Visual programming languages in the Digital Technologies curriculum (F-6)

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VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

VICTORIA State Government

In this session

- **Where is visual programming in the curriculum?**
- **Some key programming concepts**
- **Introduction to visual programming**
  - Solving a problem
    - Applying the problem solving methodology (PSM)
- **Resources**

Where is visual programming in the curriculum?

The Strands

Digital Systems

Data and Information

Creating Digital Solutions

Image credit: Paula Christophersen

Creating Digital Solutions

Explores processes and skills by which students create **digital solutions**

Four stages:

Analysing
Designing
Developing
Evaluating

Problem Solving Methodology

Creating Digital Solutions requires:

- skills in using digital systems
- different ways of thinking (computational, design and systems thinking)
- interacting safely by using appropriate technical and social protocols.

Creating Digital Solutions Levels F-6

Levels F-2	Levels 3 and 4	Levels 5 and 6
	Define simple problems	Define problems in terms of data and functional requirements, drawing on previously solved problems to identify similarities
		Design a user interface for a digital system, generating and considering alternative design ideas
Follow, describe and represent a sequence of steps and decisions (algorithms) needed to solve simple problems	Describe and follow a sequence of steps and decisions involving branching and user input (algorithms) needed to solve them	Design, modify and follow simple algorithms represented diagrammatically and in English, involving sequences of steps, branching, and iteration
	Develop simple solutions as visual programs	Develop digital solutions as simple visual programs
Explore how people safely use common information systems to meet information, communication and recreation needs	Explain how student-developed solutions and existing information systems meet common personal, school or community needs	Explain how student-developed solutions and existing information systems meet current and future community and sustainability needs

Some key programming concepts

What are …

- visual programs?
- algorithms?
- control structures?

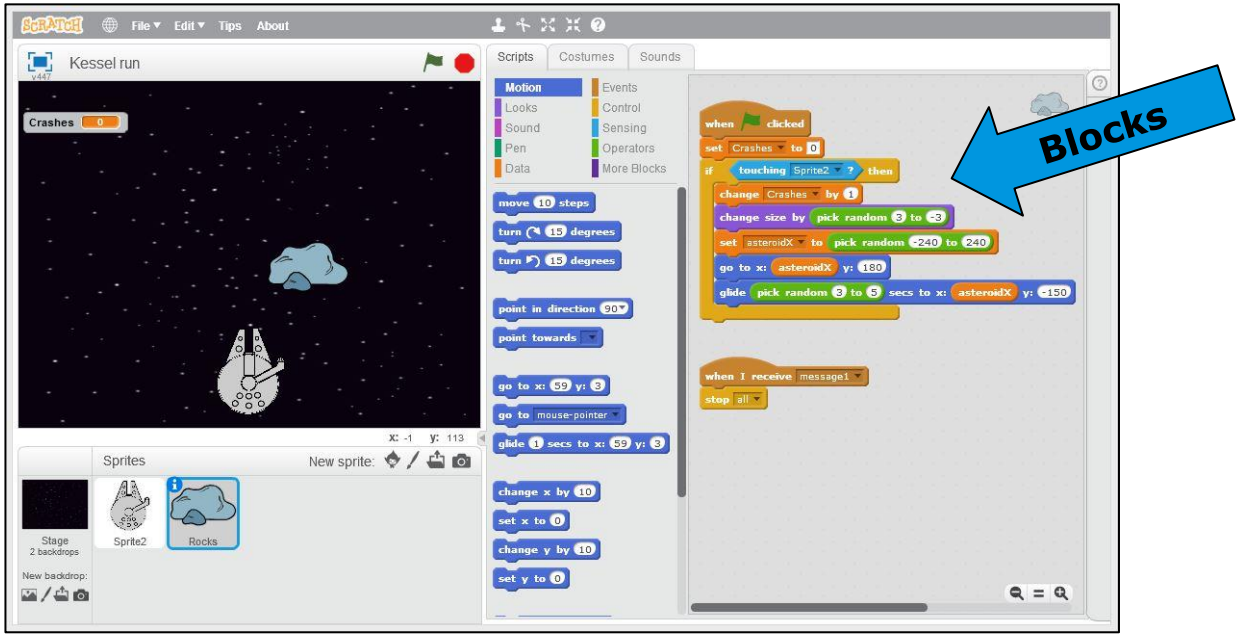
Visual programming

A programming language or environment where the program is represented and created visually rather than as text.

Examples of visual programming languages include: Alice, GameMaker, Kodu, Lego Mindstorms, MIT App Inventor, Scratch (Build Your Own Blocks and Snap).

Visual programming

https://scratch.mit.edu/



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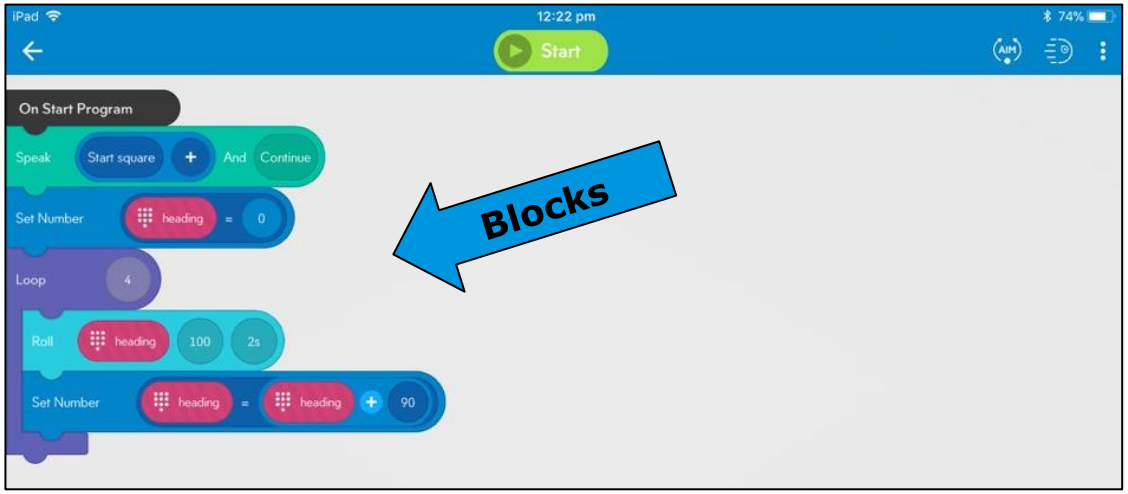


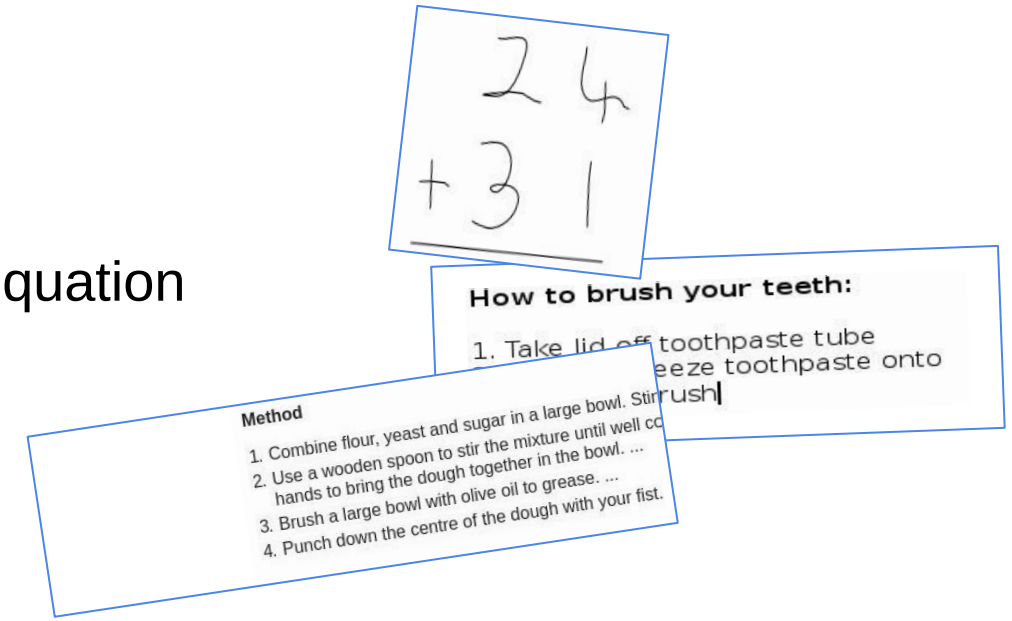
Algorithms

A description of the steps and decisions required to solve a problem.

Flowcharts are often useful in visualising an algorithm.

We use them everyday!

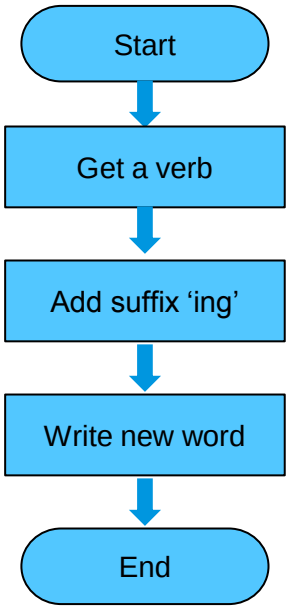
- Procedural text
- Solving a mathematical equation
- Recipes
- Our everyday routine



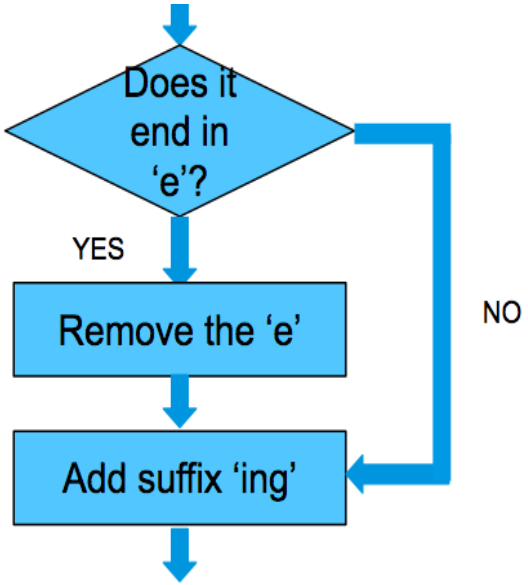
Control structures

Control structures are the way a computer works it way through the coded instructions. All problems can be solved using control structures.

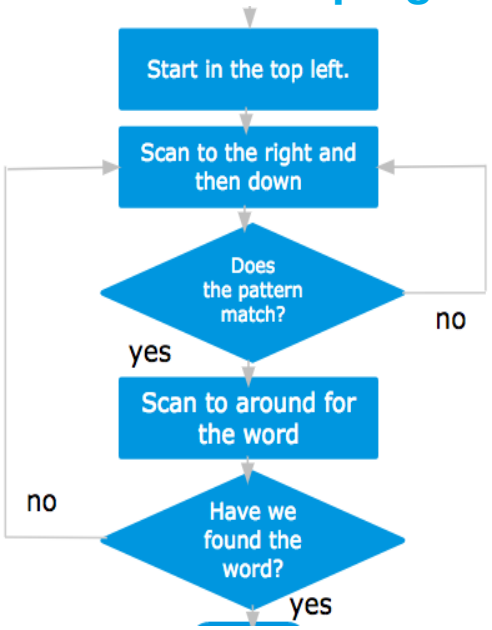
Sequence



Branching/Selection



Iteration/Looping



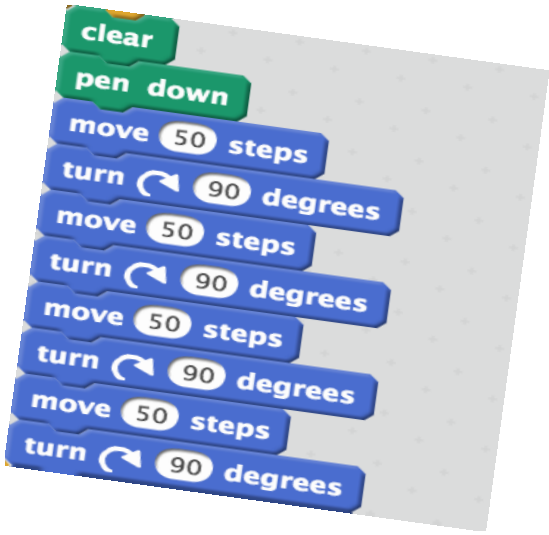
Sequence

Following step-by-step instructions, sequentially.

E.g. A recipe

Method

1. Combine flour, yeast and sugar in a large bowl. Stir ir
2. Use a wooden spoon to stir the mixture until well com
   hands to bring the dough together in the bowl. ...
3. Brush a large bowl with olive oil to grease. ...
4. Punch down the centre of the dough with your fist.



Branching

Branching occurs when an algorithm makes a choice to do one of two or more actions depending on sets of conditions and the data provided.

Making a decision!

If **this is true**, then do **that, otherwise do something else**

Branching

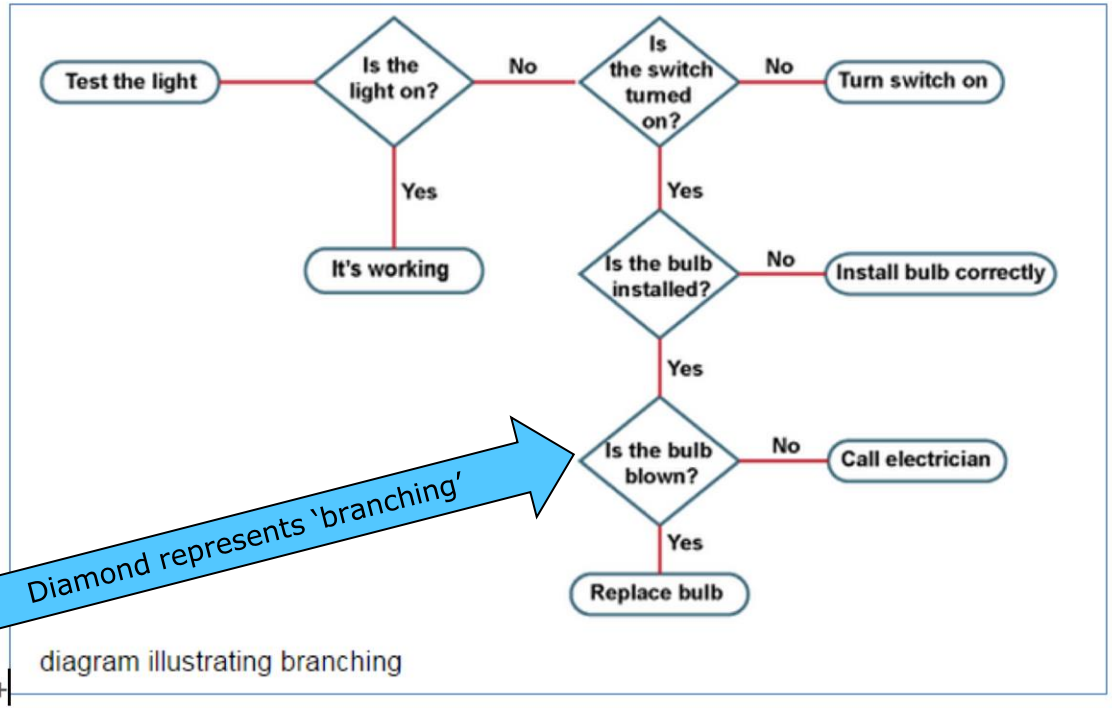
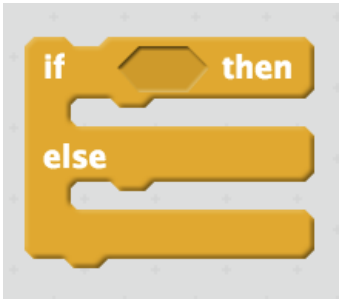


diagram illustrating branching

Visual code blocks may look similar to these:

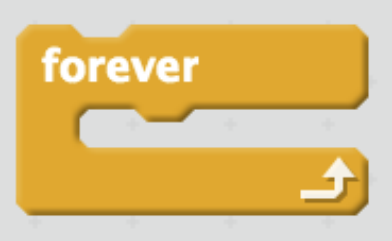


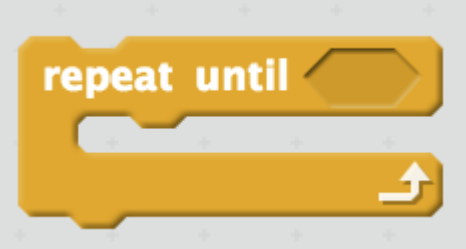
Iteration

Repetition of a process or set of instructions in computer programming.

Doing something over and over again!

Visual code blocks may look similar to these:





Visual programming

Programming stages

1. **Define a Problem**

2. **Apply Problem Solving Methodology**
   a. Analyse problem
      (Decompose, Abstraction)
   b. Design solution/s
      (Algorithm, Interface)
   c. Develop solution/s
      (Implement in Programming Language)
   d. Evaluate solution/s
      (Does it meet the needs of the problem?)

Thinking about what to program
(Defining a problem)

Defining a problem

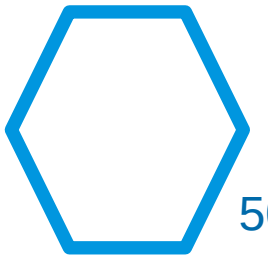
Something that needs to be solved.

May need to…

...break it down into smaller parts (decomposition)

...identify the relevant parts (abstraction)

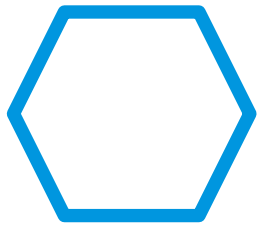
An Example:
Draw a regular hexagon with sides that are 50 steps long.



What is the problem asking us to do?
(Analyse the problem)

Analyse the problem

What do we know about hexagons?
What are the specifics of our problem?



SIX, equal length
SIX, equal angles
60 degrees
50 steps

- How many sides does a hexagon have?
- How many angles are there in a hexagon?
- What is the angle of adjoining sides?
- How long are the sides?
- Where will I need to start drawing from?

What might a solution look like?
(Design solutions to the problem)

Creating a design (Algorithm) – Levels 3 & 4

Draw a hexagon algorithm 1:

1. Begin
2. If user wants a hexagon
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
3. Stop

Branching

Sequence

Consider:

Other Control structures?

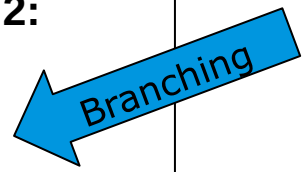
- Repetition? How many times is the same thing performed?
- Efficiency?

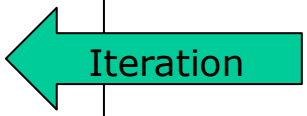
Check it. Does it work?

Creating a design (Algorithm) – Levels 5 & 6

Draw a hexagon - algorithm 2:

1. begin
2. If user wants a hexagon
   repeat 6 times
   draw a 50 step line
   turn right 60 degrees
3. stop





Check it. Does it work?

Moving from algorithms to a program

(Developing solutions using a programming language)

Code in Scratch Levels 3 & 4

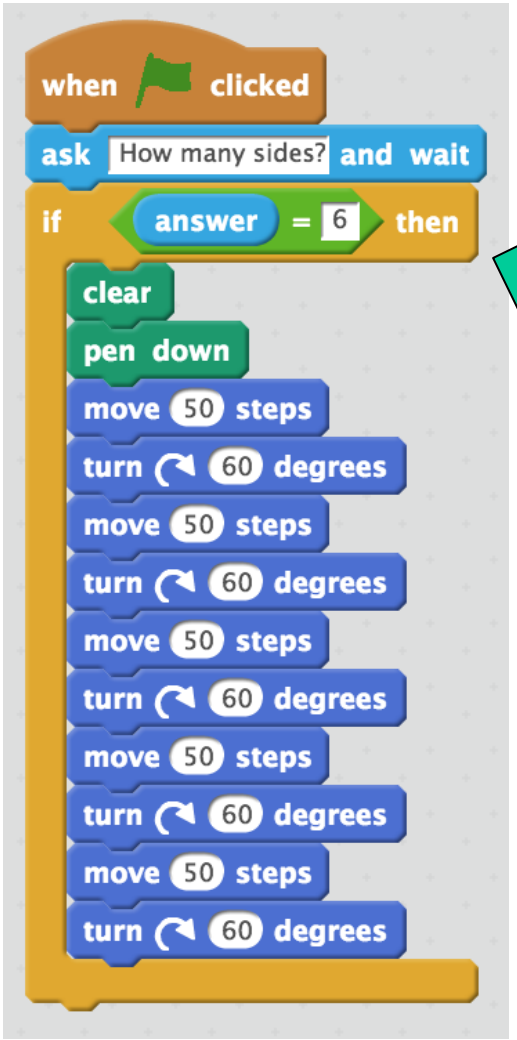
Using Branching

Let's revisit our first algorithm.

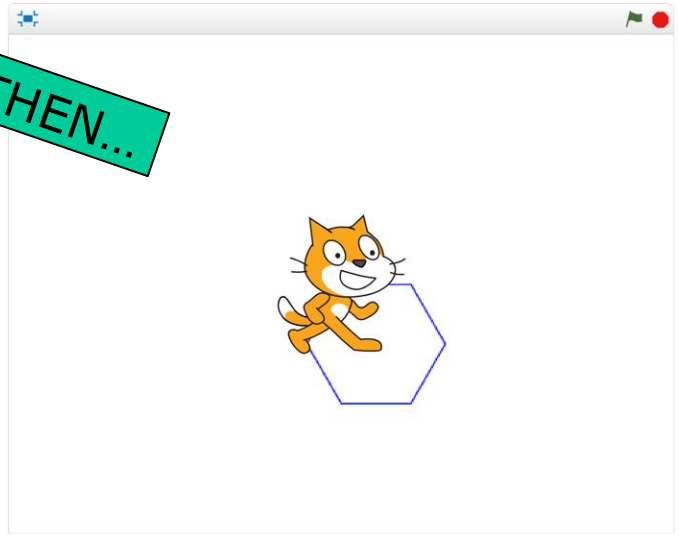
1. Begin
2. If user wants a square
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
   - draw a 50 step line
   - turn right 60 degrees
3. Stop

How might this look as a visual program?

Code in Scratch
Levels 3 & 4
Using Branching



Branching IF.. THEN...



Code in Scratch Levels 5 & 6

Adding iteration

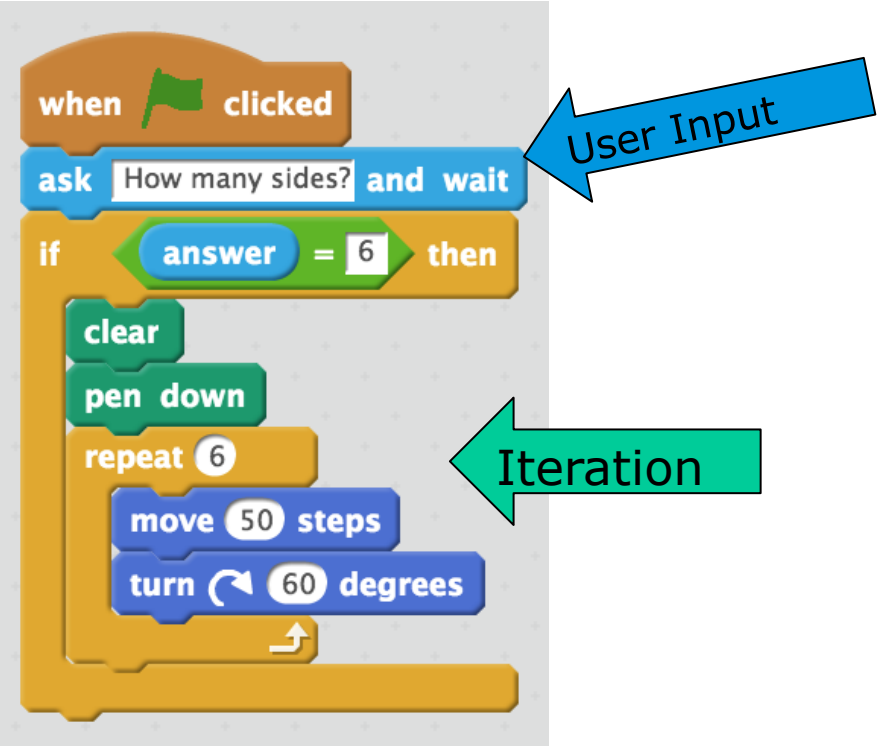
Let's revisit our second algorithm.

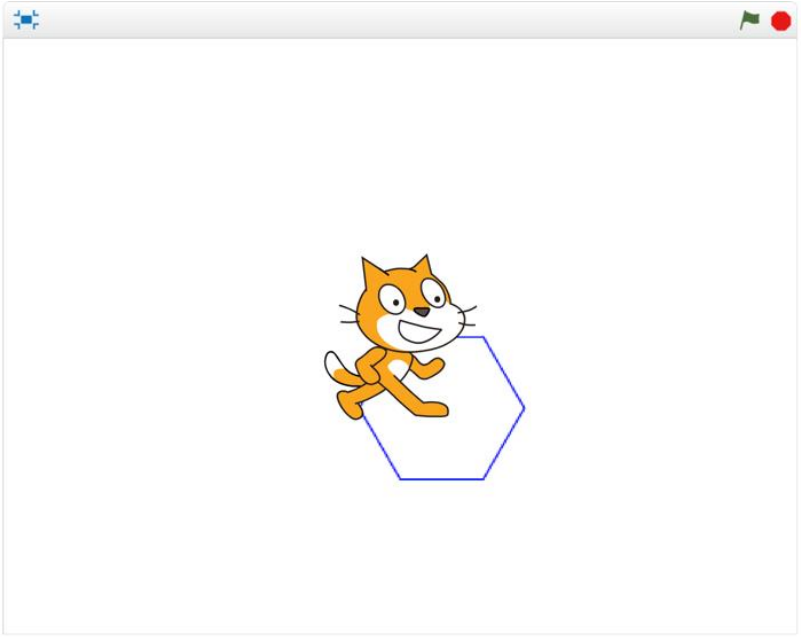
1. begin
2. If user wants a hexagon
   repeat 6 times
   draw a 50 step line
   turn right 60 degrees
3. stop

How might this look as a visual program?

Code in Scratch Levels 5 & 6

Adding iteration and user input





Does our solution solve the problem?

(Evaluating the solution to ensure it meets the problem's requirements)

Evaluating the solution

Considerations:

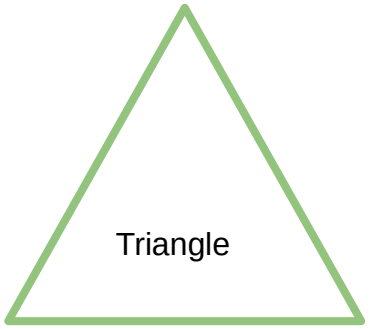
- Has the solution solved the problem?
- Does it work? (Every time!)
- Does it do what it is supposed to do?
- Does is meet ALL of the requirements specified in the problem?

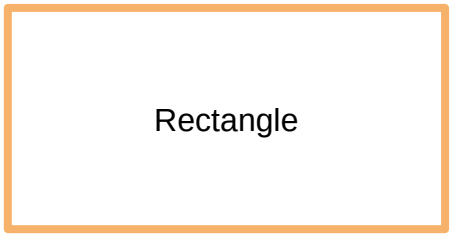
If the evaluation process determines that the solution does not satisfy the problem, then it may be necessary to revisit stages of the problem solving methodology again. This could continue until an accurate solution is reached.

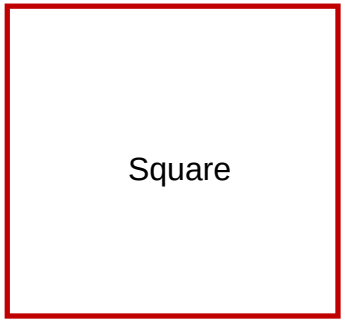
Taking it further!

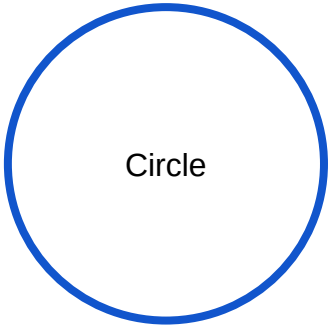
(Adding to our original problem)

What about some other shapes?









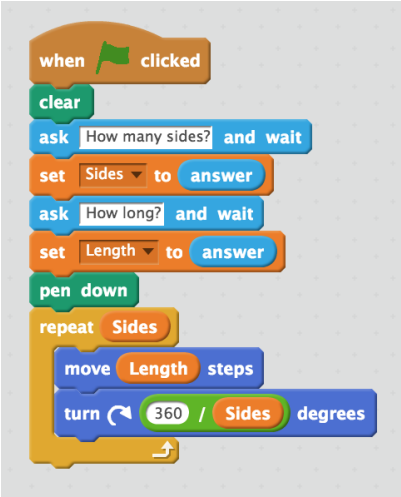
What might the algorithms look like?

Taking it even further. Any shape?

Given the number of sides, identify the shape by name and then draw it.

Might include code to:

- Get more input from user (eg. number of sides)
- Determine the name of the shape
  (outputs name to user)
- Get more input from user (eg. length of sides)
- Calculate angle between adjoining sides
  (based on number of sides)
- Draw the shape



Common visual programming languages

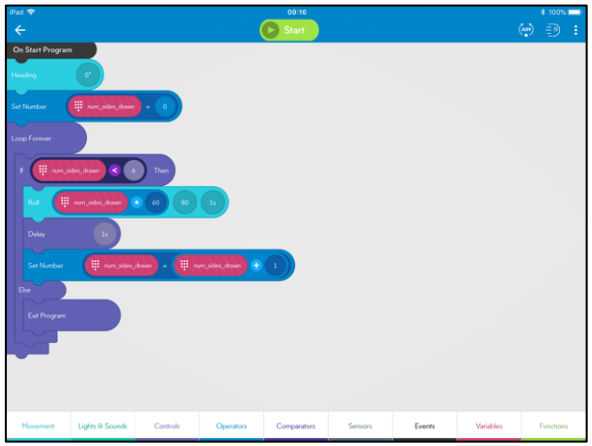
Some visual programming languages

Language	Mobile Device	Windows/Mac	Possible Level	Notes
Scratch	Pyonkee (iPad)	Web-based or standalone	Level 3+	Easily accessible for schools
Scratch Jnr	iPad, Android		Level 1 +	No branching/selection.
Hopscotch	iPad		Level 3+	
MIT App Inventor	Web-based	Web-based	Level 5+	Creates Apps for Android devices
Alice		Cross-platform	Level 5+	
Kodu		Windows	Level 3+	
Snap!		Cross-platform	Level 5+	Similar to Scratch. For devices.
Tynker	iPad, Android	Web based	Level 3+	Similar to scratch.

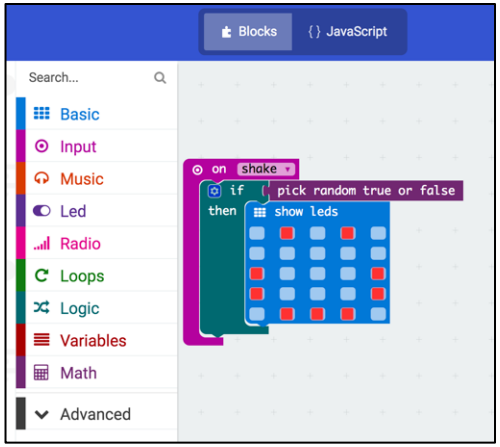
Extending visual programming to devices!

Block programming - Robotic devices

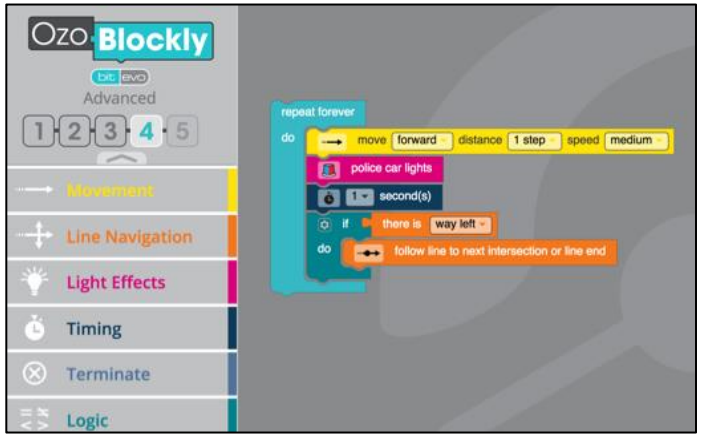
Sphero Edu App



Microbit.org



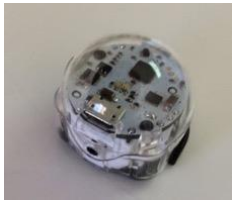
Ozoblockly.com

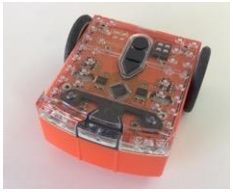


Visual programming languages

Some ‘Digital Devices’ that use block-based programming

- Sphero robot
- Edison robot
- Dash & Dot robot
- Ozobots
- mBot robot
- Micro:bit
- Hummingbird





Resources

Learning more about visual programming

- **Code.org** - https://studio.code.org
  - Start with ‘Classic Maze’
- **Scratch** - http://scratch.mit.edu
  - Introduction to Scratch tutorial and activity cards
- **CoderDojo (Resources)**
  - https://coderdojo.com/resources/
  - Beginner Scratch (dojo and sushi cards)