

Digital design : Programming

Description

These activities are provided to introduce pupils to the fundamental processes involved in programming a computer. Almost all jobs now require the use of computers and understanding a little about how they work helps us to use them effectively. In addition, over half a million people in the UK use programming skills directly in their work. These include such jobs as designing and writing computer systems used in industry or for government departments and creating computer games.

Activity 1: Frieze patterns

Activity 2: Polygons

Activity 3: Stars

Enhancement material: Making a new command

Frieze patterns provides a simple introduction to the experience of programming a computer. The geometry is straightforward but the pupils will find lots of opportunities for discovering the need for precision and accuracy.

The activity introduces the pupils to some *primitive procedures*. **REPEAT** is one such primitive command. It is very powerful and all three activities make much use of it. The command **WAIT 20** just slows down the drawing so that it becomes easier to see what is going on. Without it, **Logo** draws so quickly that the completed pattern appears immediately.

When the screen is cleared (using the command **CS**), the turtle always returns to the centre of the screen and points upwards. Sometimes, it is useful to enter **RIGHT 90** so that the turtle points to the left before it starts to draw a repeating pattern.

The next two activities build on what has been learnt in the first. When attempting to draw **Polygons**, pupils will discover the need to visualise external angles rather than internal ones. Many pupils will learn most by experimentation using trial and improvement techniques.



Resources

Several versions of Logo are available, but the syntax may vary so it is a good idea to download the MSWLogo version from:

<http://www.softronix.com/logo.html>

Simply download the file called 'Setup Kit'. It downloads as a single executable zip file. This means that you can just double click on the downloaded file and it will complete the installation for you with nothing further for you to do! (*As this is a program, you will need the relevant access rights to enable the installation to complete, so this may require the support of your technical manager*).

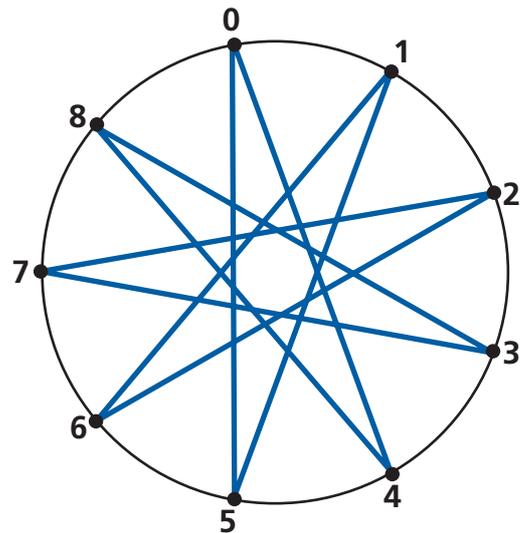
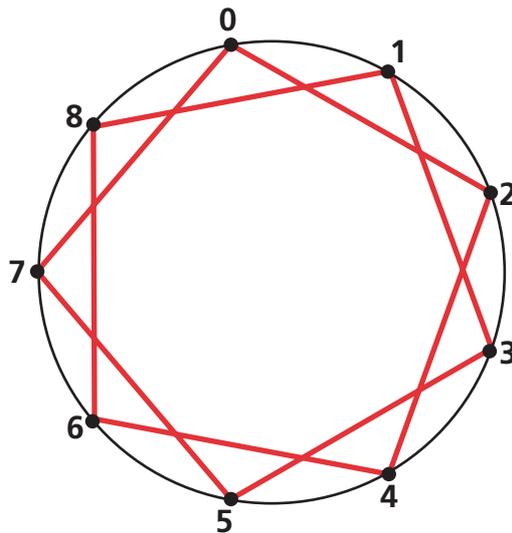
There is a series of free booklets to support work with **Logo** written by **Peter Smith** on the **Association of Teachers of Mathematics** website at: <http://www.atm.org.uk/free-resources/logo.html>

You could download these and print them out for your own use and for selected pupils to use.

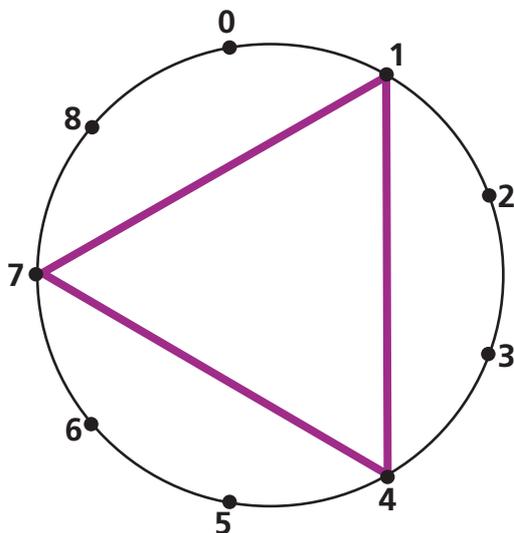
But some may be ready to write programming procedures – **Making a new command** teaches them how to do this. Building your own commands is carried out in the **Editor**. Sometimes, pupils will find it helpful to experiment with a set of commands required to produce a particular result, and then use 'copy' and 'paste' to transfer several of these remembered commands to the **Editor**. It will be helpful to introduce the idea of an *input*. Some procedures do not need an input, for example, **CS** but others like **FORWARD** take one input – a number. **REPEAT** needs two inputs – first a number and then a list of commands. The booklet *Procedures* from the ATM site may be particularly helpful for pupils building their own commands.

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Just these few simple commands can provide significant mathematical challenges. **Stars** is one such challenge. Experimentation will lead to some solutions but a full understanding of the problem requires deep mathematical thinking. For example, there are several ways to create a 9-pointed star:



In the first star, each line is made by connecting it to the point which is 2 steps on. In the second, each line is made by connecting it to the point which is 4 steps on.



Look what happens if each line is made by connecting it to the point which is 3 steps on. To make a 9-pointed star with steps of 3, you would have to start again at dot 2, and then add a third triangle starting at dot 3. Pupils will find the idea of co-prime numbers useful here.

The mathematics

Logical, algorithmic thinking is developed by all these activities. Geometric work focuses on exterior angles, particularly of polygons and star polygons.