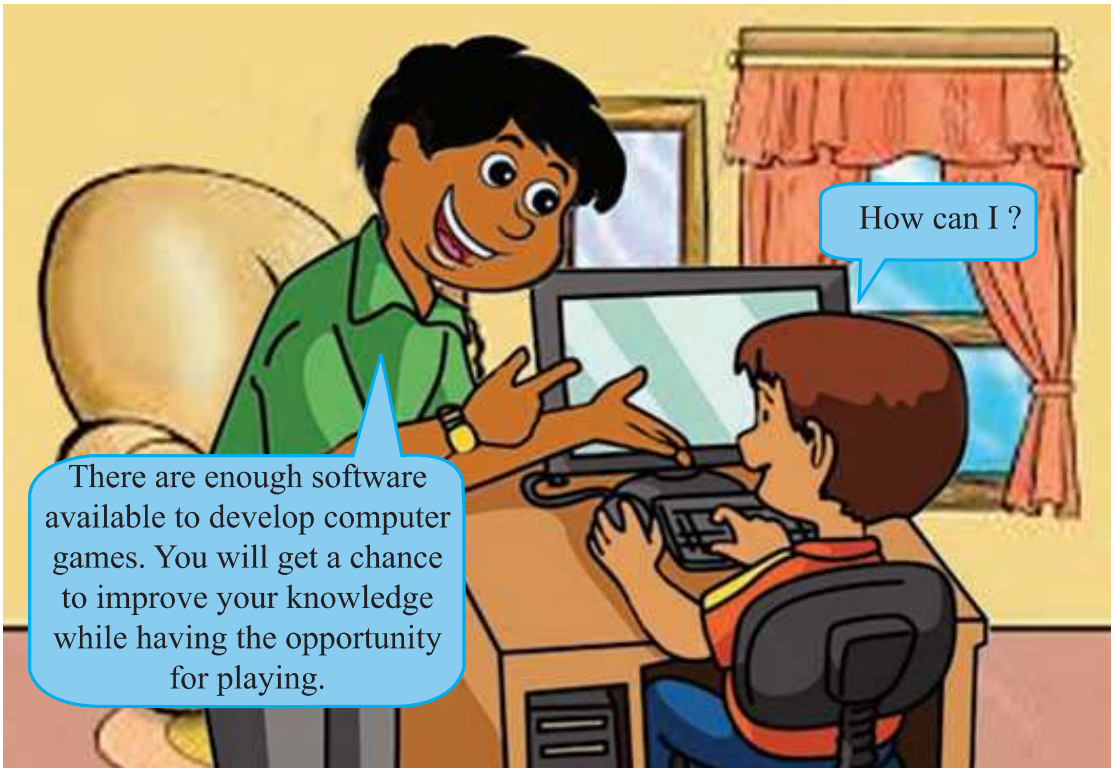
3 Programming

This chapter will cover the following:

- Multi-condition selection control structures
- Use of flowcharts to solve problems with many conditions
- Repetition control structures
- Use of flow charts to solve problems with repetition procedures
- Development of Scratch program using selection and repetition control structures
- Solutions with flow charts having nested loops
- Arrays and their usage

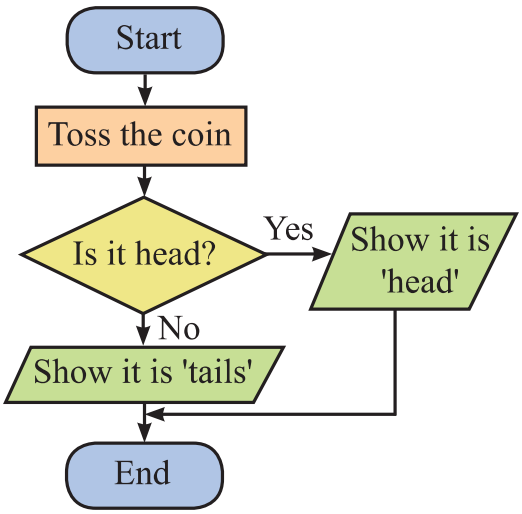
Download Scratch software from http://www.scratch.mit.edu as mentioned in Information Communication Technology Reading book of Grade 7.



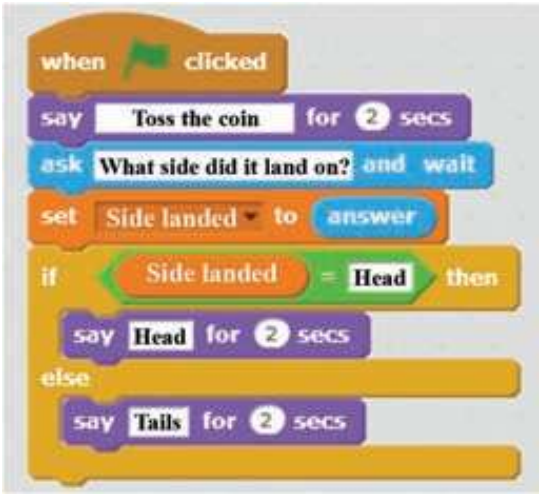
3.1 Simple selection

You learnt in programming chapter of Grade 8, ICT textbook that a simple selection is selecting one option out of two given options under a certain condition. For example, one such choice is the selection of "head" or "tail" with the toss of a coin.

Head and tail of a coin



Flowchart 1 : Getting "head" or "tail" of a coin



Scratch program 1

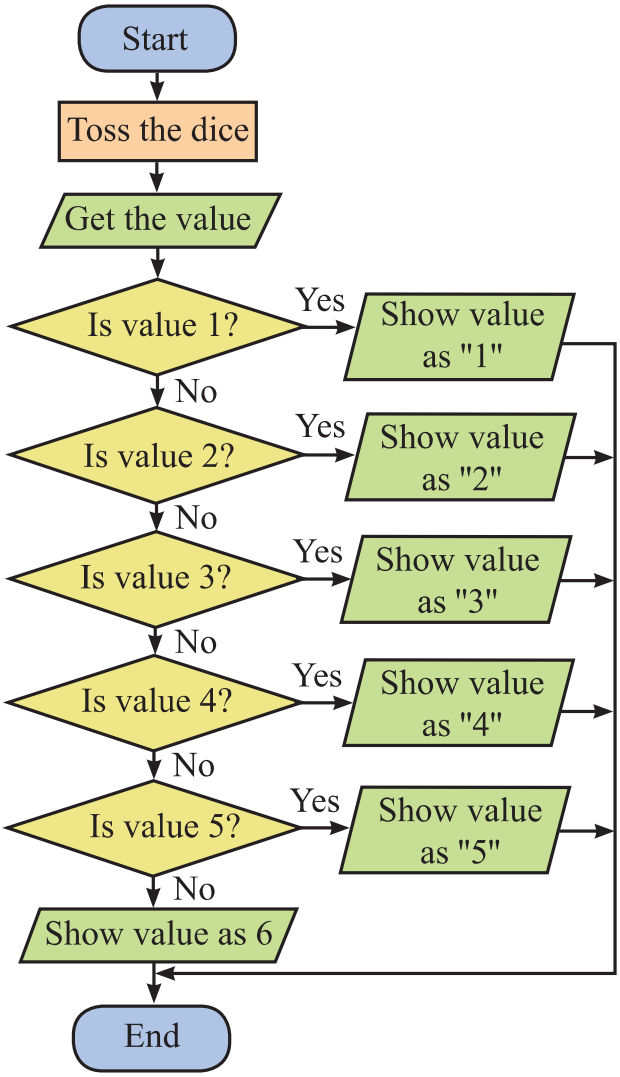
Simple selection has one condition with two options. A selection is made out of the two conditions. If the condition is true, one option is selected and if not, the other option gets selected.

Refer to workbook for Activity 3.1.

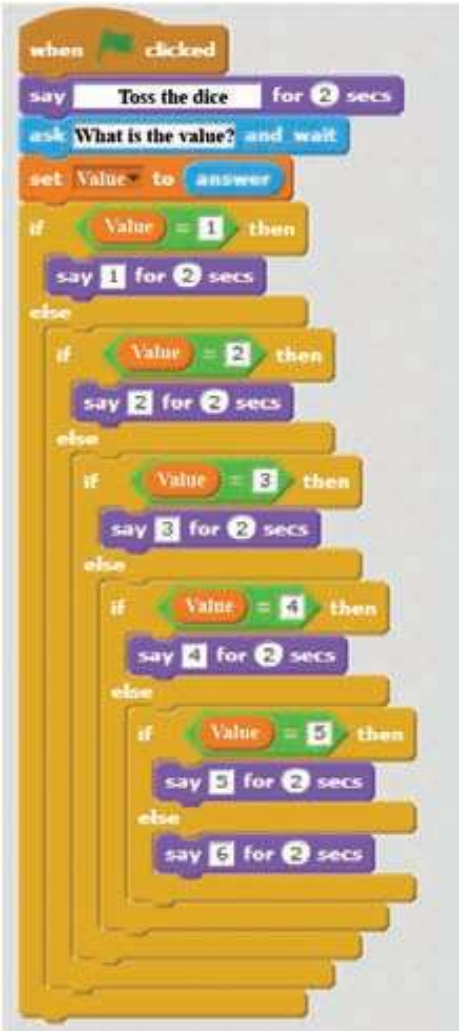
3.2 Selection out of many options

Selection out of many options is about selecting one out of more than two options.

Example Tossing a dice for values of 1 to 6



Flowchart 2 : Getting value from a tossed dice



Scratch program 2

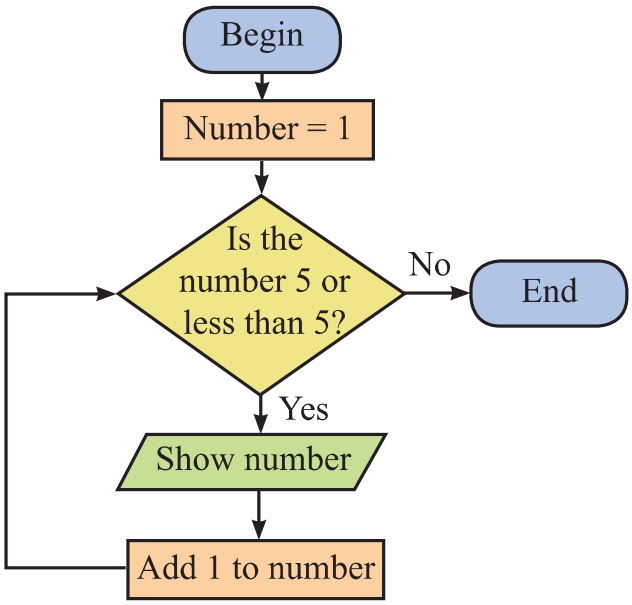
In the above, a number will be displayed if one of the five conditions is satisfied or if non of the five conditions is satisfied.

3.3 Control structure with repetition

Repetition is about an action getting repeated again and again.

With repetition, both beginning and end is based on a condition.

Example 1 Displaying numbers 1 - 5



Flowchart 3 : Display numbers 1 - 5

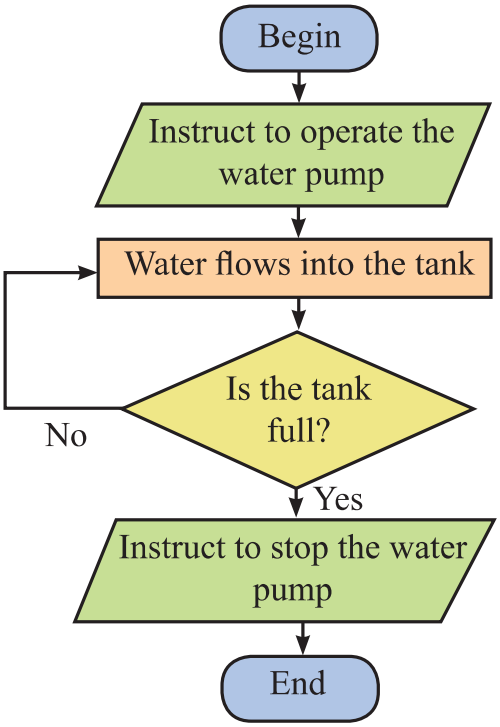
In this flowchart the condition is, "Is the number equals 5 or less than 5"?

At the beginning, condition is checked and since the condition is true, the repetitive work commences.

Once the number is shown, 1 is added to it and the condition is checked again.

When the number exceeds five, condition is not satisfied and the repetition ends.

Example 2 Consider a water pump filling water into a tank. The pump is operated until the tank becomes fill.



Flowchart 4 : Filling a tank with water

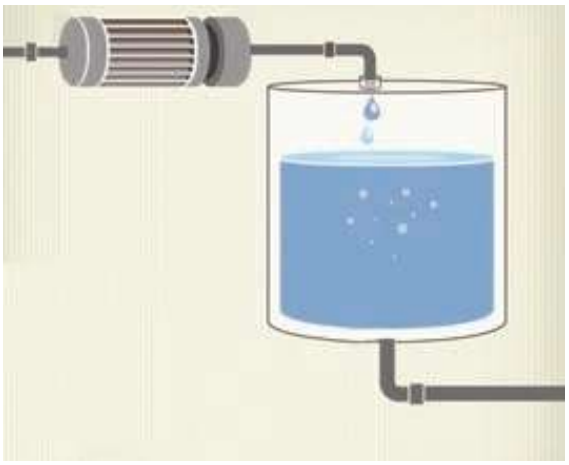
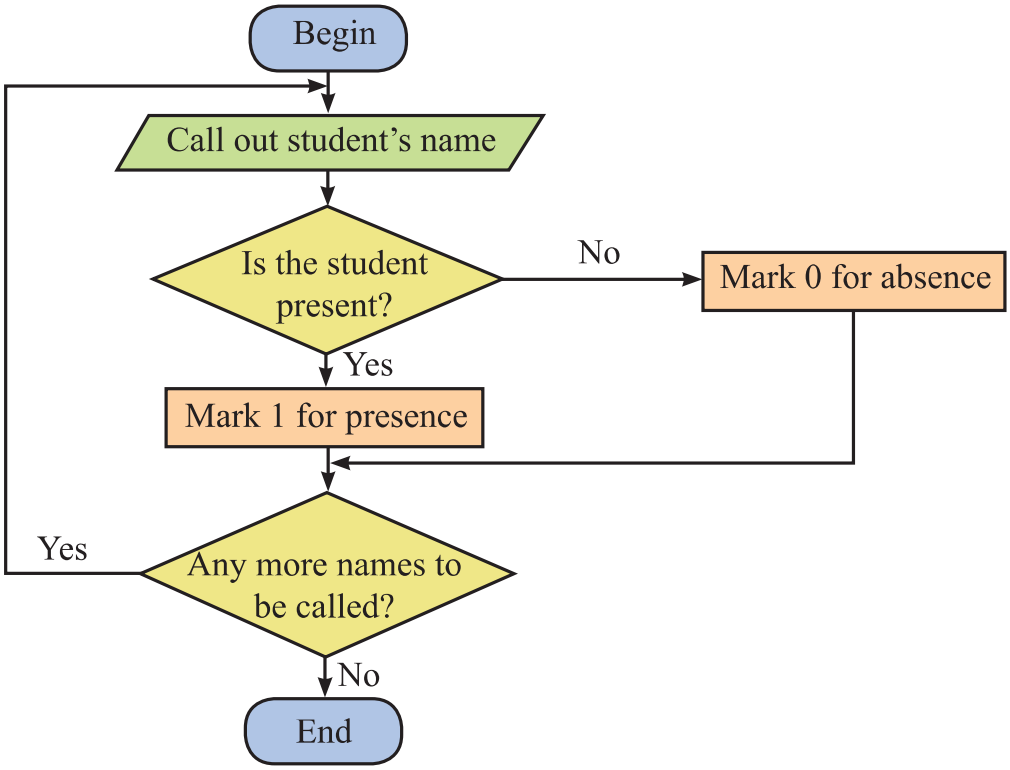


Figure 3.1 : A water pump filling a tank

Example 3 Consider marking attendance of students. If the student is present, the register is marked with 1. If student is absent it is marked with 0.

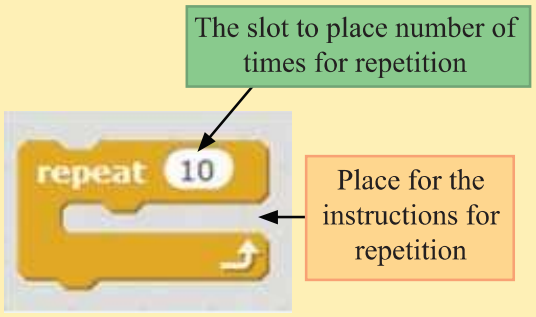
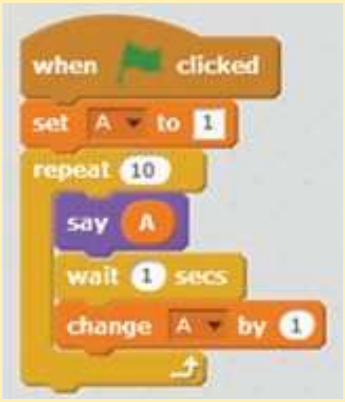
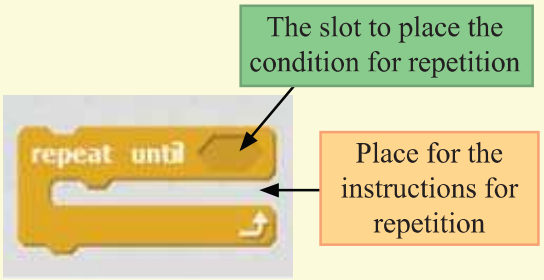
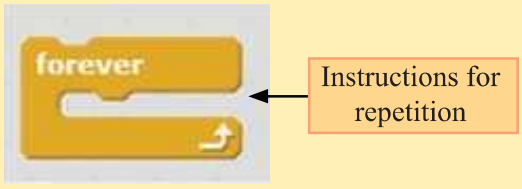


Flowchart 5 : Marking attendance register

3.4 Scratch repetition control structures

Three repetition control structures are available to build Scratch programming. They are shown below;

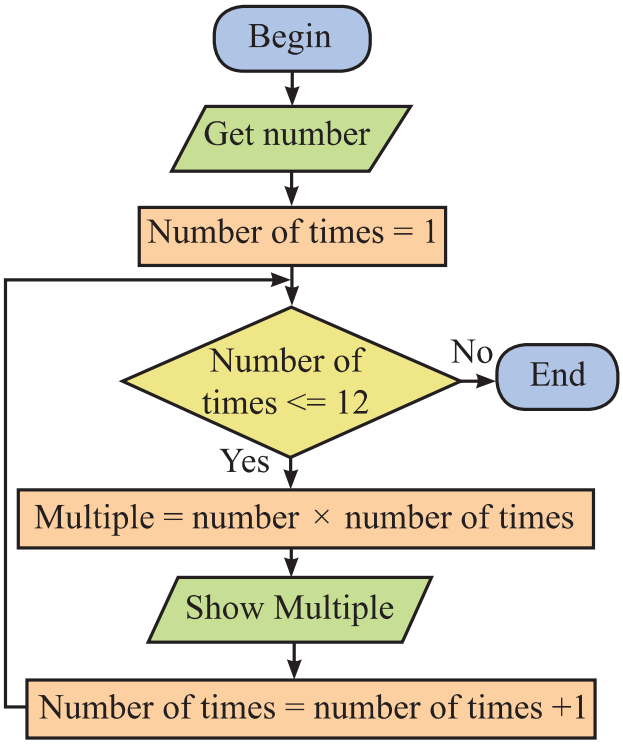
Table 3.1 : Repetition control structures

Repetition type	Example
Repetition with definite number of times 	 Scratch program 3 Displaying numbers 1 - 10 in 10 seconds
Repeating till a given condition is satisfied 	 Scratch program 4 Displaying all positive integers 1 - 5
Repeating infinite number of times 	 Scratch program 5 Displaying all positive integers from 1

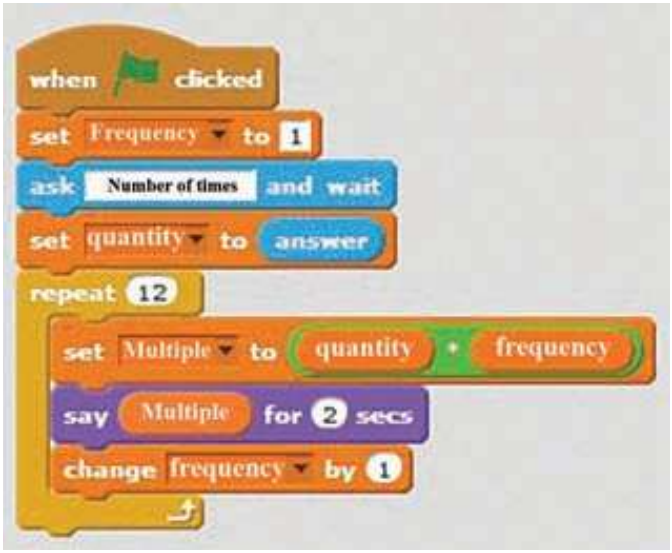
3.5 Developing visual programs involving repetition

Example 1 Showing the first multiples of 12 of any number.

> Note - For example, for number 2, the first 12 multiples are 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24 and for number 3, the first 12 multiples are 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36

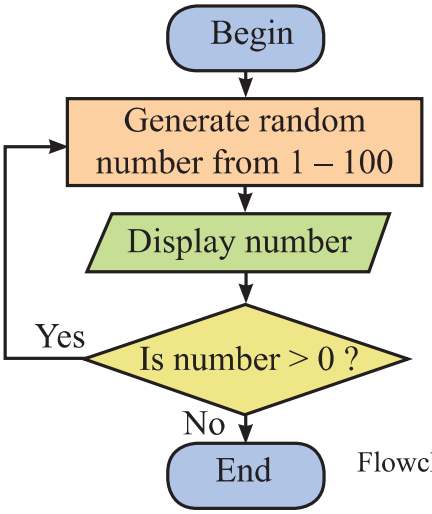


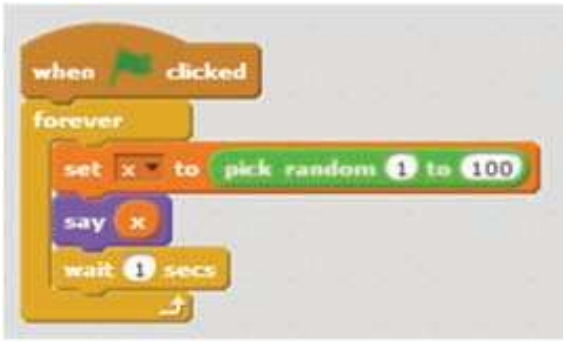
Flowchart 6



Scratch program 6

Example 2 Displaying random number from 1 to 100, an infinite number of times



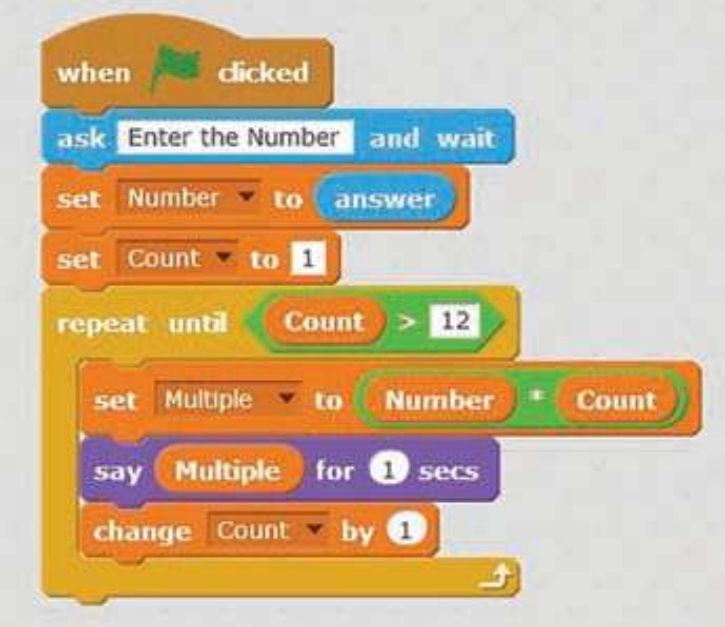


Scratch program 7

Flowchart 7 : Displaying random numbers between 1 -100

Condition in the above flowchart always remains true. It never changes to false. Therefore, continuous repetition takes place.

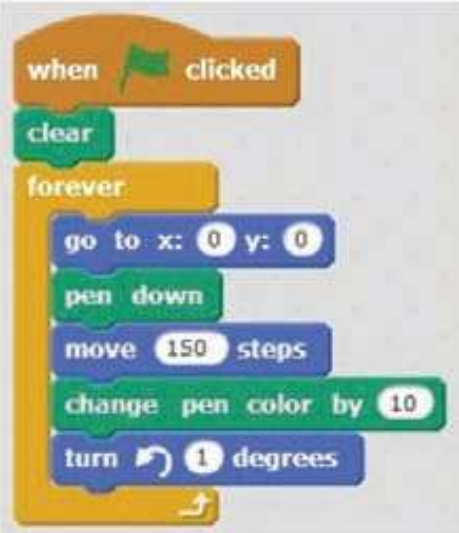
Example 3 Display the first multiples up to 12 of given number.



Scratch program 8

This is another program to display the same output of the flowchart 6 discussed earlier.

Example 4 Creating a multi-coloured circle using coloured lines



Scratch program 9

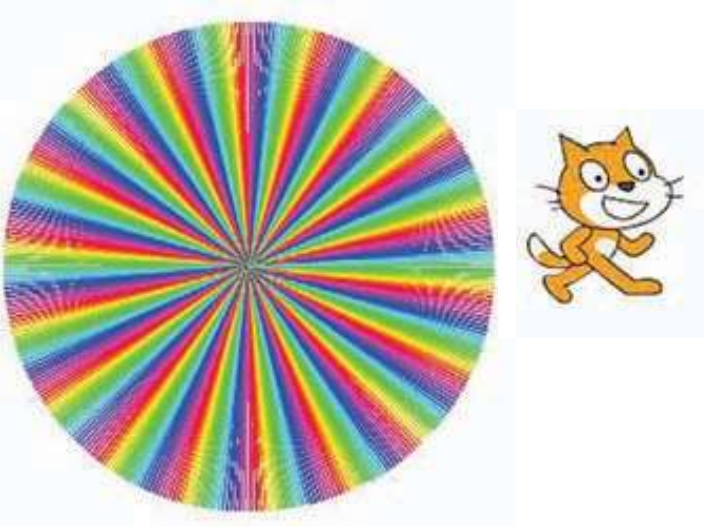


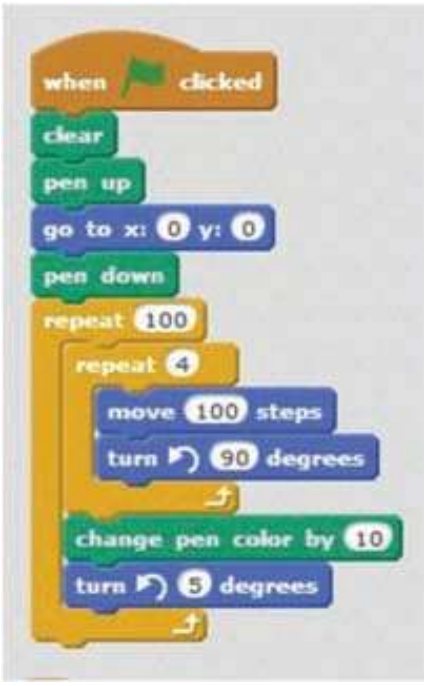
Figure 3.2 : The multi-coloured circle

3.6 Programming with nested repetition

Here, there are repetitions within repetitions.

Example 1 Repetition within a repetition

Consider the program to create the following line diagram in figure 3.3.



Scratch program 10

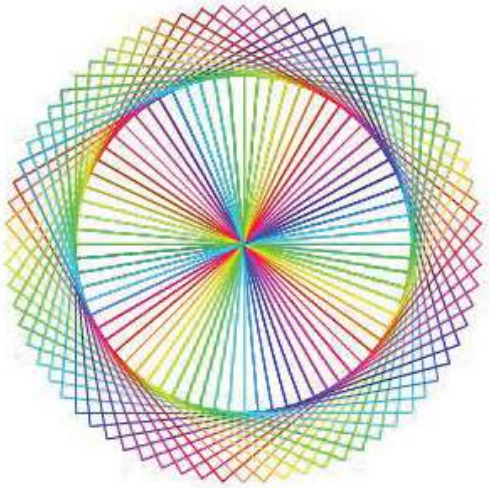


Figure 3.3

It shows repetition within repetition.

Example 2 Repetitions with selection

The flowchart and the Scratch program for a complete Snakes and ladders game is shown below. It includes repetitions with selections.

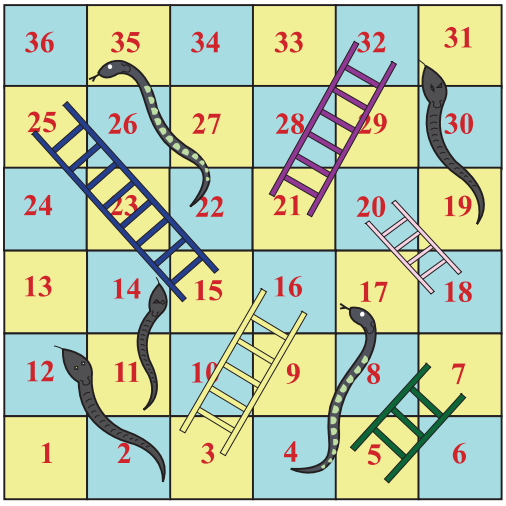
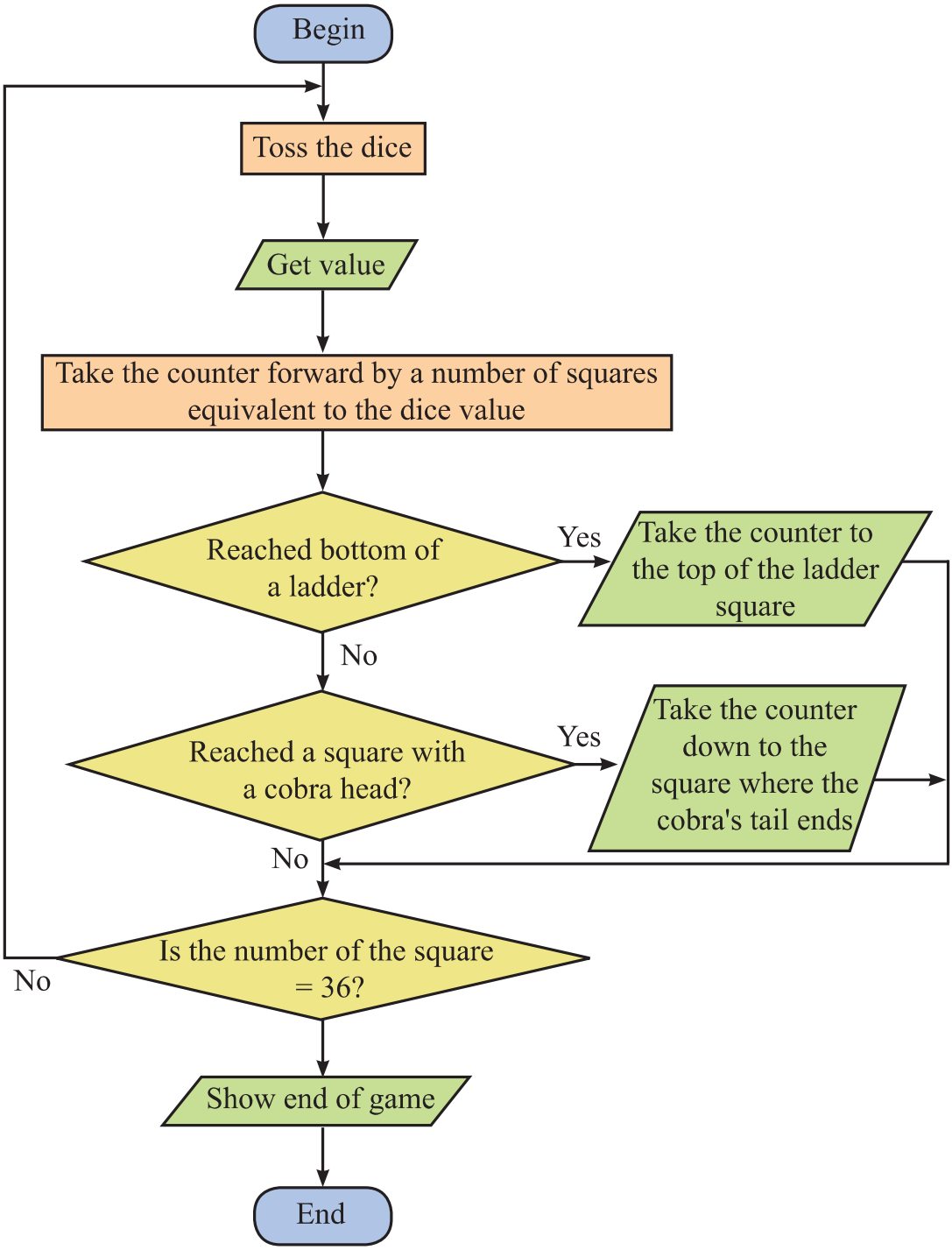


Figure 3.4 : Snakes and Ladders



Flowchart 8 : Snakes and ladders game

Scratch program 11

Refer to workbook for Activities 3.2 and 3.3.

3.7 Programming with arrays

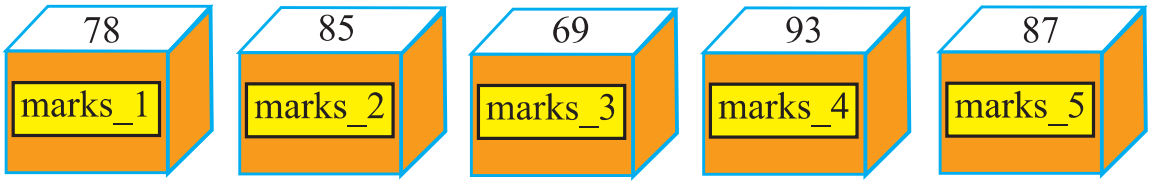
What is an array?

In Grade 7, we learnt that to store values in programming, variables are needed. We need a number of variables that is equivalent to the number of values to be stored.

For example, consider storing marks gained by a student for five question papers on general knowledge.

Five variables are required to store marks for the five question papers.

Name the variable as marks _ 1, marks _ 2, marks _ 3. marks _ 4 and marks _ 5. Marks earned by a student can be stored in these variables. Consider 78, 85, 69, 93, 87 to be the marks scored.



Each variable needs giving a name when variables are used to store values. This is difficult when a large number of variables are used. Further, the program become complicated and large with large number of variables. In such instances, arrays are used to get over this problem.

An array is a data structure that can store any number of items using a single variable name. By using arrays, programs become less complex and the number of instructions can be reduced.

Building up arrays

Lists are used for arrays in Scratch. Lists can be built as follows in Scratch.

e.g. - Using arrays to enter names of animals:

1. Select ‘Make a List’ from data
2. Give array a name
3. Select ‘For this sprite only’
4. Click 'OK'

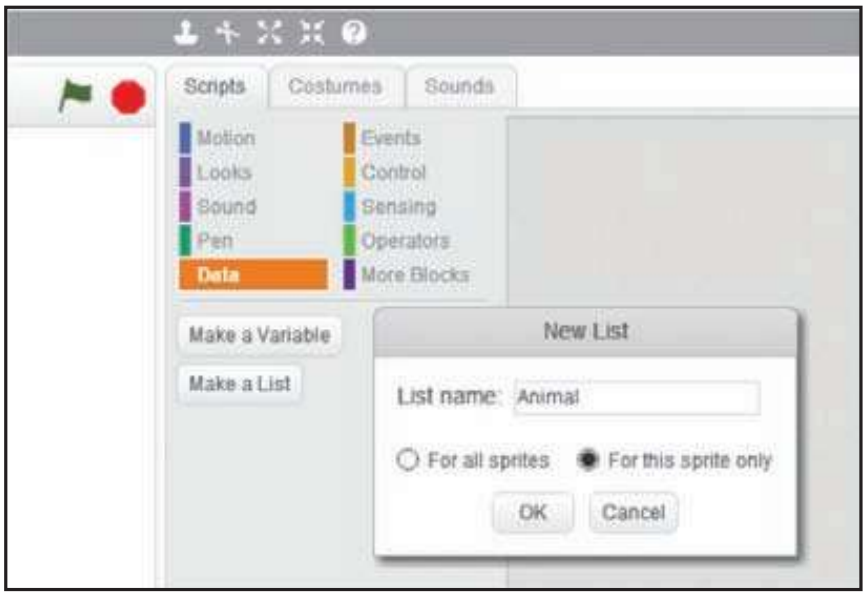


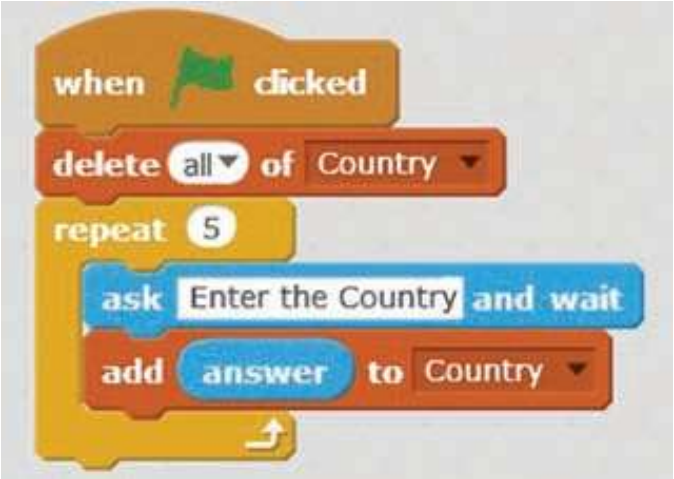
Figure 3.4 : Building up an array in Scratch

After following the steps above, instructions blocks for Animal array appear as shown below;

Scratch program 12

Assigning items into arrays

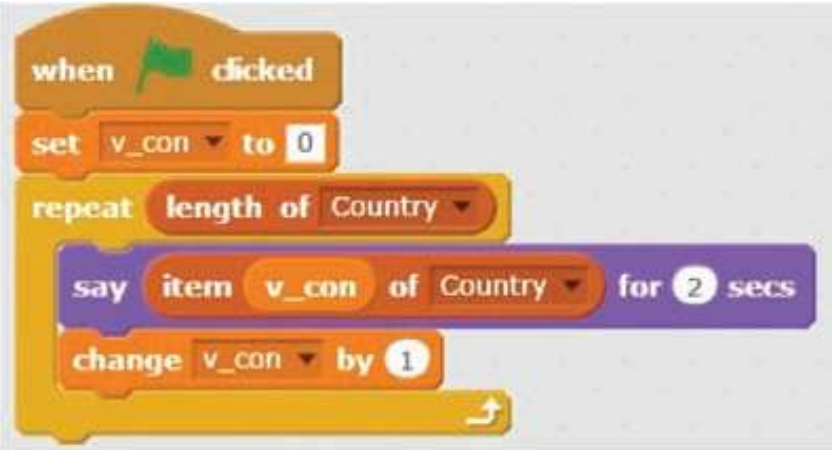
For example, after building an array named 'Country' to enter the names of five countries, the following code can be used to enter items to it.



Scratch program 13

Displaying items in an array

After entering data into an array named 'Country', the following program can be used to display its content to produce the output.

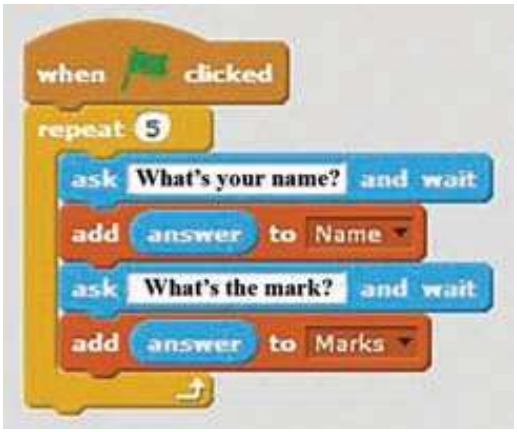


Scratch program 14

In the above program, v_con is a variable and "Country" is the name of the array.

Let us consider an example where two Scratch programs to store the names and the marks of five students are processed. The first one uses multiple variables whereas the second one uses two arrays.

Scratch program 15 : Program with variables



Scratch program 16 : Program with repetition

Array with names

Array with marks

With the arrays in use, it is possible to use a repetition construct. This helps reduce the size of the program.

Note - An array is termed a list in Scratch programming.

Let us consider another example;

A school conducted a competition to select students for a general knowledge contest. The principal decided to select students who gained over 15 marks for the interview.

Five students are to face the interview. In the code shown below, using two arrays named 'Name' and 'Marks' the names of students having marks greater than 75 are shown.

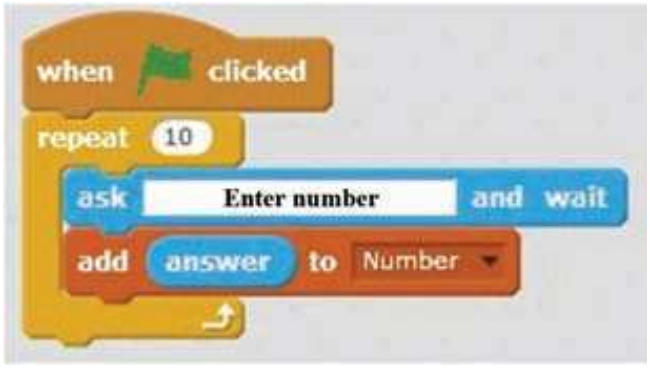
Scratch program 17

3.8 Programming with problem analysis

Dividing a problem into sections makes it easier to solve.

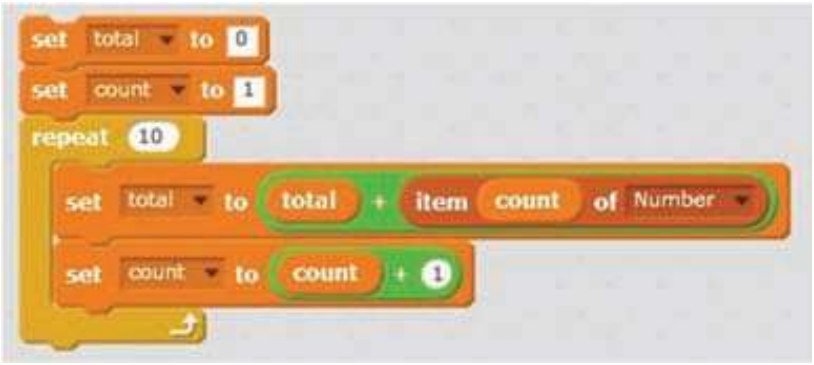
For example, Let us consider finding the average of ten numbers. This problem can be divided into sections as shown below;

1. Input ten numbers.



Scratch program 18

2. Find the total of the ten numbers



Scratch program 19

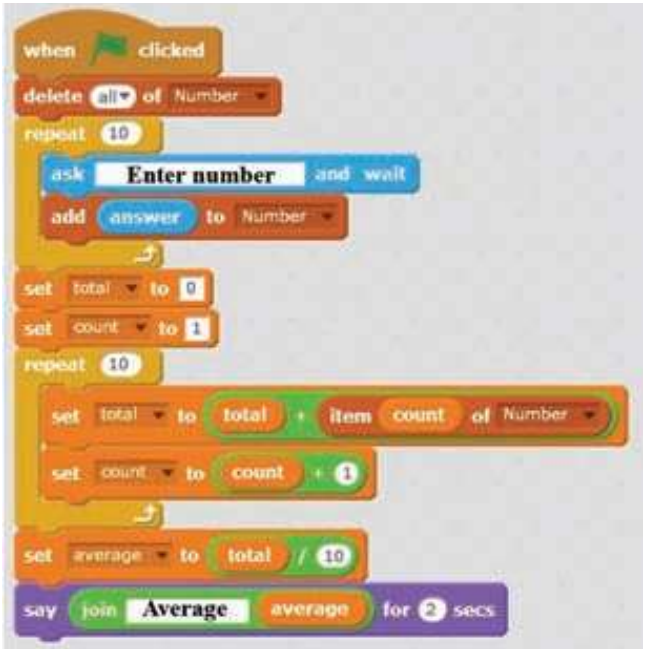
3. Divide the total by ten to find the average

Scratch program 20

4. Output average

Scratch program 21

Based on the sections written, it is possible to develop a Scratch program easily for the entire problem as follows;



Scratch program 22

Refer to workbook for Activity 3.4.

Summary

- Repetition is about repeating a statement or a set of statements.
- A condition is necessary to begin and end a repetition.
- There are Scratch repetition control structures.
- There are three repetition control structures in Scratch:

  i. Control structure for repetition a set number of times (e.g. for 10 times)

  ii. Control structure for repetition based on a condition

  iii. Control structure for endless repetition

- Repetition within a repetition is called a *nested repetition.*
- There are a few nested repetition types:

  i Repetition to satisfy a given condition

  ii. Continuous repetition a fixed number of times

  iii. Continuous repetition to satisfy a given condition

- An *array* is a data structure to store many items using a single name.
- Dividing a problem into smaller selections makes problem development easier.