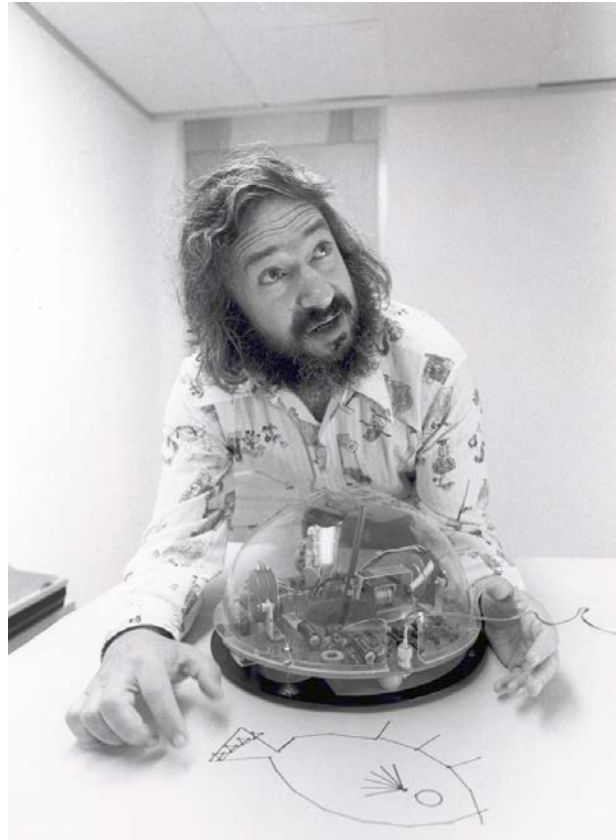


Turtles

Seymour Papert (South African Educator; 1928 -) is one of the inventors of the computer programming language *Logo* which many generations of children have used to acquire: a sense of mastery over a piece of the most modern and powerful technology and...[establish] an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building.¹

You and some of your peers may remember working with the “Turtles” that drew graphics on a screen or physically on a floor. Papert grew to be disappointed in many of the ways the computer was used in education.² Nonetheless, Logo continues to be widely used by both children and adults³ and Papert’s role in predicting some of the impact of computers is remarkable. Well before personal computers, iPods, and the general availability of any type of wireless phone, Papert wrote:



Computers can be carriers of powerful ideas and of the seeds of cultural change... They can help people form new relationships with knowledge that cut across the traditional lines separating humanities from sciences and knowledge of the self from both of these.⁴

See, for example, [StarLogo Nova](#) which is a powerful tool in modeling simulations which involve thousands of independent entities and the wonderful book *Turtle Geometry: The Computer as a Medium for Exploring Mathematics* which has key insights into fractals, computer graphics, and artificial intelligence.

¹ From *Mindstorms: Children, Computers, and Powerful Ideas*, p. 5.

² See e.g. *The Children’s Machine: Rethinking School in the Age of the Computer*.

³ See e.g. *StarLogo* which is a powerful tool in modeling simulations which involve thousands of independent entities and the wonderful book *Turtle Geometry: The Computer as a Medium for Exploring Mathematics* which has key insights into fractals, computer graphics, and artificial intelligence.

⁴ From *Mindstorms: Children, Computers, and Powerful Ideas*, p. 4.



Children programming the Logo Turtle

Logo also provides a bodily kinesthetic vehicle for learning that is particularly valuable to some learners. In this section we will ask you to mimic what Logo would do *by being a Turtle yourself*.

1. With a few peers, create a triangle. Carefully measure the length of its sides and its angles.
2. You are now to write instructions to tell the Logo Turtle how to draw the triangle. You can tell it to turn right or left any angle. You can tell it to move forward or back any distance. As it moves, it will draw a line. You can assume that the Turtle starts at any vertex you like and is already facing a specific direction of your choice.
3. Now test to see if your computer program actually draws the correct triangle. (Warning: You REALLY need to physically try this. Make a larger version of your triangle (perhaps by changing inches to feet) that you tape on the floor using masking tape. Now blindfold a peer and give her/him the instructions from your program. See if your instructions really are correct.) Describe what happened in your test.
4. When your Turtle returns to its starting spot, there is no need to have it turn, the triangle is complete. But suppose that you include an instruction so the Turtle is turned to its original orientation as the last step of your instructions. What would this instruction be?
5. With this final instruction, what is the total number of degrees the Turtle has turned in making the Triangle?

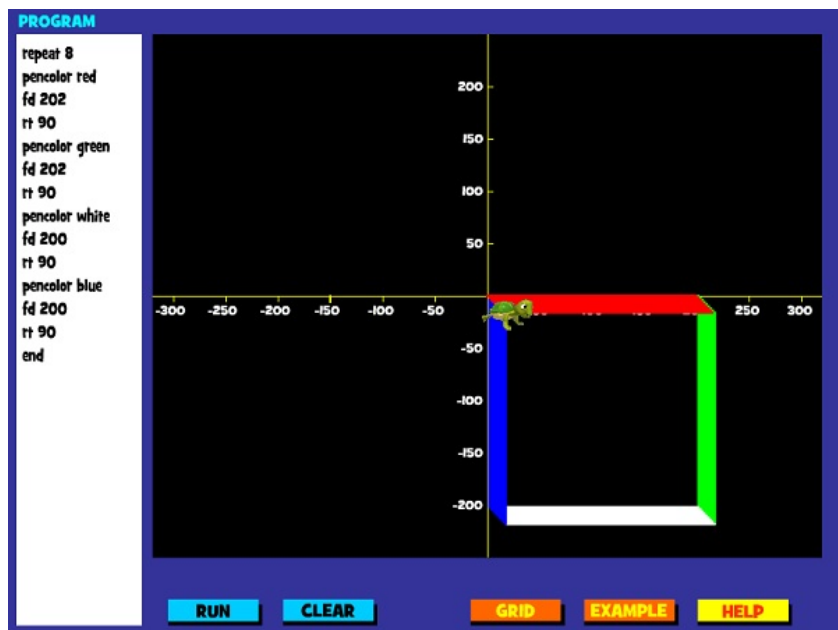
6. Does the sum of the degrees turned by the Turtle depend on the specific triangle that it draws? Explain.

7. Use this result to prove the Triangle Sum Theorem.

Turtle Geometry

There are many free versions of Logo available for download or as a web app. One free web app is located at <http://www.mathplayground.com/mathprogramming.html>. The Logo app at Math Playground includes some sample programs to run, that you might find helpful, if you've never used Logo. One is pictured below.

Seymour's own description of "the turtle." You can think of this as a drawing instrument... Imagine that you are looking at a computer screen. On it you see a small turtle, which moves when you type commands in a language called "turtle talk," leaving a line as it goes. The command "Forward 50" causes the turtle to move straight ahead a certain distance. "Forward 100" will make it move in the

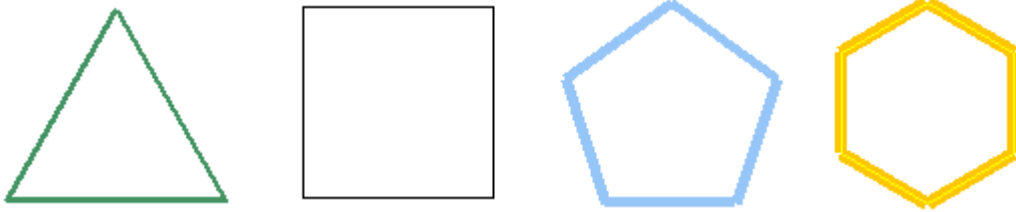


same direction twice as far. You soon get the idea that the numbers represent the distance it moves; they can be thought of as turtle steps. Now if you want to make it go in a different direction, you give it a command like "Right 90." It stays in the same place but turns on itself, facing east if it had previously been facing north. With this knowledge you should easily be able to make it draw a box. If that's easy for you, you can think about how to draw a circle, and if that's easy you can try a spiral."⁵

8. Record your Logo program that you used to draw a:
- square
 - circle
 - spiral

⁵ from "Mindstorms," Seymour Papert, Basic Books, Inc., 1980.

9. Record your Logo program that you used to draw the following:



10. Record your Logo program that you used to draw the "bear design: in the picture below:



11. Create your own design and add a screenshot and code below:

Extension:

More Turtle lessons can be found at:

<http://www.bfoit.org/itp/IntroCmds.html>