

11-1987

Logo LinX: Historical Lessons in Recursion

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Recommended Citation

Harris, J. (1987). Logo LinX: Historical lessons in recursion. *Logo Exchange*, 6(3), 12-14.

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Logo LinX

by Judi Harris

Historical Lessons in Recursion

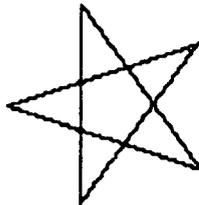
History, with all her volumes vast,
Hath but one page."

—Lord Byron (1812-1818)

You probably have heard the saying, "History repeats itself." Perhaps it would be more accurate to say, "History recurs." What is the difference?

Consider this Logo procedure:

```
TO STAR :SIDE
REPEAT 5 [FD :SIDE RT 144]
END
```



STAR 75

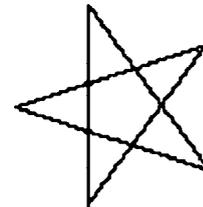
These commands tell the turtle to repeat FD :SIDE RT 144 five times. Each time the line is repeated,



The five parts of the resulting drawing are exactly the same.

Here is another way to tell the turtle to make a five-pointed star. What changes as each recursive copy of RSTAR is executed?

```
TO RSTAR :SIDE :HEADING
FD :SIDE
SETH :HEADING
IF :HEADING = 720 [STOP]
RSTAR :SIDE (:HEADING + 144)
END
```



RSTAR 75 144

STAR contains an iterative structure (REPEAT). RSTAR accomplishes the same result with a recursive structure.

Consider another interpretation of the STAR procedure:

```
TO STARS :SIDE :NUMBER
IF :NUMBER < 1 [STOP]
STAR :SIDE
PU
SETX (XCOR + 20)
PD
STARS (:SIDE + 10) (:NUMBER - 1)
END
```



STARS 45 5

These five stars are similar, but not identical, in appearance. The basic shape is the same, but the size and position are different. The stars above are *recursive copies*; they share a common pattern, but vary in dimension and placement.

Traditionally, the single star drawn with the procedure STAR :SIDE is considered *iterative*. This implies that the commands inside the brackets for the REPEAT statement (FD :SIDE RT 144) are repeated identically each time they are run.

Things Just Aren't the Same

"When two do the same thing, it is not the same thing after all." -

—Publilius Syrus, 1st century B.C.

Outside the realms of mathematics and computer science, there is no such thing as a perfect copy. Sameness is really similarity. Copies are really patterns. (The implications of this idea for Xerox, Inc. are mind-boggling!) History does not repeat itself; it recurs.

Although the academic study of history does not focus upon recurring patterns of events, the human mind, in an effort to comprehend and apply history's lessons, often perceives and codes event sequences into intuitive structures that recur, with modifications, over the centuries.

The evolution of the sonata form, as musical historians have reconstructed it, provides an excellent microcosmic example of an historical pattern. Simply stated, it is A B A.

The first section, or *exposition*, of most late 18th century symphonies, chamber music, and sona-

tas states a musical theme in the tonic key, a second theme in the dominant or relative major key, and a closing theme, also in the dominant or relative major. The second section, or *development*, uses themes or portions of themes first presented in the exposition to modulate to different melodies and keys. The final section of music written in the Classical sonata form is called the *recapitulation*. Here, the material comprising the exposition is restated, but in the tonic key. The exposition and recapitulation were commonly faster in tempo and more major in pitch than the slower, more minor development.

The sonata form itself is doubly recurrent; the exposition's three-part structure is contained within the larger three-part structure of the sonata form. Often, melodic phrases within the three sections of the sonata were also recurrent in pitch orders, modulating to different keys.

This repetitive structure recurred through history. The roots of the structure lay in the Italian opera overture, or *sinfonia*, which was most popular in the early 1700s. The three-part organization of these pieces can be described simply as fast-slow-fast.

In about 1730, Italian composers (such as Sammartini) began to write separate concert symphonies according to further developments of the A B A format. The sonata form itself was an amalgamation of Baroque and Italian opera structures. Each major composer expressed successive copies of the sonata structure, based upon the copies of the major composers before him. The level of recurrence in just this small example seem infinite.

As Ever, Recursion

Structures which recur can be detected on macrocosmic levels, also. Consider, for example, the changes happening now in our Western society as the use of computers pervades more and more aspects of our lives. This has been called the "Information Age," where access to and processing of information provides economic, political, and personal power. These times have been compared on many levels to

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the years at the turn of the 20th century, the "Industrial Age," when machines were more concerned with assisting production of goods than assisting the production of knowledge. No, conditions are not nearly the same as they were in 1900, but there are striking similarities.

Is it any wonder, then, that calls for societal and educational reform during the Industrial Revolution sound familiar? Then and now, there were and are concerned action to uphold the rights of minorities and women, determined efforts to standardize the quality of public education at the state level, bold attempts individualize and modernize instruction, and, of course, massive efforts to bring society's new machines into the school environment.

Viewed from a different perspective, recurrent structures that reflect the shape of our collective experience manifest on many levels and in numerous experiential arenas. History can be conceived as a three-dimensional, expanding spiral, rather than as a linear timeline. Events on later arms of the spiral are rooted in, and similar in structure to, earlier events. And, theoretically, it all started with one point somewhere in space and time. All occurrence has its origin in that one point. Each event is but a variation on the first; a unique, but similar recurrent pattern.

What recurrent patterns can you and your students identify in local history? state history? national history? world history? ancient history? art history? philosophical history? political history? family histories? technological history? Logo history?

"The disadvantage of men not knowing the past is that they do not know the present. History is a hill or high point of vantage, from which alone men see the town in which they live or the age in which they are living."

—G.K. Chesterton (1933) ▲