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 on **Monday 10th October** (next week)

Reading

B. Shneiderman, R. Mayer, D. McKay, and P. Heller, 1977. Experimental Investigations of the Utility of Detailed Flowcharts in Programming. *Communications of the ACM,* 20(6):373–381.

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Loops (from last time)

For loops and ranges

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for i in xrange(5):
    print i
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- Note: `xrange(n)` **does not include** n
- The `for` loop iterates through the items in a sequence **in order**
- Can also use `range` instead of `xrange`, but `range` is less efficient
  - Homework (advanced): what is the difference between `range` and `xrange`?

For loops (1)

Socrative room code: `FALCOMPED`

```
a = 0
b = 0

for i in xrange(5):
    a = i
    b = b + i

print a
print b
```

For loops (1)

Socrative room code: FALCOMPED

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print a
print b
```

Variable	Value
a	
b	
i	

For loops (2)

Socrative room code: FALCOMPED

```
a = 0
b = 0

for i in xrange(10):
    if i < 3 or i > 7:
        a += i
    else:
        b += i

print a
print b
```

For loops (2)

Socrative room code: FALCOMPED

```
a = 0
b = 0

for i in xrange(10):
    if i < 3 or i > 7:
        a += i
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print a
print b
```

Variable	Value
a	
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More ranges

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- If start point is specified, can optionally specify **step**
- `xrange(0, 20, 2)` $\rightarrow [0, 2, 4, 6, 8, 10, 12, 14, 16, 18]$
- Step can be negative:
- `xrange(10, 0, -1)` $\rightarrow [10, 9, 8, 7, 6, 5, 4, 3, 2, 1]$

While loops

Socrative room code: `FALCOMPED`

The `while` loop keeps executing while the condition is **true**

```
a = 1

while a < 100:
    a = a * 2

print a
```

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The `while` loop keeps executing while the condition is **true**

```
a = 1

while a < 100:
    a = a * 2

print a
```

Variable	Value
a	

Looping forever

```
a = 1

while True:
    a = a * 2
    print a
```

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Algorithms

What is an algorithm?

What is an algorithm?

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

Programs vs algorithms

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- 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.

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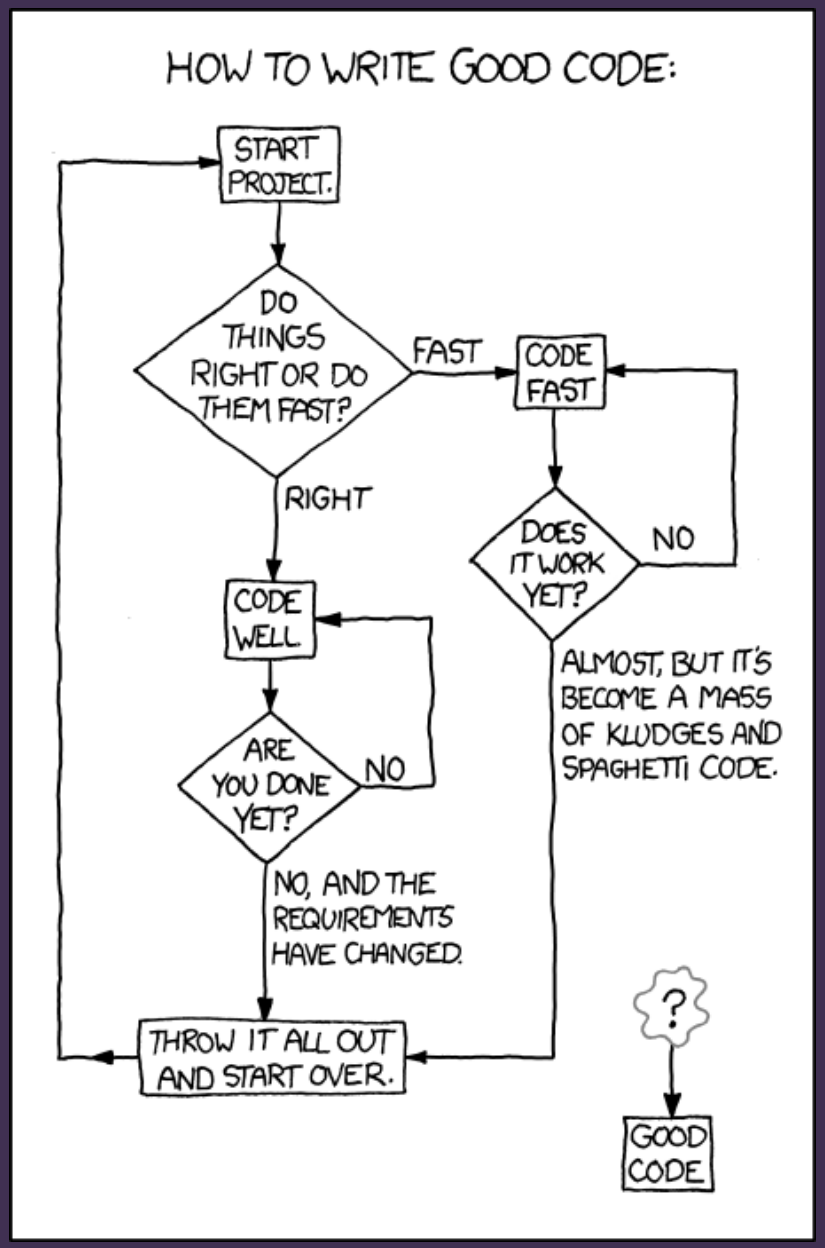
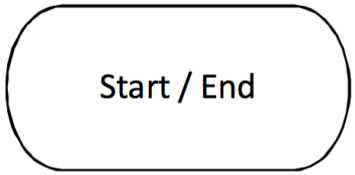
Flowcharts

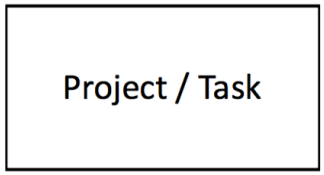


http://xkcd.com/844/

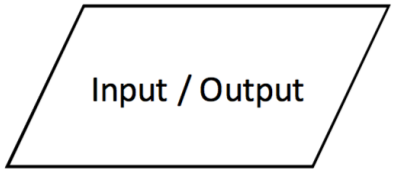
Flowchart symbols



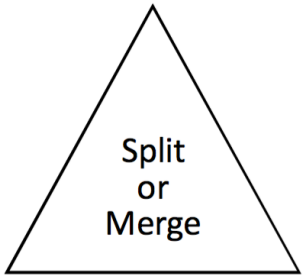
The start or end of a workflow.



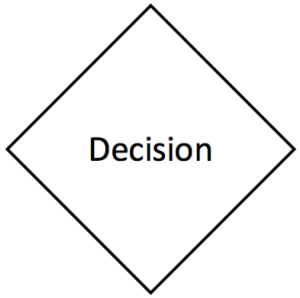
Process or action.



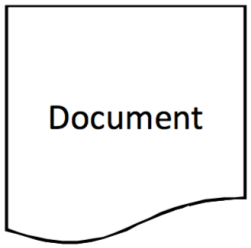
Data: Inputs to, and outputs from, a process.



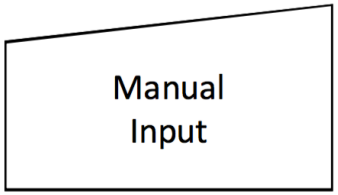
Upright indicates a process split, inverted indicates a merge of processes.



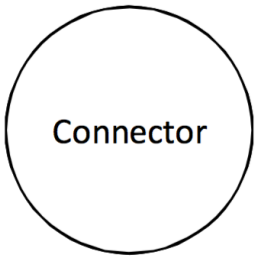
Decision point in a process or workflow.



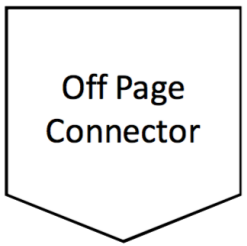
Document or report.



Prompt for information, manually entered into a system.

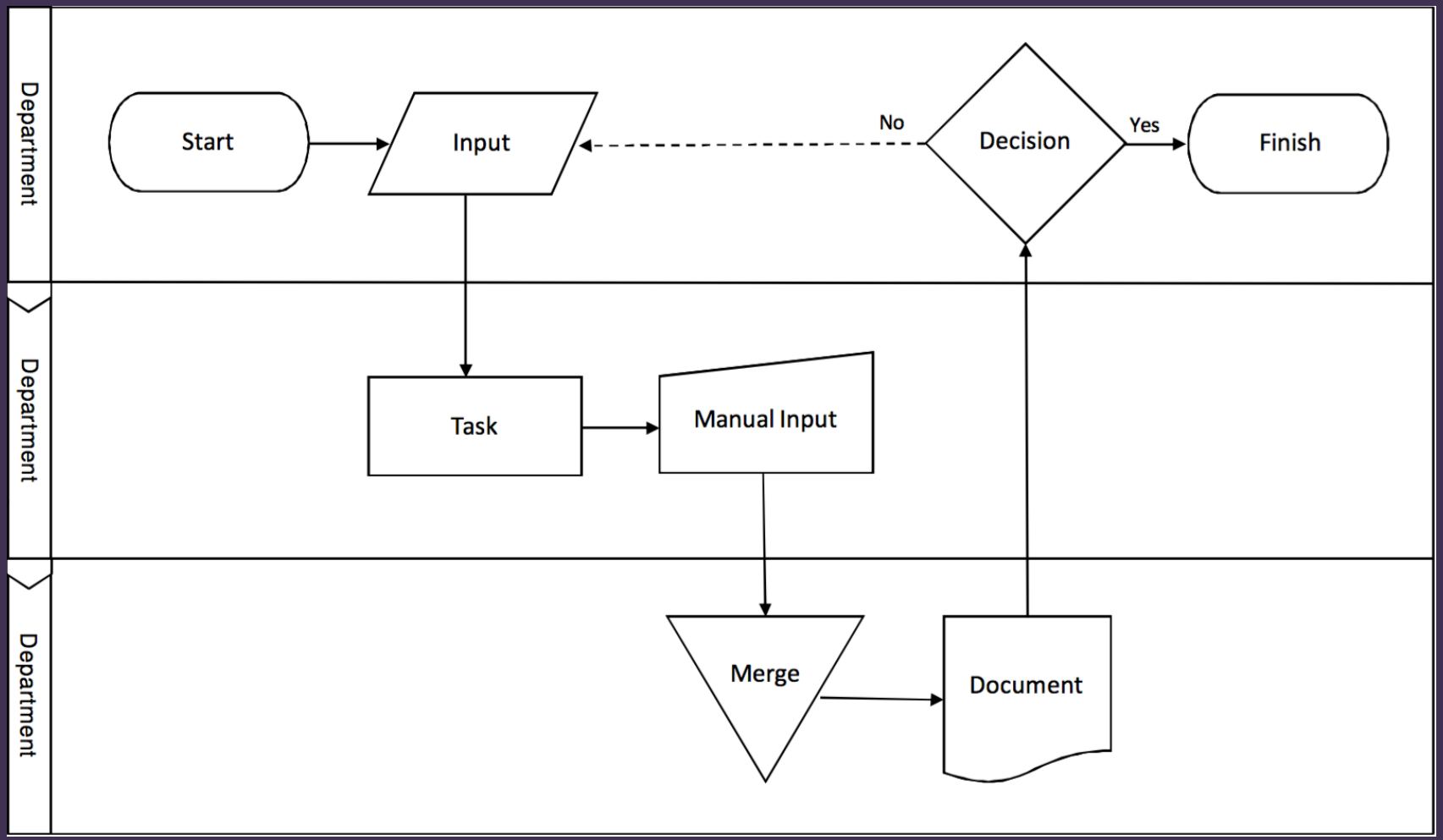


Used to connect one part of a flowchart to another.



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

Swimlanes


Department
Start
Input
No
Decision
Yes
Finish
Department
Task
Manual Input
Department
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**

Software for drawing flowcharts

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Intended for drawing flowcharts:

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

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If you're desperate:

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

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Pseudocode

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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

Formatting pseudocode

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- Pseudocode is a **communication tool**, not a **programming language**

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- Important: **clear**, **concise**, **unambiguous**, **consistent**

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

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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
...

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
- Write your pseudocode with **pen and paper** or using your favourite **text editor or word processor**