

Design

Design

During the Design phase of Software Design and Development we need to:

- identify the data types and structures required for a problem
- design a program using one of various different design techniques

Variables

Variables are used to store a single piece of data.

When creating variables we store 2 pieces of information: the name and the value

score = 215

↑ ↑
name value



Variable Data Types

There are 5 data types we need to know for National 5:

Data Type	Type of information stored
Character	A single letter or symbol
String	Multiple letters or symbols
Numeric (Integer)	A positive or negative whole number
Numeric (Real)	A positive or negative decimal number
Boolean	True or False

Arrays

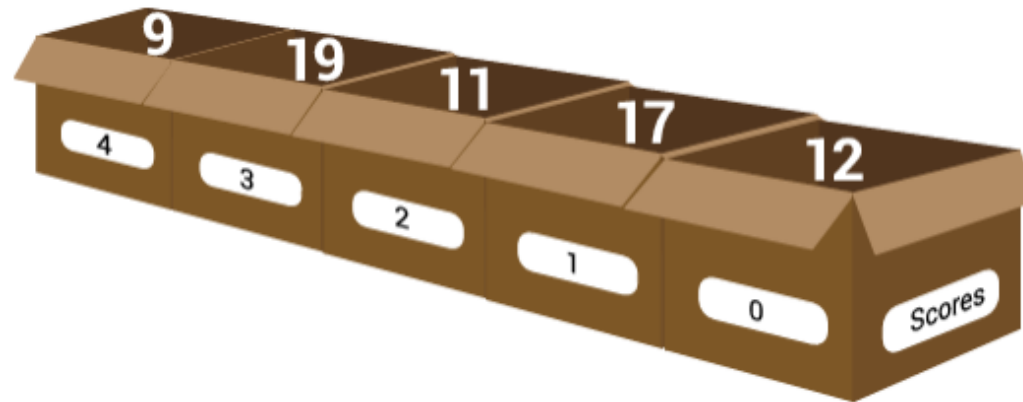
Arrays are a list of values of the same data type.

Arrays are used to stored related pieces of information e.g. we could store names in one array, and test scores in a different array.

How do arrays work?

An array has one name but multiple values.

We give each value a number, called an **index**, which represents the value's position within the array.



Arrays begins at index 0, so the first item added to the array is stored in index 0.

User Interface Design

A user interface design shows how the user is going to interact with your code, i.e. what the user of your program will see when they run your program.

In Python we have been providing the user with text prompts, so our user interfaces will include any prompts we write to get information from the user, or any information that we will display to the user.

User Interface Design

Program Purpose

A class of 20 pupils is raising money for charity. For each pupil, the program will ask how much money they raised, validate that it is a value larger than 0, and then add the amount to the total. When there are no pupils left, the program should decide if the class has won a prize by raising more than £150, displaying a congratulations message if they have. The program will then display the total amount raised.

User Interface Design

Prompt (computer)

Response (user)

How much money did you raise?

How much money did you raise?

How much money did you raise?

How much money did you raise?

How much money did you raise?

How much money did you raise?

Congratulations, your class raised more than £150!

Your class raised a total of £_____

Program Planning

Program planning is creating a solution to the program purpose. During this stage you create algorithms (i.e. deciding what steps are needed to solve the problem)

There are 3 design notations we need to be able to read and understand in National 5:

- Pseudocode
- Structure Diagrams
- Flowcharts

Pseudocode

Pseudocode is a written design notation of the steps needed to solve a problem. It is not based on a programming language, meaning you don't have to worry about syntax.

Pseudocode should:

- define the main steps of a program
- Refine/break down the main steps where possible (not all main steps need refined)
- have indentation to help identify loops and selection statements

Pseudocode Example

Program Purpose

A class of 20 pupils is raising money for charity. For each pupil, the program will ask how much money they raised, validate that it is a value larger than 0, and then add the amount to the total. When there are no pupils left, the program should decide if the class has won a prize by raising more than £150, displaying a congratulations message if they have. The program will then display the total amount raised.

Pseudocode Example

1. SET total TO 0
2. FOR LOOP 1 TO 20
3. Get valid amount from user
4. SET total TO total + amount
5. END LOOP
6. Decide if class gets a prize
7. Display total

Pseudocode Example

1. SET total TO 0
2. FOR LOOP 1 TO 20
3. Get valid amount from user
4. SET total TO total + amount
5. END LOOP
6. Decide if class gets a prize
7. Display total

Refinements

- 3.1 RECEIVE amount FROM USER
- 3.2 WHILE amount < 0
- 3.3 SEND error message TO DISPLAY
- 3.4 RECEIVE amount FROM USER
- 3.5 END LOOP
- 6.1 IF total > 150 THEN
- 6.2 SEND "Congratulations" TO DISPLAY
- 6.3 END IF

Pre-Defined Functions in Pseudocode

SET score TO ROUND (score, 2)

SET numberOfCharacters TO LENGTH (firstname)

SET bonusBall TO RANDOM(1, 59)

Structure Diagrams

Structure diagrams are a visual representation of the steps needed to solve a problem.

Structure diagrams are read from the top down, from left to right.

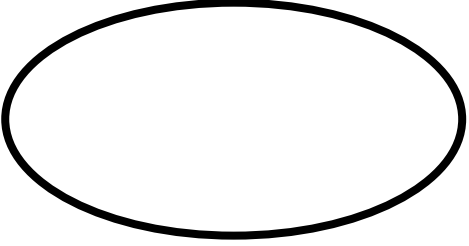
Structure Diagram Symbols

The following symbols are used in structure diagrams:

Symbol	Name	Use
	Process	Used to show that a process is needed (such as user input, a calculation or displaying information)
	Pre-Defined Function	Used to show that a pre-defined function will be used (such as random, round or length) instead of a developer writing the process themselves.

Structure Diagram Symbols

The following symbols are used in structure diagrams:

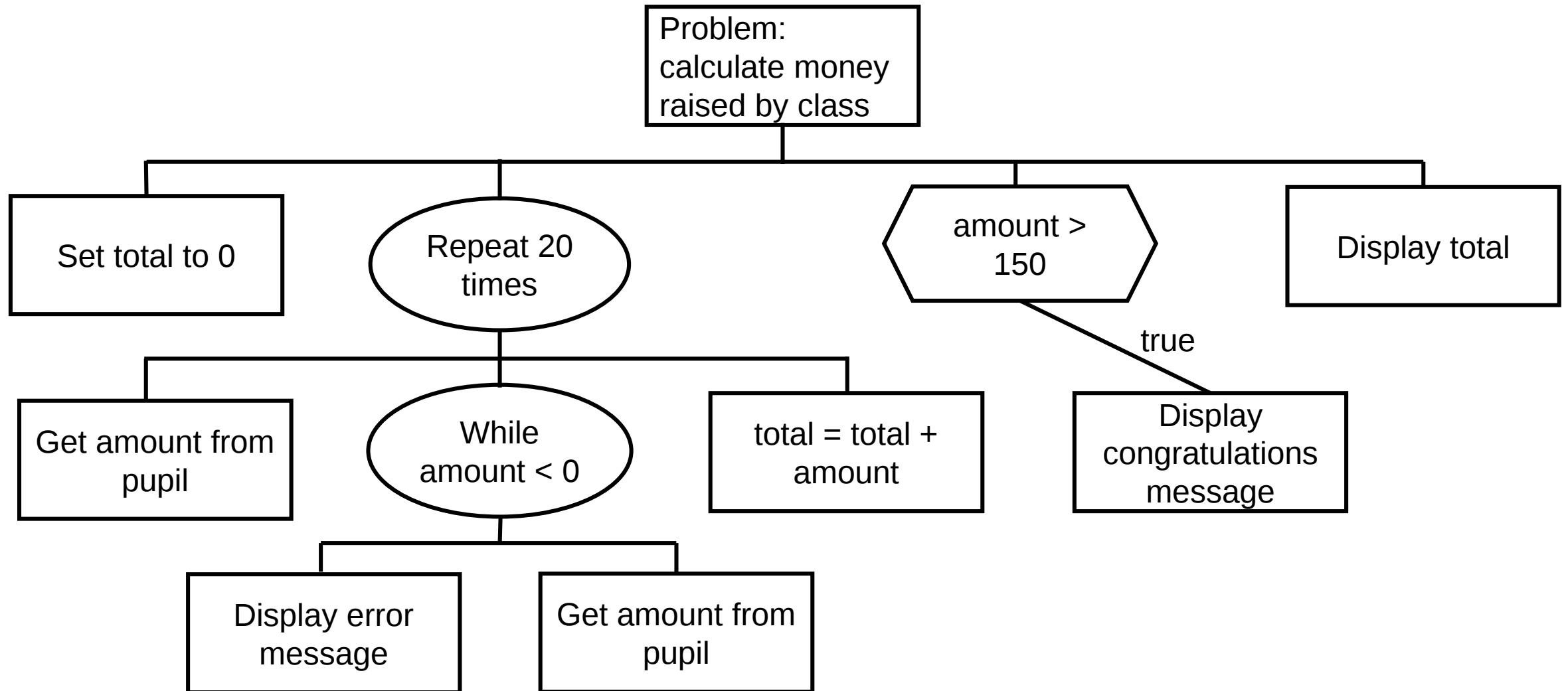
Symbol	Name	Use
	Loop	Used to show that code should be repeated. This is used for both fixed and conditional loops
	Selection	Used to show that the program needs to decide which path to follow i.e. different code should be executed for different scenarios

Structure Diagram Example

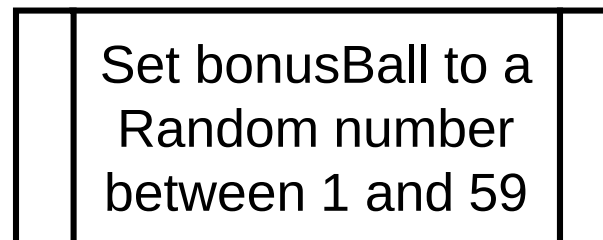
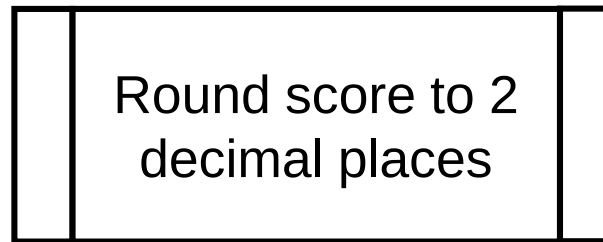
Program Purpose:

A class of 20 pupils is raising money for charity. For each pupil, the program will ask how much money they raised, validate that it is a value larger than 0, and then add the amount to the total. When there are no pupils left, the program should decide if the class has won a prize by raising more than £150, displaying a congratulations message if they have. The program will then display the total amount raised.

Structure Diagram Example



Pre-Defined Functions in Structure Diagrams



Flowcharts

Flowcharts are another visual data technique that are used to represent the flow of data through a program.

Flowcharts are read by following the flow line (arrow).

Flowchart Symbols

The following symbols are used in flowcharts:

Symbol	Name	Use
	Flow line	Shows the direction of flow between symbols
	Terminal	Shows the start and end of the program
	Initialisation	Shows the declaration of a variable, and assignment to an initial value (i.e. set total to 0 for a running total algorithm)

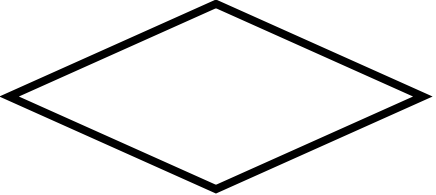
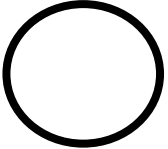
Flowchart Symbols continued...

The following symbols are used in flowcharts:

Symbol	Name	Use
	Input/Output	Shows data is input or output
	Process	Used to show that a process is needed, e.g. a calculation
	Pre-Defined Function	Used to show that a pre-defined function will be used (such as random, round or length) instead of a developer writing the process themselves.

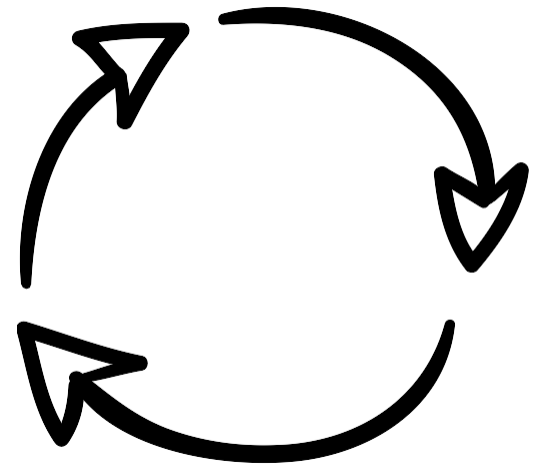
Flowchart Symbols continued...

The following symbols are used in flowcharts:

Symbol	Name	Use
	Decision	Shows a decision has to be made, with branches for different outcomes. Often used for conditional loops and selection statements
	Connector	Used if you are running out of room on the page so you can keep it all on one page

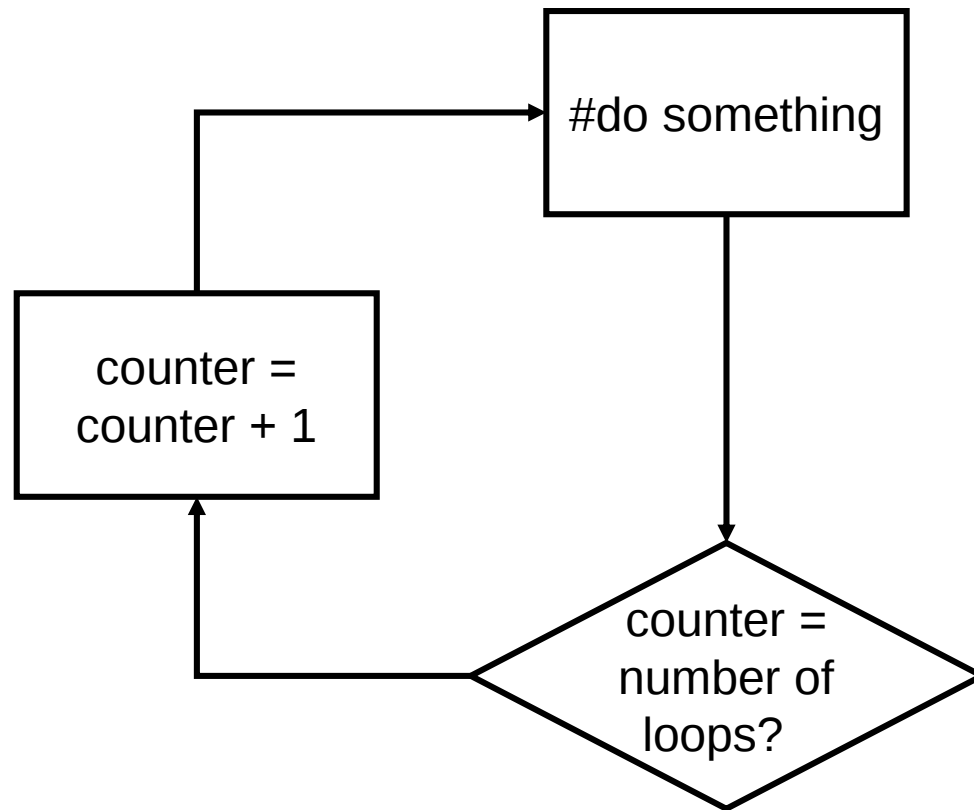
Flowchart Loops

There is no dedicated symbol for a loop because of the way a flow chart is read - by following the arrow. If the arrows returns to a symbol that has already executed then a loop should be used.

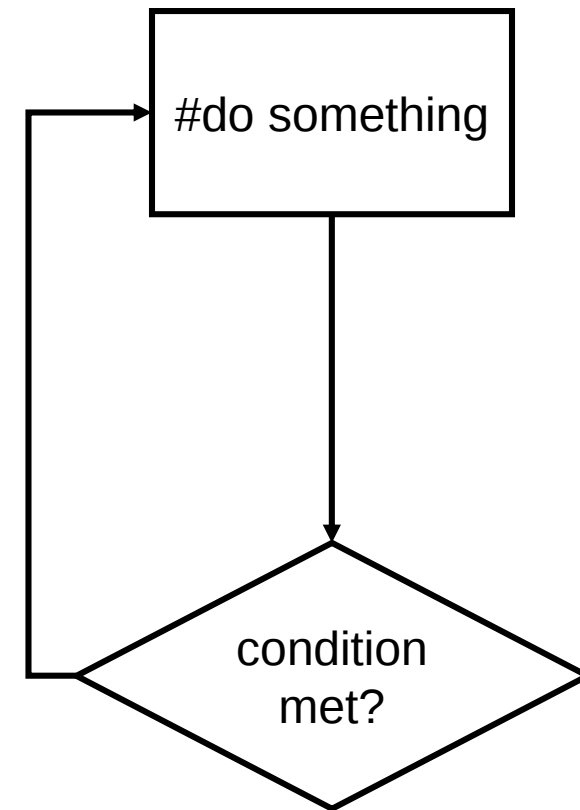


Flowchart Loops

Fixed Loop



Conditional Loop

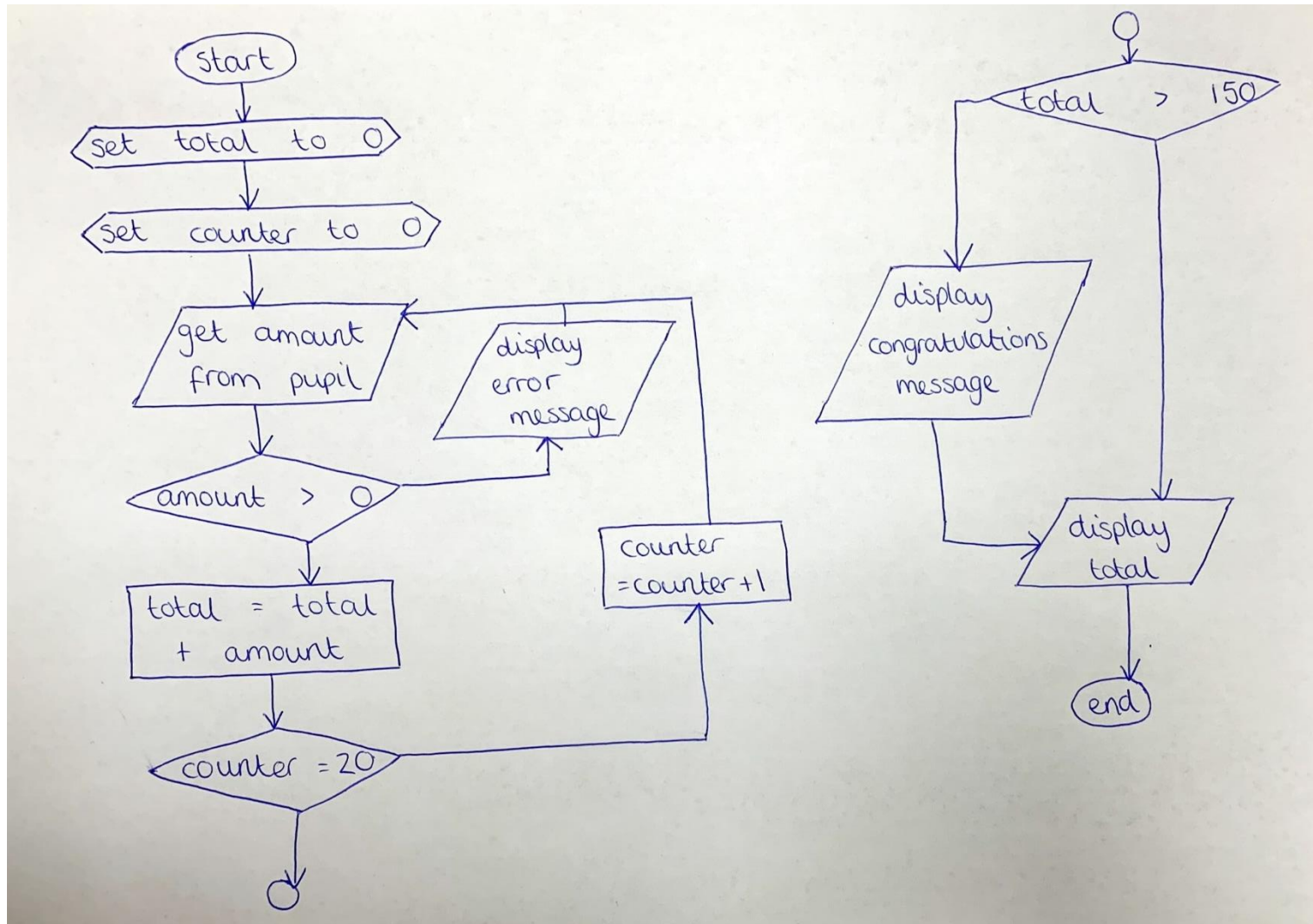


Flowchart Example

Program Purpose

A class of 20 pupils is raising money for charity. For each pupil, the program will ask how much money they raised, validate that it is a value larger than 0, and then add the amount to the total. When there are no pupils left, the program should decide if the class has won a prize by raising more than £150, displaying a congratulations message if they have. The program will then display the total amount raised.

Flowchart Example



Pre-Defined Functions in Flowcharts

	Round score to 2 decimal places	
--	---------------------------------	--

	Get length of firstName	
--	-------------------------	--

	Set bonusBall to a Random number between 1 and 59	
--	---	--