

Programming Activity 9

The maths problem

(Units 1 and 2: Problem Solving and Programming)

Learning objectives

- Analyse a problem, investigate requirements and design solutions
- Understand how to create an algorithm to solve a particular problem
- Make use of programming constructs including sequence, selection and iteration
- Be able to construct and interpret truth tables for a given logic statement (AND, OR, NOT)
- Be able to produce logic statements for a given problem

Assessment Objectives

AO2, AO3

Spec alignment

Pages 10–12, 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5

Task

The following letters show a mathematical multiplication:

$$\begin{array}{r} \text{O T T O} \times \text{I} \\ \hline \text{S T O P} \end{array}$$

Or $\text{OTTO} \times \text{I} = \text{STOP}$

Each of the letters represents a different digit between 1 and 9. The same letter always represents the same digit.

Write an algorithm to find the multiplication and product shown above, changing the letters for the numbers they represent.

Misconceptions/barriers

The use of several nested loops can cause conceptual problems as students have to close each one sequentially.

Differentiation

All students will probably need the following pointing out:

- Each of the letters O, T, I, S and P represent a different number between 1 and 9.
- Remind students about place numbers so that the top line OTTO is therefore equal to the values of:
 $(\text{O} \times 1000) + (\text{T} \times 100) + (\text{T} \times 10) + \text{O}$
- The top line is multiplied by the value of I, which must be a different number to O and T.
- The product must contain $\text{T} \times 100$ and $\text{O} \times 10$. The values of S and P must be different from all the other numbers.
- Students can be given clues for solving the problem when they have difficulties:
 1. Set up the first loop (for O) from 1 to 9.

2. Set up the second loop (for T) from 1 to 9.
 - a) Check if T is equal to O.
3. Calculate the top line as described above.
 - a) In the first iteration it will be 1221.
4. Set up the third loop – for I – from 1 to 9.
 - a) Check if I is equal to O or T.
5. Multiply the top line by I.
6. Check if the criteria have been met.
7. If not, increment I by 1 and go back to instruction 4(a).
8. When I > 9, increment T by 1 and go back to instruction 2(a).
9. When > 9, increment O by 1 and go back to instruction 2.

A flowchart to help students is given below:

