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**In this issue:... LogoWriter Ashanti Prints!** Brian Robkan

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Manuscripts should be sent by surface mail on a 3.5" disk (where possible). Preferred format is Microsoft *Word* for the Macintosh. ASCII files in either Macintosh or DOS format are also welcome. Submissions may be made by electronic mail as well. Where possible, graphics should also be submitted electronically. Please include electronic copy, either on disk (preferred) or by electronic mail, with any paper submissions. Paper submissions alone will NOT be accepted.

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It happened again. I got discouraged.

I had just returned from a conference at which my husband and I presented a number of sessions. At that conference, I presented two different *MicroWorlds* sessions to two different groups of computer education leaders from the state. Almost none of the participants had even *heard* of *MicroWorlds*, despite the fact that there were a number of Logo-using or Logo-supporting educators in my groups. Although I presented *MicroWorlds* as a hypermedia product, it took those who knew Logo only a few minutes to recognize the familiar turtle and to realize they were looking at a product closely related to Logo. By the end of the sessions, I was getting the usual reaction. Quite a few people came to me unhappy that they had purchased some popular hypermedia product, realizing that they could have used *MicroWorlds* instead, and could still have Logo.

I always find this phenomenon discouraging. It seems that even people who have used and enjoyed Logo for years are drawn to the latest "bandwagon." They feel that the world has moved beyond Logo to hypermedia, so they need to have both the Logo that they enjoy and the "latest and greatest" hypermedia product. How sad that we all feel we have to jump with the crowd rather than seek meaningful and up-to-date ways to use those things that work.

Being discouraged is not a good frame of mind in which to start editing *LX*.

### Great Minds...

It was just a coincidence that in this issue, Glen Bull discusses using *MicroWorlds* as a hypermedia product. While *MicroWorlds* makes the links between Logo and hypermedia clear, nearly any version of Logo can be thought of as having "cards" and navigation among those "cards." Those of us who have been using Logo for a long time have created any number of projects in which files were linked, often in a nonlinear manner. As you read Glen's article, think about how you might accomplish the same thing using your favorite version of Logo.

## Discouraged Again...

by Sharon Yoder

### Lookin' Up

But things got better as I worked through the material for this issue. I was again inspired by the wonderful work of Orlando Mihich and his students. They designed the cover of this issue and even the layout of their article themselves. What a wonderful experience for students. They used Logo to create a culturally meaningful product, they involved their community, and then they did the real-world work of designing the final published product. Some of my earlier discouragement went away.

In between issues of *LX*, any material destined for the next issue goes into a folder, where it waits until I am ready to do the final editing before copyediting and layout. As I was going through this folder, I found a press release from LCSL. As you may know by now, the *MicroWorlds* products received an Award of Excellence in *Technology & Learning's* Software of the Year awards. Now my Logo blues were fading rapidly. To have a Logo-based product that is able to compete with the mainstream of new software products is truly exciting. No matter what version of Logo you prefer, this can't be anything but positive news for all of us.

### So...

The next time someone says to you, "Are you still using that old Logo stuff?" you can proudly say, "Of course! Didn't you see that one of the best software products of the year was Logo based?" And *then* you can begin to educate, to engage, to encourage, to proselytize, to convert—to pass on to your colleagues whatever level of Logo commitment you have.

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# When Is RANDOM Not Random?

By Tom Lough

When I was working with a couple of Logo teachers recently, one of them remarked that her students were very excited about changing their procedures in order to produce surprising new things. But their enthusiasm waned somewhat when the surprise was repeated each time they used REPEAT to change the procedures. The new became old quickly. "Isn't there some way to make procedures unpredictable each time they are run?" they asked. We began to talk about the RANDOM primitive. This is one of my all-time favorites because you never know what it will do. (Well, that is not always strictly true, but it is usually "true enough" for our purposes.)

First, let's make sure we have a fundamental understanding of RANDOM. As a reporter primitive, it produces a value selected randomly between and including zero up to, but not including, the number you give as input. Thus,

```
SHOW RANDOM 3
```

could display either 0, 1, or 2, but not 3. Moreover, the probability of all numbers in the reporting range is approximately evenly distributed. This means that if you type

```
REPEAT 30 [SHOW RANDOM 3]
```

you would expect to see 0, 1, and 2 about 10 times each. Students can have a lot of fun with RANDOM. How far will the turtle go if you type

```
FORWARD RANDOM 50
```

Which way will the turtle travel if you type

```
RIGHT RANDOM 360 FORWARD RANDOM 50
```

RANDOM can also be used in procedures, such as the following:

```
TO FIGURE
  REPEAT 4 [FORWARD RANDOM 50 RIGHT
            90]
END
```

Hmmm. This last statement reminds you of the command to draw a square, but it doesn't seem to work out quite that way. But if you REPEAT it, you will find that it produces very interesting results.

But what if you want random behavior in a range of numbers that does not start with zero? A common example came up during the discussion with the teachers. When we tried to get Logo to play "science fiction music" using RANDOM, we got into a little trouble.

```
TO MUSICK
  REPEAT 100 [TONE RANDOM 1000 RANDOM
             30]
END
```

The version of Logo on our computer used the TONE command to play a note. TONE needed two inputs: a frequency number from 37 to 9999 for the pitch of the note, and a duration number from 0 to 255 for the length of time of the note.

Some notes were longer (duration number near 30) while other notes were short (duration number near zero). And as long as the random number produced for the frequency was 37 or higher, everything worked and we got some interesting sounds. Sooner or later, though, RANDOM produced a frequency number below 37. One of the teachers got the idea of adding something to the random number to keep it 37 or greater. The improved statement looks like this:

```
TO MUSICK
  REPEAT 100 [TONE (37 + RANDOM 1000)
             RANDOM 30]
END
```

Even if RANDOM 1000 reports a value of zero, the 37 guarantees that the value passed to the TONE command is within the operating range, because  $37 + 0 = 37$ . This time, the procedure ran with no interruptions and we heard a weird-sounding music.

```
TO FIGURE
  REPEAT 4 [FORWARD (40 + RANDOM 10)
           RIGHT 90]
END
```

Now that's more like it. At least the drawings resemble squares now.

At this point in our discussion, I suddenly saw a clue to my own behavior in the  $(40 + \text{RANDOM } 10)$ . My behavior is usually consistent up to a point, but there is always some variation. For example, as the editor of LX, Sharon Yoder knows she can count on me to have this



column written for each issue—that's the 40 part. However, the actual date of submission varies around the deadline date a bit—that's the RANDOM 10 part. Maybe this is how our students behave as well. Maybe they perform fairly consistently up to a point and then exhibit some variation. I wonder where we focus our attention most? Do we recognize the consistent behavior or harp on the inconsistent? It seems to me that we help a student to mature if we encourage a change from a "life function" (I made that up) of  $(10 + \text{RANDOM } 40)$  to a more responsible  $(40 + \text{RANDOM } 10)$ . But I also feel that we do a student a disservice if we insist on  $(50 + \text{RANDOM } 0)$ . After all, nobody's perfect!

## FD 100!

P.S. Oh, yes! When is RANDOM not really RANDOM? Some Logo versions have particular ways to initialize the random number generator. If they initialize the generator the same way each time, the pattern of random numbers can be the same. For example,

```
SHOW RANDOM 5 RERANDOM SHOW RANDOM 5
```

can produce the same value in certain Logo versions. If you experiment a little with RANDOM, you can tell whether your version works this way.



# THE CRYSTAL RAIN FOREST

## A Mathematical Learning Adventure

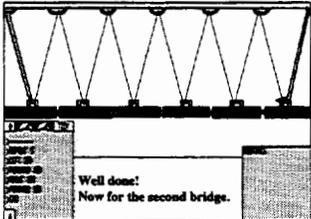
The planet Oglo is in trouble. Its rain forests are being destroyed.  
The king has been poisoned. Only YOU can save them!



**The Crystal Rain Forest** helps students in grades 3-8 use math to learn about the environment. They hunt for clues in the town, then search for the lifesaving magical crystals deep in the rain forest.

On their quest, they face a series of mathematical puzzles and challenges to solve. They give instructions to robots, guide and rotate shapes to mend bridges, navigate a boat, estimate

distances and angles to connect wires, draw shapes to make nets, change box sizes using simple algebra, and so on.



As a result of these carefully sequenced activities, students learn to use the Logo language. *Crystal Logo*, an easy-to-use version, can be run separately from the adventure, and its command names can be modified.

*The Crystal Rain Forest*, award-winning software from England, is available here as a single user version (\$49.95), as a single version for school use with curriculum materials (\$59.95), and as a building site license (\$250.00).

*PC version requires a 286 or better with VGA and a mouse.*  
*Mac version requires System 7, color*



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# My Turtle Speaks Semaphore!

by Dorothy Fitch

When I first thought about this project, I worried that it was too similar to others I had explored here—more flags and codes. But when I actually started working on it, I realized that the focus of this project is less about flags and codes than it is about planning a project, symmetry, and rotation. So, here goes!

Being curious about various types of symbolic languages, I decided to investigate semaphore signals. (For you linguists out there, *semaphore* means “bearing a sign.”) I learned that ancient Romans and Greeks used torches and flags to communicate over short distances. The modern set of signals was developed in France by a boy named Claude Chappe. He lived at school and wanted to send messages to his brother who lived a mile away, so he invented a wooden beam with a movable arm on each end. He and his brother agreed on a set of signals, and the rest is history. Semaphore signaling remains in use today on railroads and for marine communication.

If we had all the time in the world, it might be fun to learn how to do semaphore ourselves, but since we don't, let's teach the turtle how to do it!

## Planning the Program

I spent much more time thinking about how to approach this problem than I did programming. There were so many decisions to make. I am not going to give you a complete solution—that is up to you. But I'll mention the ideas that occurred to me and the process I went through in planning the program. If you want my final program listing, feel free to send me a self-addressed stamped envelope at the address listed at the end of the column. The version I used was *Logo PLUS* for the Macintosh.

First, what are we dealing with? We know that:

- There is one flag formation for each of the 26 letters of the alphabet. (The signals for the numbers 1-10 are the same as for A-J. There are also signals that you can research for Error and Numerals Follow. My reference books didn't agree on the rotation of the upper flag in the letters K and V, so your research, too, may uncover slight differences from the letters shown here.)
- Each flag formation is made up of two flags.
- Flags may be pointed at any of 8 angles (45° from horizontal or vertical).

- There is essentially one flag design, but it appears in different rotations. (Actual semaphore flags are half-red and half-yellow.) Here are all the flag shapes used:



- To simulate semaphore signalling, it would be nice to be able to switch from letter to letter rather quickly.

What next? I played around with the following ideas:

- Should I use one, two, or three turtles? Although the project could be done using one turtle, the concept really calls for two turtles: one for the left-hand flag and one for the right-hand flag. And rather than draw a figure or beam to attach them to, it might be simpler to create a shape for that as well. Using a shape would make it easier and faster to adjust its position on the screen, or refresh the screen if necessary. Therefore, I decided to use three turtles.
- Should I draw the flags using the turtle or should I create turtle shapes? There are a lot of issues to think about here.

### Turtle-Drawn Flags

**Pros:** I could draw red and yellow flags using the turtle.

I could rotate the flag in any direction.

**???:** How many different flag designs would I need to teach the turtle?



Just one, which could be rotated for the rest.

**Cons:** The shapes would be drawn too slowly when needed for signalling.

### Flag as Turtle Shapes

**Pros:** I could change shapes very quickly.

**???:** How many different flag shapes would I need to create?



I would need three shapes. I noted that a flag that appears on one side of the flagpole is the mirror image of one that appears on the opposite side. (If you look on the Copy Me page at the end of this article, you'll note that the two flags for J are the simple rotations of the same flag. The two flags for R are mirror images of each other.) *Logo PLUS* shapes rotate every 90°, so the rest can be shown as rotations of the preceding three flags.

(In retrospect, I realize that I could have gotten away with just the first two flags, but that would have required much more adjustment of the turtle to display the correct orientation of some of the flags.)

If your shapes don't rotate, you'll need to create all the flag shapes.

*Cons:* The flags would have to appear in black and white (or red and white if I set the pencolor to red and then stamped them).

Although the previous comments seem to favor the turtle-drawn flag, I decided that the speed factor was the most important and outweighed the cons of using turtle shapes for flags.

- If I used turtle shapes, should the little flagpole be part of the shape?

Having decided to use turtle shapes for the flag, I pondered whether to use the turtle to draw the stick for the flag or make the stick be part of the shape? I decided that using the turtle would make the program more flexible. I would be able to make larger flag shapes if I didn't have to include the pole. It would also allow me to change the length of the pole later, if I wanted. Also, as in the case of letter A, the poles can't be the same length (or the individual holding the flags must accommodate for this apparent discrepancy in order to align the flags as shown).

I have now decided to use three shapes (left arm, right arm, and figure) and create three flag shapes in the Shapes Editor. Now all I have to do is put everything together!

## Writing the Program

In my program, each letter procedure calls a *SETUP* procedure that clears the screen and resets the positions of all shapes. It looks like this:

```
TO SETUP
CLEARGRAPHICS
TELL BOTH HIDETURTLE PENUP
TELL 0 SETSHAPE :FIGURE SHOWTURTLE
TELL 1 SETXY -3 24
TELL 2 SETXY 3 24
TELL BOTH PENDOWN
END
```

*BOTH* is a procedure that allows me to talk to the two turtles holding flags:

```
TO BOTH
OUTPUT [1 2]
END
```

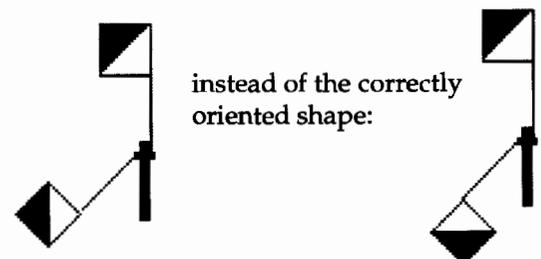
Then, for each letter, I tell Turtle 1, then Turtle 2, which way to point and what shape to use. Then I tell both of them to move and show themselves. Here is the letter R procedure:

```
TO R
SETUP
TELL 1 SETHEADING 270 SETSHAPE
:FLAG2
TELL 2 SETHEADING 90 SETSHAPE :FLAG3
TELL BOTH FORWARD 30 SHOWTURTLE
END
```

It's pretty straightforward once you have everything planned! For some letters, I needed to move a turtle and then rotate it for it to appear in the proper orientation. This is because *Logo PLUS* turtles rotate every 90°. You may want the turtle to appear at a different orientation from the way it would normally appear at that heading. For the letter K, for example, I used this sequence of commands:

```
TO K
SETUP
TELL 1 SETH 225 FORWARD 30 SETH 180
SETSHAPE :FLAG1
TELL 2 SETH 0 FORWARD 30 SETSHAPE
:FLAG2
TELL BOTH SHOWTURTLE
END
```

If I simply set Turtle 1's heading to 225 and moved it forward 30, its shape would appear as:



I also played around with *Logo PLUS's* **LOCKHEADING** command, which allows you to keep the orientation of a shape fixed as you turn the turtle. This idea worked fine, but it didn't seem to save any instructions.

Now to see the turtle(s) signal your letter, simply type the name of the letter. Type A and watch what happens. Do you need to debug anything? As you finish the other letters, be sure to test them.

## Sending Messages

The obvious next thing to try is to send a message—an entire word. You'll want to send the signal for the first letter, wait a bit, then send the next letter, and so on until the word is complete. Here is my **SIGNAL** procedure:

```
TO SIGNAL :WORD
IF EMPTY? :WORD [STOP]
RUN (LIST FIRST :WORD)
WAIT 50
SIGNAL BUTFIRST :WORD
END
```

The primitive **RUN** needs a list of instructions as input, so we need to turn the first letter of the word into a list. Then **RUN** runs the list of instructions just as if you typed it at the top level. **RUN** is handy when your program controls which procedure is to be run.

Now if you type an instruction like **SIGNAL "RECESS**, you can watch the turtle send the message.

## Classroom Suggestions

There seems to be a lot of opportunity for group work here. Assign several groups of students this challenge and see how they approach it. Start by giving them plenty of time away from the computer. If they don't know how to use multiple turtles, they don't need to learn, even though this may be a good learning project.

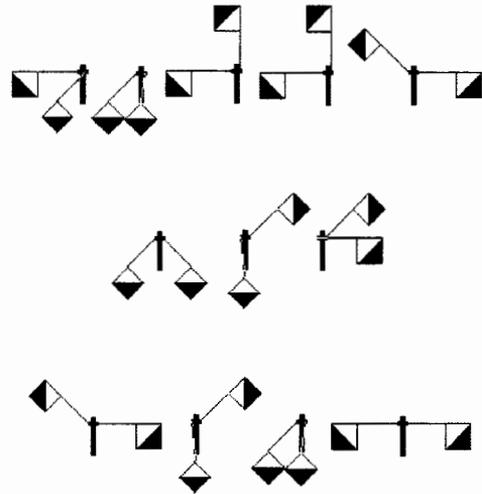
This is also an excellent project to introduce the concept of program design. The more time you spend planning, typically, the less time you spend coding. You may want to have each group explain its design to the other groups before starting to implement the design. They could learn a lot from each other!

Here are some other activities:

- Make cardboard flags on sticks and practice semaphoring.
- Have each member of a group of students each signal one letter of a word and see if the rest of the class can decode the word.
- Have your students study the flag formations and see if they can find any patterns to the arrangements.
- Can the students use variables or a pair of procedures similar to **BOTH** so that they can

easily display the mirror image of the flag formations? (Swapping the right-hand flag with the left-hand flag will make it easier to learn the patterns.)

I had a lot of fun working out this set of procedures and hope you will too. If you want a copy of my version, send me a self-addressed stamped envelope. Until next time, Happy Logo adventures, and...



Dorothy Fitch has been director of product development at Terrapin Software, Inc. since 1987. A former music educator, she has also directed a computer education classroom for teachers and students and provided inservice training and curriculum development for schools. She is the author of *Logo Data Toolkit* and coauthor of *Kinderlogo*, a single-keystroke Logo curriculum for young learners. At Terrapin Software, she coordinates software development, edits curriculum materials, writes documentation, and presents sessions at regional and national conferences.

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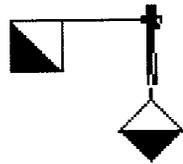
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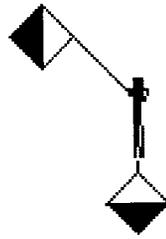
# Copy Me Page — Semaphore Signals



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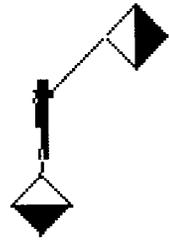
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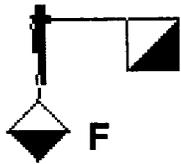
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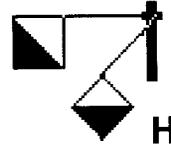
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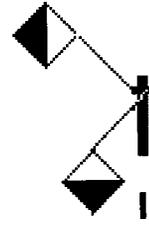
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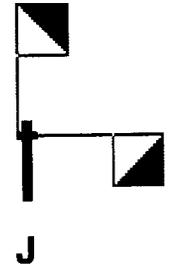
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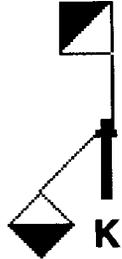
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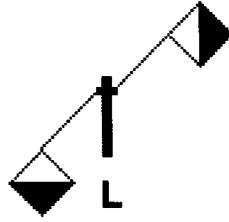
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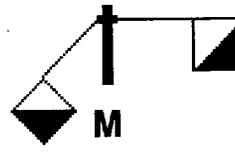
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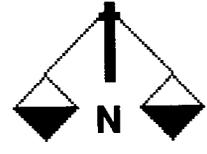
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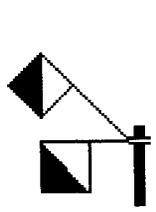
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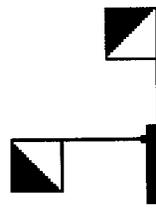
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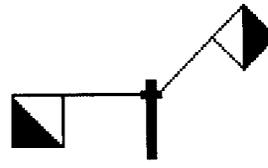
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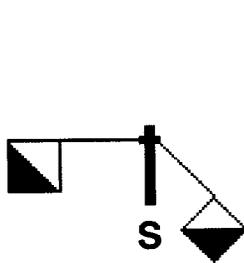
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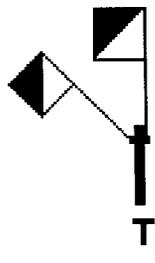
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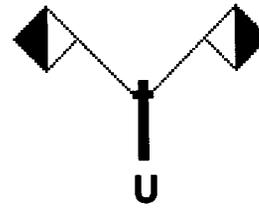
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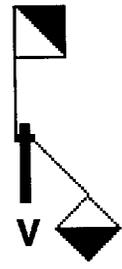
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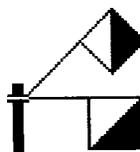
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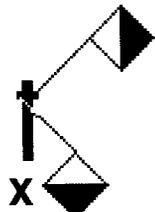
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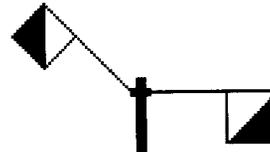
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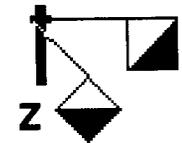
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X



Y



Z

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# Scissors, Paper, or Rock: An Adventure in Probability

by Robert Macdonald

Mathematics textbooks' series today introduce the theory of probability as soon as the concept of fractions is presented. We like to think of probability as "the ratio of the chances favoring an event to the total number of chances for and against it" (*The Reader's Digest Great Encyclopedic Dictionary*, 1975, p. 1073). Expressed as a ratio it becomes:

Probability of an event = (number of favorable chances)/(total number of chances)

As Jacob (1970) explains it,

The branch of mathematics called probability theory had its origin in the 16th century when an Italian physician and mathematician named Jerome Cardan wrote the first book on the subject, *The Book on Games of Chance*. For many years "the mathematics of chance" was used primarily to solve problems dealing with gambling. It has come a long way since then. Today the theory of probability is, according to one 20th-century mathematician "a cornerstone of all the sciences." (p. 344)

However, probability theory is a branch of mathematics in which it is all too easy for experts to blunder. Leibniz and d'Alembert fell victims to its snares. Gardner (1987) warns,

Today, probability theory provides clear, unequivocal answers to simple questions . . . , but only when the experimental procedure involved is precisely defined. A failure to do this is a common source of confusion in many recreational problems dealing with chance. (p. 220)

A simple example may suffice. If we toss a coin up into the air, the probability of it landing heads up is the same as it landing tails up. Each is one chance in two. However, when we claim this, we must make some assumptions:

- The coin will not land on an edge.
- The coin is symmetrical so that no side is favored over the other.
- There is no clever method of tossing that would create an unfair advantage.

When we add more coins to the toss, we compound the complexity of probability (see Jacobs, 1970, pp. 358 ff.).

One of the more delightful solutions to a probability problem has been offered by Martin Gardner (1986).

It deals with Frank Stockton's (1968) brief short story "The Lady or the Tiger?" It is well worth reading to a class as a literary introduction to probability.

Let me summarize the tale:

In olden times, a semibarbaric king had found a way to satisfy his desire for justice. An accused had to appear in an arena in which there were two doors on one side. Behind one door was a beautiful maiden bidden to marry the accused if her door were opened. Behind the other door lurked a ferocious man-eating tiger. Justice was sure and swift—to be married or to be devoured. The ratio was 1:2. Good odds if you were guilty. Poor if you were innocent.

One day the king discovered that his royal daughter had fallen in love with a brave and handsome commoner. Never before had a subject dared to love the daughter of the king. So the king placed the youth on trial. While the most ferocious of tigers were being hunted and trapped, the semibarbaric princess, strong in character and influence, knew all. She was troubled by the beauty of the maiden behind one door and the ferocity of the tiger behind the other. When her lover appeared in the arena, the princess nodded slightly to the right. The youth moved to open the door to the right. What came out? The lady or the tiger?

Stockton never provided the answer. Gardner (1986) does:

After extensive research on this incident, I am able to make the first full report on what happened next. The two doors were side by side and hinged to open toward each other. After opening the door on the right the courtier quickly pulled open the other door and barricaded himself inside the triangle formed by the doors and the wall. The tiger emerged through one door, entered the other and ate the lady. (pp. 77-78)

In his short story, Stockton never described the manner in which the doors were hinged. Gardner brilliantly took advantage of this. In addition, with tongue in cheek, Mr. Gardner assumes that the king was a good sport and allowed the youth a second trial. The reader is encouraged to discover Mr. Gardner's adroit application of probability in this new adventure (see Gardner, 1986, pp. 78-79, 85-86).

This tale does furnish proof positive that we must be careful of the manner in which we apply the laws of probability. It also offers this author some solace in the computer program that follows.

## The Game

The old hand-signal game of Scissors, Paper, or Rock has been played by children for many years. I had forgotten its pleasures until the appearance of Japanese children in my classes some five years ago. These children initially had a limited knowledge of English and participated in activities such as this game because little verbal language communication was necessary.

Let's review the game. The game requires three players, each of whom decide whether the hand they place behind their back will show the symbols of scissors, paper, or rock. The sign for scissors is made with the index finger and second digit finger moving as blades of scissors, while the thumb holds the third and fourth digits down. Paper is represented by holding a single hand out flush. A rock is presented as a clenched fist. Most of my classes liked to chant "one, two, three, show" to establish a group rhythm for showing hands.

Initially, children generally decide on a total number of games to be played and award points in the following manner:

- Player 1 receives a tally point if all three players display the same hand configuration.
- Player 2 receives a tally point if each player displays a different hand arrangement.
- Player 3 receives a tally point if any two players display the same hand arrangement and the third displays a different one.

## The Probabilities of the Game

The game presents an interesting study in probability. For example, each player can display three possible hand configurations. Hence, there are:

$$n_1 \times n_2 \times n_3 \quad 3 \times 3 \times 3 = 27 \text{ possibilities}$$

Of these 27 possibilities, three may have all the same hand positions (S = scissors, P = paper, R = Rock):

SSS  
PPP  
RRR

There are six possible arrangements (permutations) if all of the hand positions in the game differ. Here we are concerned with the arrangement of position. The arrangement can be made in a given order called a permutation. With three players each showing a different hand signal we are faced with 3 factorial:

$$3 \times 2 \times 1 = 3!$$

You may remember that the factorial of a number is the product of all of the positive integers from one through to that number (James, 1976, p. 148).

The permutations are:

SPR  
SRP  
PRS  
PSR  
RPS  
RSP

If we subtract (3 + 6) from the 27 possibilities, we find that the configuration of two players displaying the same hand arrangement while the third displays a different one will equal 18 configurations:

$$27 - (3 + 6) = 18$$

The 18 configurations are:

SSP SPS PSS  
PPS PSP SPP  
PPR PRP RPP  
RRP RPR PRR  
SSR SRS RSS  
RRS RSR SRR

It doesn't take a student very long to realize that Player 3 (two hand positions alike and one different) has a decided advantage over Player 1 (all the same hand positions) and Player 2 (all different hand positions). In 27 games, Player 3 has the possibility of winning 18 times, Player 2 has 6 opportunities of winning, and Player 1 has 3. It is preferable for students to come to these conclusions independently. Fairness is an essential feature in all popular children's games.

## Evening Out the Odds

How then may we even out these odds? To a large extent, we might do this by assigning 1 point to each tally won by Player 3, 3 points to each tally won by Player 2, and 6 points to each tally won by Player 1. This was easily decided on by making use of division:

$$18 / 3 = 6 \text{ points to player 1}$$
$$18 / 6 = 3 \text{ points to player 2}$$
$$18 / 18 = 1 \text{ point to player 3}$$

## Playing the Game With Other Students

A computer program for playing the game is provided at the end of this article. However, it might be prudent to have the class play through a series of 27 games away from the computer. The class can be divided into groups of four: three players and one student who is responsible for gathering data for the group. A worksheet for gathering data is also provided at the end of the article. Since this essentially will be an experiment in gathering data on experimental probability, tallying

will be a very important skill (see Birch, 1988). The nonplaying student, the tallier, will be responsible for marking tallies for Players 1, 2, and 3, and also for limiting the number of games to 27.

It might be interesting to take a group tally of all players within a room to see if the ratio of 3:6:18 generally holds true. It is easy enough to put together a worksheet for this purpose.

## Playing the Game on the Computer

Gardner's (1986) solution to the Stockton short story provides the impetus for some evasiveness on my part in the *LogoWriter* program. The computer game is played by one person. The computer will decide whether Player 1, 2, or 3 will be scissors, paper, or rock. In addition, the computer will keep a count of the 27 games. The student, however, will be required to keep a tally on a worksheet. The command to start the program is **begin**. Thereafter, the student will use the Control key with the Q key. Students are cued in the Command Center. The number of the game is tallied on the screen.

There is an inherent flaw in the program. *LogoWriter* does not have a randomize command. Other dialects of Logo do. However, it is possible to work around this. Without a randomize command, *LogoWriter* will output the same series of random numbers when the computer is turned on and the program is started. To get around this problem, the student is asked to enter a number before starting the game. This number is used to initialize the random-number generator. As long as a student does not enter the same number each time the computer is turned on, the output from the program will appear to be random.

## The Computer Program

```
to begin
  make "counter 0
  random.it
  game
end

to random.it
  print [Enter a number between 1 and
    1000]
  repeat first readlist [make "nothing
    random 10]
end
```

```
to game
  if :counter = 27 [finish stop]
  clearpage
  make "counter :counter + 1
  print [The computer chooses:]
  print []
  tab (print [Player 1 -] choose.3)
  tab (print [Player 2 -] choose.1)
  tab (print [Player 3 -] choose.2)
  print []
  print []
  (print [This is game number] word
    :counter ".)
  continue
end

to finish
  print []
  print []
  print [This finishes a series of 27
    games. Please tally your data and
    complete your worksheet.]

  cc
end

to clearpage
  if not front? [flip]
  rg
  ht
  ct
  cc
end

to continue
  (type [To continue, please use the
    CONTROL KEY with the letter Q.]
    char 13)
  when "Q [game]
end

to choose.1
  make "number random 3
  if (:number = 0) [output "SCISSORS]
  if (:number = 1) [output "ROCK]
  if (:number = 2) [output "PAPER]
end

to choose.2
  make "number random 3
  if (:number = 0) [output "ROCK]
  if (:number = 1) [output "PAPER]
  if (:number = 2) [output "SCISSORS]
end
```



```

to choose.3
make "number random 3
if (:number = 0) [output "PAPER]
if (:number = 1) [output "SCISSORS]
if (:number = 2) [output "ROCK]
end

```

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# Worksheet for SCISSORS, PAPER, OR ROCK?

Name \_\_\_\_\_

Date \_\_\_\_\_

You are to play 27 games and tally a point in the tally column if you win a game.

Fill in the experimental probability column with the total of your tally points.

In the decimal equivalency column divide your experimental tally by 27. You may use a calculator or do it at the computer.

Move your decimal point two places to the right for your percentage. In other words, if you had played 100 games, how many would you have won?

Tally	Experimental Probability	Decimal Equivalent	Percentage
Player 1	/ 27		%
Player 2	/ 27		%
Player 3	/ 27		%

To make the set of games more fair, multiply your total tally by the points given.

Total Tally Points	Points Given	Total Points
Player 1	x 6 =	
Player 2	x 3 =	
Player 3	x 1 =	

Who won this set of games? \_\_\_\_\_

# THE RUSH IS ON!



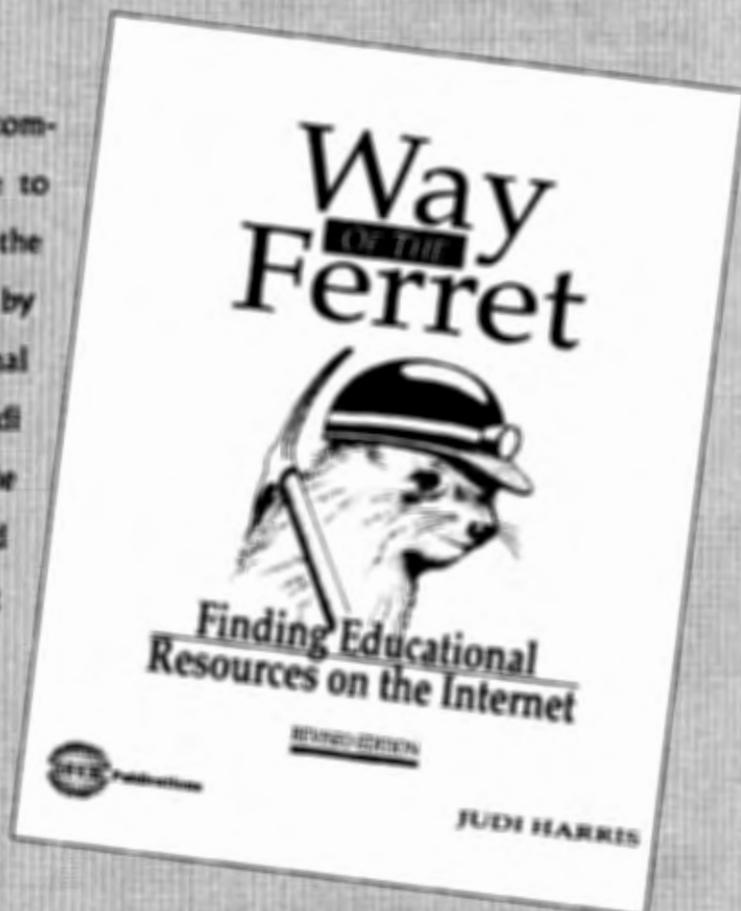
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# The Printing Turtle Exhibited

by Orlando Mihich and his students

The need to create and appreciate things of beauty, to create and enjoy art is a vital and joyful part of life.

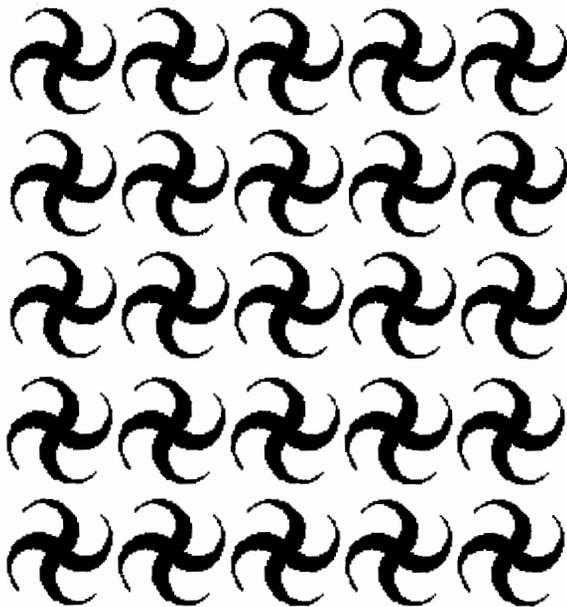
## Introduction

Two years ago, when I ventured into setting up an African Textiles exhibit (see *Logo Exchange*, Winter 1992, Volume 11, Number 2), I promised myself I would not repeat the experience too soon. But in the end, the exhibit turned out to be successful and great fun for me and my students, and was worth all the work and all the invested time. This year, I showed the exhibition's videotape to my seventh-grade students. They liked everything they saw—from the Logo screens to the music and the interviews. They never thought that what they were doing at the computer could be used in a public exhibit. They were also immediately interested to know if they would be doing something similar to the work they saw on the tape. And why not? I thought,

if Hollywood can produce a *Home Alone 2*, we could have an *African Textiles 2*.

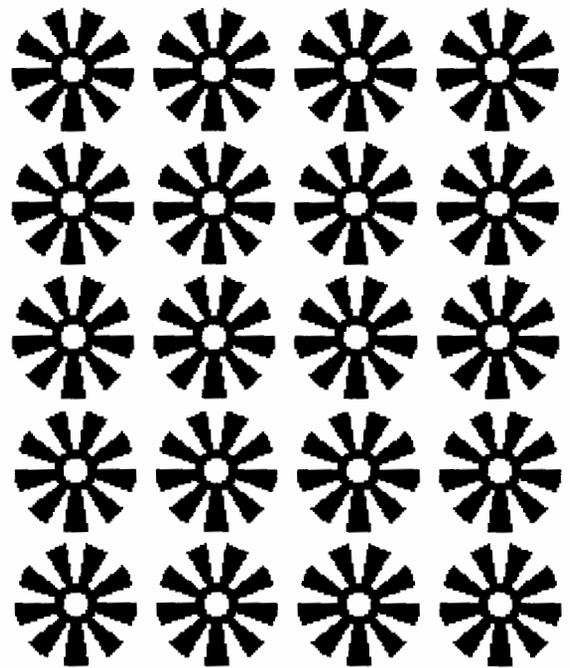
Two of my former students, Myckele Spencer and Michael Toribio, visited me and expressed the desire to continue working with Logo and to work on a project with me and my students. We started to explore more textile designs, but no one was enthusiastic about repeating work that had already been done two years ago. We came to the realization that African textiles were already explored, done, and over.

During our exploratory work, we encountered the printing stamps of the Ashanti people, and liked them very much. They had great Logo potential. From various sources, I put together a folder on Ashanti prints and photocopied it for the whole class. I worked on the prints with my seventh-grade class during regular class time, and in the after-school computer club with Myckele and Michael, who formally joined the club as "Assistants to the Ashanti Project." Three female students



*I made this with my eyes,  
and chose to use these stamps  
and these patterns.  
Their combination pleases me.*

*Celeste Wenegieme*



*I made this with my heart  
to honor Black History Month.*

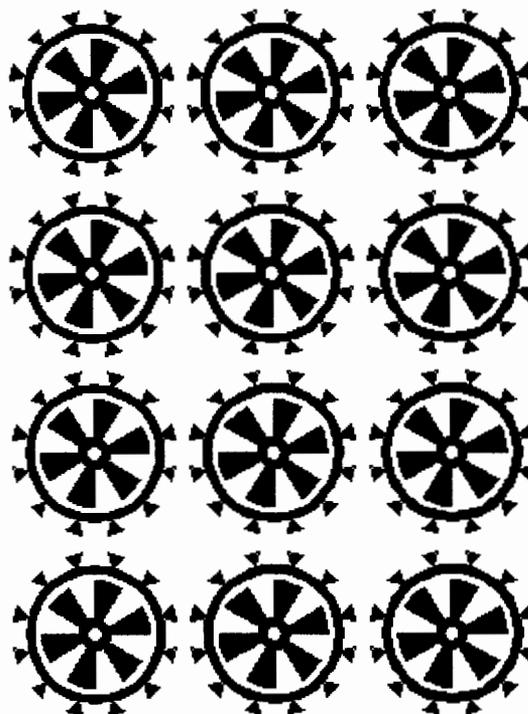
*Quanne Duncan*

joined the project in the after-school hours and created some of the most beautiful screens. The generated stamps were not simply copies of the originals; they assumed a new personal form. Sometimes the design changed to accommodate the student's imagination and/or the computer screen.

I am always moved, and always impressed, when my former students help teach my new students. Myckele, by the way, visited Russia last summer through an NYU students' exchange program. After Moscow, he visited Turkmenistan and Ashgbad, and found that they were using Logo. He impressed the students there by first overcoming some difficulties with their keyboard and later doing "some tessellations" (!) for them.

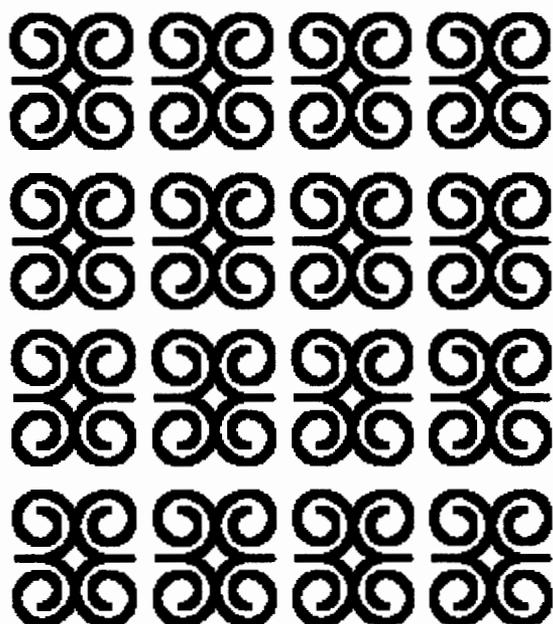
### The Exhibit

When enough screens were generated at my school, we contacted the Black Books Plus Bookstore's owner, Ms. Glenderlyn Johnson, who kindly agreed to host the exhibit again. Flyers were displayed in local stores to announce the exhibit, invitations were given and mailed out, and pamphlets were generated to familiarize the public with the content and meaning of the Ashanti stamps. After 2 1/2 months of intensive work, my students held an exhibition of "Ashanti Prints" on February 4, 1994. It happened between two snow storms and persistent subfreezing temperatures. Still, quite a few visitors came to the opening, and judging from the



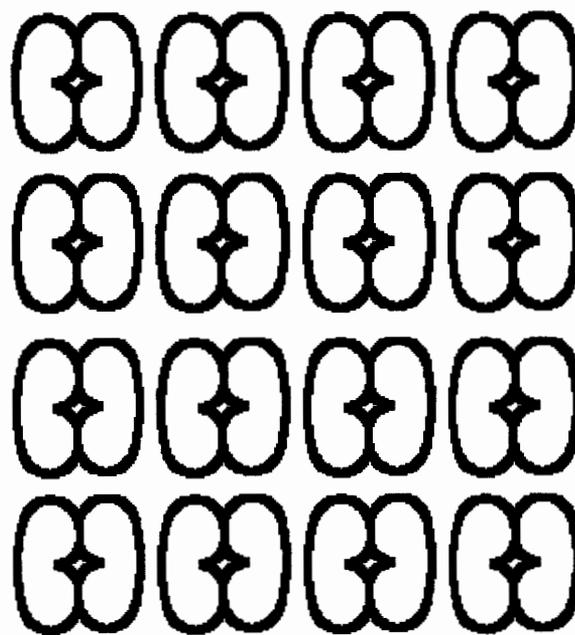
*I made this with my feelings,  
and LogoWriter.*

*Tiama Harris*



*Ram's Horns  
Strength of mind and body.  
Humility.*

*Shaun Jamison*



*I made this with my hands,  
and designed this patterns to be  
just opposed with this one.  
The contrast pleases me.*

*Amit Rawana*

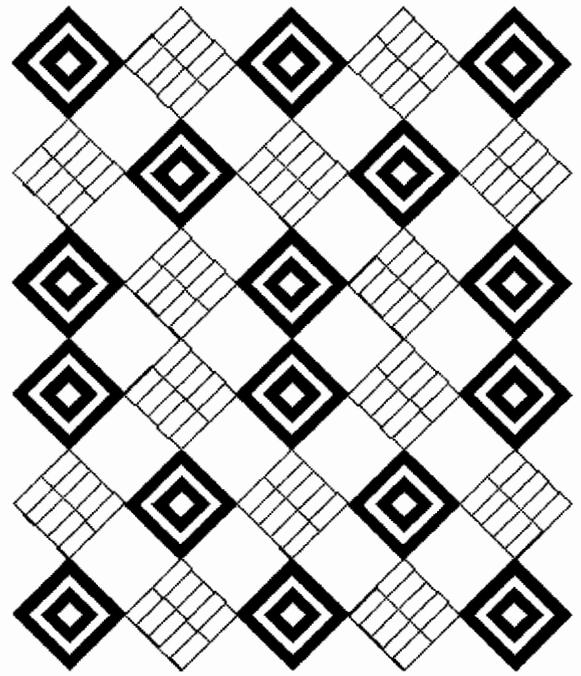


interviews and the visitors' book, the exhibit was a success.

The primary inspirational sources for the exhibit's screens and pamphlet were *African Textile* by John Picton and John Mack, published by Harper & Row in 1989; *African Designs*, by Geoffrey Williams, published by Dover Publications in 1971; and publications and tapes on the subject from the Museum of African Art in Washington, D.C.

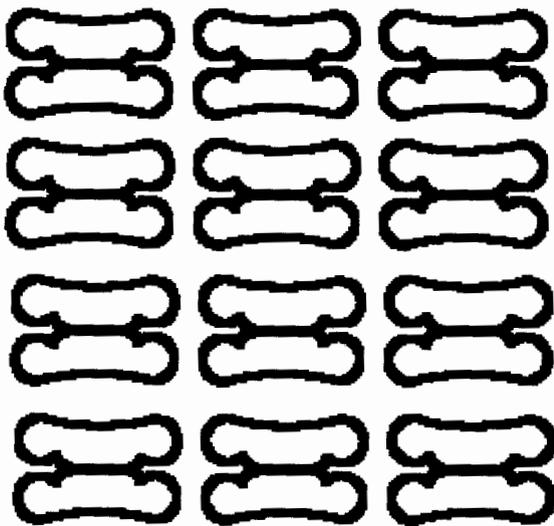
After the opening, my students transferred the colorful Apple IIGS screens onto a videotape, added some African drum music, and included the interviews from the show's opening.

In addition, during this school year, I taught three evening introductory minicourses called "Programming and Word Processing" for parents. It gave parents an understanding of what their children were learning in school and why the Logo language has been adopted as a learning tool in schools throughout this country, as well as other countries—from Australia to Costa Rica. The parents loved the experience and continued working with Logo at home even after the course was over.



*I made this with my Apple IIGS,  
and the Logo procedures.  
The tension it creates excites me.*

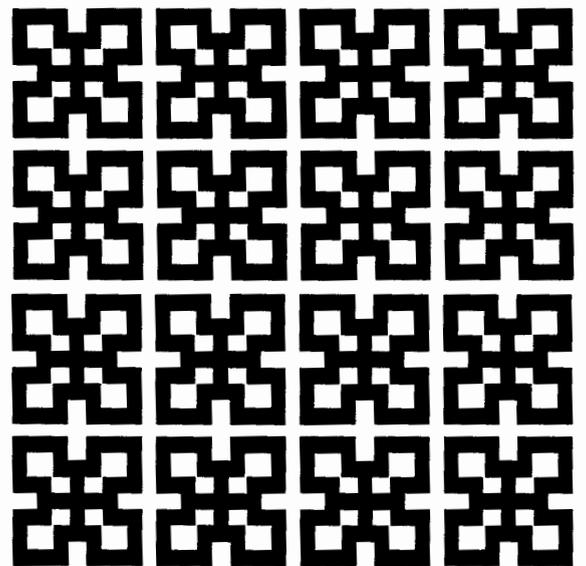
*Theo Douglas*



*I made this with my mind,  
and I decided to balance this design  
with this one,  
and to repeat this design here,  
and here.*

*The balance is satisfactory.*

*Connie Clarke*



*NSAA*

*He who cannot recognize the true*

*NSAA,*

*buys its fakes.*

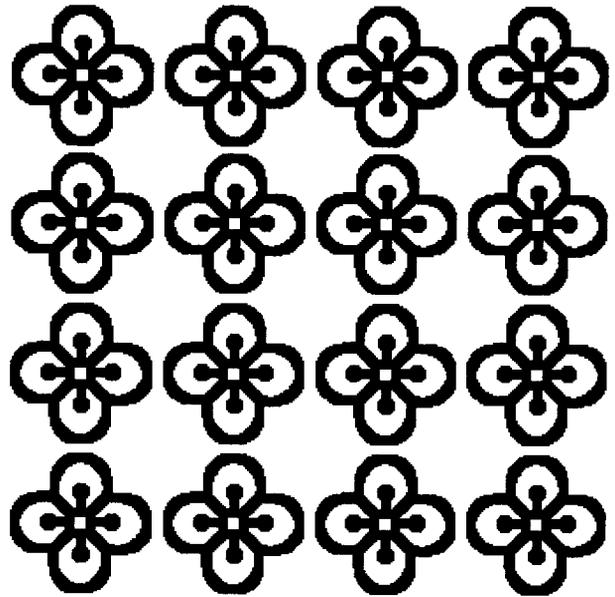
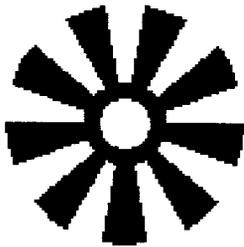
*Talib Hudson*

Finally, it gave me great satisfaction to have brought my students to the level where they felt themselves to be experts, programmers, and artists in front of the public and the community, while simultaneously getting their parents involved with the turtle.

### Logo Techniques

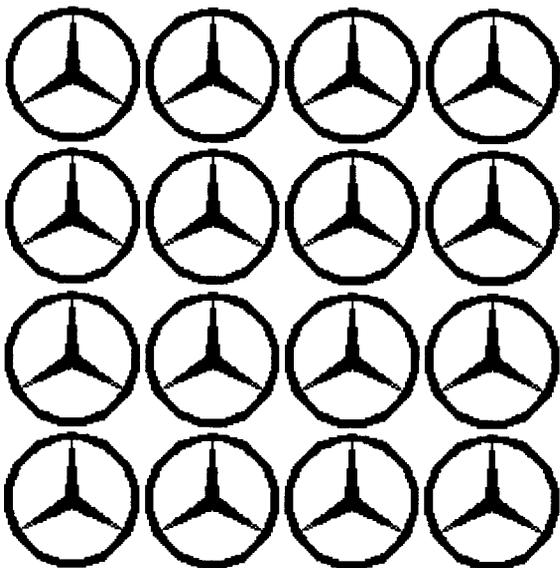
The procedures used throughout the work were quite simple—mostly triangles, squares, circles, and arcs. It was only after the students were comfortable with circles and arcs procedures that I introduced the “tools procedures” to obtain greater screen accuracy.

The following is a sample procedure for one of the stamps:



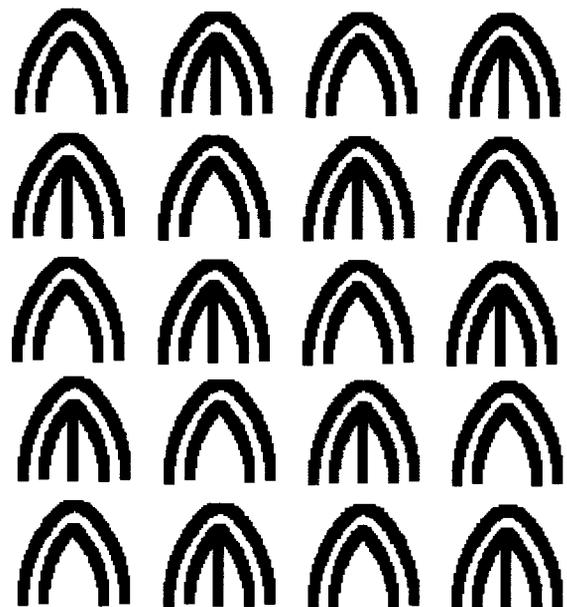
*I was here on this earth,  
and created this work.  
It pleases me.*

*Michael Toribio*



*The rich man stamp.*

*Brian Roldan*



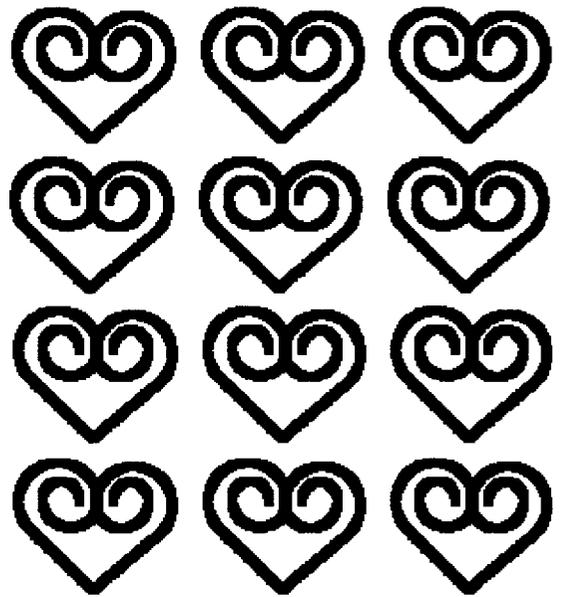
*My ASHANTI stamps.*

*Bryan Zambrano*

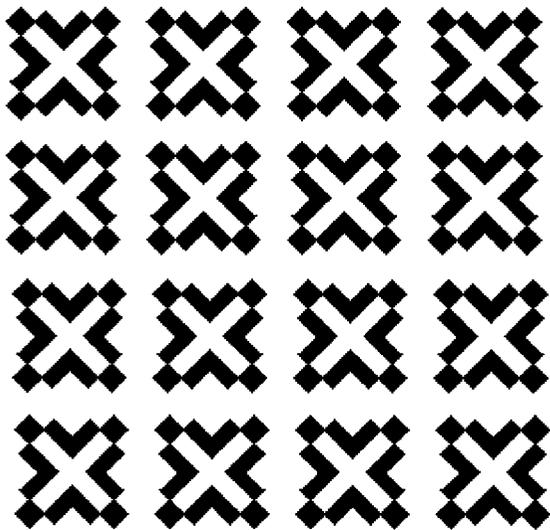
```

to adinkra2 :s
left 90
pu
forward :s
right 90
pd
circler :s
left 90
pu
forward :s / 2
right 90
pd
repeat 9 [arcr :s * 1.5 20 left 90
  forward :s * 3 right 90 arcrc :s *
  4.5 20 right 90 forward :s * 3
  left 90]
right 90
pu
forward :s * 0.25
pd
fill
pu
forward :s * (1.5 - 0.25)
left 90
end

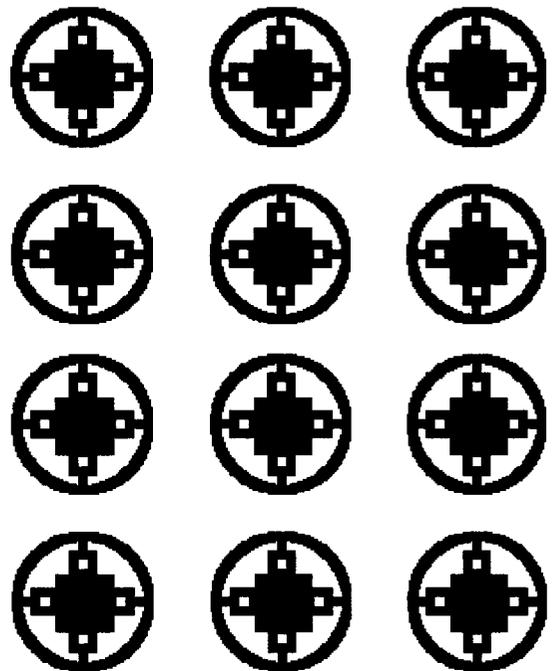
```



SANKOFA  
*Learning from the past  
in building the future.*  
Myckele Spencer



ABAN  
*Strength and Power.*  
Talib Hudson



DAMEDAME  
INTELLIGENCE AND STRATEGY.  
Melonie Everett

The thick lines were slowly drawn by the turtle stamping a small square shape; for example, a 180° arc to the right with a radius of 50 millimeters is written as:

```
arc r 50 180
```

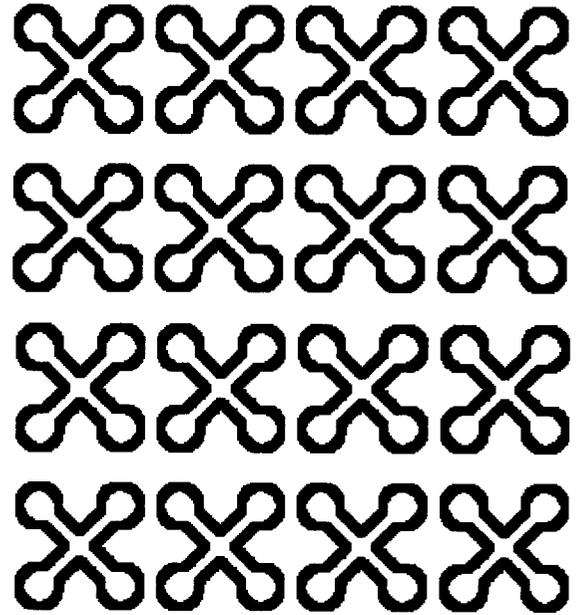
A variable radius r is written as:

```
arc r :r 180
```

To repeat 180 times and add a stamp at every single degree:

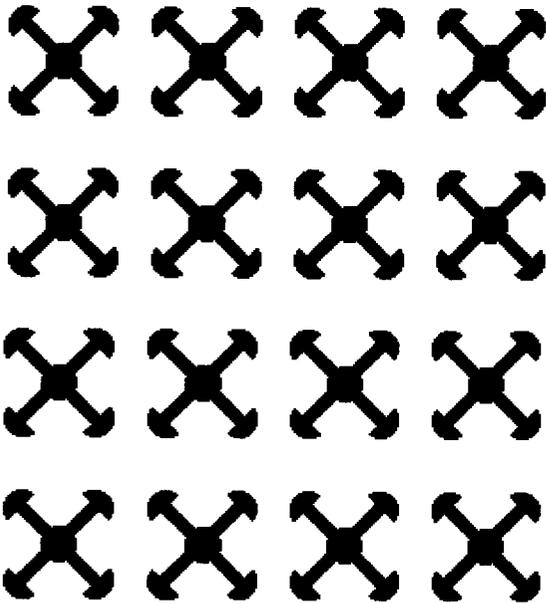
```
repeat 180 [arc r :r 1 stamp]
```

The following design is an example of what my students called "bold" drawing:



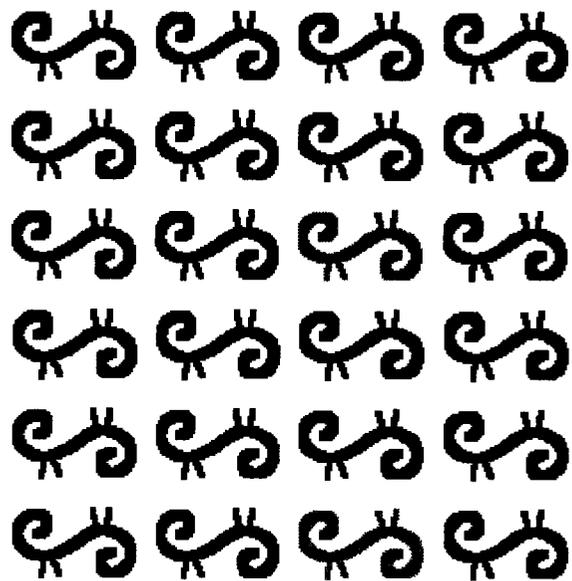
*NYAME NWU NA MAWU  
SPIRITUAL PERSISTENCE.*

*Juvariya Abdul-Karim*



*AKOMA NTOASO  
TOGETHERNESS AND UNITY.*

*Melonie Everett*



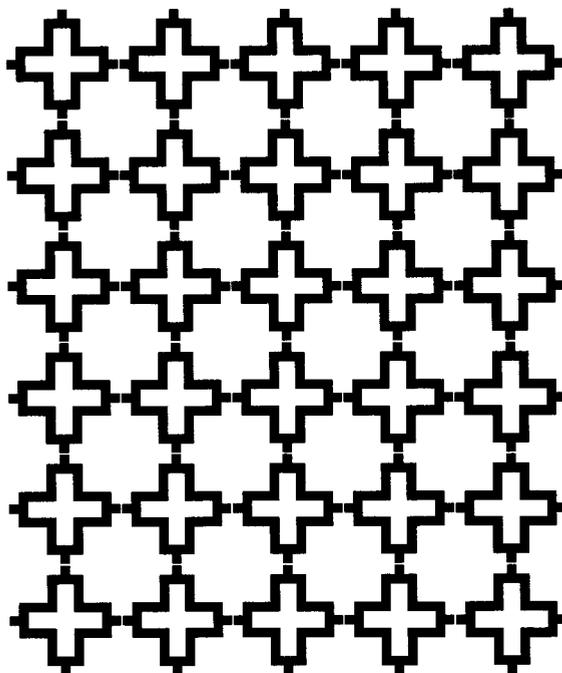
*ADINKRA CLOTH STAMPS*

*Brian Zambrano*

```

to sankofa :s
  setsh 1
  make "a pos
  pu forward :s
  pd repeat 230[arcr :s * 40 / 25 1 pd
    stamp]
  repeat :s * 90 / 25 [forward 1 pd
    stamp]
  right 85
  repeat :s * 90 / 25 [forward 1 pd
    stamp]
  repeat 230[arcr :s * 40 / 25 1 pd
    stamp]
  seth 190
  repeat 180[arcr :s * 28 / 25 1 pd
    stamp]
  repeat 180[arcr :s * 18 / 25 1 pd
    stamp]
  pu setpos :a
  seth 180
  back :s pd
  seth 170
  repeat 180[arcl :s * 28 / 25 1 pd
    stamp]
  repeat 180[arcl :s * 18 / 25 1 pd
    stamp]
  pu setpos :a
end

```



## ADINKRA STAMPS 2

Randy Archer

## The Article Layout

My students are familiar with *Logo Exchange*; I always have some issues on my desk, and my students' work published in *LX* is displayed on the walls. This time, I suggested we put together all the generated work, text, and graphics, and publish it either for in-school use, for taking home, or for a submission to *LX*. My students immediately jumped at the idea of sending in a submission to *LX* and soon found that a page with some text and two or three pictures had quite a good aesthetic impact. For submitting the material, they photocopied their work and reduced all the screens by about 20%. Some screens fit the page quite nicely and were left as they were; others had to be reworked. During this reworking, my students appropriated the screens they were working on so that what was originally termed a "class project" became a screen with the student's name. They also started guessing which screen could fit nicely on the front page. Finally, they created a "front page" by reworking the collage of screens they originally made for the exhibit. During the exhibit, a 2' x 3' collage gave the visiting public an idea of what Adinkra cloth printed with Ashanti symbols looked like. Students cut and pasted screens in class and at home and came up with several very good collages. It was determined that Brian Roldans' "front page" was the best one. The front page of this issue of *LX* and the design of the layout of this article are the result of their efforts.

Orlando Mihich is a computer teacher at Booker T. Washington, MS 54, in New York City. He has taught science and Logo for the past 10 years. Prior to that he was a chemical engineer in the surfactants and cosmetic industry.

Orlando Mihich  
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 103 W 107 St.  
 New York, NY 10025  
 212/678-2861

# Ashanti Prints

An Exhibition of Logo Screens  
by seventh-grade students

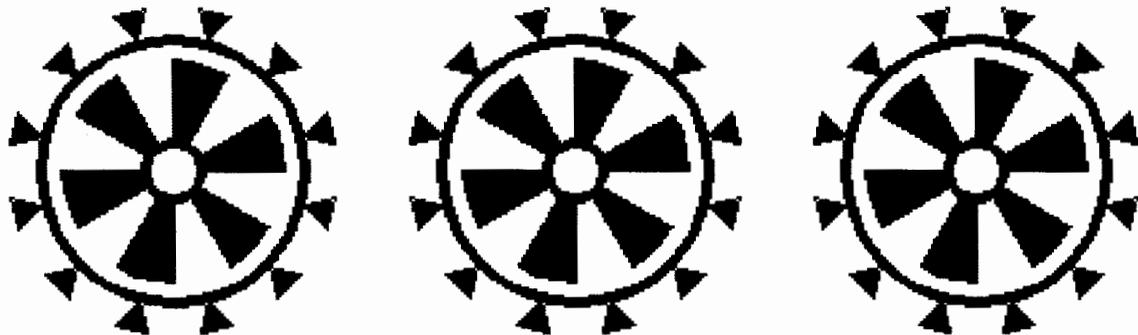
Printed cloth in Africa can be found along the Swahili coast of Kenya on the off-shore island of Zanzibar, but the most famous printed designs are the well-known “adinkra” cloths of the Ashanti people from Ghana. The material used is usually plain, white, cotton cloth, but cloth dyed in various colors from brown to red or green to purple is also used. The materials are locally produced from hand-spun cotton. The pigment used for decorating the cloth is obtained from the bark of a tree. The bark is boiled for several hours until it turns into a thick, black liquid. The stamps are made from pieces of old calabash carved into different designs. Sticks are pegged onto the back of the stamps and tied together to form a handle.

The cloth is stretched flat on the ground and divided into squares by painting lines with the thick, black dye. The various designs are then printed in each of the squares on the cloth.

Adinkra cloth is not just decorative; the stamps help people focus and express their feelings. Some compositions express inner feelings that are sometimes very difficult to put into words. The designs themselves have historical, allegorical, or magical significance. They can protect the wearer from evil spirits and/or bring good luck. Adinkra cloth is stamped with different, meaningful symbols that express joy, wealth, wisdom, grief, praise to the Lord, or even enigmatic observations about life such as: “When the hippopotamus surfaces and says the crocodile is dead, you shouldn’t argue.”

The correct placement and repetition of identical designs ensures the continuity of the cosmos and fulfills the duty of maintaining harmony in the universe. Repetition affects time itself. If you repeat the same idea, thought, or design over and over, time goes on and on ... forever.

February 1994



Visitors' Comments

Great exhibit! Cool designs!  
 Make this an annual thing,  
 next year, and the year  
 after. Thanks!  
 Jake 94



John Williams

Orlando and children,  
 Jim Song I missed you. However,  
 I did not miss your beautiful  
 work - I am proud of you all.  
 Jim Morfy

94  
 Keep on producing positive  
 work; It will pay  
 off in the future.

Thomas Mitchell  
 N.Y.C. Dept. of  
 Juvenile Justice

It was my pleasure  
 to witness the logo generated  
 Ashanti Parents Show. I admire  
 the work, proficiency, creativity and  
 inspiration of your team. Continue  
 Good things happen to good people.  
 - Rocky Butler

2/5/94 As a retired Early Childhood teacher,  
 I want to congratulate you for your fine  
 and sincere work in guiding our youths  
 to higher levels in the education process  
 Dan Johnson

Fine, creative,  
 exhilarating work.  
 Thank You  
 Mary Schlemmer

2/5/94

Thank you for your beautiful work  
 I saw it with my eyes  
 I felt it with my mind  
 I understood it with my heart

Jeanne Poggi  
 from Washington  
 Heights

# Lights! Camera! Action!

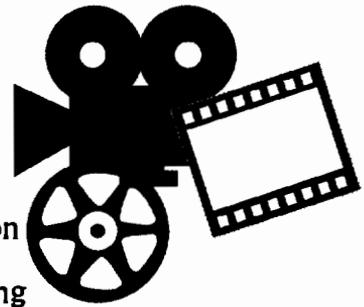
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*Now playing in a classroom near you!*

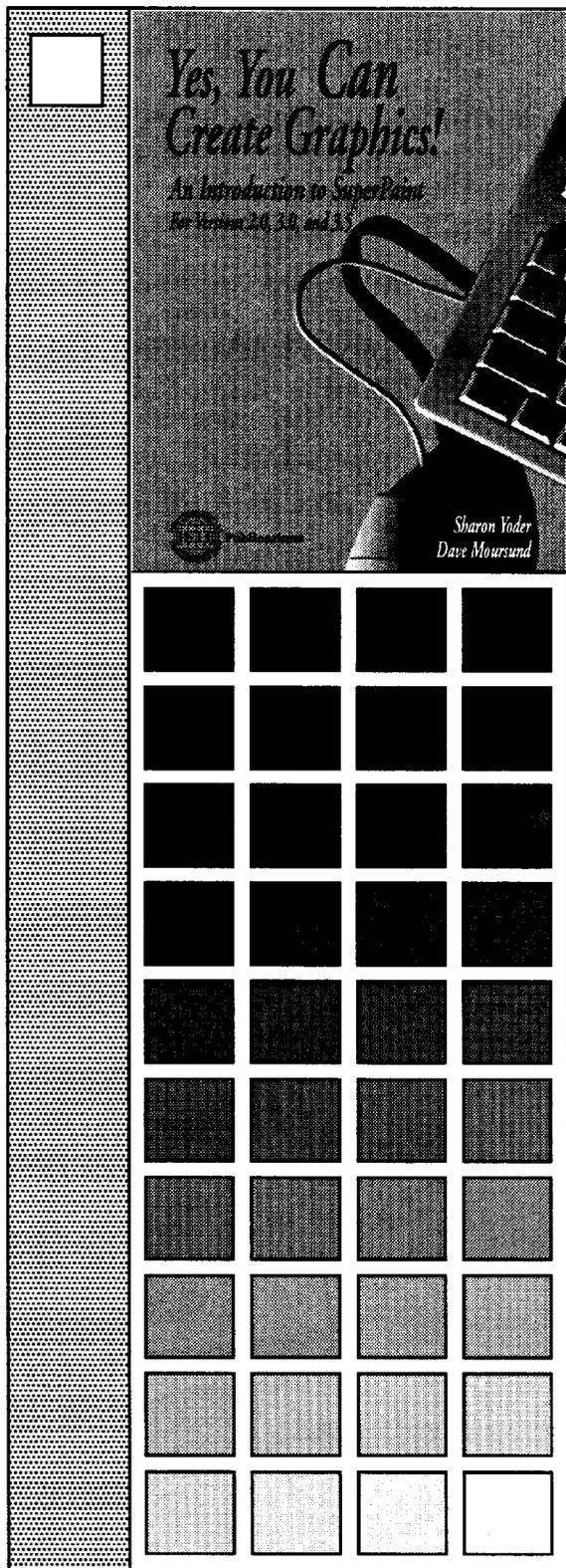


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# Pleasing to the Palette!



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Grades 9-adult (ages 14-adult).



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# An Addendum to King Arthur's Daughter

by Robert Macdonald

Some of the fringe benefits of writing a column for *Logo Exchange* are the communications occasionally received from an insightful reader. Last summer I was particularly delighted by a letter from Professor Howard A. Peelle of the University of Massachusetts. He provided another algorithm for solving the problem offered in "King Arthur Had a Daughter" (Macdonald, 1994), published in last summer's *LX* (Volume 12, No. 4).

Mr. Peelle's algorithm is assuredly simpler in that it doesn't require the logarithms cleverly proposed by Ihor Charischak, or even exponentiation as offered in the solution in the cited article. I provide Mr. Peelle's program below. Only slight changes were necessary to convert the program to *LogoWriter*. I changed **integer** to **int** and used brackets for portions of two conditional statements. You will want to use either a **print** or **show** command with the **win** procedure, which will take a numerical input indicating the number of knights sitting around the Round Table. For example:

```
print win 24
```

or

```
show win 17
```

I'm certain you will agree that Mr. Peelle has provided an elegant solution to King Arthur's dilemma, which he refers to as the Josephus Problem.

```
to win :k
output decimal rotate binary :k
end

to binary :k
if :k < 2 [output (list :k) stop]
output sentence binary int :k / 2
remainder :k 2
end

to rotate :list
output sentence butfirst :list first
:list
end
```

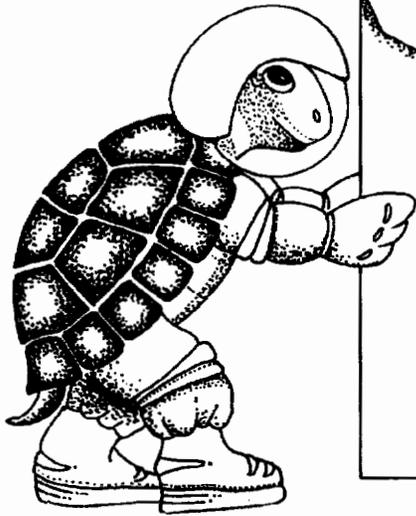
```
to decimal :list
if :list = [ ] [output 0 stop]
output (last :list) + (2 * decimal
butlast :list)
end
```

In addition, Mr. Peelle kindly enclosed an article (Lipp & Peelle, 1993) in his letter detailing a number of computer solutions to the "binary card" problem also offered in the same *LX* article. (Also, see Burns [1975], for additional information on this topic.)

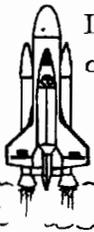
## References

- Burns, Marilyn. (1975). Smart cards. In *I hate mathematics!* (pp. 70-71). Boston: Little, Brown and Co.
- Lipp, Alan, & Peelle, Howard A. (1993). Problem solving by programming: An invitation to network. *Journal of Computer Science Education*, 8(3), 10-14.
- Macdonald, Robert. (1994). King Arthur had a daughter. *Logo Exchange*, 12(4), 26-35.

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Grosse Ile, MI 48138



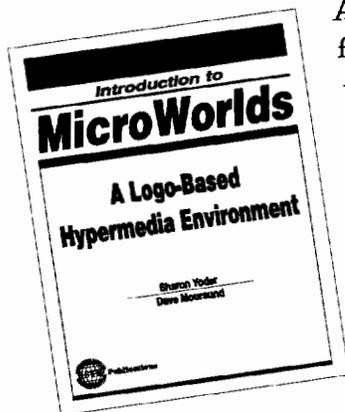
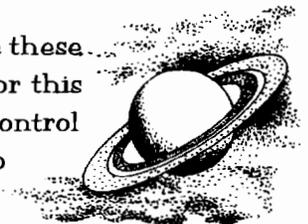
## Push the envelope with MicroWorlds



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MicroWorlds is an exciting application that offers in a single program many of the features available in HyperCard, Kid Pix, and LogoWriter.

You're the pilot. Get ready now to grab the controls, blast off, and explore these exciting new worlds with your class! To help you prepare your crew for this fantastic voyage, Sharon Yoder and Dave Moursund back at mission control have developed a 222-page flight manual titled *Introduction to MicroWorlds—A Logo-Based Hypermedia Environment*.



As a computer application, MicroWorlds contains a wide range of features that make it easy and fun to work with color graphics, sound, text, and animation. As a programming environment, MicroWorlds includes a powerful and modern version of the Logo programming language.

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# MicroWorlds and Multimedia

Glen L. Bull, Gina L. Bull, and Kim Joyce

The term *multimedia* refers to combinations of various media—text, digitized images, sound, digital movies, and animation—within a single digital document on the computer screen. At present this capability is seen as a special feature, but in the future all electronic documents will have multimedia capabilities. When that happens, use of the term *multimedia* will fade away, just as we no longer use the term *talkies* to refer to films because all movies at the local cinema incorporate sound.

The application *MicroWorlds* by Logo Computer Systems, Inc. (LCSI) supports text, digitized images, sound, and animation. While *MicroWorlds* does not yet support display of digitized video, this capability may also be incorporated into a future upgrade. In our last column, "Visible Variables," we discussed some of the enhanced capabilities of Logo in *MicroWorlds*, such as the use of slide controls to control variables within a procedure. *MicroWorlds* has all of the capabilities of *LogoWriter* and more, so much more that it might well have been called "*LogoWriter Plus*."

However, *MicroWorlds* also can stand on its own as a legitimate hypermedia application, and the name "*MicroWorlds*" was chosen to emphasize these new capabilities. For example, it is possible to design entire multimedia worlds within *MicroWorlds* without once using turtle graphics. In this respect, *MicroWorlds* combines some of the best attributes of *HyperCard*, *KidPix*, and Logo within a single application. In this column we explore some of the ways a class might use *MicroWorlds* to create an adventure story.

More than 10 years ago we devoted an *LX* column to a description of Nancy Sopp's use of an adventure story as a device for engaging children with learning disabilities. The students in Nancy's class practiced writing skills and social interaction as they developed the branches of the adventure story. Although today's classroom management techniques remain similar to those of the past, advanced technology has made it easier to create such a classroom project.

## Beginning a *MicroWorlds* Project

A *MicroWorlds* project consists of a number of pages, comparable in form to the cards in the *HyperCard* card-and-stack metaphor. Our illustrative adventure will consist of a page named "Start," which can lead to either of two branches: a page containing a forest or a

page containing a lake.

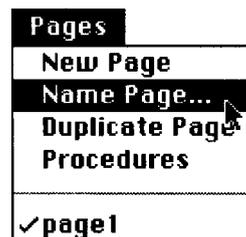
To create a new project in *MicroWorlds*, select the **New Project** option from the **File** menu.



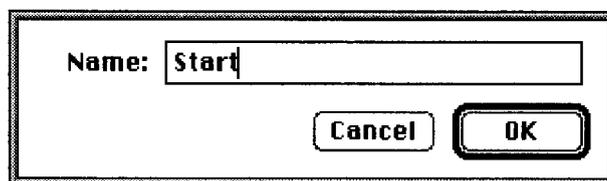
This step will create an untitled project with one page. This information is displayed in the title bar at the top of the screen:



Begin by naming the first page "Start." Select the **Name Page** option from the **Pages** menu of *MicroWorlds*.



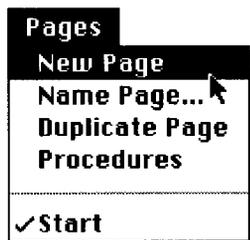
A dialog box will appear, allowing you to enter a name for the page. Enter the name of your choice, and click **OK** to confirm the selection.



## Creating the Forest Page

After naming the first page, create a second page by selecting the **New Page** option from the **Pages** menu.





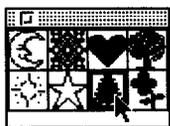
This step will create a second page, initially named "Page 2." Use the **Name Page** option from the **Pages** menu to name this page "Forest."

## The Shapes Center

Before returning to the first page, click the picture of a moon in the *MicroWorlds* toolbox to open the Shapes center.



The Shapes center displays a number of premade shapes. It is also possible to edit existing shapes or add new ones. Click the icon of an evergreen tree to select it.



After a shape in the Shapes center has been chosen, click the turtle found in the middle of the screen.



This action will cause the turtle to assume the selected shape (in this case, a tree). An icon of a hand will also appear.



The hand can be used to move the tree to another location on the screen by placing the hand over the tree and holding the mouse button as you drag the tree to another site.



Move the tree to a desired location on the screen. Then change the size of the tree by selecting the Magnify tool—the tool that looks like a magnifying glass with a plus in it. Click on the tree to increase its size. Use the magnifying glass with a minus in the center to decrease the size of the tree.



When the tree has the desired size and location, select the Stamp tool in the Shapes center. The Stamp tool is used to copy the turtle shape and stamp additional copies of it.



When the Stamp tool in the Shapes center has been selected, click the tree to stamp a copy of the shape onto the screen. (The pointer will change to the icon of the Stamp tool as the tree is clicked.)



After clicking the tree once to stamp a copy of the shape, press the mouse button down and hold it down as you drag the turtle/tree away from the stamped shape.



## The Turtle's True Identity

By dragging the icon of the turtle around the screen and stamping the tree shape in various locations, you will create a forest of trees. Use the Magnify tool in the Shapes center to create trees of various sizes.



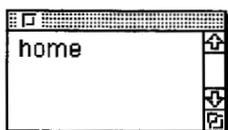
Because the turtle is camouflaged as a tree, it is possible to lose track of which shape is actually the real turtle. Only the real turtle can be used to stamp additional tree shapes. We found that first-time users sometimes be-

came frustrated when they confused a counterfeit stamped copy with the real turtle.

There are several ways to identify the real turtle. For example, the Eraser tool will erase painted copies stamped onto the screen but will not erase the real turtle. However, there is a way to identify the real turtle without erasing any of the stamped shapes. Click the cursor shaped like an arrow in the upper left corner of the Toolbox.



This will activate the Command Center. Click once inside the Command Center, type the word "home," and press the Return key.



This command will cause the turtle disguised as a tree to go to the center of the screen. The painted copies of stamped trees will not move.

## Opening the Paint Palette

The Paint icon in the Toolbox can be used to select a palette of Paint tools.



The Paint tools operate in the traditional way: The Line tool can be used to draw a line, the Oval tool draws circles and ovals, the Eraser tool can be used to erase, and so forth. (Remember, the original turtle now in the shape of a tree cannot be erased with the paint eraser. Use the scissors in the Shapes center if you want to delete a turtle.)



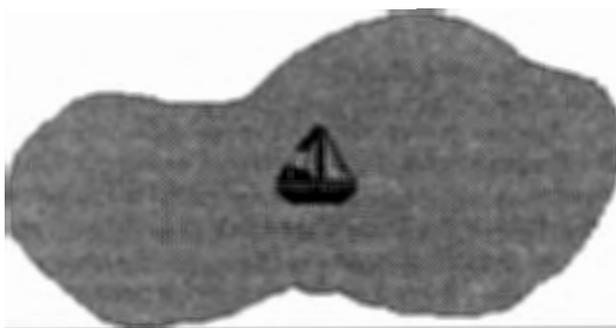
After the combination of the Paint tools and the Shapes center has been used to create a forest on the Forest page, create a third page with a lake.

## The Lake Page

To create a third page, select the **New Page** option from the **Pages** menu and then select the **Name Page** option from the **Pages** menu to name the page "Lake."

Select the Paint icon (the picture of a paintbrush) in the *MicroWorlds* toolbox to open up the paint palette.

Click the color brown in the paint palette. (Use the up and down arrows in the paint palette to increase the lightness or darkness of the tan color.) Select the Pencil icon in the paint palette to draw an irregular border of a lake. Then select a blue color and choose the paint bucket in the paint palette. Place the paint bucket inside the border of the lake and click once to fill the lake with blue.



After creating the lake, open the Shapes center by clicking the picture of a moon in the *MicroWorlds* toolbox. Select the sailboat shape and click the turtle to transform it into a sailboat. Move the sailboat to the center of the lake.

## Adding a New Icon to the Shapes Center

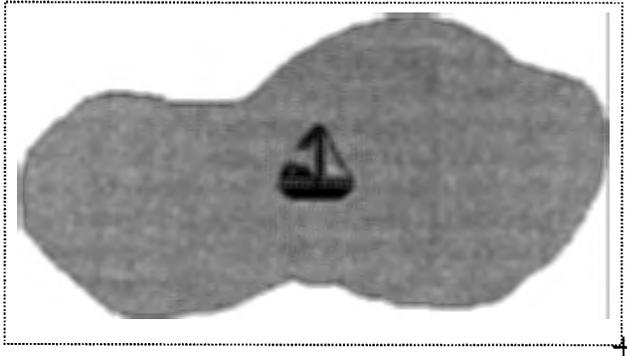
*MicroWorlds* makes it easy to add custom icons to the Shapes center. Copy the picture of the lake to the clipboard. There are four steps involved in this process. First, click the Paint icon in the Toolbox to select the paint palette. Second, click the selection rectangle (the dashed rectangle) in the paint palette.



After the selection rectangle of the paint palette has been selected, the cursor will be transformed to a cross-hair, which resembles a plus sign when it is moved onto the picture of the lake.



Third, move the cross-hair to the upper left corner of the lake. Hold down the mouse button, and drag the cross-hair to the lower right corner of the lake to enclose it in a dashed line. Release the mouse button after the lake has been enclosed.

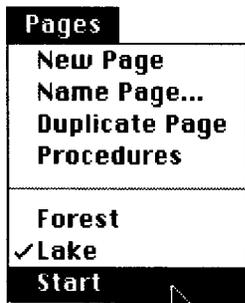


In the fourth step, select the **Copy** option from the **Edit** menu to copy the enclosed area to the clipboard.

Any image copied to the clipboard can be added to the Shapes center. To add a shape, select the Shapes center by clicking the picture of a moon in the *MicroWorlds* Toolbox. Then click one of the empty squares in the Shapes center. (If you select a square that already has a shape in it, the picture will be overwritten and lost.) Select the **Paste** option from the **Edit** menu to paste the new shape into the selected square of the Shapes center.

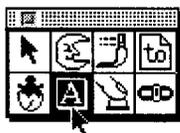


After adding a lake icon to the Shapes center, select the **Start** page on the **Pages** menu to return to the first page.



## A Story Starter on the First Page

After returning to the first page, select the Text tool in the *MicroWorlds* Toolbox to create some text describing the start of the adventure.



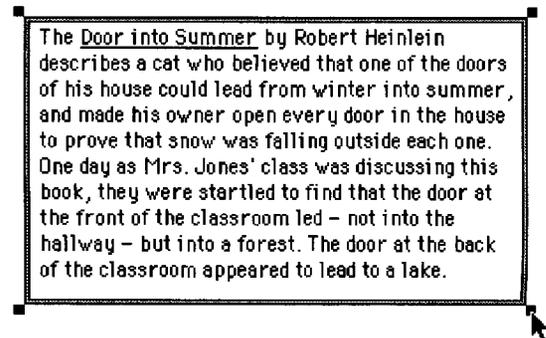
After the Text tool has been selected, position the Pen icon in the upper left corner of the screen and drag it down and to the right to create a text box.



Type a story in the text box you have created. In this example, we have created the possible beginning of an adventure story.

The Door into Summer by Robert Heinlein describes a cat who believed that one of the doors of his house could lead from winter into summer, and made his owner open every door in the house to prove that snow was falling outside each one. One day as Mrs. Jones' class was discussing this book, they were startled to find that the door at the front of the classroom led - not into the hallway - but into a forest. The door at the back of the classroom appeared to lead to a lake.

To move the text box, place the pointer on the border of the box and press the mouse button to drag it to another location. To change its size or shape, hold down the Shift key and click once on the box to select it. A black square known as a handle will appear at each corner of the text box when it has been selected. Place the pointer on a handle and press the mouse button as you move one of the corners of the box to resize it.



When a text box has been selected, the **Snaptext** option from the **Gadgets** menu can be used to remove the frame around the box. This step also protects the text from being changed inadvertently by a reader.

## Hyperlinks to Branching Pages

In this story starter, the reader will be given a choice of going to the Forest branch by clicking a tree or going to the Lake branch by clicking the icon of a lake. To create an icon linked to the Forest page, transform the

shape of the turtle on the first page to an evergreen tree. (If the turtle is not visible, move the text box to uncover it.) First click on the picture of a moon in the *MicroWorlds* Toolbox, then click on the picture of an evergreen in the Shapes center, and finally click on the turtle after the shape has been selected.

When the turtle has been transformed into a tree icon, select the arrow tool in the upper left corner of the Toolbox, hold the Shift key down, and double-click on the tree/turtle.



A dialog box will appear that will allow you to enter an instruction. Type the name "Forest" in the Instruction space and click OK to confirm the choice.

The dialog box contains the following text:

Name: 11

Instruction: Forest

Do it:  Once  Many Times

Buttons: Cancel, OK

This instruction will tell the tree/turtle to go to the page with the forest when the tree icon is clicked.

### Hatching More Turtles

A second turtle is needed to create a lake icon. When the reader clicks on this icon, he or she will be transferred to the page with the lake. The turtle-hatching icon in the *MicroWorlds* toolbox can be used to hatch another turtle. Just click the turtle-hatching icon and then click anywhere on the screen to create a new turtle. Use this process to create a second turtle.



Select the moon in the *MicroWorlds* Toolbox to open the Shapes center again. Click on the lake shape previously added to the Shapes center. Then click on the just-hatched turtle to turn it into a lake icon.



To access the turtle dialog box, hold down the Shift key and double-click the turtle that has been transformed into a lake icon. Type the word "Lake" in the Instruction space and click OK to confirm this choice.

### Branching Choices

The two icons (tree and lake) on the Start page of the *MicroWorlds* project are now linked to branches of the

story with the Forest page and the Lake page, respectively. A text box on the first page can be added to explain the choices to the reader.



Click on the tree to enter the door into the forest; click on the lake to enter the door into the lake.

Members of the class can create additional narrative for the Forest and Lake pages, containing text descriptions of the world the reader has created in that branch.

### Saving Work

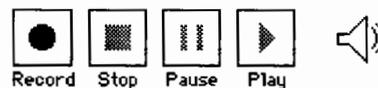
This is a good time to save the project if it has not already been saved. Select the **Save Project** option from the *MicroWorlds* File menu. Then enter the name of your project in the dialog box. In general, it is a good idea to save at least every 10 or 15 minutes.

### Incorporating Multimedia

There are numerous multimedia capabilities that can be incorporated into a project of this type. For example, *MicroWorlds* has a music editor that allows musical themes to be incorporated.



A sound digitizer is also available to record speech and sound effects.



If you have access to a scanner or a digital camera, such as the Apple Quicktake camera, digitized images can be added to the background. Access to the Internet or a network service such as CompuServe can also be a source of digitized clip art.

*MicroWorlds* has extensive animation capabilities that can be used to sail a boat across a lake or move a train down tracks into the branch of the adventure. Some of these capabilities will be explored in future columns.

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## Classroom Management

A class can be divided into World Building teams, with each team responsible for the various branches of the adventure. You can outline the different branches of the story by pinning notecards representing the various branches to a bulletin board, with strands of yarn between cards to illustrate links.

Younger students may simply focus on the development of narrative skills. Nancy Sopp found that her students were highly motivated when they wrote one another (and their teachers and principal) into the story. Older students may include more complex aspects in their stories. For example, knowledge of biology or physics facts or a mathematical algorithm may be needed to select the correct branch. The addition of this type of content turns a project into a true microworld.

## Summary

Note that the *MicroWorlds* adventure described above was created without any use of turtle graphics or Logo programming. The name *MicroWorlds* was selected for this new LCSi application to suggest the extensive hypermedia capabilities of this remarkable universe construction kit.

Teachers who have used previous versions of Logo such as *LogoWriter* will not be disappointed in *MicroWorlds* because the program incorporates the capabilities of *LogoWriter* and enhances them.

However, *MicroWorlds* is also a complete hypermedia program that can be used with no prior knowledge of Logo. In some schools Logo is reserved for gifted students or enrichment programs. But because *MicroWorlds* is a complete hypermedia program, it can be used for multimedia development in day-to-day classroom activities that may not involve Logo at all.

Of course, teachers and schools interested in both hypermedia and Logo will find that *MicroWorlds* provides an excellent environment for both.

Glen Bull is an associate professor in the instructional technology program of the Curry School of Education at the University of Virginia. Gina Bull is a computer systems engineer in the information technology and communication organization at the University of Virginia. Kim Joyce is associate director of the Curry/Albemarle Technology Infusion Program, a program designed to combine pre-service and inservice exploration of educational technologies.

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# Logo Recursion and Repetition: What's the Difference? Why the Fuss?

by John Gough

Many beginning programmers have difficulty understanding how recursion in Logo works, what it means, and why it is used. Recursion is what happens when a procedure "calls" itself by including its own name as one of its commands. For example, enter this procedure:

```
to greet.recur
  print[Hi! Glad to meet you]
  wait 5
  ct
  greet.recur
end
```

and then in the Command Center type

```
greet.recur
```

This kind of endless looping created by using "uncontrolled" recursion is able to do a great deal of work, such as printing "Hi! Glad to meet you" over and over again. But doing so doesn't really accomplish much. And it will run forever unless stopped by pressing the Stop key. Note that the procedure name **greet.recur** appears as the last line of the procedure before the **end**. In effect, this line tells the whole procedure to repeat, and when it comes back to this line it happens yet again, and so on. The procedure makes itself "recur," thereby causing it to be recursive. This type of recursion is called *tail recursion* because it repeats endlessly.

To avoid this indefinite looping, it is necessary to insert a line to stop the procedure, thus preventing its otherwise uncontrolled repetition. For example, we can modify the previous procedure as follows:

```
to greet.recur
  if key? [print[Toodleeoo!] stop]
  print[Hi! Glad to meet you]
  wait 5
  ct
  label [Press a key to stop me]
  greet.recur
end
```

Hide the turtle and run the procedure. The primitive **key?** checks whether a key is being pressed. If a key is being pressed, the commands inside the square brackets are run, which makes the procedure stop. Once such a procedure is controlled, we can find uses for it.

## Repeat and Recursion

By the time Logo learners encounter recursion they are generally familiar with the primitive **repeat**. At this point they might wonder about the difference between procedures such as **greet.recur** and the following, which uses **repeat**:

```
to greet.repeat
  repeat 50 [print[Hi! glad to meet
    you] wait 5 ct]
end
```

Of course **greet.repeat** stops by itself after 50 repetitions. We could change this value from 50 to any other number so that it repeats as much as we like. But is there no other difference? Why make such a fuss about tail recursion?

Consider these examples where **distance** is made to increase through each repetition, that is, through each loop of the recursion:

```
to ten.spi.start
  ten.spi.continue 15 1
end

to ten.spi.continue :distance
  :counter
  if :counter > 10 [stop]
  forward :distance right 36
  ten.spi.continue :distance + 5
  :counter + 1
end
```

Using **repeat** and two global variables, **counter** and **distance**, we can write similar procedures using

```
to ten.spiral
  make "counter 1
  make "distance 15
  repeat 10 [
    forward :distance
    right 36
    make "distance :distance + 5 ]
end
```

We can see which commands in the **repeat** procedure mimic the corresponding lines in the procedures using recursion. We can also see that the commands that do the counting in the procedure using recursion are ab-

sent in the **repeat** procedure because **repeat** does its counting automatically.

**Repeat** is powerful, effective, and simple, but recursion can do things that **repeat** can't do easily. Recursive procedures that include "embedded" recursive calls show important differences between recursion and repetition.

Here are two more examples. Notice that the recursive line **tri.continue**, which causes the recursion, is now embedded within the whole procedure **tri.continue**, instead of being just before the **end** statement.

```
to tri.start
  print[tri.start]
  make "counter 1
  tri.continue
end

to tri.continue
  if : counter >6 [stop]
  repeat 3 [forward 10 right 120]
  forward 20
  make "counter : counter + 1
  tri.continue
  setc 4
  repeat 4 [forward 5 right 90]
  forward 10
end
```

The following procedure, which uses **repeat**, looks much like the **tri** procedures in the previous example.

```
to triangle.string
  print[triangle.string]
  repeat 6
    [repeat 3
      [forward 10 right 120]
      forward 20]
  setc 4
  repeat 4 [forward 5 right 90]
  forward 10
end
```

Make sure you can identify which of the commands in the preceding procedure correspond to the commands in the **repeat** form. Now run both procedures. The differences are startling. The difficulty for beginners grappling with recursion is to understand where all those extra squares came from.

When a procedure uses embedded recursion, the commands after the recursive procedure call are "remembered" by Logo and will be run later when the recursion is stopped. It is as though the computer makes a "mental note" that the first time **tri.continue** runs, it leads to the second time that **tri.continue** runs, and so on until it reaches the last time **tri.continue** runs. Once **tri.continue** (number seven) has been stopped and has

no more to do, **tri.continue** (number six) realizes it has three more lines it hasn't done yet, so it does them and then reaches its **end**. Then **tri.continue** (number five) is completed by doing its last three lines, and so on until each instance of **tri.continue** has done all of the commands it contained, and has reached **end** or has been told to stop by some test or condition. This kind of "unwinding" back through all the left-over lines of the successive versions of **tri.continue** is called *embedded recursion*.

In contrast, when the six repeated steps of **triangle.string** have finished, there are exactly the same remaining three lines to be done. But because they have to be done only once, only one square is drawn after the string of triangles.

But there is even more to embedded recursion. Consider the following procedures in which the variable distance changes. These successive changes are correspondingly remembered and used during the subsequent unwinding.

```
to shr.spi.start
  print[shr.spi.start]
  shr.spi.continue 1 80
end

to shr.spi.continue :counter
  :distance
  if :counter > 5 [left 90 stop]
  forward :distance
  right 90
  shr.spi.continue :counter + 1
    (:distance - 5)
  pe
  back :distance
  left 90
  tone :distance 10
  print :distance
end
```

Using **repeat** you might write

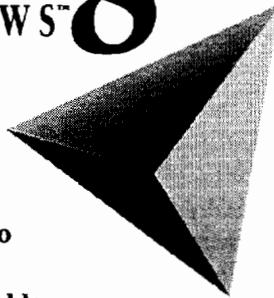
```
to shrink.spiral
  print[shrink.spiral]
  make "distance 80
  repeat 5
    [forward :distance right 90
      make "distance :distance-5]
  pe
  left 90
  repeat 5
    [back :distance left 90
      tone :distance 10
      print :distance]
  end
```

Can you see the difference between repetition and recursion?

In conclusion, simple tail recursion can build only loop structures. However, embedded recursion can add great power to recursive procedures. With practice, recursive procedures can be defined with great programming elegance and power. Yet sometimes the elegance is achieved at the expense of clarity or readability. What a recursive procedure will do is not always immediately obvious. By contrast, a repeating procedure that achieves the same work as a recursive procedure may lack programming elegance but be more explicit about what it actually does, and hence be more immediately readable. Either way, by exploring the links between recursion and repetition, students can gain understanding of important, yet subtle, logical concepts, building on their early experiences with repeat to achieve insight into the more advanced worlds of recursion.

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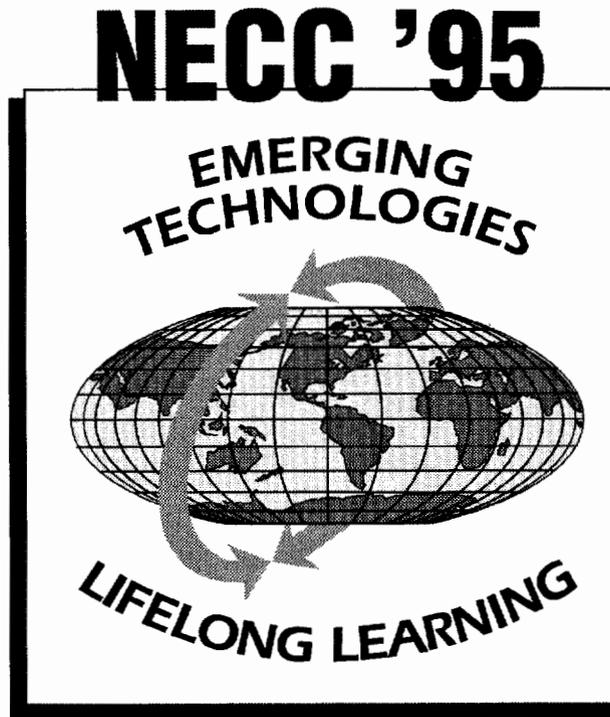
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# Notes From NECC's Logosium

by Douglas H. Clements and Julie S. Meredith

The NECC conference held last summer in Boston featured a "Logosium"—a day-long symposium of several sessions for people interested in Logo. We had originally planned to write about the session that I (Doug) led, which focused on research. Unfortunately—and we know this will come as a shock to readers of this column—I talked so much that I didn't take sufficient notes. Leave it to say there was much interest in research. Two other sessions were also interesting: one that emphasized mathematics assessment and curriculum and another that focused on action research. We discuss the content of these two sessions in this column.

## Mathematics Assessment and Curriculum: Some Tidbits

Participants in the Logosium agreed that assessment is a major issue. There was a consensus, supported by years of research reviewed in this column, that students using Logo learn much that typical tests do not measure. Individuals offered several additional insights, and we have included them in this column. We have not attempted to provide all the details of the meetings; instead, we focus on the comments we recorded. (We accept all responsibility for errors in interpreting and recording these comments. We also apologize profusely to those whose comments we recorded without their names attached!)

- The National Council of Teachers of Mathematics' *Standards* tells us to do hands-on math and the like, but assessments penalize teachers for doing so. In one district, the school that is "straight and narrow" in their approach did the best on the exams. (Susan van Gelder)
- Many of the existing tests assess only basic skills. (several participants)

These two comments address a basic problem. Despite what we'd like to believe, teaching mathematics in new ways does not guarantee that performance on basic skills tests will increase. Of course, we need to create and implement new assessments. However, we also have to find ways to build the learning of the skills we do value into our Logo activities. We've tried to do that directly with *Turtle Math*. No matter what version of and approach to Logo you use, however, you must address the issue. Here's another comment in a similar vein:

- The issue of basic skills is not black and white. It's not that basic skills are stupid. For example, if you have to know what 5 times 7 is, but you forgot, you can use mathematical reasoning to figure it out ( $5 * 5 = 25$ , 2 more 5s is 10, so  $5 * 7 = 35$ ). But it is also good to memorize such facts. To say that we shouldn't do skills is wrong. We just need to deemphasize them. We don't want months of just drill. A misinterpretation of those who advocate a project approach is they do not care about skills. (Brian Silverman)

Let's turn back to tests. How have people addressed this issue?

- There are many approaches to dealing with these tests. Some teachers are teaching test-taking skills. (Larry Davids)
- Others are rewriting tests to suit their purposes. (Marian Rosen)
- In California new tests have been implemented. For example, some tests include a number of open-ended questions, and students write about their thinking. They are keeping the standardized tests, too, though. Some of us would like to get rid of those completely.

Rewriting tests and implementing new tests are certainly worthwhile strategies. But if the traditional tests are also given—especially those that compare one school, district, or state to another—people tend to weigh those results more heavily. We need to communicate our goals more aggressively and show how these tests are not alternate forms. Traditional tests assess skills needed in the previous century. Some of these are still valuable, but many are not. And all the tests need to be expanded to address today's curricula. There are other problems as well:

- Even though the tests have focused more on testing problem-solving skills, the teachers are still teaching to the test by implying that to problem solve one has to follow a recipe. So, it'll be an uphill fight. (Ihor Charischak)
- With today's technologies, it's difficult if not impossible to design a test that you *can't* teach to. That is why we should consider other approaches, such as portfolios. The



NCTM *Standards*, we often forget, is the *Curriculum and Evaluation Standards*, and contains many helpful suggestions. (Doug Clements)

These assessment issues brought the discussion around to the mathematics curriculum. A similar problem emerges: Mathematics taught by Logophiles and the mathematics taught in traditional classrooms are two different things.

In the words of Skemp (1976, No. 791), there are "two effectively different subjects being taught under the same name *mathematics*." One subject, instrumental mathematics, consists of a limited number of "rules without reasons." The other, relational mathematics, is "knowing both what to do and why." It consists of building up mental structures from which a student can produce an unlimited number of rules to fit an unlimited set of situations. As Skemp continues, "What constitutes mathematics is not the subject matter, but a particular kind of knowledge about it."

- What should we do with fundamental contradictions between Logo and mathematics education? Why hasn't Logo been adopted more often by mathematics educators? The *Standards* are good. Papert has said they're a baby step in the right direction. What's wrong is that they're maintaining fire walls between mathematics and other subjects. Also, and more important, it's another attempt to teach the same mathematics better. (Brian Silverman)

Better teaching of the same mathematics is what certain computer-assisted instruction programs are about. They accept the goal of teaching instrumental mathematics and try to do it more efficiently. Most teachers using Logo want to teach relational mathematics.

- It's an echo of the whole-language issue. Students need the basics too. Parents want them to know how to spell. Teachers are resistant to change; they are not risk takers. (Susan van Gelder)

Again, we need to communicate to parents that we want students to develop basic skills, but in a context in which they are learning to think and communicate. And we need to work with parents to help us tear down the fire walls.

- Integration should go two ways. For example, the social studies people should have their students deal with numbers, databases, and mathematical issues, too.
- It's difficult (for teachers) to get time to talk with each other.
- Elementary school is the best place to encourage integration. You can integrate across

the curriculum. High schools are more of a problem. (Brian Silverman)

Integration might help us find a new balance between instrumental and relational mathematics, as the following two comments imply.

- That brings us back to a fundamental contradiction. Many do not understand the difference between arithmetic and mathematics. Logo is about open-ended problem situations to which you don't have a solution. There is nothing in mathematics education that comes close to that. There are no areas in the *Standards* like that. All we do is redo the work of old masters.
- There are too many "Uh-huh" experiences rather than "Ah-ha" experiences. Students have to do some mathematical research.

## Action Research

Nan Youngerman led a discussion of action research, which involves teachers doing their own research in their own classrooms, often collaborating with other teachers or with university faculty.

Nan stated that as teachers did action research, they learned more about research and more about Logo. The process helped them make changes in how they teach, and by working with people at universities they expanded their professional role.

What is the process of action research? We can think of one approach as having three parts.

1. *Coming together as a group to brainstorm.* What are our questions? What can we draw from our experience? If we are focusing on Logo, we might do an organized activity to learn more about the program. We do some things to begin to understand the action research process and how it is different from regular research. We plan the process. We make observations and reflect on what we're doing.

2. *Coming up with a plan.* Once we've come to a question, each teacher comes up with a plan and designs an approach that fits the question. One way is to videotape. One teacher stated, however, "I don't want to teach all day and then go home and watch myself teach all day!" Other sources of data are teacher notes, student work, design notebooks, interviews with students, and the teachers' own plans and anecdotal notes about what happened. One teacher had 3-by-5 cards on each child and recorded what they said. This kind of data adds up over time.

Don't let doubts creep in. One teacher-of-the-year threw her notebook down and said, "I haven't done anything!" because her husband had told her that looking at two students wasn't research. But observing just two students is okay. Action research has to be



practical. Also, you have a better understanding of the 24 students in your class if you understand just one student very well. Many other things will fall into place.

The group may or may not work with the same question. Nan used to think it was unreasonable to try to get one question. Through talking with each other, however, one group of teachers did develop a single question. Then, slowly, they all wanted to pull a slightly different question out of their own classroom experiences.

3. *Collecting and analyzing data.* The third step is to find out what happened. You collect data, think about it, and eventually report it in written form. This is action research—deciding what action you will take as the result of the research you have done.

How do teachers learn methods of data collection? Nan's group of teachers had a meeting and discussed questions such as: What is data? What could it be in your project? They also practiced collecting data, taking the minutes from their own meetings and looking through them for data. What has happened in the action research group? What are the themes? They learned the process as the year unfolded, and teachers who had already done research came in as resources.

The teachers collect their data and continue to meet to discuss their results. Recall the teachers who pulled different questions from the original question. Interestingly, commonalities still emerged. For example, many were saying, "You need to have more time for kids to share their thinking with each other." Another common theme was the importance of planning away from the computer.

Action research can benefit everyone: teachers, students, and the research community. You need to have a strong facilitator/leader and commitment. Like Logo, it's hard work, but worth doing.

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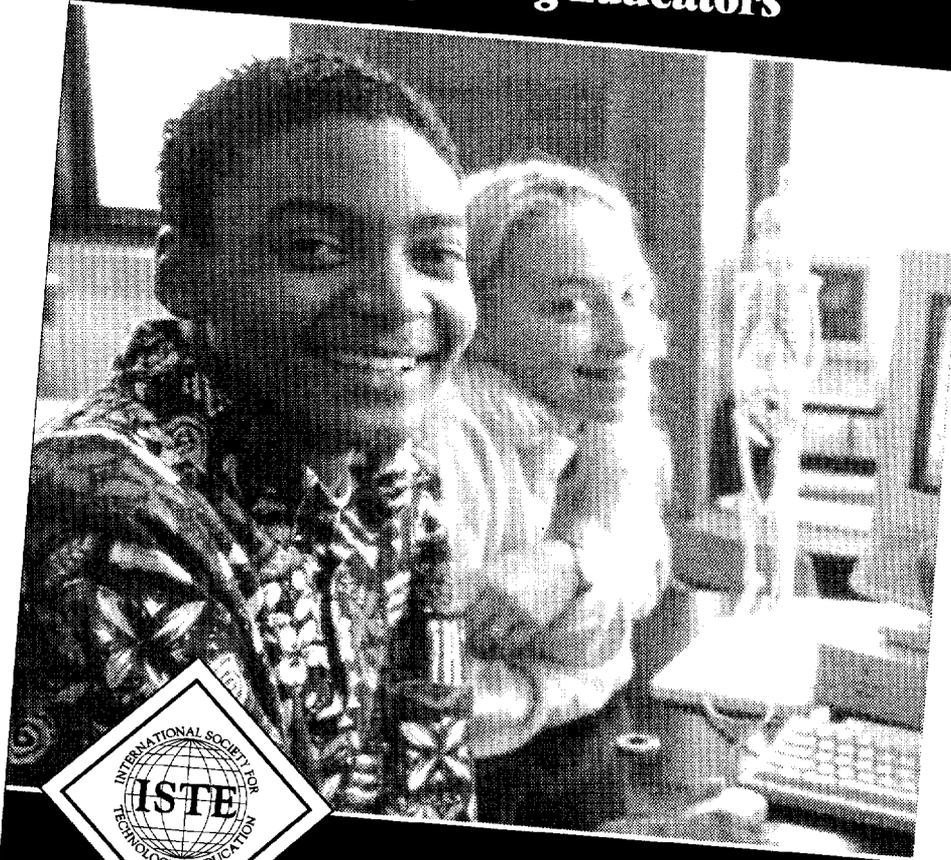
Douglas H. Clements, professor at the State University of New York at Buffalo, has studied the use of Logo environments in developing children's creative, mathematics, metacognitive, problem-solving, and social abilities. Through a National Science Foundation (NSF) grant, he developed a K-6 elementary geometry curriculum, *Logo Geometry*, published by Silver Burdett, & Ginn in 1991. He is currently working with several colleagues on a second NSF-funded project, "Investigations in Number, Data, and Space," to develop a full K-6 mathematics curriculum featuring Logo. With Julie S. Meredith, he is coauthoring a new version of Logo for learning elementary mathematics. One of these versions, *Turtle Math*, is available from LCSi.

Julie Sarama Meredith is a mathematics education doctoral student at the State University of New York at Buffalo. She has taught secondary mathematics and computer science, gifted math at the middle school level, and mathematics methods courses. Along with Douglas Clements, she is coauthor of *Turtle Math* and is currently designing and programming new version of Logo for the NSF-funded "Investigations" project.

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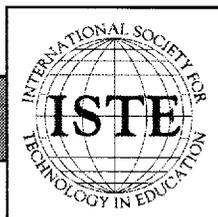
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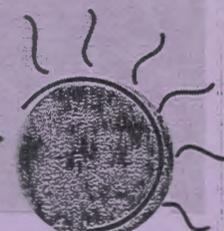
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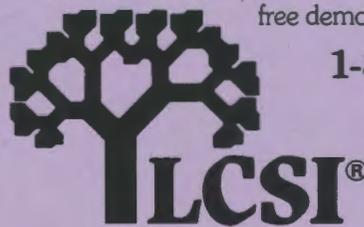
**Turtle Math**, designed for students in grades 3 - 6, lets students use a collection of activities and challenges in which measurement and geometry is the context for exploring various math concepts.

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