented. Standard graphics, such as the bar graph, are extremely limited in their usefulness because they cannot represent multiple attributes.

We have developed a visual representation, or icon, of each record of the daily sales database using metaphor graphics. The prototype was constructed using Microsoft Visual Basic version 3.0, Professional Edition, for the forms and overall GUI; InterSystems's Visual M to link the M database to the Microsoft Windows environment; and Icon Works application, which comes as a sample application with Microsoft Visual Basic, to create the 32-pixel by 32-pixel icons.

An icon represents a customer. Each icon has sales attributes. The attributes for this database have been identified as:

- Gender;
- Discount given?;
- Order location; and
- Purchase amount.

Figure 1 is a configuration of nine icons shown in three rows. Each icon represents one of the sales attributes in a specific position. The top left icon's border has a notch in its lower left corner. This represents an order that has been discounted. The icon to its right represents an order from a female customer. The third icon from the left in the top row represents an order from a male. (Both gender attributes are located within a box that represents an order that has not been discounted.)

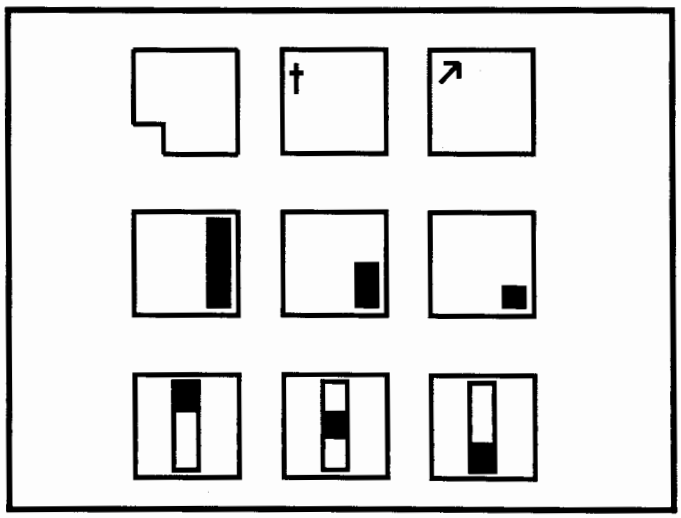

Figure 1. Sales attributes.

The three icons in the middle row represent the relative amount of the purchase. The full vertical bar represents a purchase amount of more than $100. The half-height vertical bar represents a purchase between $50 and $100. The smallest vertical bar represents sales of less than $50.

The three icons in the bottom row represent the customer location. Because this metaphor-graphic representation is used for a firm that operates in the states of California, Oregon, and Washington, the vertical box represents the West Coast of the United States. The position of the black box within the rectangular frame represents the state in which the customer is located, with California on the bottom, Oregon in the middle, and Washington on the top.

An example of what the general manager of this mail-order business would see for a given day's sales orders would be a form on the computer monitor that would look something like figure 2.

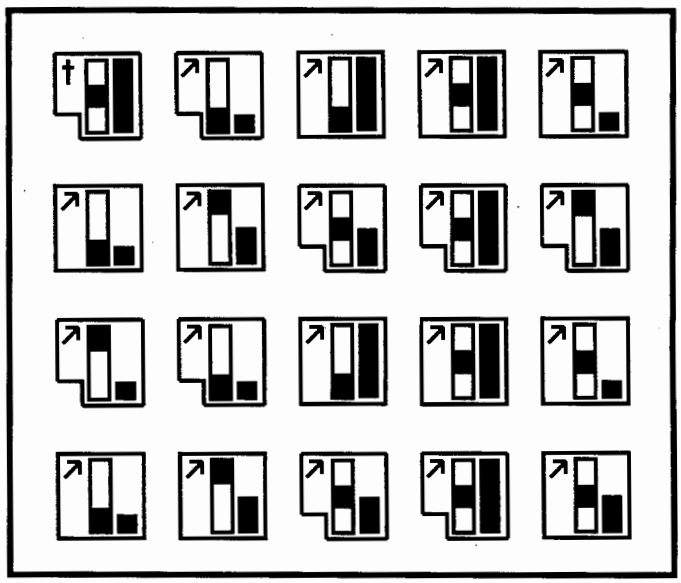

Figure 2. Sample report.

Each icon now contains all four attributes, and the user can get a quick overall view of the daily sales information. The middle icon in the bottom row represents a male customer in Oregon who placed an order totalling between $50 and $100. The icon in the upper left corner represents a female customer in Oregon who placed an order for more than $100 and received a discount. Purely for illustrative purposes, one can see that in this example it's quite easy to determine that ten orders were placed by customers who live in Oregon. Figure 3 is a more detailed explanation of a typical icon used in the illustrations here.

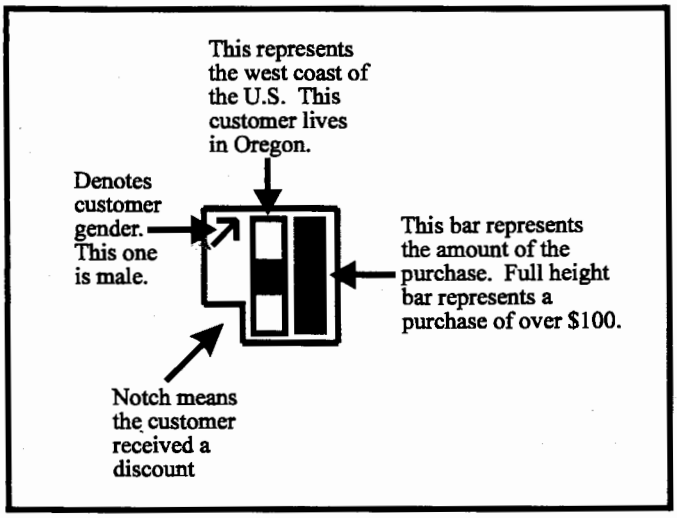

Figure 3. An icon summarizes a sales transaction.

The prototype enables the user to double-click an icon to display more detailed information about the customer. In this case, for example, a more standard form displays customer address, telephone number, purchasing history, and items purchased.

One could incur significant costs in developing a system that uses metaphor graphics because there is no generic method for constructing metaphoric graphical elements. Because such graphical objects are necessarily context-sensitive, the representational system is geared toward use with a specific real-world database. In fact, the most difficult aspect of using and implementing metaphor graphics is in creating icons themselves, in devising the metaphoric mapping. There are obvious benefits to using metaphor graphics as well. Once an acceptable representation of the data is constructed training takes only several minutes. Metaphor graphics also enables the summarization of data in a small amount of space.

Using color in metaphor graphics is not practical. Practically speaking, using a color printer is time-consuming. Using a 600 dpi (dots per inch) laser printer to print three copies of a fifty-page report incorporating (black and white) metaphor graphics can be done fairly quickly. A color printer would make it less than convenient. But even more important, though the trained human eye is capable of distinguishing between one million colors, using color in metaphor graphics complicates matters because using color by itself to project meaning is very difficult.[2] It is worth quoting Tufte when considering color. He said, "Indeed, [it is] so difficult and subtle that avoiding catastrophe becomes the first principle in bringing color to information: Above all, do no harm."[3] Very basic use of color could be considered for use in metaphor graphics such as representing temperature: blue for cold and red for hot. But what about a color representation for lukewarm? Therein lies the problem with using color.

Metaphor graphics can be exploited to devise visual representations of a database. Finding the appropriate metaphor mapping is difficult. Once a representation is constructed, however, learning the metaphor is relatively easy and using representations can summarize information in the database. Metaphor graphics is a relatively new idea but it is worth considering when one is faced with the problem of succinctly presenting large amounts of information from a database.

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Endnotes

1. W.G. Cole, *Metaphor Graphics and Visual Analogy for Medical Data*. Tutorial supplement to SCAMC, 1987.
2. E.R. Tufte, *Envisioning Information* (Cheshire, Connecticut: Graphics Press, 1990), 81.
3. Tufte, 81.