COMP110: Principles of Computing

3: Flowcharts and pseudocode

Learning outcomes

- Produce and explain basic flowcharts
- Produce and explain basic pseudocode

Worksheet B

- Flowcharts and pseudocode
- Due in class **next week**
- Online quiz will be released **next week** and due **the week after**

Algorithms

What is an algorithm?

A **sequence of instructions** which can be followed **step by step** to perform a **computational task**.

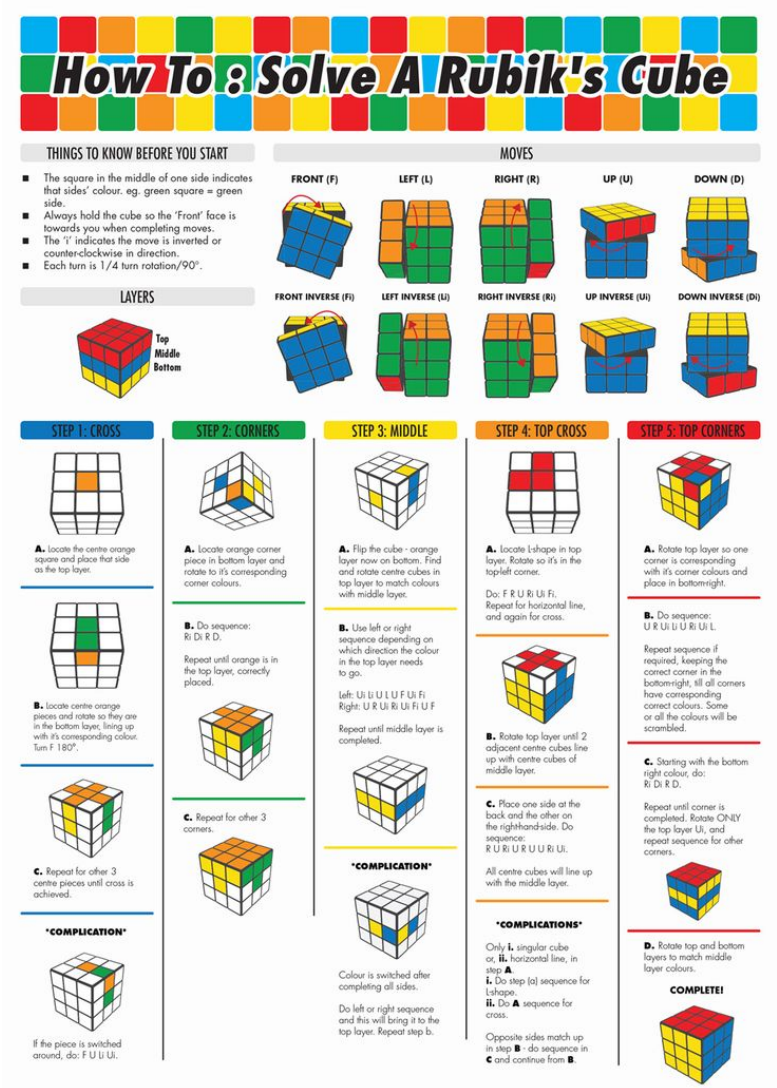
Programs vs algorithms

- A program is **specific** to a particular programming language and/or machine
- An algorithm is **general**
- An algorithm must be **implemented** as a program before a computer can run it
- An algorithm generally performs **one task**, whereas a program may perform **many**
  - E.g. Microsoft Word is not an algorithm, but it implements many algorithms
  - E.g. it implements an algorithm for determining where to break a line of text, how much space to add to centre a line, etc.

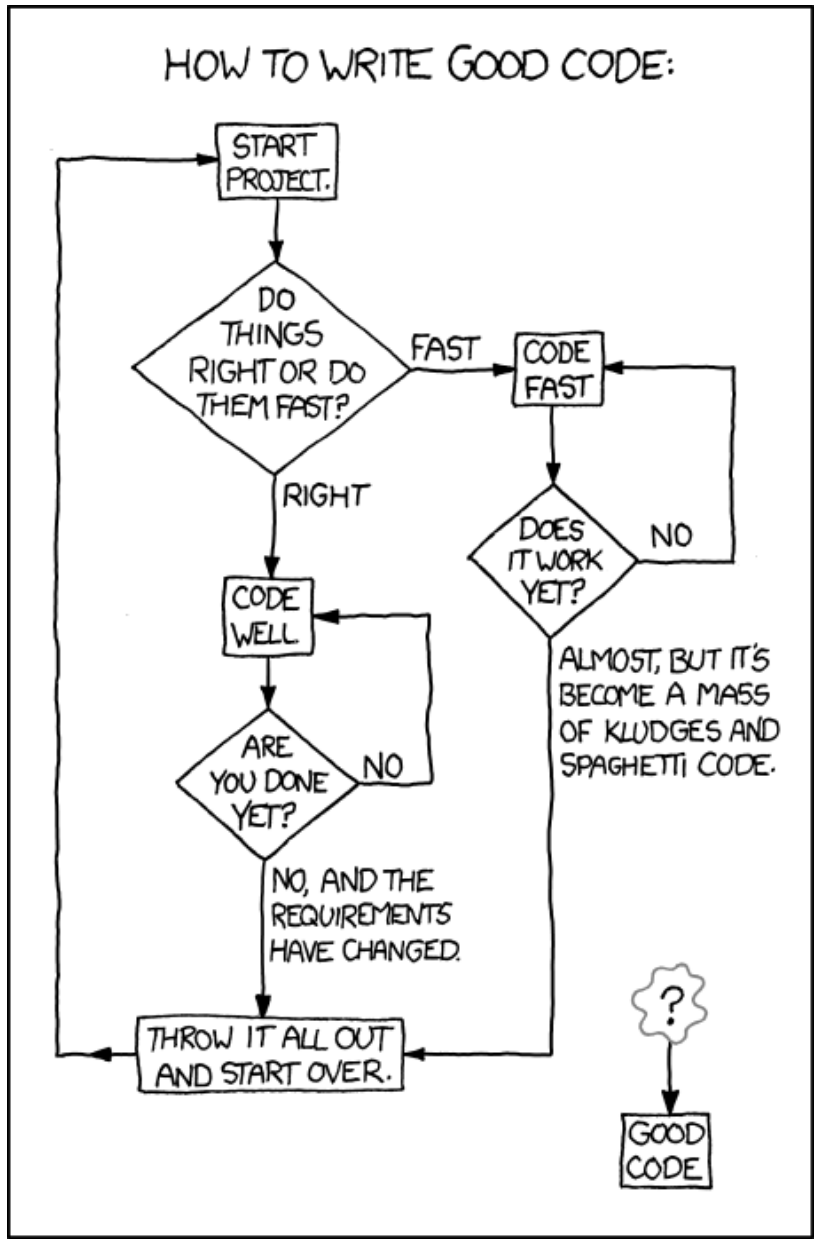
Algorithms outside computing

1. Preheat the oven to 180C, gas 4.
2. Beat together the eggs, flour, caster sugar, butter and baking powder until smooth in a large mixing bowl.
3. Put the cocoa in separate mixing bowl, and add the water a little at a time to make a stiff paste. Add to the cake mixture.
4. Turn into the prepared tins, level the top and bake in the preheated oven for about 20-25 mins, or until shrinking away from the sides of the tin and springy to the touch.
5. Leave to cool in the tin, then turn on to a wire rack to become completely cold before icing.
6. To make the icing: measure the cream and chocolate into a bowl and carefully melt over a pan of hot water over a low heat, or gently in the microwave for 1 min (600w microwave). Stir until melted, then set aside to cool a little and to thicken up.
7. To ice the cake: spread the apricot jam on the top of each cake. Spread half of the ganache icing on the top of the jam on one of the cakes, then lay the other cake on top, sandwiching them together.
8. Use the remaining ganache icing to ice the top of the cake in a swirl pattern. Dust with icing sugar to serve.

Algorithms outside computing

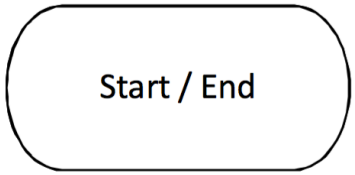


Flowcharts

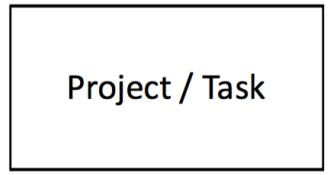


http://xkcd.com/844/

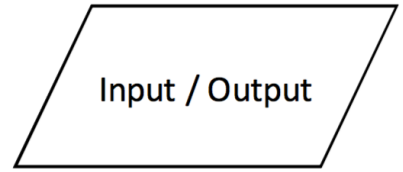
Flowchart symbols



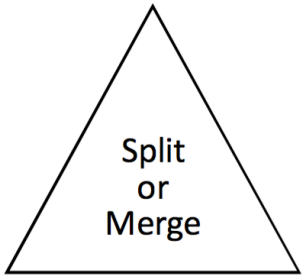
The start or end of a workflow.



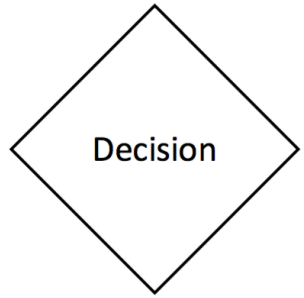
Process or action.



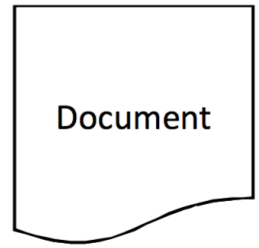
Data: Inputs to, and outputs from, a process.



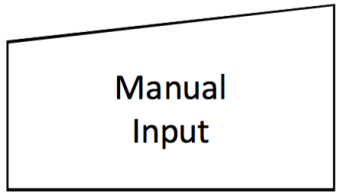
Upright indicates a process split, inverted indicates a merge of processes.



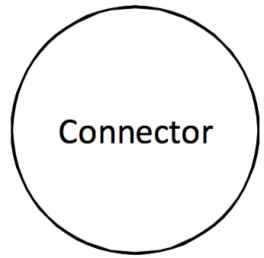
Decision point in a process or workflow.



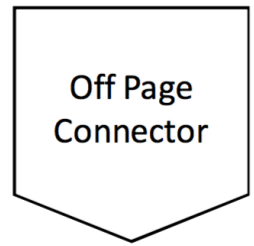
Document or report.



Prompt for information, manually entered into a system.

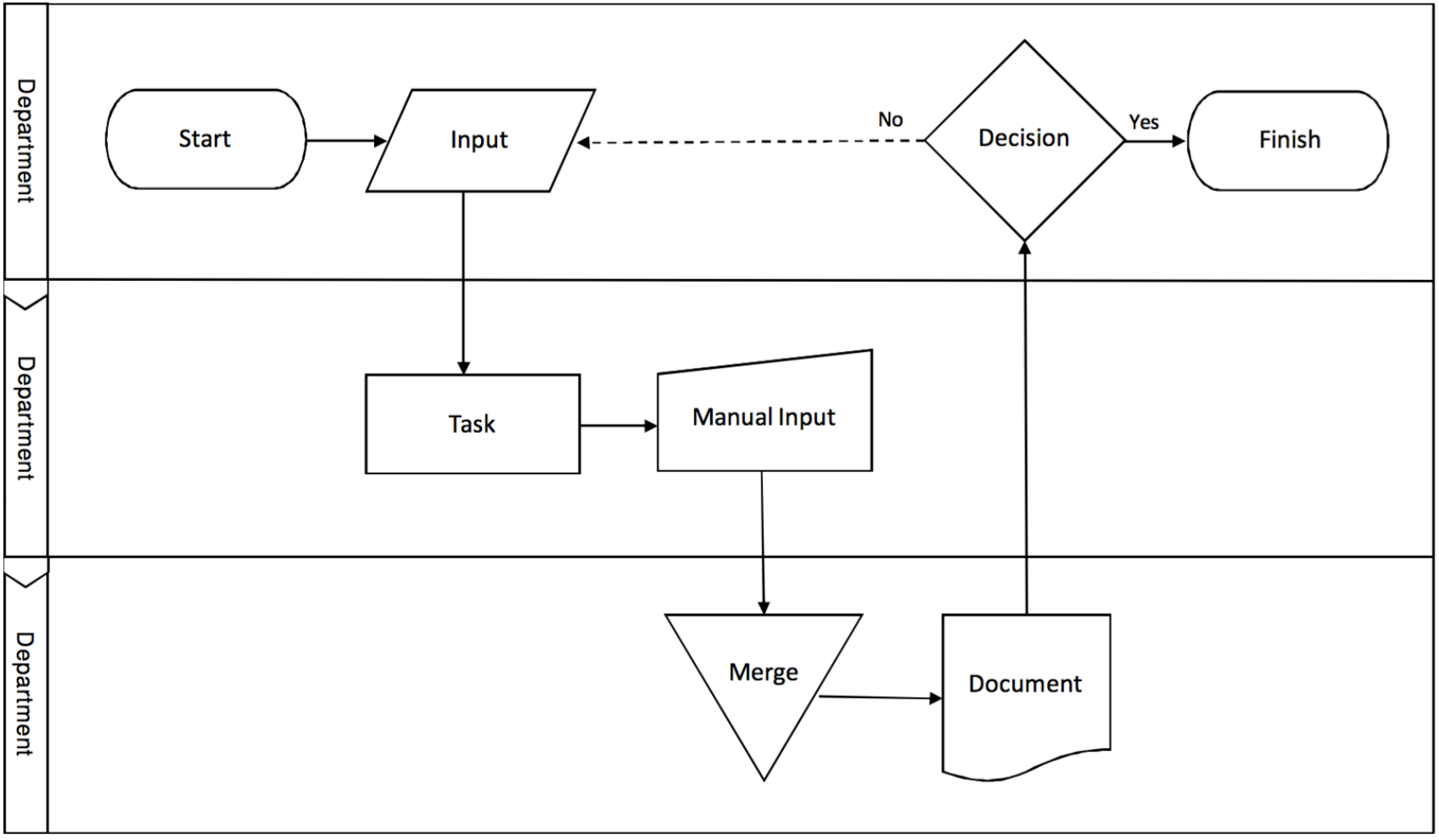


Used to connect one part of a flowchart to another.



Connector used to connect one page of a flowchart to another.

Swimlanes


Department
Department
Department
Start
Input
No
Decision
Yes
Finish
Task
Manual Input
Merge
Document

Activity

- In **groups of 2-3**
- **Draw** a flowchart for **logging into Facebook**
- Draw your flowchart using **pen and paper**
- Include at least two swimlanes: **the user's browser/device** and **the Facebook server**
- Take a **photo** of your flowchart and post it on **Slack**

Software for drawing flowcharts

Intended for drawing flowcharts:

- Gliffy `https://www.gliffy.com`
- Microsoft Visio

Can draw flowcharts:

- Microsoft PowerPoint
- Google Docs

If you're desperate:

- Any drawing package (Inkscape, Adobe Illustrator, Apple Keynote, ...)
- MS Paint

Pseudocode

Pseudocode

Flowcharts are useful, but...

- Can be time-consuming to draw
- Do not reflect structured programming concepts well

Pseudocode expresses an algorithm in a way that looks more like a structured program

Pseudocode example

```
print "How old are you?"
read age
if age < 13 then
    print "You are a child"
else if age < 18 then
    print "You are a teenager"
else
    print "You are an adult"
end if
```

Pseudocode example

$sum \leftarrow 0$ ▷ initialisation
for i in $1, \ldots, 9$ **do**
    $sum \leftarrow sum + i$
end for
print *sum* ▷ print the result

Pseudocode example

$a \leftarrow 1$ ▷ initialisation
while $a < 100$ **do**
    $a \leftarrow a \times 2$
end while
print a ▷ print the result

Formatting pseudocode

- Pseudocode is a **communication tool**, not a **programming language**
- Important: **clear**, **concise**, **unambiguous**, **consistent**
- **Not** important: adhering to a strict set of style guidelines, ensuring direct translatability to your chosen programming language

Level of abstraction

Whether working with flowcharts or pseudocode, choose your **level of abstraction** carefully

Level of abstraction: Good

Fill kettle
Turn kettle on
Put instant coffee in mug
if sugar wanted **then**
    Add sugar
end if
Wait for kettle to boil
if milk wanted **then**
    Pour water to $\frac{4}{5}$ full
    Add milk
else
    Fill mug with water
end if
Stir

Level of abstraction: Not so good

Position kettle beneath tap
Turn tap on
while water is below halfway point **do**
    Wait
end while
Turn tap off
Place kettle on base
Press power button
...

Level of abstraction: Silly

Place right palm on kettle handle
Bend fingers on right hand
Lift arm upwards
while tap spout is not directly above kettle **do**
    Move arm to the right
end while
Place left palm on tap handle
Bend fingers on left hand
Rotate left hand
...

Level of abstraction: also silly

Make a cup of coffee

Activity

A number guessing game: The computer chooses a number between 1 and 20 at random. The player guesses a number. The computer says whether the guessed number is "too high", "too low" or "correct". The game ends when the correct number is guessed, or after 5 incorrect guesses.

- In **groups of 2-3**
- **Write** pseudocode for the number guessing game
- **Post** your pseudocode on Slack

Activity

- In **groups of 2-3**
- **Choose** an algorithm from one of the following:
  - Lego Robot Olympiad
  - COMP120 Tinkering Graphics
  - COMP150 Game Development Project
- **Express** the algorithm as a flowchart **and**
- **Express** the algorithm as pseudocode
- **Post** both your flowchart and your pseudocode on Slack