2020 specification
First examinations from 2022

Unplugged Classroom Activities

for OCR GCSE Computer Science (J277)

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Contents

Teacher's Introduction

This resource is intended for any teacher who wishes to develop their 'unplugged' repertoire. With most Computer Science lessons now taking place in dedicated computer rooms, there is often an assumption, among both teachers and students, that all learning takes place with the involvement of a computer. Of course, this is far from the truth. As fundamental as they are to any Computer Science course, many of the building blocks of computer science can be taught just as effectively (if not more) away from computer screens using conventional teaching.

Each activity in this resource includes everything you need to deliver it in the classroom. Some are five-minute starters; some occupy whole lessons; others are somewhere in between. When using this resource, I encourage you to observe the following:

- All activities were devised and assembled by a teacher, but a teacher with their own experiences and their own classes. Use discretion, and change whatever you see fit to change.

- While individual work can be beneficial, group work offers more learning opportunity, since students learn from the activity, from themselves and from each other.

- Wherever possible, students should role-play aspects of computing, and the activities herein offer many ideas in that regard. A student can be a CPU component, a piece of data or a node on a network.

- Questioning is particularly important during the more fun activities. If a student, for example, translates symbols to words to learn to dance the Macarena, that's great. If they also understand how this relates to source code and object code, that's a meaningful Computer Science learning experience. The most important question in the middle of an activity might simply be *'Why are we doing this?'*

- Look at the 'adaptations' box for each activity. Some activities transfer perfectly to other areas of the syllabus, meaning this resource offers more suggestions for activities than it might first appear.

- Regard these activities as a starting point for your own. You have a unique style and a unique background; you teach unique students at a unique school. Every aspect of these activities is flexible.

Support files: For three of the activities (*Activity 3*, *Activity 32* and *Activity 34*), there are electronic files that require downloading prior to using the activity. These are clearly referenced in the corresponding teacher notes. Download this now via the following URL: **http://zzed.uk/ocr-unplugged**

I hope that you and your students enjoy Computer Science, and that this resource plays some part in that enjoyment.

Richard Lee, September 2020

Activity 1: CPU – Forbidden Wor

Students must describe some element of a processor, without mentioning words listed on a card. This tests powers of communication, as well as und

| ⏱ **Time** Depending on how this activity is used, it could be a **five-minute** starter or an **hour-long** lesson. | ✎ **Prer** An un helpfu compl textbo doing contai |

RESOURCES

Set of forbidden word cards, or part of the set as needed, cut up individual

PREPARATION

Cut out the cards individually. The quantity will depend on how the lesson involve an individual or a group of students at the front of the room, along could compete with one another for the fastest time. Each individual migh to write a definition of each term while avoiding all forbidden words.

DELIVERY

- A speaker attempts to describe the processor term at the top of the c permitted to mention that term, or any of the other forbidden words I

- Once this has been attempted a few times, it would be advisable to as second time, having been given permission to now use the forbidden requirement that they use all four. These definitions should now be e forbidden terms (which are likely to be used in any exam answer).

ADAPTATIONS

- In terms of OCR's topic 1.1, these cards offer fairly exhaustive coverag applied to any of the other topics.

- Students could write forbidden cards for inclusion in a class set.

'Forbidden word' cards

REGISTER	CPU
CPU/PROCESSOR STORAGE ACCUMULATOR PROGRAM COUNTER	PROCESSOR HERTZ BRAIN CALCULATIONS
CORE	CACHE
CPU/PROCESSOR DUAL, QUAD, OCTA, ETC. INSTRUCTION SIMULTANEOUS	SPEED MEMORY FREQUENTLY DATA
CONTROL UNIT	ACCUMULATOR
INSTRUCTIONS CPU/PROCESSOR DECISIONS ALU	REGISTER CALCULATION INTERMEDIATE TOTAL
PROGRAM COUNTER	VON NEUMANN
INSTRUCTION NEXT ADDRESS LOCATION	ARCHITECTURE BUS MEMORY CPU/PROCESSOR
INSTRUCTION	MEMORY DATA REGISTER
ALGORITHM TASK PROBLEM STEPS	CPU/PROCESSOR INFORMATION BUS RAM

Activity 2: Trump Cards

Based on any number of classic card games, this one quantifies the proces
phones. Players of this game try to collect cards from their opponents by
characteristic of the card in their hand.

Time

Five minutes is recommended, although this can be extended by requiring students to produce additional cards based on phones not listed.

Prer

No pre
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of que:

RESOURCES

Set of 27 cards per group, with group sizes of two to three

PREPARATION

Cut out as many sets of cards as there are to be games. Each game shoulc

DELIVERY

* Cards are shuffled then dealt, face down, to each player.
* Players pick up their cards and look only at the card at the front.
* The person whose turn it is should pick a characteristic of a processor good card.
* Each player of the game puts down their front card, and whoever has terms of the chosen characteristic keeps all the played cards.
* In the event of a tie, the cards stay in the middle and another set of ca
* Play moves clockwise and continues until time runs out or one person
* Questioning can be directed at players to ensure they understand 'clo

ADAPTATIONS

* This activity would also work well for storage media.
* A cross-topic approach could be taken to compare more aspects of cc systems, covering processor, memory, storage, ports, etc.
* The devices included on the trump cards were up to date at the time (As new devices with enhanced specifications become available, you m of the cards, to keep the activity fully relevant to your current cohort c

An editable version (trump-cards-template.docx) is provided with the dow

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Apple iPhone 6

Year: 2014

Cores: 2

Clock speed: 1.4 GHz

Cache size: 4 MB

Apple iPhone 7

Year: 2016

Cores: 4

Clock speed: 2.34 GHz

Cache size: 8 MB

Apple iPhone X

Year: 2017

Cores: 6

Clock speed: 2.39 GHz

Cache size: 8 MB

Samsung Galaxy S8

Year: 2017

Cores: 8

Clock speed: 2.35 GHz

Cache size: 2 MB

Samsung Galaxy Note 8

Year: 2017

Cores: 8

Clock speed: 2.35 GHz

Cache size: 2 MB

Samsung Galaxy S9+

Year: 2018

Cores: 8

Clock speed: 2.7 GHz

Cache size: 2 MB

Sony Xperia XA1

Year: 2017

Cores: 8

Clock speed: 2.3 GHz

Cache size: 2 MB

Sony Xperia XZ1

Year: 2017

Cores: 8

Clock speed: 2.35 GHz

Cache size: 2 MB

Huawei Y6

Year: 2015

Cores: 4

Clock speed: 1.1 GHz

Cache size: 0.5 MB

Huawei P20 Pro

Year: 2018

Cores: 8

Clock speed: 2.4 GHz

Cache size: 8 MB

Huawei Ascend W2

Year: 2013

Cores: 2

Clock speed: 1.4 GHz

Cache size: 0 MB

Google Nexus 5

Year: 2013

Cores: 4

Clock speed: 2.26 GHz

Cache size: 2 MB

Google
Nexus 5X

Year: 2015

Cores: 6

Clock speed: 1.8 GHz

Cache size: 2 MB

Google
Nexus 6P

Year: 2015

Cores: 8

Clock speed: 2.0 GHz

Cache size: 2 MB

Motorola
Moto X Play

Year: 2015

Cores: 8

Clock speed: 1.7 GHz

Cache size: 2 MB

Motorola
G6 Play

Year: 2018

Cores: 8

Clock speed: 1.4 GHz

Cache size: 2 MB

Samsung
Note20

Year: 2020

Cores: 8

Clock speed: 2.7 GHz

Cache size: 8 MB

Apple
iPhone SE

Year: 2020

Cores: 6

Clock speed: 2.65 GHz

Cache size: 8 MB

Activity 3: Desktop FDE Cycle

This activity allows students to work through the fetch–decode–execute cyc
This is similar to the whole-class activity, but it requires individuals to look a
includes buses (which the whole-class activity does not). This can be perfor

Time

Around **20 minutes** for a first attempt at
a single activity, although this will vary
based on the abilities of students.
Subsequent attempts will be quicker.

Prei

This a
introu
cycle,

RESOURCES

* Tabletop CPU/RAM sheet (one per individual or group)

  A PDF of the above resource (cpu-ram-model.pdf) is provided with the d
  This will enable you to print in A3 if required

* Data and instructions set (one per individual or group) and two progra
* Fetch–decode–execute instructions (one per individual or group)

PREPARATION

* Ensure that there is a tabletop CPU/RAM model, a set of data and inst
  student instructions for each individual or group. These can either be
  cut out by students as required. Within the 'data and instructions set'
  should be kept separate from the rest, as these will need to be 'loaded
* Familiarise yourself with the contents of the student instruction sheet.

DELIVERY

* Ensure each individual or group has the resources they need.
* Students should follow the instructions on their instruction sheet, with

ADAPTATIONS

* More memory locations and a larger instruction set, based on Little M
* Creation of a narrated stop-motion fetch–decode–execute cycle video
* A challenge exists on this task for highly capable problem-solvers. Us
  locations, and with a number in each of locations 6 and 7, create a pro
  6 and 7. (Hint: the program instructions themselves will not all surviv

ACCUMULATOR

MEMORY DATA REGISTER

DATA BUS

0

1

2

ARITHMETIC LOGIC UNIT

CONTROL UNIT

CONTROL BUS

3

PROGRAM COUNTER

MEMORY ADDRESS REGISTER

ADDRESS BUS

4

5

Data and Instructions Set

0	0	0	
1	2	2	
3	3	4	
5	5	5	
6	7	7	
8	8	9	
LOAD 0	ADD 0	SUB 0	ST(
LOAD 0	ADD 0	SUB 0	ST(
LOAD 1	ADD 1	SUB 1	ST
LOAD 1	ADD 1	SUB 1	ST
LOAD 2	ADD 2	SUB 2	ST(
LOAD 2	ADD 2	SUB 2	ST(
LOAD 3	ADD 3	SUB 3	ST(
LOAD 3	ADD 3	SUB 3	ST(
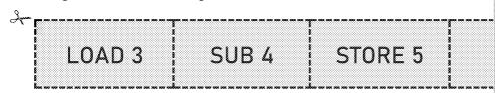
LOAD 4	ADD 4	SUB 4	ST(
LOAD 4	ADD 4	SUB 4	ST(
LOAD 5	ADD 5	SUB 5	ST(
LOAD 5	ADD 5	SUB 5	ST(
LOAD 6	ADD 6	SUB 6	ST(
LOAD 6	ADD 6	SUB 6	ST(
LOAD 7	ADD 7	SUB 7	ST(
LOAD 7	ADD 7	SUB 7	ST(

Program 1: adding together two numbers

LOAD 3	ADD 4	STORE 5	

Program 2: subtracting one number from another

LOAD 3	SUB 4	STORE 5	

LOAD PROGRAM

1. Put the instructions into memory in order.
2. Put a zero into the program counter.

FETCH

3. Copy the contents of the program counter to the
4. Increment (add 1 to) the program counter.
5. Place 'READ' on the control bus and a copy of the on the address bus.
6. Place a copy of the memory location's content on
7. Move that content into the memory data register.
8. Clear the rest of the buses.

DECODE and EXECUTE

9. You now need to determine how to execute this ir

- LOAD requires that the address from the LOAD the memory address register. The data is ther (just as in steps 3 to 5 above), before being pla

- ADD and SUB require data to be fetched from 5 to 7 above, with the data being placed into th along with the contents of the accumulator. Th (add or subtract) goes into the accumulator.

- STORE requires a copy of the accumulator to b data register and the number of the memory lc the memory address register. The control bus bus contains a copy of the memory data regist contains a copy of the memory address registe data bus is written to the location in the addre

10. If this was the last instruction, you've finished. O 3.

Activity 4: Whole-class FDE Cy

This activity assigns CPU components and memory locations to students.
decode–execute cycle as a whole class, passing data among themselves to
subtraction operation.

Time
Around **15 minutes** to introduce,
complete and commentate a single pass
of the activity, although there is plenty
of upward scope for questioning.

Prei
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execu

RESOURCES

- Half-page labels to represent components, memory locations, instruct
- Teacher instruction sheet describing how to set up and run the activit

PREPARATION

- Print out all sheets and cut up half-page labels.
- Clear as much space as possible in the classroom.

DELIVERY

- Assign each component (single border) and memory location (double
students or pairs. There are six components and seven memory locati
- Follow the instructions on the instruction sheet for set-up and runninc
- Pause frequently to clarify the fetch–decode–execute cycle and to ask
- Repeat the activity in order to maximise participation and clarify miscc

ADAPTATIONS

- Further instructions and more complex programs could be added.
- See the 'Little Man Computer' online for additional instructions.

NB. This activity has been attempted using students in the role of buses, and it got q
execute' activity, which students complete individually or in smaller groups, does sho

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The Setup

1. Assign each of the CPU components (solid border) to a student and p

2. Memory locations (double border) should each be assigned to a stude
near each other, but separate from the CPU components.

3. Assign the following instructions (dotted border) and values (wavy bo
   * Memory 0: LOAD 4
   * Memory 1: ADD 5
   * Memory 2: STORE 6
   * Memory 3: HALT
   * Memory 4: 2
   * Memory 5: 6
   * Memory 6: [nothing]

   (The program is going to add together '2' and '6' and store the result

4. Assign the program counter '0'.

The Cycle

5. Copy the program counter's contents (there should be two of each pc
counter can hold) into the memory address register.

6. The program counter is incremented.

7. The memory data register fetches the contents of memory at the loca
register

8. The control unit looks at the instruction and tells the other componen
   a. Anything fetched from memory or put in memory is done so by
   b. Any calculations are performed by the ALU, who should keep a
   c. Any data that forms part of a calculation goes into the accumula

   *Nothing should ever be removed from memory, as there are copies of a
   important for students to learn that a data item that has been read rem*

9. Once the instruction has been executed, return to step 1. This continu
point the program is complete.

CONTRO
UNIT

ARITHME

LOGIC UN

**PROGRA
COUNTE**

**MEMORY ADD
REGISTE**

MEMORY D
REGISTE

ACCUMULA

MEMORY

MEMORY

MEMORY

MEMORY

MEMORY

MEMORY

MEMORY

LOAD 4

ADD 5

ADD 5

STORE 6

STORE 6

HALT

HALT

0

0

INSPECTION COPY

1

1

2

2

2

2

3

3

4

4

5

5

6

6

8

8

Activity 5: Short-term Memory

This starter-sized activity allows students to clearly differentiate between t
long-term memory. Links can then be made with the distinction between
on a computer.

Time
10 minutes

Prei
None

RESOURCES

Sheet of random numbers, ranging in length from five to fourteen digits.

PREPARATION

The sheet of random numbers can be printed, or you can use your own ra
combinations. There should be a series of 'words', beginning at five chara
subsequent string being one character longer than its predecessor.

DELIVERY

- Students take out pen and scrap paper.
- Explain that you will read a number once and they must write it down,
begin writing until you have said the whole number (indicate complet
- Students who remembered correctly remain in the game for the next
- The sheet is reusable and contains multiple numbers, each containing
should only use one five-digit number, one six-digit number, etc. Othe
the activity later. The spaces in the larger numbers are only there to m
- Ask students if they recall something bigger but from further back, e.g
- Use this exercise as a starting point to explain that computers also ha
and that long-term memory has a much larger capacity.

ADAPTATIONS

This activity, especially if the 'numbers' are alphanumeric with symbols, wo
exploring passwords. A password that can be read over someone's should
poor password.

5-digit	96074	28914
	15048	35963
6-digit	086 549	539 140
	519 735	416 982
7-digit	819 3475	317 4521
	524 1973	109 6274
8-digit	3414 6901	3244 7345
	2642 7376	1286 5294
9-digit	1387 30687	2054 25463
	8267 71769	9802 42346
10-digit	57690 49865	64186 20395
	38714 45482	07897 38713
11-digit	471 4102 4786	134 0461 0285
	673 2602 8917	287 6244 9121
12-digit	8507 9115 0787	7886 1223 3055
	1268 3876 7287	9496 9285 6580
13-digit	4657 3195 24357	9712 5339 15778
	5496 1901 23529	6978 6571 05181
14-digit	8594 96786 19508	0601 55383 9380
	3803 21994 72920	1340 02754 0863

Activity 6: RAM vs ROM

Exam questions that look at the difference between RAM and ROM are qu
Venn diagram onto which statements are placed to indicate that they desc

Time
10–20 minutes, depending on the
extent to which questioning will be used.

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Stude
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acces
which

RESOURCES

- Cut-out statement sheet (one per group). Each sheet contains two set
- Blank Venn diagram (one per group)
- Teacher's answer sheet along with additional questions

PREPARATION

- Ensure there is a set of 12 statements and a blank diagram for each gr
- The ideal group size would be two to three, fostering discussion, but t
  completed individually.

DELIVERY

- If the class is unfamiliar with the concept of Venn diagrams, illustrate t
  accessible example. This might be nail vs screw, or it might compare r
  computer games.
- Students position each of the statements according to whether they b
  neither. Each section will contain three statements, and it is at your di
  told this.
- In terms of questioning, initially ask why an item was so positioned an
- Further questions are provided on the teacher's answer sheet.

ADAPTATIONS

- This would make a good extended starter, which could be built upon t
  diagrams to produce written reports as to the differences.
- This approach can be applied to almost any area of the syllabus, and s
  statements too.

Measured in Hertz	Mea
A form of memory	Found
A type of input device	A type
Volatile	Contair
Stores currently used data	Cannot b
Stores instructions to boot up device	Conte

Measured in Hertz	Mea
A form of memory	Found
A type of input device	A type
Volatile	Contair
Stores currently used data	Cannot b
Stores instructions to boot up device	Conte

Random Access
Memory (RAM)

Both

Read Only Memory
(ROM)

Answer sheet

Category	Statement	Follo
Both	A form of storage	*What withi*
	Measured in bytes	*Whic have*
	Found in mobile devices	*What lapto RAM*
Neither	Measured in Hertz	*What meas*
	A type of input device	*Can soph own*
	A type of output device	*Can soph own*
RAM	Volatile	*Why that's*
	Stores currently used data	*Why curre*
	Contains programs open right now	*What more space*
ROM	Stores instructions to boot up device	*How comp instr*
	Cannot be easily overwritten	*Why diffic ROM*
	Content remains when powered off	*Why non-*

Activity 7: Storage Cut-out

A simple table-top activity to examine the differences between optical, ma
This activity can be completed individually or in groups.

Time
5–10 minutes

Pre
Either
media
resou

RESOURCES

Cut-up storage statements (one per individual or group, as you see fit)

PREPARATION

Print and cut out enough full sets of the resource for each individual or gr
completion offers competition; group completion offers discussion.

DELIVERY

- Students group together each storage type (optical, magnetic, solid-s
  statements that are true about them.
- The role of the teacher, once the activity is underway, is of questionin
  misconceptions.

ADAPTATIONS

- Following completion of the activity, produce animations, posters or p
  storage types, delivering to the class or to smaller groups in a 'jigsaw
- Cut-out activities run the risk of being overused, but students could b
  themselves for another topic.

| **Optical** | At predetermined points on the disk, a pit (tiny hole) is either present or absent | A laser is directed onto the surface of the disk, and its reflection is measured | CDs, DVDs and Blu-rays are examples of this technology | Defragmenting this type of device is not practical – many disks are read-only |
| **Solid-state** | Transistors are used to represent the contents of individual bits, with two to six transistors per bit | With no moving parts, data is read from this type of device using electrical signals | This is the more expensive choice for an internal drive, but access speeds are quicker | A drive of this type should never be defragmented, as each bit can be changed a limited number of times |

Activity 8: The Travelling Salesr

This is not the travelling salesman problem that you might be used to. He the class into overestimating the capabilities of each storage technology. truth from lies.

Time

10–15 minutes per sales pitch, with scope for extension tasks.

Pre

None

RESOURCES

- Sales pitches (one copy for teacher)
- Answer sheet (one copy for teacher)

PREPARATION

Print out both resources (once each) and cut up the sales pitches.

DELIVERY

- Either the teacher or nominated students can read out each of the sal
- While the sales pitch is being read, students are noting down which st lies. There is not a fixed number of lies for each pitch.
- The sales pitch is read a second time, possibly by a different individua selections of lies.
- Students switch papers with a peer.
- Question students to identify which they thought were lies, clarifying point is extremely useful and can dispel many misconceptions.
- Peers mark the work, giving 1 point for an identified lie and taking aw thought that a truth was a lie (this means that the total score may be l

ADAPTATIONS

- You could deliver one of these sales pitches per lesson for three conse more detail, or you could make a lesson out of all three.
- Students could write their own articles in which their peers must find t

✂

Optical

Optical storage devices use lasers to burn into the surface of o
sounds dangerous, their inception has been greatly beneficial f
industry. The first compact disc was actually released in 1996,
billions have been made. Since they are so cheap, the producti
continued to rise.

After the popularity of the CD came the DVD, which stands for '
DVD was first released in 1995 and has a storage capacity of ju
Twenty gigabytes, for those who are not tech-savvy, is enough
high-resolution photographs. Beyond the capability of DVDs co
the highest-capacity optical disk currently available to consum

When reading an optical disc, a laser is pointed at a pre-detern
has been burnt there, the laser doesn't bounce back. If a hole h
bounce back. Since there are no moving parts, even the lowly (
a rate of megabytes per second.

Magnetic

While magnetic storage is slightly more expensive than the alte
it comes with advantages. A magnetic disc can be removed fro
installed in a Mac, as magnetic devices are not device-specific.
moving parts to access its data. The disc inside a magnetic dri
7,200 revolutions per second.

Inside a single magnetic drive, you could have lots of individual
each of which is accessed by the drive's main read/write head.
the disc, but can also change it. The disc spins until the data to
head, then the head swings in like the needle of an old record p
magnetic, and it aligns some of the millions of magnetic particl
or south.

While solid-state devices can be internal or external, magnetic
inside the computer. Internal devices are much better protecte
This is especially relevant given the magnetic device's moving p
especially vulnerable. The platter in some disks is so flimsy, th
'floppy disks'. These still exist, but they're starting to become s

Solid-state

Solid-state devices are a recent development, originating in the
popularity ever since. They're called 'solid-state' because ever
remains stationary at all times, unless of course you pick up th

They store bits in billions or trillions of electronic components ca
common places to find solid-state technology is in tablets, mobil
Flash technology is a type of solid-state technology. Since solid
circuits to store data, any data is lost when the device is powere
desktop cannot have only solid-state memory; there must also b

Solid-state memory is the cheapest form available, but this wa
a 20-megabyte solid-state drive retailed for $1,000.

Answer Sheet

Optical

- Lasers burning holes? This one's **true**
- CD released in 1996? It's **false** – the CD was released in 1982
- Hundreds of billions produced? That's **true**
- Sale of CDs rising? **False** – far more music is being downloaded n
- Digital versatile disk? That's **true** – DVD stands for this as well as d
- DVD released in 1995? **True**
- Twenty gig storage? **False** – it's 4.7 GB, or 9.4 if a disk is double-si
- Two million photographs? **False** – you'd need a terabyte for that
- High-capacity Blu-ray? **True** – they are the highest-capacity currer
- Lasers bouncing off burnt holes? **True** – this is exactly how they w
- No moving parts? **False** – the disk spins and the laser emitter mov disk's centre
- Megabytes per second? **True** – up to 6 per second on a 50x CD-R

Magnetic

- Expensive? **False** – it's the cheapest of the three in terms of unit of
- Not device-specific? **True** (although that's true of all of these tech
- Moving parts? **True** – a read/write head, as well as a motor to spir
- 7,200 revolutions per second? **False** – this figure would be per mir
- Multiple platters? **True** – and they're double-sided too
- Only one read/write head? **False** – each platter would actually hav each side
- Access and change data? **True** – that's why it's called the read/wri is also true.
- Only internal drives? **False** – external magnetic drives exist
- Physical vulnerability? **True** –a magnetic device is more likely to b
- Floppy disk? **True** – 1.44 MB of raw 90s storage power

Solid-state

- Early 1990s? **False** – it's either 1950s or 1970s depending on how resemble today's when making a comparison
  (the 'gaining in popularity' part is **true**)
- Stationary device? **True** – no moving parts
- Capacitors? **False** – transistors are used for the actual storage
- Tables, phones, pen drives? **True** – these are all examples
- Flash is a type of solid-state storage? **True**
- Lost data when powered down? **False** – it's true of RAM, but certa
- Desktops need magnetic storage as backup? **False** – there is no re
- Cheapest? **False** – magnetic is almost always cheaper
- $1,000 for 20 MB? **True** – this is always the case with technology; becomes

Activity 9: Binary Relay

This is a teamwork-based starter in which denary to binary translations are 'adaptations' box at the bottom of the page to see the variety of ways this

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Time

No more than a **few minutes** per game, with no limit to the number of games.

Prer

Studer
to bin
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RESOURCES

Optional: denary → binary conversion sheet

PREPARATION

None is needed, but the conversion examples are recommended.

DELIVERY

* Students form groups of up to eight and line up in front of the board; a proportionate amount of the board to use.
* The teacher announces a number in denary form for which they know
* The first student writes the denary number on the board, and the plac 2, 1 (then joins the back of the line).
* From that point on, each student can carry out one action, such as wri from the denary number.
* If any group communicates verbally, the penalty is that they cannot pl
* The winner is the team to produce the correct binary number first.
* The game should be played two or three times as a starter.

ADAPTATIONS

* Similar activities could be contrived to translate between binary and d and hexadecimal in both directions.
* This would also work for additions as well as shift operations, and cou (individual or team-based) to decode an ASCII message.
* Note that the grey-backed colours in the table are for numbers of mo

Denary → Binary Conversion (Examples)

20	0001 0100	215	1101
29	0001 1101	219	1101
37	0010 0101	222	1101
48	0011 0000	230	1110
59	0011 1011	237	1110
63	0011 1111	240	1111
70	0100 0110	243	1111
78	0100 1110	248	1111
85	0101 0101	251	1111
94	0101 1110	253	1111
101	0110 0101	260	1 00
109	0110 1101	285	1 00
114	0111 0010	300	1 00
120	0111 1000	320	1 01
126	0111 1110	445	1 101
131	1000 0011	589	1 00
140	1000 1100	627	10 0
151	1001 0111	743	10 11
162	1010 0010	823	11 00
173	1010 1101	1000	11 11
179	1011 0011	1107	100
184	1011 1000	2971	1011
192	1100 0000	13046	11 00
196	1100 0100	25006	110 0
206	1100 1110	51004	1100

Activity 10: Ranking File Sizes

This activity tests and develops students' understanding of units of storage
starter activity, but it can be repeated, as there are six separate sets of reso

Time

Five minutes per run-through. This
resource contains enough versions for
six run-throughs (one for each
measurement unit)

Prep

An un
prefer.
repeat
such a

RESOURCES

* Table containing different measures of data (see 'preparation' below f

PREPARATION

* Each column in the table on the next page is an individual activity. Th
  with the other five being of similar difficulty to each other.
* Select the column you want to use, and cut it into its component elem
  each pair of students in the class.
* The quantities are currently in order, from the smallest at the top to th
  intact column for yourself for reference.

DELIVERY

* Instruct students to arrange the items into order of size.
* No more than three minutes should be required, although you might
  from another column in case some students finish very quickly.
* Once the activity is complete, questioning can address issues such as
  0.01 gigabytes', etc.

To clarify, for the purposes of this resource, 1 kilobyte = 1,000 bytes; 1 me
This is based on guidance from the exam board.

ADAPTATIONS

* This is quite a mathematical activity, and could be enhanced by addin
  which of the data measures would be the smallest available that coulc
* This resource actually provides far more than six run-throughs of this
  from different columns, far more combinations are available, includinç
* A similar activity would be applicable to ranking sizes of image files w
  depths; this would also be a fairly mathematical activity.

1 bit	1 kilobyte	1 million bytes	200 bytes	1 kilobyte	Half a gigabyte
1 nibble	1,020 bytes	1,001 kilobytes	2,000 bits	1,025 bytes	600 megabytes
1 byte	0.11 megabytes	1.01 megabyte	450 bytes	2,100 nibbles	750 million bytes
1 kilobyte	1,200 kilobytes	0.1 gigabytes	Half a kilobyte	20,000 bits	0.9 terabytes
1 megabyte	1 megabyte	200 megabytes	0.001 megabytes	999 kilobytes	2,000 megabytes
1 gigabyte	1,000 megabytes	100 gigabytes	2,000 bytes	1 megabyte	105 terabytes

Activity 11: Binary Addition Knoc

This activity allows students to expose their competitive streak while practi arithmetic. The examples here deal with addition, but similar techniques c

---

Time

Two minutes per round, with no limit to the number of rounds

Prer

An un

RESOURCES

- Examples sheet (one for teacher)

PREPARATION

Print out a single copy of the sheet. Bear in mind that if more than 10 rou additional numbers will be needed. If this becomes a fixture, you will need

More than this is unnecessary, as students are unlikely to remember comb It's also possible to make up numbers on the spot, provided that they proc

DELIVERY

- Two students approach the board. These might be chosen at random
- The teacher says two denary numbers out loud.
- The students convert the two numbers into binary, one above the oth addition to produce a total. Students should show their working to er mentally calculating the total of the two denary numbers and converti
- The first student with the correct answer wins that round.
- It would be unlikely that this would be used to fill a lesson, and it wou fixture, with a leaderboard or league table being developed over the y

ADAPTATIONS

- This approach can be taken within many other topics, including binary conversion, calculation of file sizes and binary shift operations.
- If a league table is to be maintained, ultimately everyone must play ev advisable for any two players to be of similar ability.

Examples

70		132
0100 0110	+	1000 0100

59		104
001 11011	+	0110 1000

112		91
0111 0000	+	0101 1011

86		75
0101 0110	+	0100 1011

68		159
0100 0100	+	1001 1111

209		13
1101 0001	+	0000 1101

114		99
0111 0010	+	0110 0011

76		100
0100 1100	+	0110 0100

54		191
0011 0110	+	1011 1111

104		119
0110 1000	+	0111 0111

Activity 12: Binary Mastermind

Students need as much practice as they can get when it comes to binary, a
means that students (or anyone) will be more willing to participate This ac
of times.

Time
10 **minutes** per game

Pre
An un
0–255

RESOURCES

* Game sheet (one per pair per game) – provided 2 to a page

PREPARATION

* Ensure you have enough game sheets for one per playing pair per gar
  might keep a stack of them on hand at all times.
* All players will also need scrap paper.

DELIVERY

* Students are divided into pairs, hereafter referred to as Player 1 and P
* Player 1 devises an eight-bit binary number that player 2 will attempt
* Player 2 writes down a binary number on their scrap paper and conver
  denary number in the first row of the denary column.
* Player 1 translates this into binary on the game sheet, while Player 2 o
  translation matches their original number.
* Player 1 writes down how many bits of this number are correct.
* Player 2 modifies their guess, writing a new number on the second rov
* Play continues until the guess is correct or the table is full, and then p

ADAPTATIONS

* If the game is proving to be too difficult, the number of bits could be
* If games tend to always result in a filled table rather than a guessed n
  added to the game sheet.

Binary Mastermind						
Denary	Binary					
	128	64	32	16	8	4

✂ -

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Activity 13: Data Transmission

In this activity, students use everyday objects to signal silently in binary to
group is the one that accurately transmits the most data in the smallest am

 Time

Very flexible activity. This could be a
10-minute extended starter, a whole
lesson or a fixture across a series of
lessons.

 Pre

An un
betwe

RESOURCES

No resources are provided here, but this activity can be carried out with an
contrived to have one of two binary states. For example:

- torches, which can obviously be on or off
- a piece of card with a different colour on either side
- a piece of card that can be held up or not held up
- auditory actions such as striking a table with two different-soundin

PREPARATION

Prepare a series of numbers between 0 and 255, ideally avoiding those tha
binary, e.g. 128 (1000 0000). There should be a set of numbers for each gr
group.

DELIVERY

- Form groups of three or four – ideally four.
- Each group splits in half, namely the 'transmitting' half and the 'receiv
- Students are told they are going to be sending and receiving eight-bi
- Groups get five minutes to discuss exactly how they will represent bits
  is underway, no talking is allowed, and penalties can be applied for si
  protocols.
- Provide denary numbers to the transmitting students, which the recei
- Receiving students and transmitting students stand across the room f
  students translate their denary numbers to binary and signal them. R
  binary signal back to denary.
- At the end of the activity (timing at your discretion), points can be awa
  receiving students, with points deducted for any incorrect numbers.

ADAPTATIONS

This activity could be combined with student-created protocols for more c
might need to include recipients (senders might have a choice), senders (d
multiple nodes), and start and stop bits ('packets' might not be of fixed len

Activity 14: Network Factors

This exercise is a practical exploration of the factors that affect network pe
interference, network traffic and the reliability of the network medium.

⏱ **Time** 40 minutes	🪄 **Pre** None

RESOURCES

- Number to identify nodes (one of each)
- 'Data packets' (one sheet of each, cut up)
- Network layouts sheet (one for teacher)

PREPARATION

Each individual factor of network performance will need to be prepared fo
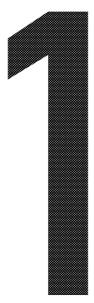sheet' for details of each one). The networks should be physically laid out

DELIVERY

- As each factor of network performance is acted out, students should b
  question 'What is being demonstrated here?' Questions of this nature
  asked throughout.
- Between each factor, while the area is being set up for the next one, a
  demonstrated, ensuring you glean all insight from them before you te
  demonstration.
- As a plenary, definitions of each of the factors can be discussed and w

ADAPTATIONS

- This approach would work for all network-related theory. Peer-to-pe
  compared with client–server networks; mesh and star networks could

1

2

3

4

Data Packets

1	1	1
1	1	1
1	1	1
1	1	1
1	1	1
1	1	1

2	2	2
2	2	2
2	2	2
2	2	2
2	2	2
2	2	2

3	3	3
3	3	3
3	3	3
3	3	3
3	3	3
3	3	3
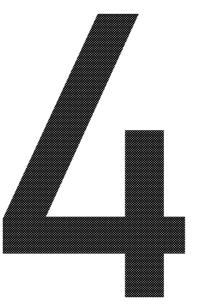
4	4	4
4	4	4
4	4	4
4	4	4
4	4	4
4	4	4

Factor
Bandwidth Place all '1' packets at node 3 and vice versa. Place all '2' packets at node 4 and vice versa. Divide half of the students into four groups and put one group at each node. They each pick up 1 packet and move towards their destination. Then they reach the bus (main vertical line). There will be congestion, and they must queue. One moves up the line, then one moves down, alternately. They take no packets for the return journey, and do not need to move along a line. They then pick up another packet from their original node and transport that in the same way, repeating the process until all packets are at their destination.
Interference Use the other half of the students, divided again into four groups. Packets start in the same place as previously and transmission of them, one at a time, takes place as before. The bandwidth has now been doubled, meaning traffic can travel in both directions simultaneously. The problem here is interference. To model interference, wander noisily into the network, steal someone's data packet, scribble out the number and give it back to them. Alternatively, give them a different packet and tell them to continue to their original destination. Numbers permitting, you might encourage a few students to join you in this endeavour, but don't corrupt all of the data.
Network Traffic This time, use all students, and randomise the starting locations of the data packets. The aim here is to represent the slowdown inherent to a network with too much data trying to use it. If you shorten the bus cables in the middle, congestion will be even more apparent.
Reliability Periodically stop data from travelling across one of the bus cables, telling students that it's no longer working. When this happens, the single cable will have to take on both directions, as it did for the 'bandwidth' example. After half a minute, tell them that the cable has been repaired, then break the other cable. If you use all students for this one, and corrupt some more data at random, students will see all network factors in play at the same time.

Activity 15: Encrypted Battleshi

In this game of battleships, each team announces the position of their ship announcement, however, is encrypted. It's up to the opposing team to cra

🕐 **Time**	🔧 **Prer**
Approximately **40 minutes** (although games of battleships naturally vary in length).	Basic u encryp essenti

RESOURCES

- Battleship board (four copies)
- Cut-out ships (four sets) – provided 2 to a page, so 2 pages total
- 'Top Secret' encryption techniques (two sets) – provided 2 to a page, :

PREPARATION

Print the resources as indicated above.

DELIVERY

- Ensure that everyone in the room is familiar with 'Battleships'; it's dan(
- Split the class into two teams, who should go to two adjacent corners
- Students should devise encryption of ship positions to include which : or vertical) and which game square will contain the top-left corner of (described on the 'Top Secret' sheet, which should be filled in twice. F(

    o They might name the patrol boat 'Mike', with similar names for (
    o They could use 'sneaky' and 'cunning' for 'horizontal' or 'vertical
    o Instead of saying B5, they might say A6, translating letters dowr

- They must not agree ship positions at this point.
- Each team nominates around two members who will position their shi the remaining corners of the room, each taking a board, a set of cut-o
- The larger cohorts decide where ships should be positioned, placing t encrypt these positions according to their rules and say them out louc
- The smaller cohorts decrypt the messages and position the ships. The transmission.
- Game then proceeds as per normal 'Battleships', with dual aims of sinl the opposing team's encryption algorithm.

ADAPTATIONS

A cooperative version of the game could be created to run alongside the '(different set of encryption rules would be created to model the 24-hour lif

Battleships

	A	B	C	D	E	F	
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							

Notes:

Cut-out Ships

Carrier:

C	C	C	C	C

Battleship:

B	B	B	B

Submarine:

S	S	S

Destroyer:

D	D	D

Patrol Boat:

P	P

- -

Cut-out Ships

Carrier:

C	C	C	C	C

Battleship:

B	B	B	B

Submarine:

S	S	S

Destroyer:

D	D	D

Patrol Boat:

P	P
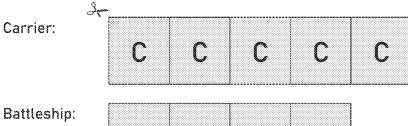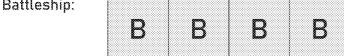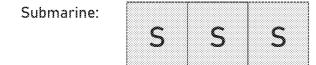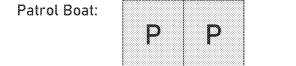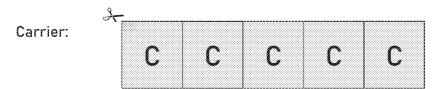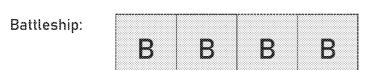
Top Secret

---✂--

Top Secret

Activity 16: Phishing

This activity develops students' skills in identifying a phishing email, essent
of spot the difference. Which email is genuine? What should people look
security breaches?

Time

15 minutes should be spent here, as
close reading is required.

Pre

None
under
detra

RESOURCES

Set of five prospective emails

PREPARATION

Cut out and shuffle the five emails, one set per individual or group. Small-
as there's quite a bit to read and discussion could prove useful.

DELIVERY

- Begin with a definition of 'phishing' and questioning on how a phishir
- Students should work to identify which email appears the most genuir
- Part way through, questioning could focus on identifying one email tha
- End with groups stating which they feel is the genuine email. Ensure (
  before the answer (email 2) is made known.

ADAPTATIONS

- An additional list of modifications for further emails is provided in the
- This approach would work for several other subject areas, including pr
  listings would do the job?') and hardware ('Which of these computers

TEACHER NOTES

Email descriptions

1. The 'from' email address is not from HSBC.
2. This is the most plausible email.
3. The hyperlink would not take the user to an HSBC page.
4. Names in this email are not capitalised.
5. The first two paragraphs are written with poor grammar.

Potential email modifications

- Address the email to 'customer' instead of an actual name.
- Write the email with an undue tone of urgency.
- Use a phone number that starts with two zeros.
- Remove the reference to 'copy it into your browser'.
- Replace the hyperlink with a simple 'click here'.

Email 1

To: m.smith@gmail.com
From: security@hbsc.co.uk

Dear Mr Smith

I am writing to inform you of a potential security breach to a n
account may have been compromised. Let us first reassure y
on your behalf, and that no money has been lost from your ac

In order to keep our systems as robust as possible, we would
password as soon as possible. You only need to do this once,
your new password on any devices you use to access your ac

To change your login details, click on the link below or copy it
https://www.hsbc.co.uk/security-centre/change-password

If you have any questions, please feel free to contact us on 08

Yours sincerely
S Parker
Account Manager

Email 2

To: m.smith@gmail.com
From: security@hsbc.co.uk

Dear Mr Smith

I am writing to inform you of a potential security breach to a n
account may have been compromised. Let us first reassure y
on your behalf, and that no money has been lost from your ac

In order to keep our systems as robust as possible, we would
password as soon as possible. You only need to do this once,
your new password on any devices you use to access your ac

To change your login details, click on the link below or copy it
https://www.hsbc.co.uk/security-centre/change-password

If you have any questions, please feel free to contact us on 08

Yours sincerely
S Parker
Account Manager

Email 3

To: m.smith@gmail.com
From: security@hsbc.co.uk

Dear Mr Smith

I am writing to inform you of a potential security breach to a n
account may have been compromised. Let us first reassure y
on your behalf, and that no money has been lost from your ac

In order to keep our systems as robust as possible, we would
password as soon as possible. You only need to do this once,
your new password on any devices you use to access your ac

To change your login details, click on the link below or copy it
https://www.security-centre-hsbc.co.uk/ change-password

If you have any questions, please feel free to contact us on 08

Yours sincerely
S Parker
Account Manager

Email 4

To: m.smith@gmail.com
From: security@hsbc.co.uk

Dear Mr smith

I am writing to inform you of a potential security breach to a n
account may have been compromised. Let us first reassure y
on your behalf, and that no money has been lost from your ac

In order to keep our systems as robust as possible, we would
password as soon as possible. You only need to do this once,
your new password on any devices you use to access your ac

To change your login details, click on the link below or copy it
https://www.hsbc.co.uk/security-centre/change-password

If you have any questions, please feel free to contact us on 08

Yours sincerely
S parker
Account Manager

Email 5

To: m.smith@gmail.com
From: security@hsbc.co.uk

Dear Mr Smith

I am writing here to inform you of a potential security breach
Your account may or may not have been compromised. Let us
we have acted swiftly on your behalf, and that no money has b

In order to keep our systems as robust as can, we would ask
password as soon as possible. You only need to do this one ti
password should use on any devices you use to access your a

To change your login details, click on the link below or copy it
https://www.hsbc.co.uk/security-centre/change-password

If you have any questions, please feel free to contact us on 08

Yours sincerely
S Parker
Account Manager

Activity 17: Denial of Service

In this activity, students will model a Denial of Service (DoS) attack. This sh
understanding and a greater ability to put that understanding into words k

Time

5 to **10 minutes** as a starter or as a
mid-lesson interactive demonstration

Prer

None

RESOURCES

- Genuine request numbers, cut into individual cells (one sheet per clas
- Malicious request numbers, cut into individual cells (one sheet per cla

PREPARATION

Cut out the numbers, laminating if you desire, and create a pile of genuine
separate pile of malicious request numbers (grey). The order within each p

DELIVERY

- Nominate a student to be 'the service'. They will add together any co
  brought to them, as this is the nature of the service that they provide.

- Nominate around three students to make genuine requests. At a wall
  least two white-background numbers and take them to 'the service' to
  this has taken place, they return the numbers to the pile and repeat.

- Nominate around two students to make malicious requests (at this po
  error – there should be enough malicious requests added that the ser
  quickly as they arrive). These students should use the grey pile, and th
  normal.

- Question the group for a solution until they (or you) suggest that an a
  service'. We have now doubled the bandwidth of the service.

- Keep adding students to make malicious requests until the two 'servic
  At this point, you should nominate a student to be the firewall, who w
  the numbers. Both malicious and genuine data requests must pass vi
  white-background numbers to pass. Grey-background numbers will k

- Add yet more malicious users, so that the firewall is now overwhelmed
  addressed by increasing the bandwidth of the firewall (i.e. adding ano

ADAPTATIONS

This activity can be expanded with the incorporation of IP address lists, all

1	2	3
5	6	7
9	10	11
13	14	15
17	18	19
21	22	23
25	26	27
29	30	31

1	2	3
5	6	7
9	10	11
13	14	15
17	18	19
21	22	23
25	26	27
29	30	31

Activity 18: Systems Software

A concept map is similar to a mind map, but with more strictly observed co
nouns are written into rectangles, which are semantically connected using
written. This is a useful approach for any topic, but it seems to work partic
and related topics.

⏱ **Time**	🔖 **Prer**
20 to 25 minutes	Studer
	systen
	relevai
	should
	what a

RESOURCES

* Sample concept map (one per student)
* Cloze concept map (one per student)
* Solution (one for teacher)

PREPARATION

Print out a sample concept map and a cloze concept map for each student
be beneficial, each student should still complete their own concept map.

DELIVERY

* Begin by introducing concept maps, using the sample. Check underst
* Ask students to make a statement using information drawn from this (
  e.g. 'Encryption enhances security' or 'Backup prevents data loss'.
* Prompt students for what they might add to this map and where any i
  may need to be reminded that rectangles contain nouns and arrows c
  everyone will be familiar with the terms 'noun' and 'verb' to begin witl
* Allow five minutes for completion of the cloze concept map. There ar
  added to an incomplete concept map about operating systems. Ques
  and whether they're right or not, and encourage those who finish earl
* Again, prompt students for anything they might add once the activity
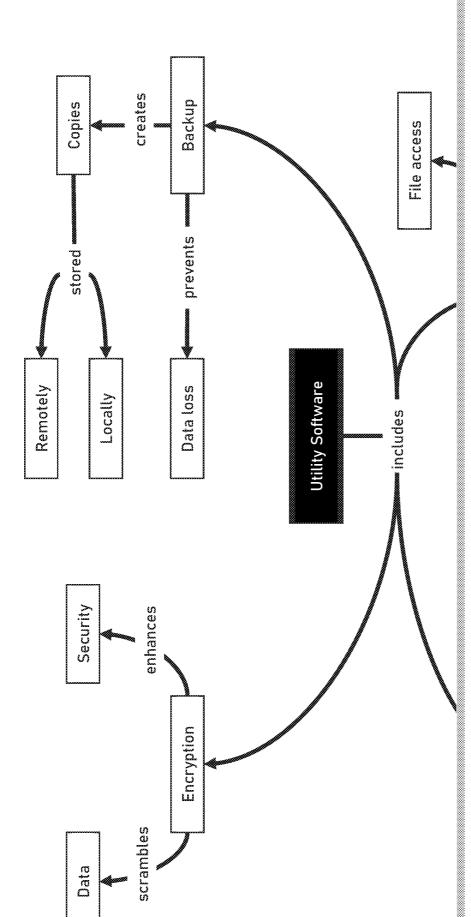
ADAPTATIONS

* An extension for this task is to create a concept map from scratch. Wi
  advisable to lead into this with incrementally less helpful cloze concep
  work from scratch.
* This approach is beneficial in all areas of Computer Science, as well as
  master concept maps, as both a learning tool and a revision tool, are I
  worth spending some time on this, even if students don't fully underst

Example Concept Map (Utility Software)

Concept Map Activity (Operating Systems)

The concept map includes the following connected boxes and labels:

- Mouse
- Peripherals — require →
- Memory
- Operating Systems — manage
- Files — delete, move

Completed Concept Map (Operating Systems)

Activity 19: User Interface on th

Designing a user interface is hardly a challenge for today's tech-savvy you
they design one against the clock, with continually changing user requirem
software development world).

| 🕰 **Time** 45 – 60 minutes, although this can be changed upwards or downwards by deviating from the teacher script. | 🪄 **Prer** None |

RESOURCES

* Teacher script
* Peer marking grid (one per student)

PREPARATION

* Print out a single teacher script and a copy of the marking grid for ea
* Have plenty of blank paper on hand, and ideally coloured pencils or s

DELIVERY

* Introduce the activity minimally – you are going to read out some req
  design, and they have to do their best work in drawing and labelling t

* Work through the teacher script, making any pre-planned or on-the-f
  probably need to alter timings to meet the needs of the group, but th

* Be prepared for complaints, as you will be changing the requirements
  point out that this is how the software development industry generall
  mind at a moment's notice and expect developers to adapt.

* Once the script has been worked through, each student passes their w
  peer marking grid. Each point from the script (apart from the first on
  was announced, the more points it is potentially worth. Peers need to
  comment, totalling at the bottom.

* As a plenary, discuss positive aspects of a user interface.

ADAPTATIONS

* Steps can be added to and removed from the script to vary the length
* Bear in mind that any changes made to the script will need to be mirr
* Ask students to create their own scripts on a smaller scale for use in s
  same topic.

Teacher Script

1. A user would like a desktop program that allows them to track the nu[...] they eat.
   5 minutes

2. They would like the program to keep track of the calories, fat, saturate[...] day.
   5 minutes

3. The user would like to preview the values for calories, fat, saturated fa[...] food item.
   5 minutes

4. The user would like to see their calories for the last five days in the for[...]
   3 minutes

5. Any days that go over the 2,500-calorie limit should appear on the col[...] green.
   1 minute

6. The user would like to be able to alter the 2,500-calorie limit from day[...]
   2 minutes

7. The user is partially sighted, so the interface should display any text in[...]
   2 minutes

8. However, other people will use the program too, so there should be a[...]
   2 minutes

9. There should also be alternative colours available for the column char[...] combination for anyone who is colour-blind.
   2 minutes

10. The program should recommend what food you eat next, based on fo[...]
    3 minutes

11. Actually, this would be better as an Android app instead of a desktop[...]
    5 minutes

Criterion	Mark	
The program keeps track of calories, fat, saturated fat, sugar and salt.	/ 1	
The nutritional value of a food item can be previewed before it is entered.	/ 2	
There is a column chart that shows calorie intake for the last five days.	/ 3	
Days that go over the calorie limit are highlighted on the column chart.	/ 4	
The calorie limit can be altered from day to day.	/ 5	
Font sizes can be enlarged to meet the needs of partially sighted users.	/ 6	
Font sizes are customisable to meet the needs of all users.	/ 7	
The colour of the column chart can be customised.	/ 8	
The program recommends food for the user to eat next.	/ 9	
The program is presented in a scale appropriate to an Android device.	/ 10	
TOTAL:	/ 55	

Activity 20: Compression

This activity involves trying to convey a 30-character message to a group h
from it as possible (without making it unintelligible).

Time

Highly variable, depending on how many rounds are played, up to a maximum of **30 minutes**. It can be adapted to form a starter.

Prer

At leas
compr

RESOURCES

None besides those that will be created and used by the students themsel

PREPARATION

- If this is the first time students have encountered compression, other
  to be on hand to introduce the concept.
- Create a bank of 30-character (including spaces) statements that stud
  unable to devise their own; for example:
  - COMPRESSION IS SHRINKING FILES
  - TRANSMISSION TAKES PLACE FAST
  - EVEN SMALL FILES WILL COMPRESS
  - SMALL FILES STORED EFFICIENTLY
- Ensure the board is clear, as students will be using it

DELIVERY

- Introduce the concept of compression if necessary.
- Divide class into groups of 2–3 students.
- Give groups two minutes (vary as needed) to devise a 30-character me
- Each group then removes as many characters as possible over a furthe
  message as readable as possible (spaces can be removed if the group
- When it is that group's turn, they write their 'compressed' message or
  have 30 seconds (vary as needed) to decompress it.
- The team that decompresses an opposing team's message first receiv
  gains 1 point per character removed during compression, but only if t
  decompressed (i.e. if their compressed message was 21 characters, the
  nine characters).
- Repeat for as many groups as required.

ADAPTATIONS

- The length of the message can vary according to time available and th
- Compression techniques could be applied to binary numbers, which w
  decompressed; this could be competitive or cooperative in nature.

Activity 21: Topic Categorisation

Students need, by the time they finish the course, an understanding of cul and privacy-related issues. This activity offers some groundwork in terms or more of these labels.

Time
Five minutes per scenario.

Prer
None
introd

RESOURCES

* List of scenarios (one copy for the teacher)
* Categories (cut up and distributed, one set per group of four)

PREPARATION

Cut out the categories into individual words, and have one complete set p

DELIVERY

* Place students into their groups and explain that they will hear a scen
* Based on what they hear, they need to decide, as a group, whether it some combination of two or more.
* After around a minute, groups nominate a member to hold up the lab
* Choose a few groups and ask them to justify their decision.
* Give all groups a minute to decide whether they wish to re-vote.
* The vote takes place again, at which point you can offer your own inp consider to be the 'right' answer, as there might be several.
* As a plenary, the words 'cultural', 'environmental', 'legal', 'ethical' and

ADAPTATIONS

* One scenario will take about five minutes. A useful way of deploying for the time in which you are covering topic 1.6.
* The scenarios can easily be added to from experiences of both teache current news stories.
* Each scenario could be used as the basis for a discussion of any forma
* Long-term homework assignment to generate regular new statement

Scenarios

A. A well-known technology company seems to be de
   devices to function more slowly. People know abo
   to buy the product.

B. My working hours go on indefinitely because I have
   technology. My boss has come to expect response

C. Online retailers might abuse their market position,
   order literally anything for next-day delivery.

D. Driverless cars are going to change the nature of e
   so it would be good if at least some of them are m

E. Smart speakers will soon be able to offer persona
   advice would be more accurate from a smart spea
   medical records.

F. Advances in artificial intelligence have made robot
   possibility. If we can automate car production, wh
   education?

G. The nature of employment continues to change. M
   done from home, so fewer people need to travel to

H. I like that there's so much for free on the Internet.
   keep entering so many of my details whenever I si

I. Prospective employers will always have a look at :
   should make sure I behave on mine. Better yet, I'll

J. Military drones are better for two reasons. There'
   and there's less chance of any collateral damage.

K. Mobile phones are becoming more expensive beca
   easily accessible metals needed to make them.

L. Telecommuting reduces congestion on the roads, v

M. It seems to have become the social norm to just ri
   YouTube video. No one bothers with CDs any more

N. I have no idea what my social media provider does
   from me, but I prefer this arrangement to paying fe

✂

CULTURAL

ENVIRONMENT/

LEGAL

PRIVACY

ETHICAL

Activity 22: Stakeholder Matrix

This is an approach to writing answers to discussion questions in the exam complex and are influenced by a range of perspectives. This activity requir perspectives.

Time
30–50 minutes, depending on the extent of any questioning.

Prer
Knowl

RESOURCES

- Blank matrix (one per individual or pair per discussion)
- Discussion prompts (one for the teacher)
- Writing guidance (one per student)

PREPARATION

Print out the resources in the quantity indicated above and select a topic. a single lesson if full write-ups are assigned as homework.

DELIVERY

- Split class into pairs, or allow individual work at your discretion (discus
- Announce the topic, such as 'technology in the classroom'.
- Students to identify the stakeholders. They may identify more than ju should be allowed. The matrix does not have to be 2 × 2, although th schemes. Students should, in the event of too many stakeholders, ide
- Move on to another topic and repeat if students need more practice i
- Discussion to take place to fill in the boxes in the matrix, either in pair two; each box should have at least two valid points, but there will prol the matrix could be drawn on the board. An example for advantages different room at short notice does not mean all resources are lost'.
- Once the grid is complete, it can be used as a starting point for a mini writing guidance.

ADAPTATIONS

Students tend to get the point of this exercise after the first time they try i they identify a few stakeholders in a few scenarios before they start filling i to fill in a few matrices before they start writing anything.

Advantages	
Group 1:	
Group 2:	

Discussion Prompts

- ## Technology in the classroom
  Advantages and disadvantages for teachers and pupils

- ## Increase in telecommuting / working from hoı
  Advantages and disadvantages for employers and employees

- ## Drone strikes instead of invading armies
  Advantages and disadvantages for military users and civilian

- ## Driverless cars
  Advantages and disadvantages for 'drivers' and pedestrians

- ## Growth in online shopping
  Advantages and disadvantages for retailers and customers

- ## Children owning smartphones
  Advantages and disadvantages for parents and children

- ## Democratisation of news
  Advantages and disadvantages for the public and social medi

- ## New data protection laws (GDPR, Data Protec
  Advantages and disadvantages for the public and (small) bus

- ## Ubiquity of computer technology
  Advantages and disadvantages for the environment and tech

- ## Increase in use of artificial intelligence in crin
  Advantages and disadvantages for the public and the police

Writing Guidance

1. **Introduce the topic:**

   - There are several ways in which...
   - A number of valid viewpoints exist around the issue of...
   - _____ is a fairly complex issue, since...
   - Not everyone sees _____ in the same way.

2. **Introduce your first argument:**

   - On the one hand...
   - One way of looking at this issue is...
   - Primarily...
   - One key factor is...

3. **Throw in a valid example:**

   - A valid example of this is...
   - Recently, this issue has been in the spotlight...
   - A specific instance of this was...
   - This can be seen clearly in the example of...

4. **Extend an argument with a related but separate point:**

   - Additionally,...
   - Moreover,...
   - Another factor is...
   - Furthermore,...

5. **Clearly indicate that you are now changing tack:**

   - However,...
   - On the other hand,...
   - There is an alternative way of looking at this situation.
   - Another viewpoint is that...

   (use examples and extensions here too)

6. **Sum up your argument:**

   - In conclusion, I believe...
   - The logical conclusion to this issue is...
   - There might not be a single right answer...
   - On balance, both viewpoints are valid to an extent.

Activity 23: Debating Prompts

The area of key importance with topic 1.6 is to recognise that complex issu
of which are not necessarily right or wrong. This activity requires that lear
they disagree with, and argue their case.

Time

From **20 minutes** to **60 minutes**,
depending on the number of topics
addressed.

Prer

Knowl

RESOURCES

Set of 24 statements, along with discussion points (one copy for teacher)

PREPARATION

Either print out the resource or prepare a presentation one discussion poir

DELIVERY

* Divide the class into two groups, each of which should nominate two
* Make the statement known and ask the class to vote on whether they
* Decide which group will take which side (each statement can be agree
  groups will not look for middle ground yet).
* Students work collaboratively within each group (you may wish to set
  contributions) to marshal as many arguments in their favour as possib
  prompts if needed.
* Encourage students to consider what the arguments of the opposing
  counterarguments.
* After 10 minutes, the spokespeople come to the front, and they each
  argument, assembled with the help of their team, across to the class.
* Other team members can now ask questions in an attempt to persuad
  thought. Spokespeople should do their best to answer. At this point,
  apparent.
* After five minutes (including the initial arguments), the debate is over.
  irrespective of their grouping, and that tally is compared with the earl
* Whichever group coaxed the tally in their direction has won the debat

ADAPTATIONS

This is just one debate format, and there are many others. Other subject s
English, History and Philosophy, would be best placed to advise for studen

Discussion Points

1. Manufacturers should be held liable in the event of a drive
   On the one hand, this could be argued as being one step av
   manufacturers for knife crime. On the other, we could arg
   crashes into a pedestrian is as criminal as a poorly made

2. The environmental benefits of computer technology outwe
   Benefits are likely to start with the increase of telecommu
   printing. These could be countered by technology going int
   renewable minerals and people with a service such as Am
   journeys to be made for very small deliveries.

3. Copyright law should be more strictly enforced.
   Supporting this argument would be copyright owners, who lc
   to the detriment of the futures of their industries. On the oth
   can penalise people who breach the law inadvertently (such
   broadcast). Besides this, however, is the question of how we
   routinely, (probably) billions of times a day.

4. In the future, most jobs will be done using robots and artifi
   The discussion is likely to focus on jobs that can readily be
   manufacturing) and jobs that cannot (such as investigating
   would include the fact that technology tends to outpace ou
   topic of what people might do if robots do all the work.

5. Telecommuting, or working from home, is better for both e
   Money is saved, in the form of rent and utilities for the emp
   for the employee. Social benefits, however, are lost, and f
   and technical support are more challenging to manage.

6. Technology has had an overall negative impact on society.
   This is a deliberately open-ended topic, with any number o
   students.

7. Thanks to the Internet and social media, anyone can report
   thing.
   The Arab Spring was brought to the attention of the world
   people simply posting about it on a personal level. Social i
   key tool for governments who want undue influence over c

8. It's reasonable for employers to check the social media pr
   There should be an expectation of privacy, and an assumpl
   professional life are two distinct elements. Nevertheless,
   social media can have a detrimental impact on their emplo

9. If people don't set their social media privacy settings corre
   consequences.

   Even the most technologically savvy of us would struggle
   of the privacy settings on a single social media platform.
   responsibility to make it easier. On the other hand, people
   compromising photos without knowing who can see them

10. With so much personal data shared with so many organisa
    of privacy is unrealistic.

    It would be difficult to recall the number of online services
    accounts, phone numbers and email addresses. Some of t
    with very different data protection laws from our own, but
    not acceptable, where do we go from here?

11. Now that people tend to work in offices rather than factori

    The question of whether eyestrain results in poorer quality
    for debate. There are probably fewer fatal accidents, but e
    workstation is subject to RSI.

12. Workplace safety is the responsibility of the employer.

    If I arrive at work and am told to do my job dangerously cl
    that is clearly the fault of my employer. If I go joyriding on
    that's my fault as an employee. Where do we draw the lin
    absolved of responsibility?

13. Smartphones are good for the well-being of children.

    Physical well-being and emotional well-being can be discu
    issues on either side. They can be a distraction when cros
    24/7 bullying and a cause of physical inactivity, but they al
    information, a plethora of fitness apps and a means of eme

14. As soon as you click on 'send' or 'upload', you can no longe

    Even if you know that your privacy settings are airtight, an
    have posted can take a screen capture and share it publicl
    self-expression if people become afraid to communicate?

15. Many administrative roles are now automated, which is ba

    Not everyone whose job is automated can retrain for some
    be a year or two from retirement. Employers, however, ar
    to modernise, all of their employees might find themselves

16. Technology in the classroom is more of a distraction than

    Do students really benefit from a multimedia, online, intera
    Computer Science students in particular see themselves a
    technology rather than consumers?

17. Since the Internet crosses so many borders, data protectic

    Pursuing a data breach in a foreign country is very difficul
    government cooperates. What about breaches that span n
    in America uses a Russian server to access the financial r
    Panama, where do we start? Data protection is too import

18. The impact of a globally connected world has been largely

    Think about business and social connections; think about t
    information available to everyone. Also, think about cyber
    think about how much time is lost doing literally nothing o

19. Computer users are responsible for their own safety onlin

    Are we guilty of victim blaming when we make this statem
    person's ignorance of the online world excuse them from t
    about the less tech-savvy among us? Should they avoid th

20. Employers should not monitor what their employees acce:

    Employers pay for the computer and the Internet connectic
    misused, especially to the detriment of a company's reput
    to have a workforce so rigidly under control?

21. If you access a 'free' service online, you should expect you
    financial gain.

    We all know that nothing is really ever 'free', or do we? If ;
    and targeting advertising accordingly, is the provider gaini
    relationship? Would I rather pay for my email service?

22. Governments should provide Internet access to those who

    It's not fair that some people are unable to access job listi
    online, thus causing them to remain in poverty. It's also no
    foot the bill for someone else's Internet connection. Which

23. In spite of our interconnected world, people have never be

    How many people on your 'friends' list do you actually talk
    easy is it to make a new friend thousands of miles away, a
    culture?

24. It's quite easy to determine what is 'fake news' and what is

    It's worth asking a class how many of them consider them
    at spotting fake news. It's likely that more than half of the
    'average' would not be where they think it is. How do we k
    than through the news that we read? How do we spot fake

Activity 24: Sixty Seconds

For this activity, students are required to try to speak for 60 uninterrupted
hesitation or deviation. Assuming they fail in this task, another student wil
This is based on the Radio 4 show 'Just a Minute'.

Time
Around **five minutes** per round

Prer
None

RESOURCES

List of topics together with the moderator's script. You will also need acce

PREPARATION

Other than printing the sheet (once) and getting a stopwatch, no preparati

DELIVERY

- Select a panel of four (confident) students. Confidence is important, k
  to interrupt the game to make a challenge. Introverts tend to be hapr
  run down (see 'adaptations' below).
- Read out the moderator script.
- Announce a topic and start the stopwatch.
- If a challenge is made by a player raising their hand, the stopwatch mu
  resolved.
- Either you or a student should keep score based on the rules in the m
  most points at the end wins.
- It's possible to play just a single round of *Just a Minute*, although it's c
  start once, which means four rounds in total.

ADAPTATIONS

- Instead of a panel of four students, this could be implemented as a wl
  would require more time as well as strategies to engage everyone in t
- This is a good end-of-topic or end-of-term activity and can be played
  Nothing would prevent the moderator announcing 'Python' or 'Memo
- To include the introverts, audience members might also be involved.
  been broken, and a point can be deducted from the rule breaker, but
  speak for the rest of the minute.

Topic List

1. Computers and the environment
2. Health and safety in IT
3. Ethical issues in computing
4. Laws relating to computers
5. Computers and the working world
6. Communication using technology
7. Dangers of social media
8. Driverless cars
9. The 24-hour workplace
10. Fake news
11. Artificial intelligence
12. Threats to privacy online
13. Children and technology
14. Computers in education
15. Opportunities of the Internet
16. Unequal access to technology
17. Changing cultural norms
18. Computers and shopping
19. The perils of technology
20. Law enforcement online

Moderator Script

In this game, you are required to speak for 60 seconds on a to
not allowed to hesitate, by pausing, saying 'ummmmm' or spe
allowed to repeat any words other than those in the topic, as
'the' and 'of'. You're also not allowed to change the subject frc
given.

[You may wish to write 'hesitation', 'repetition' and 'deviation' c
If you feel a player has broken one of these rules, raise your h
think they've broken. If you're right, you get a point, together v
minute. If you're wrong, they get a point and they can carry or
end of the minute gets a bonus point.

In case of any disagreement, the moderator's decision is final

Activity 25: Abstract Creations

This is a resource that can be used in a number of different ways. The aim
instructions while allowing students to express themselves creatively.

Time
Minimum **10 minutes**, with no effective
upper limit.

Prer
None.
early i
group

RESOURCES

* Shape mat (one for each student)
* Sample creations (one for each student)
* Instruction table (one for each student) – provided 2 to a page

PREPARATION

The shape mat will need to be cut into its component shapes, with each se
prevent shapes being put back in the wrong envelope, you might photoco
colours of paper as possible.

DELIVERY

Possible approaches include:
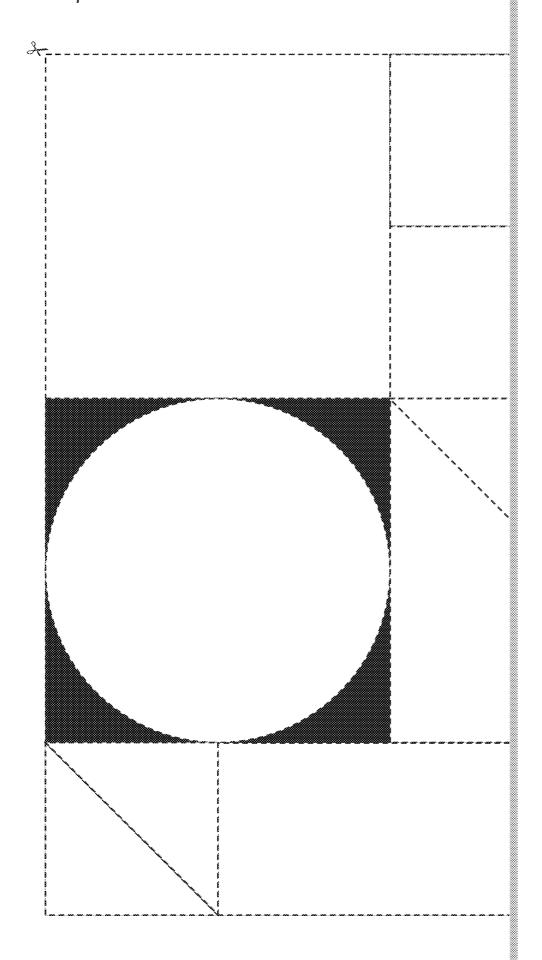
* A student stands at the front of the class and attempts to describe the
  other creation without showing the class. The class is not allowed to a
  the instructions as best they can.
* Students assemble their own creation then write instructions for some
  these instructions does not match the original, the instructions can be
* A student reads out their instructions, and others must attempt to asc
  creations is being described. Note that they cannot describe the finish
  their instructions.

ADAPTATIONS
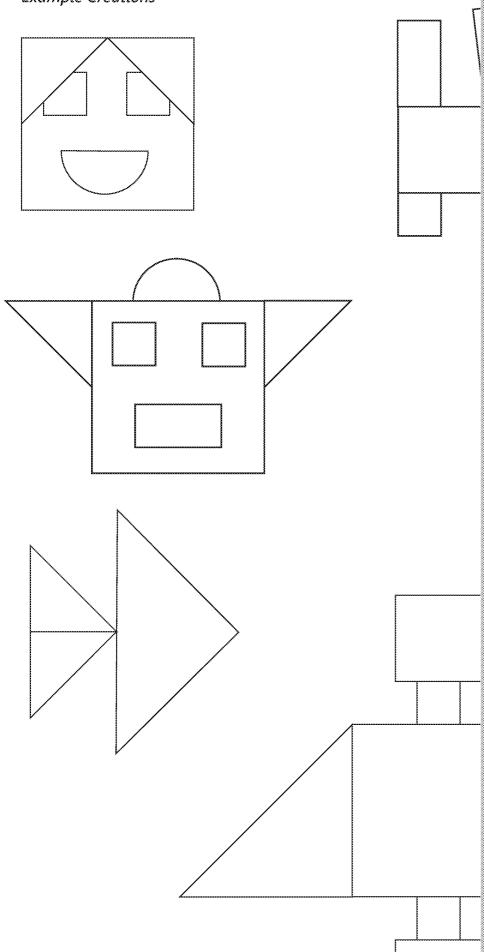
* In moving this activity more towards practical applications of compute
  require that a user interface is created, rather than an animal.
* Plenaries in activities such as this are extremely useful, and should foc
  dealing with instructions. Humans, after all, can work to interpret wha
  said. Computers cannot.

Shape Mat

Name:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

✂ --

Name:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Activity 26: Draw a Beastie

Students often struggle with the notion that the computer, when program
exactly what they want it to do. This activity, which requires students to p
them some guidance.

| ⏱ **Time** 10 minutes | 🖊 **Prer** None enjoya of its e |

RESOURCES

- Drawing sheet (one per student)
- Scrap paper (one per student)

PREPARATION

- Prepare the printed resources so that each student has one drawing s
- Optional: prepare a series of timers for each of the activity parts in 'de

DELIVERY

- Each student writes their name at the top of the printed page (20 sec
- Each student draws a creature of their own design on the scrap paper,
- Instructions on how to draw that creature should then be written on t
  Students do not need to use all five spaces, but they are not allowed
  sentence.
- Students should now fold up and conceal their drawing (10 seconds).
- The instructions should now go to someone else in the class (1 minut
- That 'someone else' will now attempt to recreate the drawing, in the s
  only on the instructions written, with no additional clarification (2 mii
- The artist writes their name at the bottom of the page (20 seconds) ar
  (20 seconds).
- As a mini-plenary, ask how many matched perfectly, how many 'sort o
  match.

ADAPTATIONS

This approach can be adapted in any number of different ways, including L
room blindfolded, cutting a shape out of a piece of paper using only writte

Programmer's name:
1.
2.
3.
4.
5.
Drawing:
Artist's name:

Activity 27: Flow Charts and Py

This exercise allows students to create paper-based flow charts without th
a mistake is made. Python code is parsed and translated to flow charts.

⏱ **Time**	✎ **Prer**
45-50 minutes	Althou the ab

RESOURCES

- Cut-out flow chart components (one per pair or group)
- Tasks (one per student)
- Solution sheet (one for teacher)

PREPARATION

- Print and cut out flow chart components. There should be a full set fo
  to include some spares.
- For each group, have around three sheets of plain paper, onto which a

DELIVERY
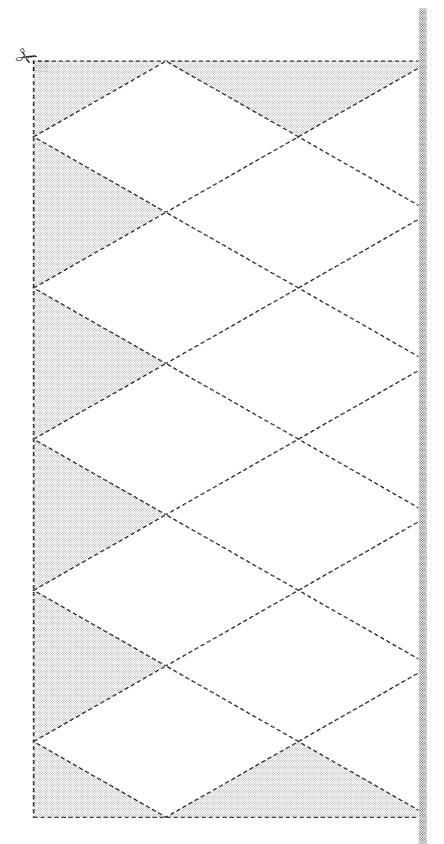
- Students read the Python code and attempt to predict what it would c
- For each one, students will then attempt to construct a flow chart. Inc
  out and these can be placed on (and moved around) a blank page. Th
  need to be written on the blank page.
- For students who reach question 5, a single blank page may not be er
  A4 sheets should be used.

ADAPTATIONS

- You may wish to show students one or more flow chart solutions befo
  depending on their ability.
- Students should spend time, with any program or algorithm, translatir
  languages, pseudocode, flow charts and descriptions.
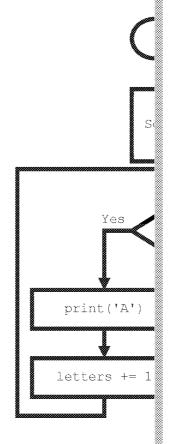
```
1   letters = 0
    while(letters < 5):
        print('A')
        letters += 1
```

Output: _____

```
2   letters = 0
    print('N')
    while(letters < 10):
        print('O')
        letters += 1
```

Output: _____

```
3   letters = 1
    print('N')
    while(letters < 10):
        print('O')
        letters += 1
    print('!')
```

Output: _____

```
4   letters = 0
    print('WHY')
    while(letters < 5):
        print('?')
        print('!')
        letters += 1
```

Output: _____

```
5   letters =
    while(lett
        print
        letter

    letters =
    while(lett
        print
        letter

    letters =
    while(lett
        print
        letter

    letters =
    while(lett
        print
        letter
```

Output: _____

6   In the space below, write the code that would display the following u

NEVER!!!!!!   (There are six exclamation marks)

Solutions

1. AAAAA

Yes

print('A')

letters += 1

2. NOOOOOOOOOO

Se

Yes

print('O')

letters += 1

1. NOOOOOOOOO!

Set

Yes

```
print('O')
```

```
letters += 1
```

2. WHY?!?!?!?!?!

pr

Set

Yes

```
print('?!')
```

```
letters += 1
```
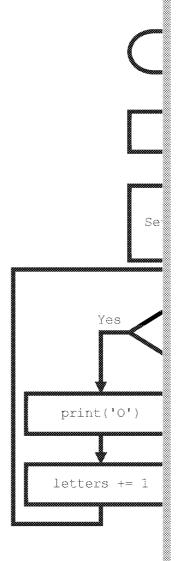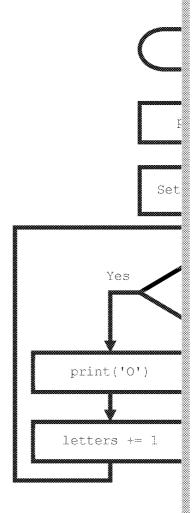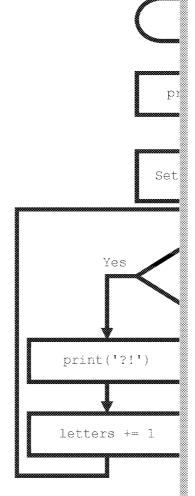
3. AAAARRRGGH

```
          ┌─────────────────┐
          │      Start       │
          └─────────────────┘
                   │
          ┌─────────────────┐
          │  Set letters = 1 │
          └─────────────────┘
                   │
   Yes          letters         No
    ◄───────────  < 5  ───────────►
    │                              │
┌──────────┐              ┌─────────────────┐
│ print('A')│              │  Set letters = 1 │
└──────────┘              └─────────────────┘
    │                              │
┌──────────┐          Yes       letters       No
│letters += 1│          ◄───────── < 4 ──────────►
└──────────┘          │                          │
                 ┌──────────┐            ┌─────────────────┐
                 │ print('R')│            │  Set letters =   │
                 └──────────┘            └─────────────────┘
                      │                          │
                 ┌──────────┐          Yes    letters    No
                 │letters += 1│          ◄────── < 3 ──────►
                 └──────────┘          │
                                  ┌──────────┐
                                  │ print('G')│
                                  └──────────┘
                                       │
                                  ┌──────────┐
                                  │letters += 1│
                                  └──────────┘
                                                    Yes
                                            ┌──────────┐
                                            │ print('H')│
                                            └──────────┘
                                                 │
                                            ┌──────────┐
                                            │letters += │
                                            └──────────┘
```

6. print('NEVER')
   letters = 0
   while (letters < 6):
       print('!')
       letters += 1

Activity 28: Practical Searches

This activity introduces students to the binary search and the linear search, between them.

Time

15 minutes should be spent here, as close reading is required.

Prer

None.
introd

RESOURCES

Numbered words in alphabetical order (one copy for the whole class)

PREPARATION

Print and cut out the resource into individual words. There is no connectio randomly selected seven-letter words, distributed fairly evenly throughout there to allow for quick sorting between activities.

DELIVERY

- Give 10 words, evenly distributed from the list, to 10 students, who sh class. They should stand in alphabetical order at the front of the room
- Nominate a student to find a word that you know is in that list. Questi
- Randomise the 10 students, so that they are no longer in order.
- Ask another nominee to look for a word that you know does not appe common in computing (e.g. searching for a web domain that's unavai be checked before we could say the word was definitely not there.
- Replace the 10 students with 10 others, take the old words in and this
- Ask another nominee to find 'pottery' – they probably won't look for i
- Demonstrate the binary search, questioning continually, e.g. 'Where d asked that half of the group to sit down?', etc.
- Give words to everyone in the class except one nominee and ask them
- Ask another nominee to search for a word that is not there (e.g. salute need to be examined to clarify its absence; compare this with previou
- Randomise the students/words and ask another nominee to attempt :

ADAPTATIONS

- Numbers, letters, dates, times can all be subject to this approach.
- Manipulating students as data tends to work well, as long as you mov

01. abandon	19. hi(
02. address	20. m(
03. archive	21. m(
04. balance	22. mi
05. chicken	23. ne
06. compete	24. os
07. concert	25. pl(
08. courage	26. po
09. develop	27. pr
10. digital	28. pu
11. dribble	29. re
12. evening	30. sc
13. explain	31. se
14. factory	32. sp
15. fortune	33. sv
16. freedom	34. tri
17. grimace	35. w(
18. haircut	

Activity 29: Practical Sorts

This activity centres around sorting students (each of whom carries a num[...] implementations of the bubble sort and insertion sort. Merge sort does n[...] as it is recursive.

Time
Up to **15 minutes** per search

Prer[...]
Stude[...]
algorit[...]
experi[...]

RESOURCES

- Code listing (one per student)
- Cut-out value numbers (one set for the whole class)
- Index numbers (one set for the whole class)

PREPARATION

- Print resources and cut out the numbers. These include integers, real numbers.
- Write spaces on a board for variables ('index' and 'position' for inserti[...] bubble sort).

DELIVERY

- Give the 10 value numbers (half-page-sized) to 10 students and positio[...] random order. An eleventh student can update variables on the board[...]
- Make it clear to the class that each number has a position, starting with [...] numbers (full-page-sized) at the feet of the appropriate students. Stude[...]
- Read through the code together as a class, taking advantage of the o[...] questioning; everyone should contribute multiple times.
- When the code moves a number in 'myList', the students should repo[...] changes, student #11 should write the change on the board.
- Repeat for the second search algorithm (with different students) if mome[...] at code would probably be beneficial at the interval for some groups, so [...]
- The activity can be repeated, with the same numbers, with new numb[...]

ADAPTATIONS

- This approach can suit any other algorithms, with the possible excepti[...] merge sort.
- Flowcharts and pseudocode can be interpreted, just as actual code is [...]

Insertion Sort

```
# The list begins unsorted
myList = [6, 3, -5, 0.2, -0.2, 10, 9, 1000, 3.141, 4

# Loop from the second element to the end
# (the first element makes up the 'sorted' part)
for index in range(1,len(myList)):

    # Put the current list item in a variable
    # It will be correctly positioned in the 'sorted' p
    currentvalue = myList[index]

    # Make a note of where we are
    position = index

    # While we're still within the list...
    # ... and while the value to the left of where we a
    # ... is greater than the value we're trying to pla
    while position > 0 and myList[position-1] > current

        # ... shift a number in the 'sorted' part right o
        myList[position] = myList[position-1]

        # then look at the next sorted number to the left
        position = position-1

    # Either when we reach the start of the 'sorted' pa
    # ... or the current number > number to its left...
    # ... put the number in the current position
    myList[position]=currentvalue

# Print the sorted list
print(myList)
```

Bubble Sort

```
# Original, unsorted list can be of any length, incl
myList = [6, 3, -5, 0.2, -0.2, 10, 9, 1000, 3.141, 4

# First outer iteration: go up to the last number
# Second outer iteration: go to the last but one
# ... then last but two, last but three, etc.
for passNumber in range(len(myList)-1, 0, -1):

    # For each of the numbers in this iteration...
    for i in range(passNumber):

        # If the number is greater than the one to its ri
        if myList[i] > myList[i+1]:

            # Swap them over
            temp = myList[i]
            myList[i] = myList[i+1]
            myList[i+1] = temp

# Display the sorted list
print(myList)
```

6

3

-5

0.2
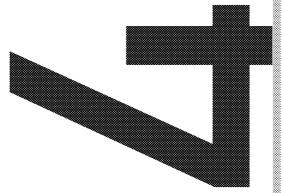
-0.1

10

9

100

3.14
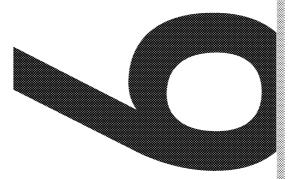
42

10

3

2

5

4

7

6

9

8
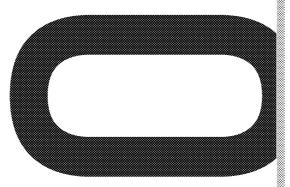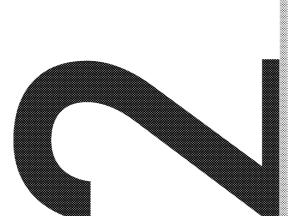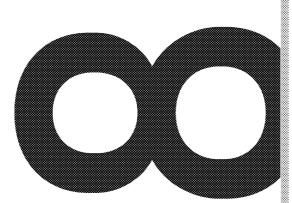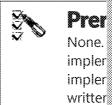
Activity 30: Sort Grid

This resource allows students to conduct a slow walk-through of the merg(search or sort algorithm. The grid contains spaces that can stand in as var meaning students can begin to conceptualise their own search and sort al(

Time
20 minutes

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None.
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writter

RESOURCES

- Search grid (one per individual or pair)
- Instructions (one per individual or pair)

PREPARATION

- Cut out the search grid, but leave it as a single piece (do not cut it int(
- Cut out the individual numbers and paper-clip them together.
- Bundle the grid, the numbers and the instructions, so each individual (

DELIVERY

- Students are provided with all instructions, leaving the teacher to que(
- Ultimately, the students will take up to 10 minutes to complete the m(repeatedly would be good for retention.
- Once all groups/pairs have attempted the activity, there can be a clas(turn stating where an individual number is moved to next. This shoul(misconceptions.
- As a plenary, students can devise a collective definition of 'merge sort

ADAPTATIONS

- The grid can also be used to walk through other sorts, such as the bu(The Python code from *Activity 29: Practical Sorts* can be used here.
- Students can devise their own sort algorithms, assessing them in term extra memory was needed) and time efficiency (how many individual !

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1. Begin with your list of unsorted numbers – random
   keep them together on a single row.

2. Break them into two equal sub-lists – we'll sort ea
   there's ever an odd number, it's fine for one sub-li
   number than the other.

3. How do we sort a sub-list? Begin by breaking it dc
   Keep going until each sub-list contains only a sing

4. Choose two sub-lists to build up into a larger sub-
   smaller goes into the new, larger sub-list first, foll
   number. If they're the same, the order doesn't mat
   remaining sub-lists, doubling the size of them, and
   are.

5. You can now build a pair of two-count sub-lists int
   list. Look at the first number in each of the smalle
   smaller goes into the new sub-list first.

6. Next, look at the smallest number of the *remains* c
   come from the sub-list you just took a number fro
   smaller number of the other sub-list. Place it into

7. Repeat steps 5 and 6 until all of your sub-lists are

8. Now look at two four-count sub-lists and repeat th
   number is smallest (from the front of either sub-li
   eight-count sub-list.

9. After you do this with another pair of four-count s
   sub-lists. Two each have eight numbers, and the c
   four-count sub-list with one of the eight-count sub
   have an eight-count and a twelve-count sub-list, e
   sorted.

10. Merge these last two sub-lists into a single list. If
    the list should be sorted into ascending numerical

Activity 31: Sub Programs

Before students begin programming sub programs, they should have a cle
This understanding is helped in this activity by a complete lack of code to
about sub programs, and they will also learn quite a bit about the system

Time
20 minutes

Prer
None

RESOURCES

- Sub program labels (one copy)
- Sub program instructions (enough copies for all group members to be five copies for a class of thirty students).
- Answer sheet (one copy for teacher)
- Ten paper clips
- Ten blank sheets of paper, approximately A6 size
- Thirty blank sheets of paper, approximately playing card size

PREPARATION

- Cut out the four sub program labels and position each one on a differ
- Place sub program instructions sets on their corresponding table
- Cut up 10 playing-card-sized pieces of paper onto each of the 'Main', 'ge
- Put 10 A6 sheets on the 'printPayslip' table.
- Give 10 paper clips to the 'Main' group..

DELIVERY

- Divide students into four groups, each of which will occupy a table. Th group twice the size of the others, and it should contain mathematica
- When the activity is running, you should provide salary amounts, in ar should not give anything to the other groups, but you can provide sal groups should be able to work on multiple payslips at the same time).
- Each group will pass data to other groups to model parameters and re
- The only group that should give anything to you is the 'printPayslip' g whether any mistakes were made (and, if so, in which sub program).

ADAPTATION

- Discussions (when they deviate from the fairness or otherwise of fiscal simplicity of each task vs the complexity of the whole; students could 'calculateTax' into yet smaller sub programs.
- In a later lesson, students could attempt to code this using a real prog

Main

calculateAllowance

calculateTax

Main

- Ask the user (the teacher will play the rule of the user, but don'
  much they get paid, and write this on a piece of paper marked 's
- Pass the salary to 'calculateAllowance' as a parameter.
- It will get passed back, together with a return value called 'allo\
- Attach 'salary' to 'allowance' with a paper clip, and pass them b(
- On return, there will now be a third value called 'tax'.
- Pass 'salary', allowance and 'tax' to 'printPayslip'.

✂ --

calculateAllowance(salary)

- You will receive a parameter called 'salary',
- If the salary is anything up to £100,000, the allowance is £11,850
- For every two pounds earned above £100,000, £1 comes off the

Income	Allowance
£100,000	£11,850 (the most you can earn and still get the
£100,002	£11,849 (income goes up by £2; allowance goes
£101,000	£11,350 (income goes up by £1,000; allowance g(
£123,700	£0 (from this point upwards, there is no allowa

- Write the allowance on a piece of paper called 'allowance', and p.

✂ --

printPayslip(salary, tax)

- You should receive a salary, an allowance and a tax amount fro
  the net pay (salary minus tax) and create a payslip like this:

[Today's date]	Gross pay:	[salary]
	Tax-free allowance:	[allowance]
	Deductions:	[tax]
	Net pay:	[salary – tax]

- Give this payslip to the teacher.

✂ --

calculateTax(salary, allowance)

- You should have received a salary and an allowance from 'Main
- Write 'tax' on a piece of paper along with the tax value. The tax
  - If the salary is less than or equal to the allowance, the tax is
  - If the salary is between the allowance and £45,000, the tax i
    the salary minus the allowance, with the result multiplied b\
  - If the person earns between £45,000 and £150,000, they pay
    - o   20% of the difference between their allowance and £\
    - o   40% of the difference between £45,000 and their sala
    (The tax is the result of these two numbers added together.)
  - If the person earns over £150,000, tax is paid in three parts:
    - o   20% of the difference between their allowance and £\
    - o   40% of the difference between £45,000 and £150,000
    - o   45% of the difference between £150,000 and their sal
    (The tax is the result of these three numbers added togethe\
- Give the salary, allowance and tax, as return values, back to Ma

Answer Sheet

Salary	Allowance	
£20,000	£11,850	
£105,000	£9,350	
£50,000	£11,850	
£100,000	£11,850	£
£115,000	£4,350	£
£200,000	£0	£
£250,000	£0	£
£10,000	£11,850	
£110,000	£6,850	£
£120,000	£1,850	£

Activity 32: Code Prediction

Ideally, students should learn to read code long before they try writing it. there's no reason to think it doesn't endure. In any language, we're gener; In this activity, students will attempt to discern what a piece of code does ?

Time
20–30 minutes, depending on depth of discussion; code snippets can be removed to cut down on time.

Prer
None.
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beginr
progra

RESOURCES

* PowerPoint presentation containing the code snippets with questions

  The above resource (code-prediction.pptx) is provided with the downloa

* Answer sheet
* Multiple-choice letters [A, B, C, D] (one set, cut out, per group of three

PREPARATION

* Open presentation and distribute multiple-choice letters (one set per

DELIVERY

* All students see the question and have around 30 seconds to read the c
* Within their groups of three or four, they (try to) come to a consensus
* Each group votes for the answer they feel is correct.
* A few groups are called upon to justify their answers, which may chan
* Each group votes again, based on what they have just heard.
* The teacher reveals the correct answer.

ADAPTATIONS

* Code snippets can be added, edited or removed.
* Students can be invited to contribute questions – the aim is to trip pe
  some way awkward).
* The multiple-choice format used here is effective, as it requires discus
  can be applied to any area for which a multiple-choice quiz could be (

Q1

```
giant = 1.6
ogre = 2.1
IF giant > ogre THEN
     Print('Ogre is taller')
ELSE
     Print('Giant is taller')
END IF
```

What will be displayed?

A. <u>'Giant is taller'</u>
B. 'Ogre is taller'
C. 'Giant is taller Ogre is Taller'
D. Nothing

Q2

```
counter = 1
WHILE counte
     print('
     counter
END WHILE
```

How many time

A. 9
B. 10
C. 1
D. <u>Infinity</u>

Q3

```
FOR x = 1 to 4
     FOR y = 0 to 2
          Print('Hello World')
     NEXT y
NEXT x
```

How many times is Hello World displayed?

A. 4
B. 8
C. <u>12</u>
D. 16

Q4

```
count = 20
REPEAT count
     count =
     print('
END REPEAT
Print('Goose
```

How many ducl

A. <u>20</u>
B. 12
C. 10
D. 8

Q5

```
Print('*')
FOR x = 1 to 5
     Print('*')
     FOR y = 0 to 2
          Print('*')
     NEXT y
NEXT x
```

How many asterisks (*) are displayed?

A. 10
B. 11
C. 20
D. <u>21</u>

Q6

```
count = 10
WHILE count
     Print('
     count =
END WHILE
```

How many time

A. An infini
B. 10
C. 1
D. <u>0</u>

B

D

A

C

Activity 33: Operator Bingo

The aim of this activity is to expose students to arithmetic operators in a w
of this bingo game is that everyone is performing the calculation, since no
number until it's resolved.

Time
10 minutes – but is repeatable.

Prei
None.
gaps i
addres

RESOURCES

* Caller's reference (one copy)
* Unique bingo cards (36 available), one per person

PREPARATION

Cut out the bingo cards and print out the caller's reference. Each bingo ca
and 19, and each is unique.

DELIVERY

* For purposes of keeping track, you might want to play the game usinc
and match between columns.

* The teacher (or the caller if a student) calls out a clue next to a numbe
symbols (e.g. 'Two chevron three') than the effect (e.g. 'Two to the po\

* Students get time to calculate the value of the clue, and then several ;
everyone knows what the number is, and any misconceptions are add
crosses it off on their card.

* This continues until one student (or several at once) have crossed off ;

ADAPTATIONS

* Problems could be made more challenging by showing multiple lines
value of a variable at the end of it.

* Bingo could be expanded to include a huge variety of clues, as well as
cards taken from all areas of the syllabus.

Number	Clue 1	Clue 2
0	8 MOD 2	(2 ^ 0) – 1
1	4 ^ 0	20 DIV 11
2	4 * 0.5	1 / 0.5
3	1 ^ 10 + 2	9 DIV 3
4	2 ^ 2	(4 * 5) / 5
5	11 DIV 2	32 MOD 9
6	2 ^ 3 – 2	2 ^ 2 + 2
7	63 / 9	21,000 / 3,000
8	(2 * 4) / 1	320 DIV 40
9	3 ^ 2	29 DIV 3
10	10 ^ 2 * 0.1	5 + (10 / 2)
11	2 ^ 3 + 3	100 DIV 9
12	2 ^ 4 – 4	2 * (10 – 4)
13	2 ^ 2 + 3 * 3	3 ^ 3 – 14
14	2 * 2 * 2 * 2 – 2	2 ^ 4 – (1 + 1)
15	1 + 2 + 3 + 4 + 5	150 DIV (2 * 5)
16	2 ^ 5 * 0.5	2 ^ 4
17	2 ^ 2 * 2 ^ 2 + 1	17 DIV 1
18	90 DIV (15 / 3)	2 ^ 4 + 2
19	99 MOD 20	57 DIV 3

Name:						
0		2		4		6
		12		14		16

✂ -

Name:						
0		2			5	
	11		13	14		16

✂ -

Name:						
0		2	3	4		6
			13		15	

✂ -

Name:						
0		2	3			
10	11	12			15	

✂ -

Name:						
0		2	3	4	5	
10	11				15	

✂ -

Name:						
0		2			5	
		12	13			16

✂ -

Name:						
0	1	2		4	5	
		12		14		

✂ -

Name:						
0	1	2		4	5	6
10			13			

Name:

0	1	2		4		6
10		12	13		15	

Name:

0	1	2	3	4		
				14	15	

Name:

0	1	2				
10			13		15	16

Name:

0	1	2			5	
10		12			15	16

Name:

			3			
10	11	12	13		15	16

Name:

			3		5	
10		12	13		15	16

Name:

			3	4	5	6
		12				16

Name:

			3	4	5	
10	11	12	13		15	

Name:

			3		5	
10	11	12	13		15	

✂ -

Name:

			3			
10	11				15	16

✂ -

Name:

	1	2			5	6
		12	13	14		

✂ -

Name:

	1	2				6
10			13	14		

✂ -

Name:

	1	2	3		5	
10		12	13		15	

✂ -

Name:

	1	2	3	4		
				14		

✂ -

Name:

	1	2	3	4		
10	11	12			15	16

✂ -

Name:

	1	2	3		5	
10		12		14		16

Name:						
0	1		3		5	
		12		14		16

✂ -

Name:						
0	1		3	4		6
				14		16

✂ -

Name:						
0	1		3	4	5	
		12	13			16

✂ -

Name:						
0	1		3			
10		12		14		16

✂ -

Name:						
0	1				5	6
	11	12	13	14		

✂ -

Name:						
0	1		3	4		6
10						

✂ -

Name:						
		2	3			6
10	11			14	15	

✂ -

Name:						
		2			5	6
10			13	14		

Name:						
		2	3	4		
		12			15	16

Name:						
		2	3	4		
10	11	12			15	

Name:						
		2	3	4	5	6
			13	14		

Name:						
		2	3	4	5	6

Activity 34: Murder Mystery

This activity involves students spending time reading Python, specifically w
and relational operators. Hidden in the code are the clues to a murder my

Time
30 minutes

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weake

RESOURCES

Four sets of clues, each of which is followed by the code to 'interpret' then

PREPARATION

You may wish to customise the resources here to suit your locale and sens

- 'Time of death code' refers to period 6, which won't exist on all time
- 'Weapon code' includes amusing weapon names, but they might no
- 'Murder code' and 'motive code' should include names of students/s
  institution, along with motives commensurate with their personalitie

An editable version (murder-mystery.docx) is provided with the downloadab

DELIVERY

- Each group is given the 'time of death' code and the crime scene infor
  through these until they have successfully determined the time of dea
  at the end of this resource).

- Next comes the receipt and the 'weapon code', which should be dealt

- Next is the murderer, along with the psychological profile.

- Finally comes the motive code, which requires only that the murderer'

- For large discrepancies in completion time, this could be made compe
  crime first wins. Early finishers could produce their own resource and s
  scene element, such as a co-conspirator or any witnesses.

ADAPTATIONS

- This could form part of a much larger investigation project, which mig
  encrypted clues. Such an exercise could occupy several weeks.

- With some adaptations, this exercise could cross into the realms of IT
  Computer Misuse Act? Clues could include time of day, IP address an

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Crime Scene Information

Body temperature:	21 °C
Lunch:	eaten
Door:	locked from the outside
Thursday's period 6 work:	not marked

Time of Death Code

```
if bodyTemp < 20:
    DayOfDeath = 'Wednesday'
elif bodyTemp > 30:
    DayOfDeath = 'Friday'
else:
    DayOfDeath = 'Thursday'

if LunchEaten == False and DayOfDeath == 'Thursd
    HourOfDeath = '13'
elif DayOfDeath == 'Thursday':
    HourOfDeath = '16'
else:
    HourOfDeath = '18'

if ThurSixMarking == False and Door != 'Locked f
    MinuteOfDeath = '15'
elif ThurSixMarking == True and Door == 'Locked
    MinuteOfDeath = '30'
elif ThurSixMarking == False and Door == 'Locked
    MinuteOfDeath = '45'
else:
    MinuteOfDeath = '00'

print('Death occurred: ' + DayOfDeath + 'at' + H
MinuteOfDeath)
```
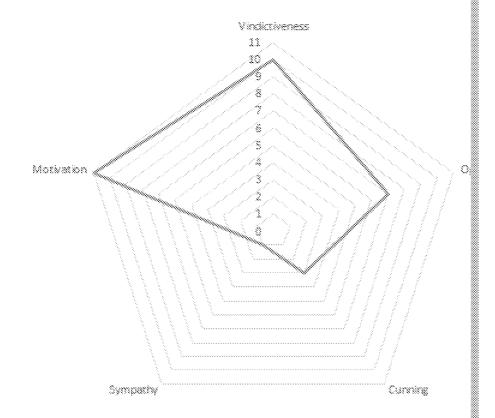
Receipt for Weapon Purchase

```
Zombie Apocalypse
Hardware Store
==================
Sales receipt
==================
Dept/Product

67/A14B    £500

TOTAL      £500

24/12/2017 - 1100
```

Weapon Code

```
if time > 1100 and time < 1600:
    model = 'model-a'
elif time < 1100 or time > 1400:
    model = 'model-b'
elif time > 111 and time < 1111:
    model = 'model-c'

if DeptID > 67:
    type = 'electric'
elif DeptID < 67:
    type = 'manually-operated'
else:
    type = 'petrol-driven''

if product[1] == 'B' and product[4] == 'A':
    description = 'bunny burner'
elif product[1] == 'A' and product[4] == 'B':
    description = 'doggie disembowler'
elif product[0] == 'B' and product[3] == 'A':
    description = 'meerkat maimer'
elif product[0] == 'A' and product[3] == 'B':
    description = 'kitten killer'

print('The weapon was a' + model + ' ' + Type +
```

Psychological Profile of Killer

Murderer Code

```
if (vindictiveness > 8 or sympathy < 1) and cunn
    murderer = 'Student1'
elif opportunity > 7 or (cunning < 5 and sympath
    murderer = 'Student2'
elif (vindictiveness >= 10 or sympathy < 1) and
    murderer = 'Student3'
elif (cunning < 5 or opportunity > 10) and motiv
    murderer = 'Student4'
elif (opportunity > 1 and motivation > 50) or sy
    murderer = 'Student5'
elif cunning > 3 or (sympathy >= 1 and motivatic
    murderer = 'Student6'

print('The murderer is: ' + murderer)
```

Motive Code

```
if killer == 'Student1':
    motive = 'Motive1'
elif killer == 'Student2':
    motive = 'Motive2'
elif killer == 'Student3':
    motive = 'Motive3'
elif killer == 'Student4':
    motive = 'Motive4'
elif killer == 'Student5':
    motive = 'Motive5'
else:
    motive = 'Motive6'

print('The motive was' + motive)
```

Use these code examples:

Time of death:	Thursday at 16:45
Weapon:	Model-c petrol-driven kitter
Murderer:	Student5
Motive:	Motive5

Activity 35: Beat the Banker

The aim of this activity is to expose students to arithmetic operators. The a
specification, but focuses mainly on DIV, MOD and exponentiation (as well

It is based on 'Deal or No Deal', in which participants can choose to accept
money from their teacher in this case) or risk receiving a lower amount in p
here is that participants are required to perform calculations in order to ful

Time

Up to **15 minutes** for a single game

Prer

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MOD a
BIDMA

RESOURCES

Examples sheet (one for teacher) with answers

PREPARATION

- Choose a column from the example sheet, or a combination, as long a
  represented once (i.e. don't have two equations that both result in 10,
- Print each equation from your chosen column(s) on a sheet of paper l
  the room, or add them to a presentation. If you use a presentation, m
  any slide without showing students what is on the other slides.
- If you're going paper-based, put each piece of paper into an envelope
  deal box.

DELIVERY

- The player can be an individual or a small group.
- The rest of the class serves as an audience. That being a passive role,
  expectation that everyone in the room attempts to solve all equations
- Tell everyone there are 10 possible prizes available: 1, 50, 100, 250, 50
  100,000.
- Take two envelopes out of the game and show their contents to every
  attempting them, but no one should shout out an answer, as the com
  need to work it out). Those prizes are now unavailable.
- You now take the role of the banker and offer a prize that the player c
  than the remaining maximum (and earlier in the game, you should off
- If they accept it, that's their prize and this round is now over. If not, a
  and the process is repeated.
- Once you have removed two prizes four times, there should be two le
  envelope at random and ask the player to open the last remaining on

ADAPTATIONS

- For weaker groups, a smaller set of numbers might be advisable, as cc
  calculating. Conversely, more can be offered for stronger groups, and
- Allow an audience member to 'steal' the game if the player gets a calc

Answer	Example 1	Example 2	Example 3
1	10 MOD 3	(3 * 6 * 0 * 9) + 1	(50,000 MOD 1) + 1
50	650 DIV 13	101 MOD 51	50 * 0 + 50
100	(880 DIV 8) – 10	2 ^ 6 + 6 ^ 2	10 ^ 2
250	((3 ^ 3) * 10) – 20	(25 * 20) DIV 2	550 MOD 300
500	600 – 10 ^ 2	1,000 DIV 2	(1,000 MOD 100) + 500
1,000	10 ^ 3	1,000,000 DIV 1,000	10 ^ 4 / 10
5,000	255,000 MOD 10,000	10 ^ 3 * (15 MOD 10)	10 ^ 4 DIV 2
10,000	(1,000 MOD 1,000) + 10,000	10 ^ 4	90,000 MOD 20,000
50,000	10 ^ 4 * (5 MOD 10)	(250,000 DIV 5) ^ 1	50,000 MOD 100,000

Activity 36: Hostile Robot

A truly unique activity that teaches students that, when programming, one malicious or ill-informed input on the part of a user.

Time

5 minutes – can be extended by increasing the number (and/or complexity) of tasks

RESOURCES

Optional: suggested activities sheet, to be used as a reference by the teach

PREPARATION

The suggested activities sheet does not need to be followed, but the teach or on paper that pupils will instruct other pupils to carry out.

DELIVERY

- Divide students into groups of around four.
- One student in each group is the hostile robot, and they should switch group's hostile robot. Each hostile robot belongs to their original gro
- The teacher assigns an activity, such as standing up and walking to a s
- The 'programmers' tell the hostile robot what to do in order to comple
- The job of the hostile robot is to look for any loopholes in the instruct programmers' task more challenging. For example:
  - if asked to turn right, they could turn one degree, or turn contin
  - if asked to turn 90 degrees, they could do so slowly, or about th
- The only things the hostile robot cannot do are:
  - fail to follow an instruction (e.g. turning left instead of right)
  - carry out a task they were not instructed to do (e.g. sticking out possible)
- The group programming the first hostile robot to finish wins.

ADAPTATIONS

- This activity could be made yet more infuriating by insisting that the p the hostile robot does anything. This would be an interesting way of (between an interpreter and a compiler.

Suggested Activities

- Stand up and walk behind your chair, facing the sar
- Retrieve an item from across the room, with variou
- Draw a particular picture, using a single pencil or n
- Stack 10 upside-down plastic cups into a four-layer
- Reorganise the order of three stacked alphabet blo
- Walk to a door, open it, walk through it and close it.
- Construct something out of Lego or something sim
- Retrieve and put on a blazer that has been put else
- Put together the main components of a computer s
- Put a row of chairs under the desk.
- Create a piece of art using Microsoft Paint.

Activity 37: Logic Gates

This activity allows students to become intimately familiar with logic gates
They will be asked to identify a missing input, output or gate up to 28 time

Time
5–15 minutes

Prer
Famili
OR an
could
this ac

RESOURCES

- Logic gates cards (cut out, one per individual)
- Answer sheet (for the teacher)

PREPARATION

- The cards should be cut out for use by students, but not necessarily a
  student. You might wish to give all 28 to all students, or you might wi
  small subset as a starter.
- Alternatively, you could pair up students, who could either help one a

DELIVERY

Delivery will vary based on the time and tone of the lesson:
- Students could work through the set (or part thereof), methodically in
- Pairs of students could compete with one another. They have two mi
  possible. A correct answer gains a point, an incorrect answer loses a
  score as it is.
- The whole class could be shown each in turn and stand at one side of
  other side to indicate FALSE. Justifications would then be requested.

ADAPTATIONS
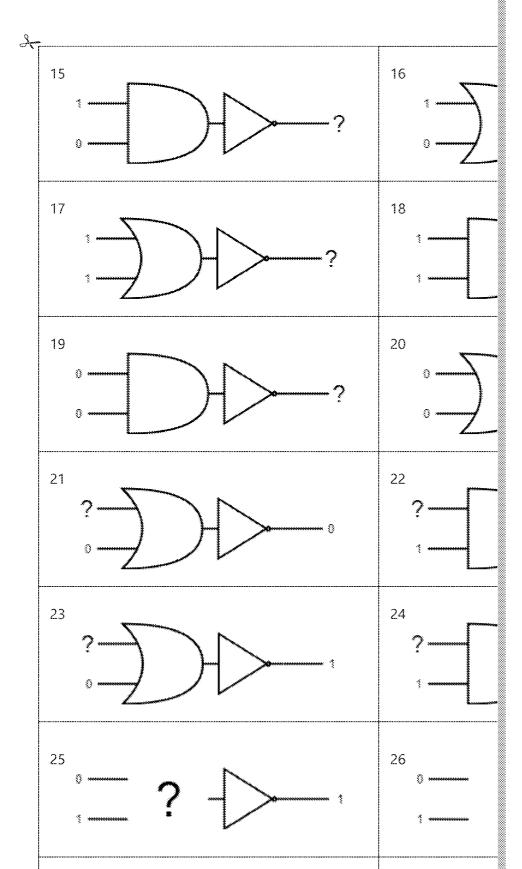
- This approach would also work for code snippets as well as relational
- There is no upper limit to the complexity of the logic circuits for this t
  create similar challenges for their peers.

Logic Gate Cards

1 	**2** 1 1
3 	**4** 1 1
5 	**6** 0 0
7 	**8** ? 0
9 	**10** ? 0
11 0 **?** 1 1	**12** 0 1
13 1 **?** 0 1	**14** 1 0

15

1
0
?

16

1
0

17

1
1
?

18

1
1

19

0
0
?

20

0
0

21

?
0
0

22

?
1

23

?
0
1

24

?
1

25

0
1
?
1

26

0
1

27

1
0
?
1

28

1
0

Answer Sheet

1. 0 / FALSE

2. 1 / TRUE

3. 1 / TRUE

4. 1 / TRUE

5. 0 / FALSE

6. 0 / FALSE

7. 1 / TRUE

8. 1 / TRUE

9. 0 / FALSE

10. 0 / FALSE

11. OR

12. AND

13. OR

14. AND

15. 1 / TRUE

16. 0 / FALSE

17. 0 / FALSE

18. 0 / FALSE

19. 1 / TRUE

20. 1 / TRUE

21. 1 / TRUE

22. 0 / FALSE

23. 0 / FALSE

24. 1 / TRUE

25. AND

26. OR

27. OR

28. AND

Activity 38: Logic Puzzle

This is a challenge of students' powers of deduction. Using only five clues, explorers began their expeditions in which European cities, as well as how

Time

15 minutes is recommended, including 5 minutes for marking

Prer

None,
lend it
studer

RESOURCES

- Puzzle sheet (one per pair)
- A solution and a walkthrough is available for the teacher

PREPARATION

Print out enough puzzle sheets for one between two. This is the optimal g larger group results in passengers, and it is a difficult puzzle to solve alone

DELIVERY

- Distribute the puzzle sheets 1 between 2
- Inform students that they will gain a mark for each correctly-filled box incorrectly-filled box; boxes left empty will not affect the score either \
- If students feel a fact is true, e.g. that Jones took 85 days, they should 'Jones' and '85 days'.
- If students feel a fact is false, e.g. that Jones did **not** take 85 days, they intersection of 'Jones' and '85 days'.
- All relationships are mutually exclusive, meaning that if Jones **did** take and Jones didn't take any other amount of time.
- Students will need to read some clues more than once to solve the pu
- You may wish to work through the first clue with the class.
- After ten minutes, students will probably have resolved as many clues assessment can be used, led by the teacher with his/her answer sheet,

ADAPTATIONS

- Similar puzzles can be used as a starter on a regular basis; there are lo online.

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		Explorers					
		Jones	Morgan	Covington	Brown	Geneva	Florence
Durations	85 days						
	96 days						
	107 days						
	118 days						
Cities	Geneva						
	Florence						
	Paris						
	Lisbon						

Clues

1. Morgan's expedition lasted for 118 days
2. Covington was on an expedition for 107 days
3. The explorer named 'Brown' took 11 days less than the e: Lisbon
4. The explorer from Geneva finished 22 days after the exp
5. The explorer who was on the road for 96 days was eithe initially based in Lisbon

Solution

		Jones	Morgan	Covington	Brown	Geneva	Florence
						Explorers	
Durations	85 days	–	–	–	X	–	⟩
	96 days	X	–	–	–	–	–
	107 days	–	–	X	–	X	–
	118 days	–	X	–	–	–	–
Cities	Geneva	–	–	X	–		
	Florence	–	–	–	X		
	Paris	–	X	–	–		
	Lisbon	X	–	–	–		

Walkthrough

a. The first two clues are self-explanatory - place an X at the intersection at the intersection of 'Covington and '107'.

		Explorers				Cities			
		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days								
	96 days								
	107 days			X					
	118 days		X						
Cities	Geneva								
	Florence								
	Paris								
	Lisbon								

b. Now, within that 4 x 4 area, add dashes across all remaining rows and (placed.

		Explorers				Cities			
		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days		-	-					
	96 days		-	-					
	107 days	-	-	X	-				
	118 days	-	X	-	-				
Cities	Geneva								
	Florence								
	Paris								
	Lisbon								

c. Clue 3 doesn't allow us to place an X, but we can add a dash. The clue start in Lisbon, so we can put a dash at the intersection of 'Brown' and

		Explorers				Cities			
		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days		-	-					
	96 days		-	-					
	107 days	-	-	X	-				
	118 days	-	X	-	-				
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

d. Clue 4 tells us that the Geneva trip couldn't have been 85 or 96 days, s[...]
longer than any of the other values. Similarly, the Florence trip can't h[...]

		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days		-	-		-			
	96 days		-	-		-			
	107 days	-	-	X	-		-		
	118 days	-	X	-	-		-		
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

e. Clue 5 gives us two possibilities, but since we already know Covington [...]
conclude that the Lisbon trip took 96 days.

		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days		-	-		-			
	96 days		-	-		-	-	-	)
	107 days	-	-	X	-		-		
	118 days	-	X	-	-		-		
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

f. The 'Florence' column now contains three dashes, so by process of elir[...]
the 85 day expedition.

		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days		-	-		-	X	-	
	96 days		-	-		-	-	-	)
	107 days	-	-	X	-		-		
	118 days	-	X	-	-		-		
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

g. Look back at clue 3. Now that we know that the Lisbon trip took 96 da[ys] have taken 85 days.

		Explorers				Cities			
		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days	-	-	-	X	-	X	-	
	96 days		-	-		-	-	-	)
	107 days	-	-	X	-		-		
	118 days	-	X	-	-		-		
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

h. By process of elimination, Jones must have taken 96 days.

		Explorers				Cities			
		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days	-	-	-	X	-	X	-	
	96 days	X	-	-	-	-	-	-	)
	107 days	-	-	X	-		-		
	118 days	-	X	-	-		-		
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

i. Look back at clue 4. Since we now know that the Florence trip took 85 [days] taken 107.

		Explorers				Cities			
		Jones	Morgan	Covington	Brown	Geneva	Florence	Paris	Lisbon
Durations	85 days	-	-	-	X	-	X	-	
	96 days	X	-	-	-	-	-	-	)
	107 days	-	-	X	-	X	-	-	
	118 days	-	X	-	-	-	-		
Cities	Geneva								
	Florence								
	Paris								
	Lisbon				-				

Activity 39: Debugging

The premise for this resource is that students must spend time reading cod
identifying errors in the code of others, one's own code quality improves.

⏱ **Time**	🔧 **Prer**
10 minutes	Studer
	of pro

RESOURCES

- Commented original code, free from errors (for teacher)
- Debugging activity (one per student or pair)
- Commentary (one per student)

PREPARATION

- Ensure a debugging activity is printed for each student or pair.
- Optional: print enough commentaries if students are likely to keep the
- Print a copy of each resource for the teacher.

DELIVERY

- Students are given 10 minutes (adjust at your own discretion) to ident
  code as they can.
- At various points as the clock runs down, students can state how man
  competition).
- At the end of the exercise, students should lead the discussion on whe
- Questioning should involve all students, as one student can be asked
  another.
- The role of the teacher, at the end, is to clarify any remaining issues as
  what does not.

ADAPTATIONS

- This activity should be repeated frequently. As the level of code grow
  grow in obscurity.
- As part of learning to debug their own code, students should delibera
  note of what they did and what the error message said, they will be in
  that error message the next time they see it.

```
# Declare the sub program
def checkPrime(number):

    # For numbers below 2, don't check to see if it's prime
    if number <= 1:
        print("Not greater than 1")

    # Otherwise...
    else:

        # ... begin by assuming the number is true
        prime = True

        # Check for each integer between 2 and number - 1
        for x in range(2, number):

            # If the number divides without a remainder...
            if number % x == 0:

                # ... then it can't be prime
                prime = False

        # Display appropriate output
        if prime:
            print("Number is prime")
        else:
            print("Number is not prime")

# Prompt the user for a number
number = int(input("Enter number: "))

# Pass that number as a parameter to the sub program
checkPrime(number)
```

Circle the Issues

This Python program should determine whether a number is prime or not.
Numbers below 2 cannot be prime, so they are not considered. The number

```
1    Def CheckPrime(number):

2        if number <= "1"

3            Print("Not greater than 1)

4        else:

5        prime = True:

6            for x in range(number):

7                if number % x = 0:

8                    prime == false

9            if Prime:

10                print("Number is prime")

11            else:

12                print("Number is not prime"

13

14    Number = input(int("Enter number:

15    checkPrime(Number)
```

```
1    Def CheckPrime(number):
2        if number <= "1"
3            Print("Not greater than 1)
4        else:
5        prime = True:
6            for x in range(number):
7                if number % x = 0:
8                    prime == false
9            if Prime:
10               print("Number is prime")
11           else:
12               print("Number is not prime")
13
```

Line 1 – should be a lower case 'd' for 'def'

Line 2 – When comparing numbers, quotation marks should not be used (for strings only)

Line 2 – Missing colon from the end of the line

Line 3 – 'Print' should begin with a lower-case 'p'

Line 3 – Missing quotation mark inside the brackets

Line 5 – Not a selection or iteration statement; should not be a colon (therefore, the following line would not need to be indented)

Line 6 – This loop should run from 2, otherwise it would divide any number by 1 to get a remainder of zero, thus showing all numbers as 'not prime' (this is a tough one – well done if you noticed it)

Line 7 – Making a comparison requires two equals signs

Line 8 – Assigning a value to a variable should be only a single equals sign

Line 8 – False statements should begin with a capital (same applies with True)

Activity 40: Human Translation

Spoiler alert: if this activity is successful, you will have a class of students d
pleasure to watch, especially as they won't realise, at the same time, what (
Pedagogically, they're being introduced to the concept of translation betw

⏱ **Time**	🖊 **Prer**
From **5 minutes** upwards	None

RESOURCES

- Symbol table (one per pair) – provided 2 to a page
- Code listing (one per pair)

PREPARATION

- Assuming students will be in pairs, print enough resources for one per
  work, and individual work might also be beneficial. It depends on the
  good place to start.
- A video or audio copy of the Macarena would be good to have close t
  end of the activity.

DELIVERY

- Students are informed they are taking the role of computers. They are
  first, which they do not understand. They can be told that, parallel to
  Python without first translating it into object code.
- At this point, students can be given the symbol table, which translates
  object code that they understand.
- Students translate and execute (i.e. act out) the code. The activity will
  they don't know the end goal. This is poignant, as computers also do
  simply execute one instruction at a time.
- It is important to reiterate the relationship between the source code a
  definitions of the two could be produced as a mini-plenary.

ADAPTATIONS

- In order to facilitate discussion of the difference between compilers ar
  execute a line at a time, while another executes the whole program. C
  then be observed.

Symbols Table

Symbol	Translation
👌	90
☽	Arm
✏	Circle
✋	Clap
☺	Degrees
😐	Down
☹	Ear
💾	Forwards
☠	Hand

Symbol
🏳
🏴
✶
⧗
❄
✂
☢
📖
✠

Symbols Table

Symbol	Translation
👌	90
☽	Arm
✏	Circle
✋	Clap
☺	Degrees
😐	Down
☹	Ear
💾	Forwards
☠	Hand

Symbol
🏳
🏴
✶
⧗
❄
✂
☢
📖
✠

Code Listing