

Merge Sort



A	2	9	7	8	4	1	3	10
B	7	9	12	4	6	10	4	1
C	17	12	19	7	8	14	28	3

Sort the above numbers using the merge sort algorithm.

Show the numbers being divided and merged as shown in the example.

Bubble Sort

Choose a sorting / searching algorithm.

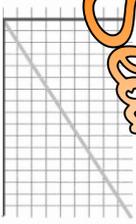
List the different steps required to

complete the algorithm and either represent these as a flow diagram and/or pseudocode.

Binary Search

01101100
01101111
01110110
01100101

Linear Search



Insertion Sort

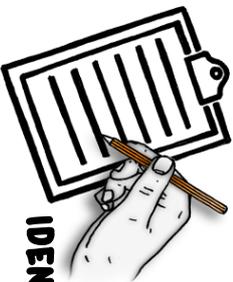


Compare!

BUBBLE	INSERTION	MERGE

LINEAR	BINARY

KNOW IT ALGORITHM



IDENTIFY A PROBLEM.

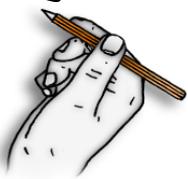
USE DECOMPOSITION TO

IDENTIFY ALL OF THE

SUBPROBLEM YOU WOULD

BE REQUIRED TO ADDRESS.

Design!



Create an algorithm for one of the situations below!

(Your algorithm can either be a **flow diagram** or **pseudo code**)

Make your algorithms as **efficient** as possible!

1) Create an algorithm for a guessing game. It is a two person game. The first player gets to enter a number. The second player gets three guesses to guess the number. They either get told that they are correct or to guess again!

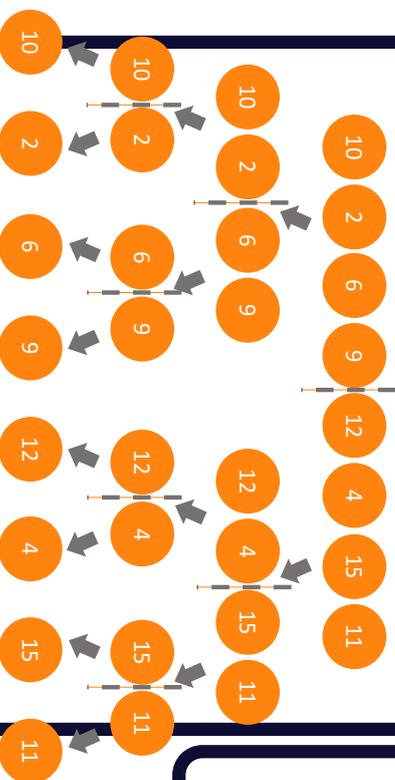
2) Create an algorithm for a binary, denary and hexadecimal converter. The user should be able to enter their conversion and the number which they wish to convert. They should be asked for another number to convert until they enter 'Exit'.

3) A quiz which asks 10 random maths questions from +, -, * and /. **Expand** - ask for an answer to each question and/or keep score as they go along. *Hint: You will have to GENERATE random number*

Merge Sort - Summarise the method of a merge sort.

The **merge sort** works by dividing the list into sublists until each sublist contains a single item before repeatedly merging the sublists until an ordered list remains.

Step 1: Repeatedly divide the list into sublists until you have individual items.



Step 2: Begin to merge the sublists together, rearranging them if necessary.



Step 3: Continue to merge the sublists, rearranging them if necessary.



Step 4: Continue to merge the sublists, rearranging them if necessary.



You will be left with a list which is ordered!

Sorting and Searching Algorithms

The stages of the **merge sort** algorithm are often referred to as 'divide', 'conquer' and 'combine'. Which stages do you think these are used in reference to?

Investigate/compare the binary search and linear search algorithms in terms of efficiency. Which is more efficient? Focus your comparison on time.

Investigate/compare the bubble sort and merge search algorithms in terms of efficiency. Which is more efficient? Focus your comparison on time.

Investigate/compare the merge sort and insertion sort algorithms in terms of efficiency. Which is more efficient? Focus your comparison on time.

Investigate/compare the bubble sort and insertion sort algorithms in terms of efficiency. Which is more efficient? Focus your comparison on time.

The example of merge sort used contains an even list of numbers. Will the method change if an odd list of numbers is used? **Demonstrate** a merge sort using an odd list of numbers.

Computational Thinking

Explain why the use of abstraction is important when designing algorithms.

Explain why the use of decomposition is important when designing algorithms.

Taking the game 'Hang Man', use **decomposition** to **identify** all of the subproblem that you would need to address to create the game on a computer.

Algorithms

Compare the two different methods of writing algorithms, which is best? **Justify** your decision.

Discuss which method of creating algorithms you feel is best suited for a programmer to use? **Justify** your answer.

Explain why is it important that algorithms are **efficient**. If possible, **link** this to the hardware topic.

Explain the difference between a **while loop** and a **for loop**. Give an **example** where each should be used. Which **loop** would you use for the following situations? **Explain/justify** your answer.

- To read each letter in a person's name.
- To repeat the 5 times table from 1 x 5 to 10 x 5.
- To make a user re-enter a password if it is incorrect.



Bubble Sort

- A** 10 20 30 40 50 60 78 80
- B** 15 9 22 27 14 33 30 21
- C** 44 30 16 51 27 28 12 6

Sort the above numbers using the **bubble sort** algorithm. Show the order of the numbers after each time you have passed through the list.

Insertion Sort

- A** 4 2 8 9 7 12 11 10
- B** 19 5 8 7 15 22 4 2
- C** 40 9 32 27 20 51 18 1

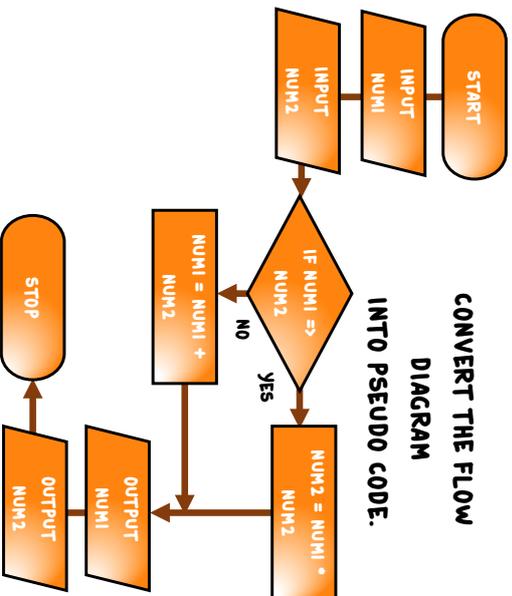
Sort the above numbers using the **insertion sort** algorithm. Show the order of the numbers after each time you moved/inserted a number.

Binary Search

- A** 14 2 7 9 1 11 8 4 2
- B** 7 3 19 4 8 8 17 9 17
- C** 19 27 2 41 33 21 13 49 50

Search for the numbers above using the **binary search** algorithm. Show the order of the numbers after each time you have split the list into two.

Convert!



Grasp IT



ALGORITHM

Design!

Create an algorithm for one of the situations below!
(Your algorithm can either be a **flow diagram** or **pseudo code**)
Make your algorithms as **efficient** as possible!

- 1) Create an algorithm which allows for any number to be entered. The number should be multiplied by 2 then output. If the number is bigger than 100 it should also print target met. If less than 100 it should print target not met.
- 2) Create an algorithm which asks an employee how many days they work per week and how many hours they work per day. Multiply these two numbers together and then multiply it by 52 to work out how much they earn per year. Output this number.
- 3) Create an algorithm which will convert from miles to kilometres or vice versa. The user should be asked which calculation they want to make, the distance which they want to convert and be given the converted distance.



LIST THE MAIN DIFFERENCES BETWEEN THE SORT / SEARCH ALGORITHMS.

Bubble Sort - Summarise the method of a bubble sort.

A **bubble sort** works by comparing each item in the list to the item to the right of it. The item is then moved based on which is bigger / smaller.

Step 1: Compare the first two numbers.
Are they in order? Adjust them if not.



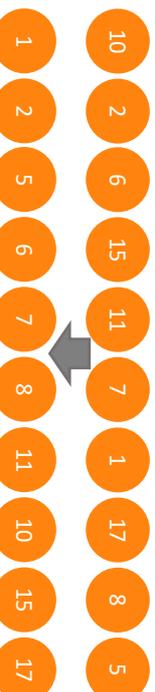
Step 3: Move to the next two numbers.
Are they in order? Adjust them if not.



Step 5: Once you have been through the entire list, check that they are in order. If they are, great! If not, undertake the same process again until they are in order.

Binary Search - Summarise the method of a binary search.
A **binary search** works by repeatedly dividing the number of items by two until you are left with the item that you are searching for. We are searching for the number 2!

Step 1: Put the items into order.



Step 2: Locate the middle number (Divide the total by 2 e.g. $10/2 = 5$)



Step 3: Check! Is your this number less than, equal to or greater than the number you are looking for?

If it is greater than, you can remove all of the numbers to the right. If it is less then, you can remove all of the numbers to the left.

Repeat steps 2 and 3 until you find the number you are looking for.

Insertion Sort - Summarise the method of an insertion sort.

The **insertion sort** works by looking at each value in turn and inserting the value into its correct place in the list.

Step 1: Compare the first two items.
 $9 > 2$ so 2 moves position.



Step 2: Insert 5 into its correct position.
 $5 > 2$ and $5 < 8$ so 5 moves position.



Step 3: Insert 8 into its correct position.
 $8 > 5$ so stays in the same position.



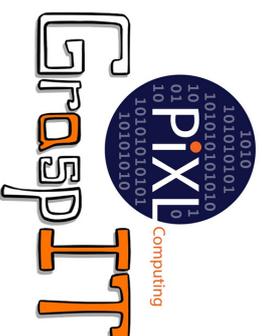
Step 4: Insert 7 into its correct position.
 $7 > 5$ and $7 < 8$ so 7 moves position.



Algorithm Efficiency

Algorithm Efficiency

When creating algorithms it is important that they are **efficient**. This would mean using the least numbers of instructions possible. This would make the algorithm quicker to go through. This is known as **time efficiency**.



ALGORITHM

Algorithms

Explain why the order of instructions in an algorithm is important.

Explain why it is important to design/create algorithms before creating a coded solution.

Explain which search method is most efficient?

Explain which search method is least efficient?

Creating Algorithms

Give a **benefit** of using a flow diagram over pseudo code.

Give a **benefit** of using pseudo code over a flow diagram.

Select an algorithm from over the page. **Convert** it from a **flow diagram** to **pseudocode** or vice versa.

Linear Search - Summarise the method of a linear search.

A linear search checks item in the list to find the item that you are looking for. We are searching for the number 7!



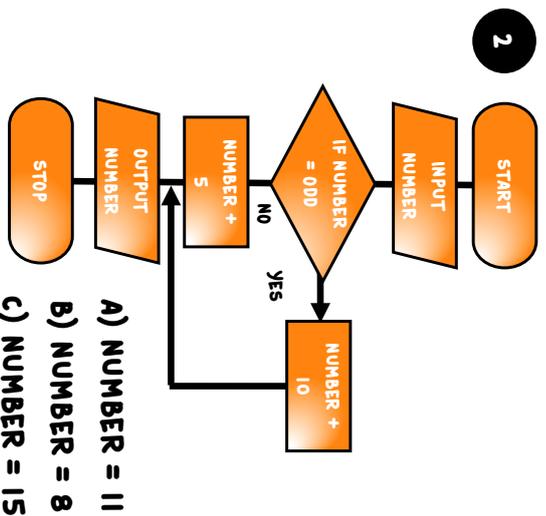
This continues until the desired value is located!

Follow the algorithm!

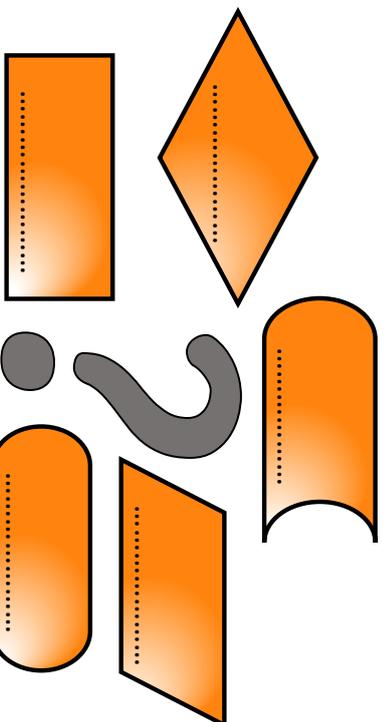
EXPLAIN WHAT EACH IS DOING AND WORK OUT WHAT IS OUTPUT WITH THE DIFFERENT INPUTS!

```

1 number = 0
FOR count = 0 to 10 DO
  number = number *
  IF number < 50 THEN
    OUTPUT "True"
  ELSE
    OUTPUT "False"
NEXT count
a) total = 5 b) total = 8 c) total = 10
  
```



- A) NUMBER = 11
- B) NUMBER = 8
- C) NUMBER = 15



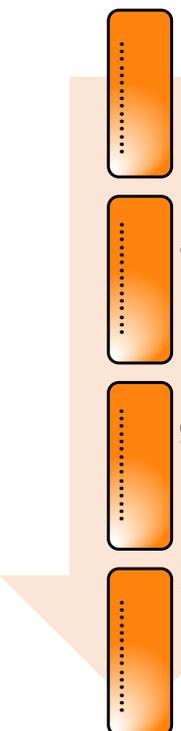
EXPAND – STATE THE PURPOSE OF EACH SYMBOL



THINK IT ALGORITHM

Algorithm Design!

- PSEUDOCODE?
- ABSTRACTION?
- DECOMPOSITION?
- FLOW DIAGRAM?

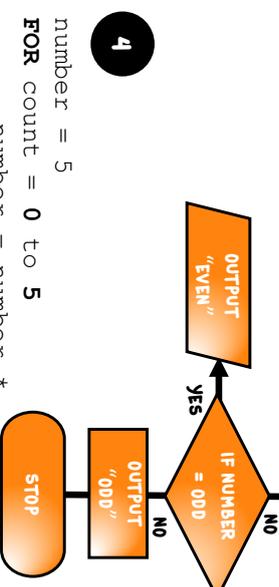
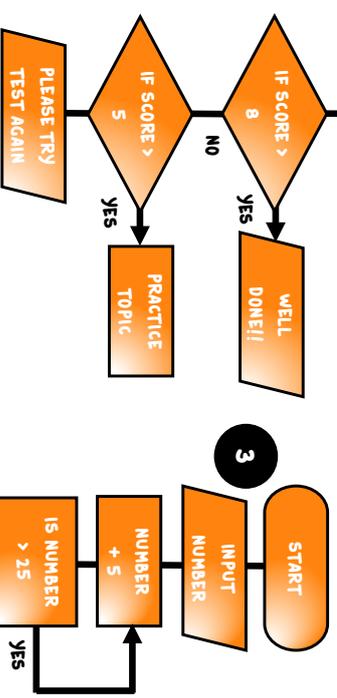


Summary!

(CORRECT THE MISTAKES)

```

1 START
  INPUT number
  IF number > 50 then
    OUTPUT "Bigger than 50!"
  ELSE number > 25 THEN
    "Bigger than 25!"
  END
  INPUT name
  INPUT age
  END
  
```



```

4 number = 5
FOR count = 0 to 5
  number = number *
  3 number = number -
  OUTPUT number
  count
  IF number > 20
  print "Target met!"
  
```

Computational Thinking

What is **computational thinking**?

Analysing a problem and identifying the solution in a way that a computer can carry it out.

What is **decomposition**?

Breaking down a problem into number of sub problems. Each subproblem should be a different task. Decomposition helps us solve complex problems.

What is **abstraction**?

Filtering out ideas and details that are not needed to concentrate on those that are. E.g. your timetable is an abstraction of what happens in a school day.

What is **algorithmic thinking**?

Identifying the exact steps required to solve a particular problem – usually by creating an **algorithm**. E.g. Identifying the exact steps required to create an automated quiz etc. Algorithms are usually displayed as **flow diagrams** or **pseudocode**.

Creating Algorithms

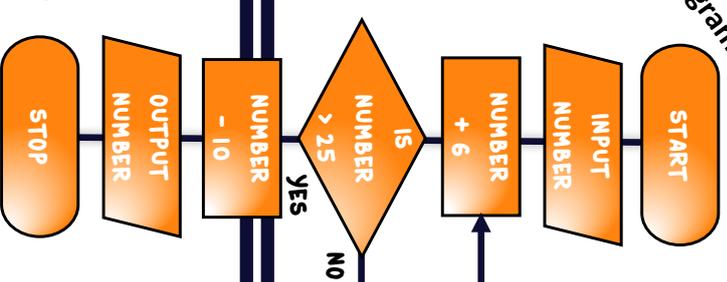
Two main methods are used to design algorithms: flow diagrams and pseudocode.

Flow Diagrams – Different symbols are used to start and end the diagram, whether information has been input or output, where a decision needs to be made (usually an IF statement or loop) and where a process is triggered e.g. add number 1 and number 2.

Pseudocode – Programs are written using a programming language which has specific rules and a specific syntax. The program will not run if the correct syntax is not used. Pseudocode looks similar to a programming language but it does not have a specific syntax which needs to be followed.

Pseudocode is not a programming language, it is a simple way of describing a set of instructions that does not have to use specific syntax.

Flow Diagram



Pseudocode

Sequence
INPUT number1
INPUT number2
total = number1 x number2
OUTPUT total

IF Statement
INPUT password
IF password == "Password1" THEN
OUTPUT "Welcome!"
ELSE

OUTPUT "Please try again!"
ENDIF

For Loop (Definite Loop)

number = 6
FOR count = 0 to 15 DO
number = number * 2
OUTPUT number
NEXT count

While Loop (Indefinite Loop)

total = 8
WHILE total < 100 DO
OUTPUT total
total = total * 2
ENDWHILE



Algorithms

What is an **algorithm**?

An **algorithm** is a sequence of steps that can be followed to complete a task or solve a problem. In computer science algorithms can either be expressed as **standard English**, a **flow diagram** or **pseudocode**.

What is a **searching algorithm**?

A step-by-step procedure used to locate specific data among a collection of data. It is considered a fundamental procedure in computing. E.g. locating a number within a larger list of numbers.

What is a **sorting algorithm**?

A step-by-step procedure that puts elements of a list into a certain order. This could be numerical or alphabetical order.

BIT PATTERN DENARY PATTERN

00000000	0
00000001	1
11111111	-1
00000011	3
11111101	-3
00011111	31
11100001	-31

Binary Data



KNOW IT

COMPUTATIONAL LOGIC

CS & Math's

```

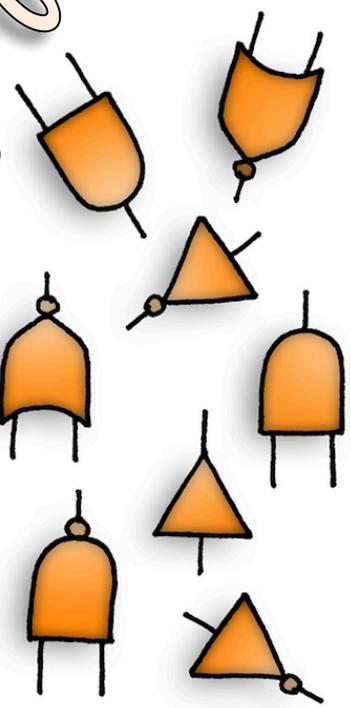
24  getline(cin, s);
25  system("cls");
26  string t=trim(s);
27  string s=trim(t);
28  if (s.length() < 4) {
29      again = true;
30      continue;
31  }
    
```

A	B	CARRY-IN	SUM	CARRY-OUT
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0

Truth Tables

NOT	A'	$\neg A$	\bar{A}	$\neg A$
AND	AB	$A*B$	$A \cdot B$	$A \wedge B$
OR	$A+B$	$A \vee B$	$A \cup B$	$A \vee B$
NAND	$(AB)'$	\overline{AB}		
NOR	$(A+B)'$	$\overline{A+B}$		
XOR	$A \oplus B$	$A \otimes B$		
XNOR	$(A \oplus B)'$	$\overline{A \oplus B}$	$(A \otimes B)'$	$A \odot B$

Logical Operators



Logic Diagrams

Binary Data

- How does a Turing machine work?
- What is the problem with Moore's Law and transistors?
- Investigate quantum computing. How do bits represent information in a quantum computer?
- What is a qubit and and what does superposition mean?

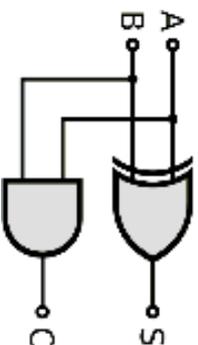
Computer Mathematics

Print($\text{round}(12+(6/9)*3-2,5)$)

- What is the answer to this problem?
- Explain how you arrived at your answer
- Mr Jones is writing a CS book. The text file has a maximum of 15,000 lines. Each page can fit 55 lines. Show how the MOD function can be used to determine whether the text file is long enough.
- Explain how two's complement works.
- Calculate this two's complement addition $10001111 + 11110000$ Does the result create an issue in an 8 bit system? Explain your answer
- What does the expression $23 \text{ DIV } 6$ evaluate to?
- Discuss integer division with reference to MOD and DIV

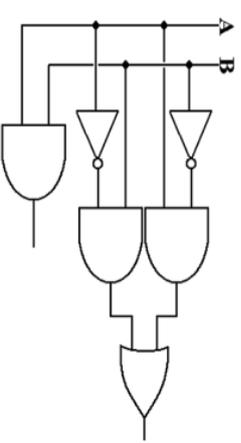
Logic Gates & Diagrams

Create the Boolean expression for this logic circuit



Label the gates

- What does the circuit represent?
- Explain how the circuit represents the flow of binary data in a computer



Explain the relationship between this logic circuit and the one to the left

The top logic diagram has the expression

$$A \oplus B$$

The bottom logic diagram has the

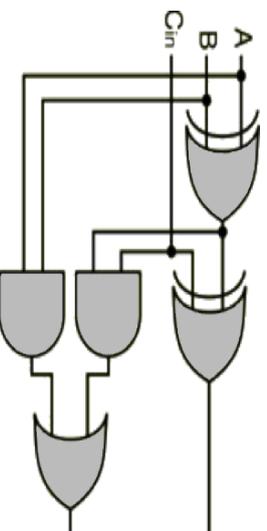
$$\text{expression } A \wedge B \vee A \wedge \overline{B}$$

- Which outputs do the expressions refer to?
- What input values would produce an output of 1 for the expressions?
- Discuss the importance of logic gates, truth tables and Boolean expressions in computer science



KNOW IT COMPUTATIONAL LOGIC

Truth Tables



What does the circuit represent?

Discuss how the circuit might be used in a calculator

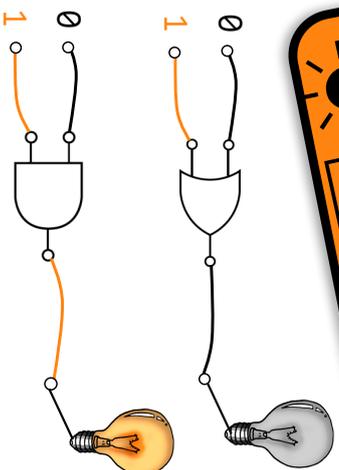
Create the truth table for this logic circuit and label the gates

Why Binary?

Computer data

0111010101010101010101010101010101
 10101010101010101010101010101010101
 010101010101010100010101010101010101
 010101010101010101010101010101010101
 1010101010101010101010101010101010101
 010101010101010101010101010101010101

Your data



BINARY DIGIT (BIT)	ELECTRONIC CHARGE	ELECTRONIC SYSTEM
1		ON
0		OFF



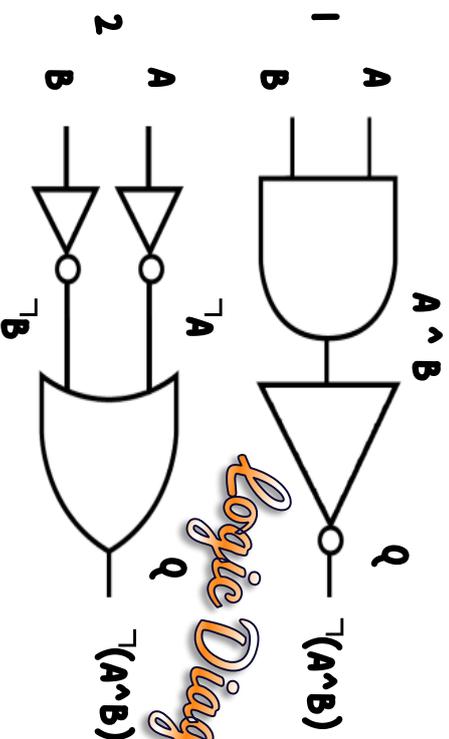
GroSPIT

COMPUTATIONAL LOGIC

OPERATOR	DESCRIPTION	EXAMPLE
+	ADDS 2 VALUES	2 + 34 = 36
-	SUBTRACTS ONE VALUE FROM ANOTHER	34 - 2 = 32
*	MULTIPLIES BOTH VALUES	2 * 34 = 68
/	DIVIDES ONE NUMBER BY ANOTHER	34 / 2 = 17
MOD	REMAINDER MODULUS - FINDS THE REMAINDER OF A DIVISION	39 MOD 2 = 1
DIV	INTEGER DIVISION - FINDS THE INTEGER PART OF A DIVISION	39 DIV 2 = 19
^	EXPONENTIAL - CALCULATES THE RESULT OF RAISING TO A POWER	2 ^ 4 =

OPERATOR	EXAMPLE
AND ^	X = 15 Y = 9 X < 16 ^ Y > 8 RETURN TRUE
OR v	X = 15 Y = 9 X == 8 v Y == 5 RETURN FALSE
NOT ~	X = 16 Y = 9 ~(X == Y) RETURN TRUE

Logic Diagrams & Truth Tables



GATE	A	B	Q
AND	1	1	0
	1	1	1

- 1 bit
- 1 nibble (4 bits)
- 1 byte (8 bits) (1024 bytes)
- 1 kilobyte (1024 kilobytes)
- 1 MB 1 megabyte (1024 megabytes)
- 1 GB 1 gigabyte (1024 gigabytes)
- 1 TB 1 terabyte (1024 terabytes)
- 1 PB 1 petabyte (1024 petabytes)

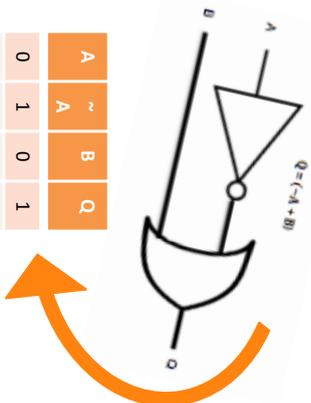
Why Binary?

- Know that an 'instruction' is a set of binary digits from 4 bits to several bytes in length
- Be able to discuss how a processor characterization eg 32 bit, 64 bit relates to the size of the instructions and memory
- Know that a binary file will also contain metadata. Explain why meta data is important.
- Be able to discuss the link between logic gates and binary making it clear that the bit value output from a logic gate forms part of an instruction set

Know how to work with variable values:
 num1 = 39, num2 = 71, total = num1 ? num2
 grossValue = 101, netValue = 71, deductions = grossValue ? netValue
 radius = 10, pi = 3.142, circle = pi ? (r^r)
 triangle = b * h ? 2, print(triangle)
 Check if a number is even with MOD: IF numIn MOD 2 != 0 print("Odd number")
 Check if a number is an integer with DIV: IF numIn DIV 1 == numIn print("Integer")
 Calculate the value with base and exponent:
 input base (5), input exponent (2), product = base ^ exponent (25)

Computer Mathematics

Mathematical Terms and Symbols
 MOD : % (percentage sign)
 DIV : // (double division sign)
 Exponent : ** (double asterisk)

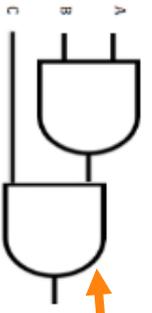


Be able to interpret logic statements and produce the circuit and truth table:
 eg (A \ \ B) \ \ C
 Understand equivalence:
 AND = \wedge (A \ \ B) , OR = \vee , + (A \ \ B = A+B) ,
 NOT = \neg , \sim ($\sim A$, A, $\sim A$)

Be able to calculate the number of rows required in a truth table based on the inputs
 and/or logic gates: rows = 2ⁿ where n = inputs (3 inputs = 2*2*2)

Logic Diagrams & Truth Tables

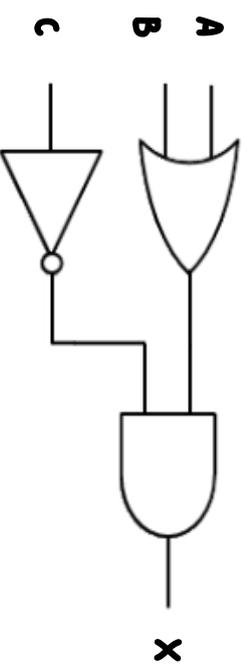
EG - ((A \ \ B) \ \ C)
 Inputs = 3 (A, B, C)



A	B	A \ \ B	C	(A \ \ B) \ \ C
0	0	0	0	0
1	0	0	0	0
0	1	0	0	0
0	0	0	1	0
1	1	1	1	0
0	1	0	1	0
1	0	0	1	0
1	1	1	1	1

There are only 10 types of people in the world: Those who understand binary and those who don't

(AND OR B) AND (NOT C)



$p \Rightarrow q$

read "p implies q"



THINKIT
COMPUTATIONAL LOGIC

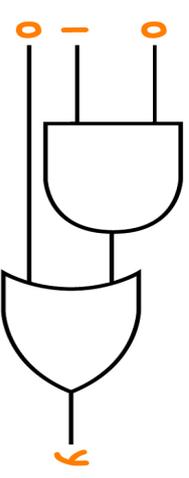
p	q	$p \Rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

BIDMAS
Computer Arithmetic
The Science of Algorithms

$$() \times \div \pm -$$

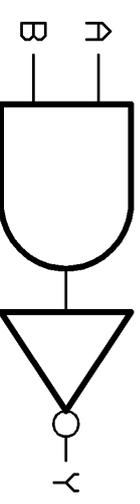
Logic Gates & Diagrams

- Create the logic gate symbols for AND, OR, NOT
- Identify the following Boolean operations:
 $A \wedge B$ $A \vee B$ $\neg A$
- What is the value at Y? Why is this?
- What is the alternative name for a NOT gate?
- How many input rows would you require for an AND gate?
- What would the output be for two NOT gates in series if the first input = 0



Truth Tables

- Draw the truth tables for AND, OR, NOT gates
- Draw the truth table for this series of logic gates



Why Binary?

- What is the link between transistors and binary?
- How many states can a binary system have?
- How many combinations could a 4 bit system have?
- What is the connection between False and 0?



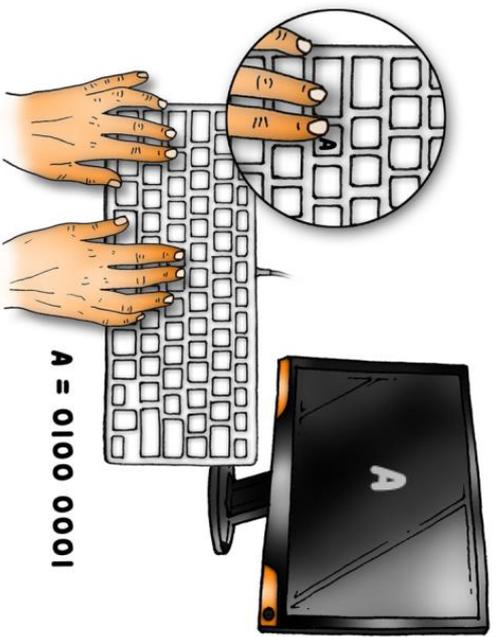
ThinkIT COMPUTATIONAL LOGIC

Computer Arithmetic

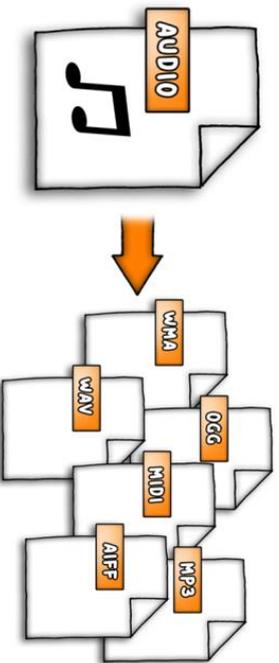
What is the answer to the following:

- width = 10, length = 5 **area** = width * length
- gross = 100, VAT = 20, **net** = gross + VAT
- allHeight = 40, groupSize = 20, **aveHeight** = allHeight / groupSize
- salePrice = 128, commission = 10%, moneyRec = salePrice - commission

- totalIncome = 75, days = 7, totalIncome **MOD** days
- ISBNnum = 132, digits = 10, ISBNnum **DIV** digits
- **2*5** =
- What is the difference between MOD and DIV?
- What is the answer to 5 + 6 / 2



A = 0100 0001



COMPUTER BIT



COMPUTER BYTE



THOUSANDS

HUNDREDS

TENS

UNITS

3140



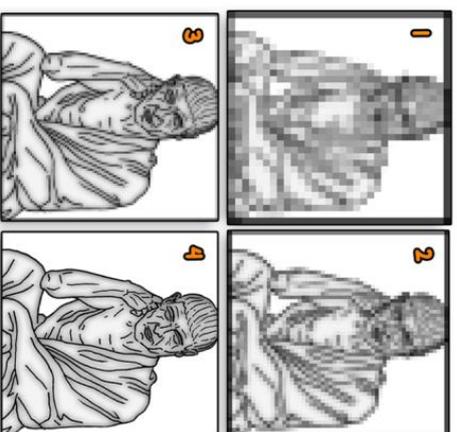
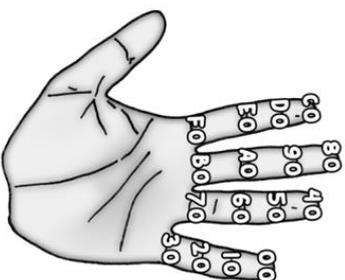
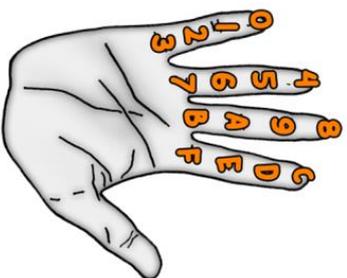
CD QUALITY 44.1 kHz



VEP1 QUALITY 8 kHz



KNOW IT DATA REPRESENTATION



INCREASING RESOLUTION



Units

- Analyse the difference between a bit and a byte
- Specify how many megabytes are contained within a gigabyte of data
- Examine some of the reasons as to why some organisations will eventually need more than a yottabyte of data storage
- **Specify the amount of storage required to store 1 hour of film compressed in the MPEG4 file format**

Numbers

- Examine how and why most computers use two's complement to represent signed numbers
- Outline each of the stages involved in converting a denary number to hexadecimal and vice versa
- Analyse how computers represent and manipulate numbers
- **Add the two following binary numbers together:
00001011 and 00010010**

Characters

- Distinguish the difference between ASCII and extended ASCII
- Examine how character codes are commonly stored in encoding tables
- Compare how ASCII and Unicode are similar to each other
- **State the range of bits which are used to store characters within the Unicode character set**

Images

- Specify how the resolution of an image can be calculated
- Illustrate the difference between an image which has a 2-bit colour depth and one which has an 8-bit colour depth
- Analyse some of the problems that can arise from using a high image resolution to create and manipulate images
- **State the number of pixels contained within a 1 inch grid that measures 72 pixels by 72 pixels in size**

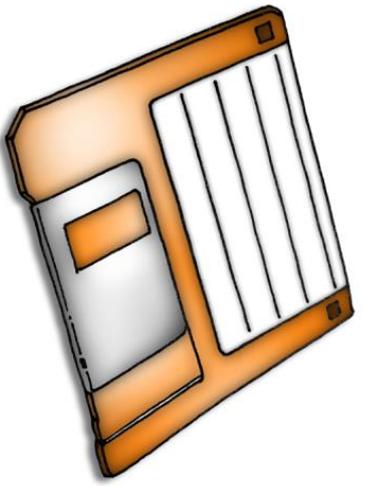
Sound

- Examine some of the reasons why VoIP services often use a lower sampling rate than the rate used to digitalise audio
- Produce a graph to demonstrate how you would sample an analogue audio signal
- Specify how to calculate the size of an audio file
- **Explain how the number of channels available can affect the size of an audio file**

Compression

- Specify with an example of when lossy file compression would be appropriate to use on an image
- Examine with an analogy how lossless file compression works
- Outline how to calculate the compression ratio of an image which has been compressed
- **Specify the file compression technique a photographer should use if he is getting his users to upload and download images from his website to print**



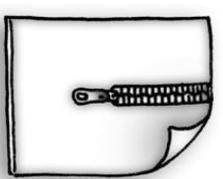
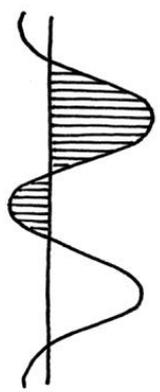
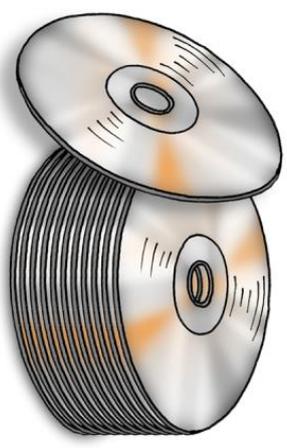


P P



GroSPIT

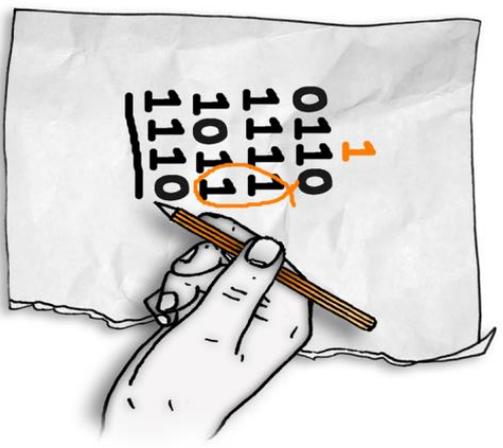
DATA REPRESENTATION



2-BIT



4-BIT



Units

- Explain why different units of data such as PB, GB, MB exist.
- Make a list of each of the different units of data which exist and give examples of their data size i.e. 4.7GB = 1 DVD.
- Determine why in an era of supercomputing small units of data such as kilobytes are still used.
- Specify the amount of storage space required to store a 3MB audio file.

Numbers

- Show how you would add two 8-bit binary integers together.
- Outline each of the stages involved in converting a binary number to hexadecimal and vice versa.
- State a situation where a binary shift (left or right) might need to be used.
- Outline how to convert the denary value of 124 into hexadecimal.

Characters

- Determine what the ASCII abbreviation stands for.
- State how many characters the ASCII and Unicode character sets contain.
- Describe the purpose of Unicode and explain its advantages and disadvantages.
- State the letter value "65" represents in the ASCII table.

Images

- Compare and contrast the difference between a bitmap and a vector image.
- Specify some of the different types of metadata that can be contained within an image file.
- Determine how the colour depth of a digitalised image can be measured.
- State the number of available colours per pixel in a 24-bit image.



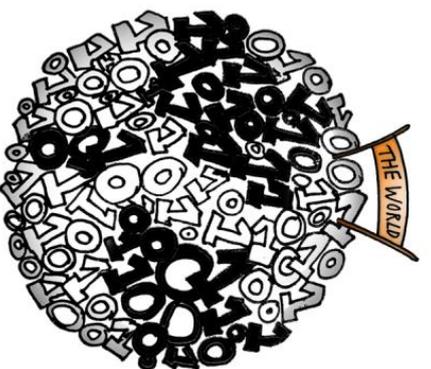
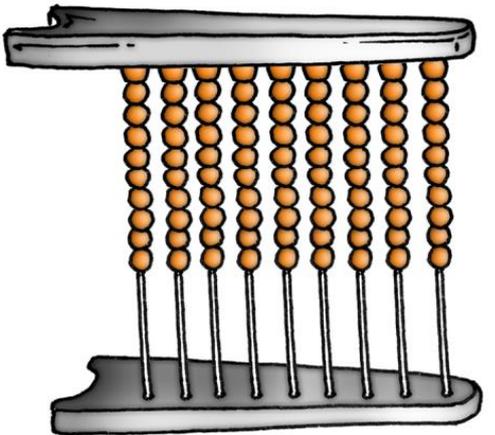
DATA REPRESENTATION

Sound

- Describe the benefits and drawbacks of sampling an analogue sound at a high sampling rate.
- Specify what bit depth is and explain why DVDs normally have a higher bit depth than CDs.
- Show how to calculate the bit rate of an audio file.
- Specify the two binary values a 16-bit audio sample can be encompassed between.

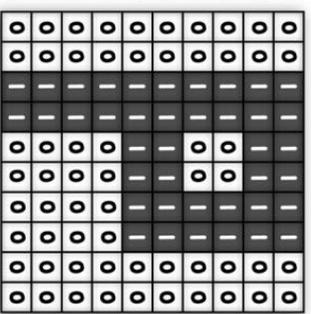
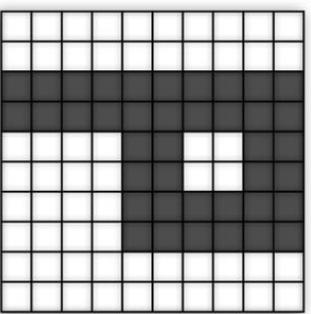
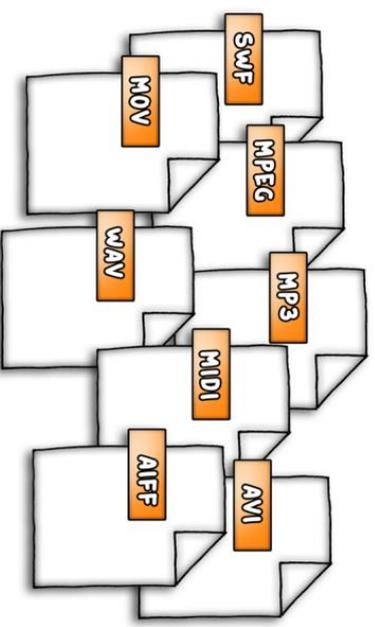
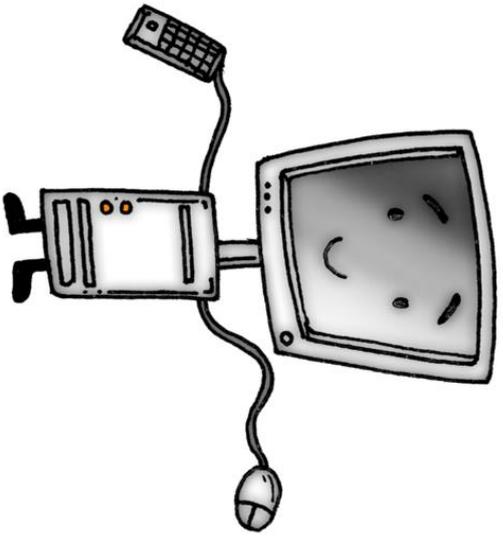
Compression

- Specify with an example of when lossless file compression would be appropriate to use on an image.
- Determine why lossy file compression doesn't allow an image to be restored to its original state.
- Specify with an example what a zip file is.
- State two benefits of a social networking site using the lossy file compression technique when users upload their images.



ThinkIT

DATA REPRESENTATION



Units

- List each of the different units of data which exist and arrange them in order of their size
- State the abbreviations used within different units of data i.e. MB = megabyte
- Explain why data needs to be converted into a binary format
- **Specify the amount of storage space required to store the word "Friday" in a word document**

Numbers

- Explain the difference between denary, binary and hexadecimal values
- List each of the stages involved in converting a denary number to binary and vice versa
- Produce a table of denary numbers from 0-15 which lists their equivalent binary and hexadecimal values
- **Outline how to convert the binary value of 1011 0111 into denary**

Characters

- Discuss why binary codes are used to represent characters within a computer system
- Explain what the term character set means
- Outline the benefits and drawbacks of the ASCII and Unicode character sets
- **State how many bytes are needed to store the extended ASCII character "B" in a text document**

Images

- List some of the common image file formats which exist
- Explain how an image is represented by pixels in a binary format
- Outline some of the different ways in which colour depth and resolution can affect the overall quality of an image
- **State the number of colours available in an image if it has a 6-bit colour depth**

Sound

- Outline each of the different stages involved in digitalising an analogue sound
- Explain the three factors which can influence the quality of a digitalised sound
- List some of the common audio file formats which exist
- **A common sample rate for a piece of music is 44,100 samples per second, simplify this number into kilohertz**

Compression

- List some of the typical file formats which are associated with lossy and lossless file compression techniques
- Explain some of the reasons as to why a file might need to be compressed
- Compare and contrast the difference between the lossy and lossless file compression techniques
- **If an image is compressed via the lossy compression technique from 824kb in size to 76kb, illustrate with an example how the two images will be different from each other**





I'M NOT ADDICTED...
I JUST WON'T GIVE MY
MOBILE UP...EVER!



HELLO DAVE,
I'VE BEEN WAITING
YOU FOR SOME TIME AND
WOULD LIKE TO CONVINCE
YOU TO VOTE FOR
ME...



Know IT

ETHICAL, LEGAL, CULTURAL
AND ENVIRONMENTAL FACTORS



Legislation

- Write a 500 word summary of the Apple vs Samsung global law suits
- Explain which company you agree with, Apple or Samsung
- Explain why there has been a cultural shift in illegal downloading to the extent that most don't consider it to be illegal.
- Create your own version of the Copyright, Designs and Patents Act so that it is more effective.
- Which is the most important piece of legislation that you've studied? Explain your answer with reference to at least 3 different pieces of legislation.

Mobile Technologies

- What are the ethical, legal, cultural and environmental consequences of the rise in mobile technology? Which is the most significant and why?
- "The development of mobile technology has had the biggest cultural impact of the last 50 years." To what extent do you agree with this statement?
- What would be the benefits of your school having a "device free day"? What objections would you have to overcome to convince people to take part?

Cultural impacts

- Is it right that political parties can use data they have collected to target adverts at individuals on social media?
- Does this represent a loss in freedom of choice?
- Where do your generation learn about News/the world? Are you truly capable of thinking for yourself?
- Is there any type of News that isn't "Fake News?"
- Considering changing shopping habits, will we still have high street shops in 20 years?
- Explain how the dark web allows people in countries that have restricted internet access to have freedom of speech.

Ethics

- Was Edward Snowden right to leak details of his government's illegal activities?
- Find examples of when governments have used laws in a way other than they were initially intended to catch criminals.
- Write a justification for doing this from the government's perspective.
- Explain the ethical responsibilities of a software developer.
- Research the rise use of 'medical apps'. What different things can be done by a medical app that a doctor could also do?
- With a partner, argue for/against replacing doctors with technology



KNOW IT ETHICAL, LEGAL, CULTURAL AND ENVIRONMENTAL FACTORS

Privacy

- If a company stores customer data on a cloud based server and data is hacked and stolen, who is at fault? The company or the cloud server?
- If you have a smartphone that tracks GPS and live in a town with extensive CCTV, is there any point at which you are not being monitored? If not, explain if you are comfortable with this concept.
- Roomba (an automatic vacuum cleaner) will map the layout of its owner's rooms/home and upload them to the manufacturer who will then sell the details to other companies. Explain if you think this is an invasion of privacy.

Hacking, Cracking and Cyber Security

- The most effective methods of hacking and cracking haven't changed since the 1980s. Why not?
- To what extent what the cyber attack on the NHS (May 2017) the fault of the NHS?
- List at least 3 potential computer based implants. Analyse the benefits of the implants vs the potential consequences of them being hacked.

Environmental Impacts

- Analyse the different environmental impacts of cloud based storage and explain which you think is the worst.
- Explain the ways in which an individual can use technology to have a positive impact on the environment. Which is the most significant action and why?

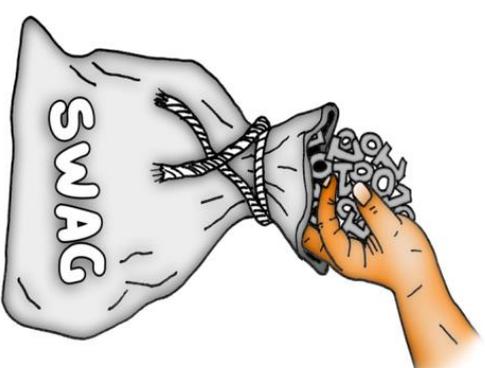
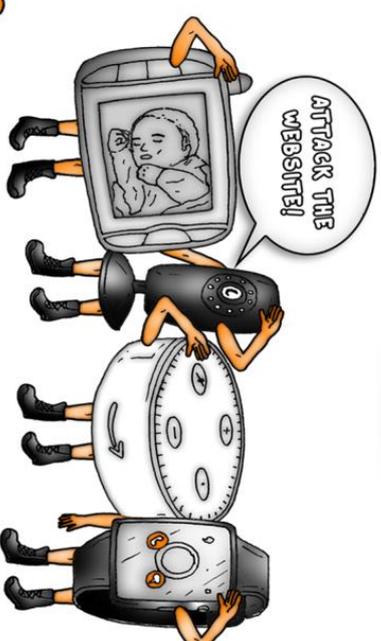
Things!

- "Soon every home will have a household device connected to the internet." With reference to the statement explain the ethical, legal, cultural and environmental impact of the Internet of Things.
- Explain the advantages and disadvantages of wearable technology. Reference ethical, legal, cultural and environmental factors in your answer.



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ETHICAL, LEGAL, CULTURAL AND ENVIRONMENTAL FACTORS



Legislation

- What are the 8 principles of the Data Protection Act 1988?
- Explain why the Computer Misuse Act 1990 was developed.
- If you could make 1 change to the Computer Misuse Act what would it be?
- Find out how much the pirating of software and music costs their industries each year.
- Explain if you think the Copyright and Patents Act is effective.
- Explain the different levels of Creative Commons Licencing
- What are the three most important revelations made under the FOI Act? Justify the order you have put them in.

Environmental Impacts

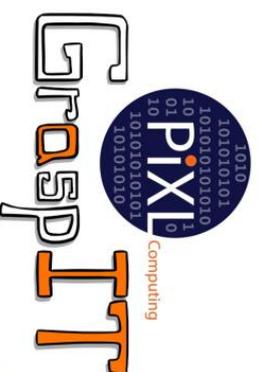
- Explain who is responsible for the negative environmental consequences of technology. The individual, the manufacturers, the government or someone else?
- Explain how decommissioning technology in the UK can have a negative impact on another country.
- What will have a bigger positive impact on the environment: electronic cars or renewable forms of energy?
- To what extent does technology have a positive impact on the environment?

Cultural Impacts

- Explain how social media has helped re-engage young people in democracy. Try to give examples to illustrate your answer.
- “Parents should seek their children’s permission before posting photos of them online”. To what extent do you agree with this statement?
- Is there a link between the rise in social media and the rise in mental health/wellbeing issues? Explain your answer
- Due to developing technology, the next generation will never need physical money. Explain why this could be the case.

Ethics

- Explain, with examples, the difference between formal and informal codes of ethical behaviour.
- Explain the difference between unethical behaviour and illegal behaviour
- Give 3 examples of legal but unethical actions
- Why is a code of ethics important for computer scientists? Can you illustrate your answer with examples?
- Create 5 ethical guidelines for computer scientists to follow
- What is the *most* unethical but legal action you can think of?
- Is there ever an occasion when an action could be ethical but illegal?



ETHICAL, LEGAL, CULTURAL AND ENVIRONMENTAL FACTORS

Privacy

- “There is no longer any such thing as privacy”. To what extent do you agree with this statement?
- Explain how companies like Google and Facebook collect data individuals’ data.
- Is targeted advertising an invasion of privacy? Explain your answer.
- What personal freedoms would you give up to help the state keep you safer?

Hacking and Cracking

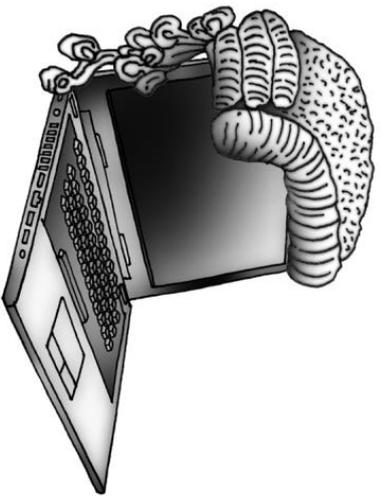
- Explain what a hacker is
- Explain what a cracker is
- Would you prefer to be a white or black box penetration tester? Why?
- What is a hacktivist?
- Write a 200 word essay arguing for/against hacktivism.
- If one country “hacks” the election of another country, should the election be redone?

Things!

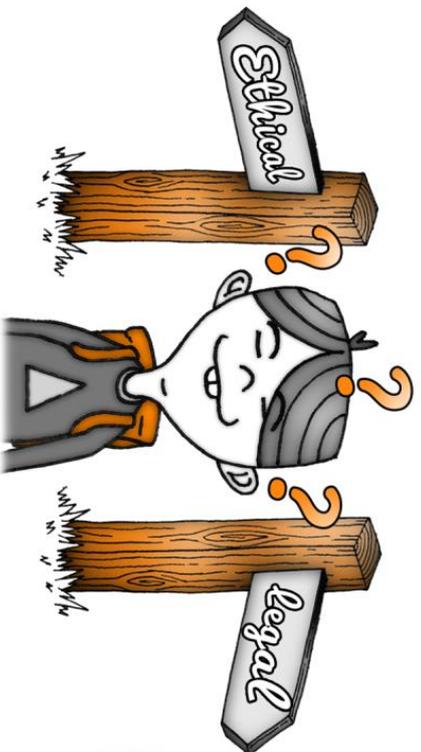
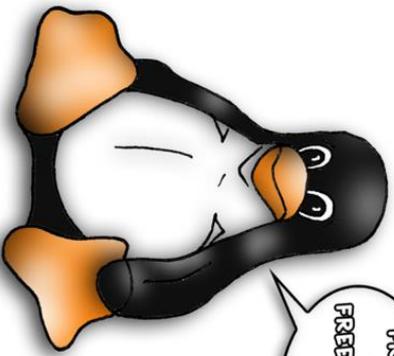
- To what extent do you agree with the statement “everyone will own wearable technology in 10 years”?
- To what extent do you agree with the statement “everyone will have a computer based implant in 20 years”?
- Explain how the global population could benefit from computer based implants?
- Explain the rise in popularity of the “internet of things”
- Research and explain how the internet of things have been used to launch DDOS Attacks and increase “click revenue” for websites.

How key stakeholders are effected by technology

- Explain the impact driverless cars will have on the automotive industry and its customers.
- Explain the impact driverless lorries could have on the transport and haulage industry and its customers.
- If a driverless car crashes into and kills someone, who is responsible: The owner, the company that made the car or the software developers that programmed the car?
- Computer code isn’t a physical object. Therefore is it stealing if you copy a software company’s code for your own use?

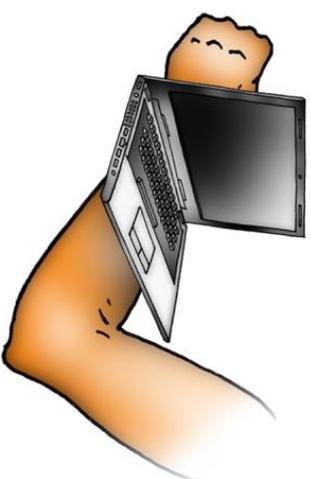
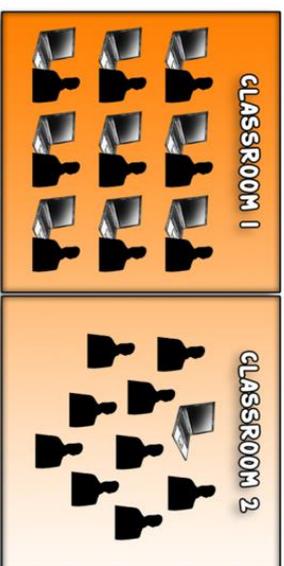
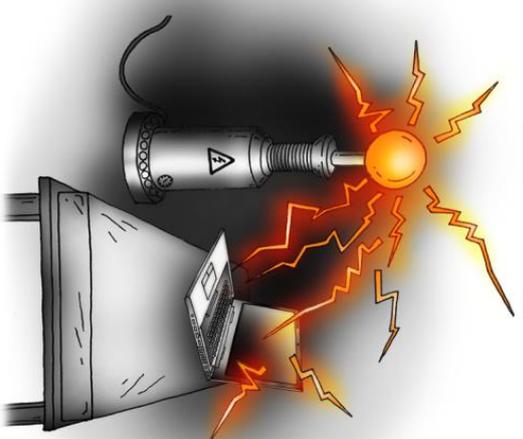


FREE HUGS...
IN FAST
FREE EVERYTHING



ThinkIT

ETHICAL, LEGAL, CULTURAL
AND ENVIRONMENTAL FACTORS



Legislation

Give a simple definition of each of the following:

- The Data Protection Act 1998
- The Computer Misuse Act 1990
- Copyright, Designs and Patents Act 1988
- Creative Commons Licensing
- Freedom of Information Act 2000

Find a real world example of each of these acts being implemented.

Open Source vs. Proprietary Software

- Define the term open source software
- Give at least 3 examples of open source software
- What are the advantages and disadvantages of open source software?
- Define the term proprietary software.
- Give at least 3 examples of proprietary software
- What are the advantages and disadvantages of proprietary software.

Cultural Impacts

- What is meant by the phrase "cultural impact of technology"?
- How do you think attitudes and use of technology has changed in the last 10 years?
- When was social media invented? How has social media developed in that time and how has this impacted culture?
- What is the difference between the way in which people aged over 35 and those aged under 35 consume media?
- How has developing technology changed business culture?

Ethics

- Define the term ethics
- Discuss if you think the following are ethical or unethical:
 - Uploading photos of friends to social media without their permission
 - Using a work computer to send personal emails
 - Using a friend's unlocked phone to access their social media account
 - Using a neighbour's Wi-Fi without permission
- Copying and pasting information from the internet for homework and pretending it's your own work



ETHICAL, LEGAL, CULTURAL AND ENVIRONMENTAL FACTORS

Privacy

- Research Article 8 of the European Convention on Human Rights.
- Research the Regulation of Investigatory Powers Act 2000
- Of the above, which one protects a person's right to privacy and which one allows the right to be eroded?
- Name another act that protects a person's privacy
- List the ways that using a smart device can undermine your right to privacy.

Environmental Impacts

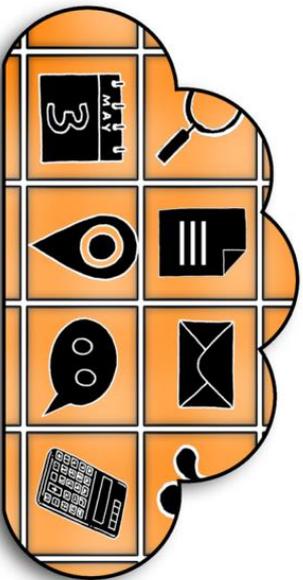
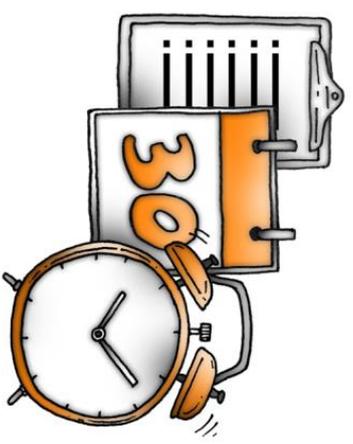
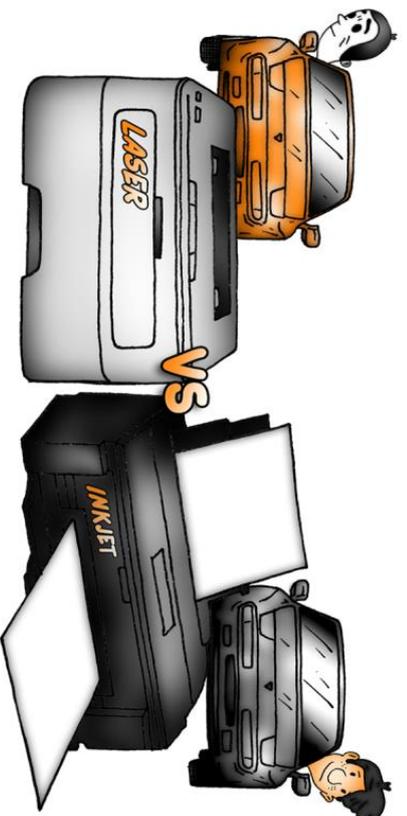
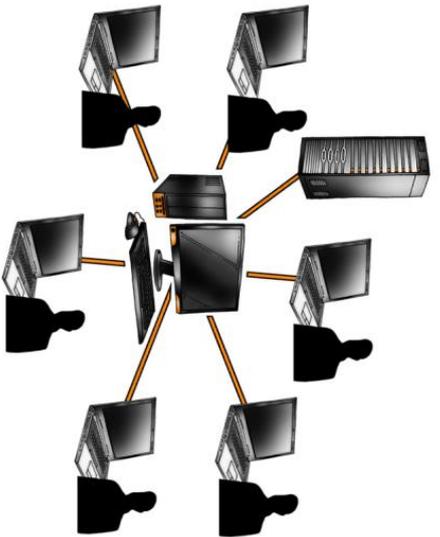
- List 3 positive impacts of technology on the environment
- List 3 negative impacts of technology on the environment
- What uses more energy: a computer being created or a computer being used for its whole life time?
- How does technology impact the environment when it has been thrown away?
- How many computers and devices are in your school right now? Is the school and pupils' technology having a positive or negative impact on the environment?

Digital Divide (cultural impact)

- Define the term "digital divide"
- Do you think there is a global digital divide?
- Do you think there is a national digital divide?
- Do you think there is a local digital divide?
- For each of the above, what could be done to reduce the digital divide?
- What impact would reducing the digital divide have on society?

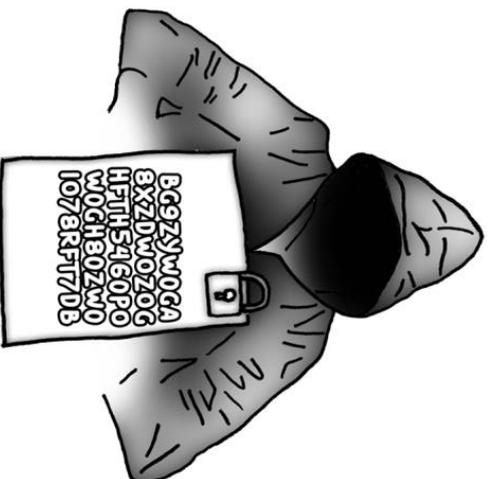
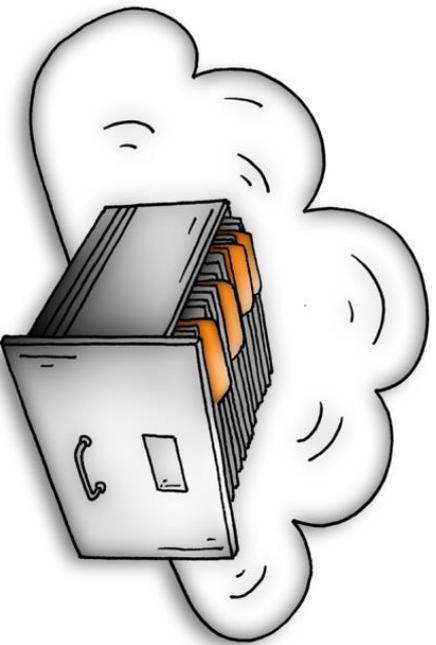
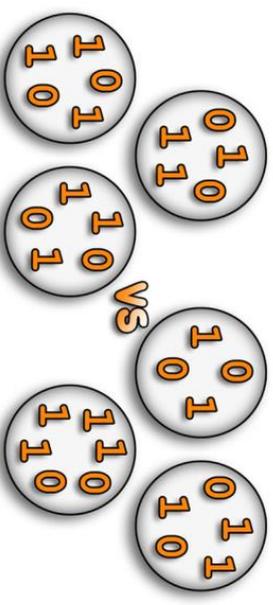
Wearable Technology

- What is the definition of wearable technology
- Find 5 examples of wearable technology - apart from smart watches!
- How many people do you know that own some wearable technology?
- List at least 3 benefits of wearable technology. Be as specific as possible.
- What is the difference between wearable technology and computer based implants?



KNOW IT

SYSTEM AND APPLICATION SOFTWARE



Operating system

- Examine why an Operating System is essential when running applications on a computer
- Multi-tasking, Multi-user and Single-User are types of Operating System, others include:
 - Distributed
 - Embedded
 - Real-time
- Research these types of Operating system
- Research what category Windows 10 falls into

Operating system - Device drivers

- A printer is one example of a Device driver, justify the need for a Device driver for each specific printer
- Explain how having an incorrect driver installed on the computer can impact how the Computer works
- It is important to ensure a modem driver is up to date, justify why this is important and the impact it will have on the device

Operating System - Multi-tasking

- Justify the need for a Multi-tasking operating system
- Describe the types of tasks a Multi-tasking Operating system may carry out at the same time
- The Operating System must ensure each job gets enough processor time, it does this using a scheduler. Research how different Scheduling algorithms work

Application Software

- Explain the difference between an Application and a Utility
- Research Applications which may be used by a call centre
- “Some types of application software are more suited to the hardware they are being used with” discuss this statement using examples with reference to memory, speed and cost
- More and more applications are becoming cloud based, explain the benefits of using cloud based applications?

Utility Software- Backup

- Explain what a network manager should consider when deciding which Backup Utility to use
- Justify the best time for a bank to complete a backup
- Write a Backup policy which could be implemented in a school
- “It is a good idea to back up on an external device”, discuss this statement
- Explain how Backup and Compression Software can work together

Utility Software- Encryption

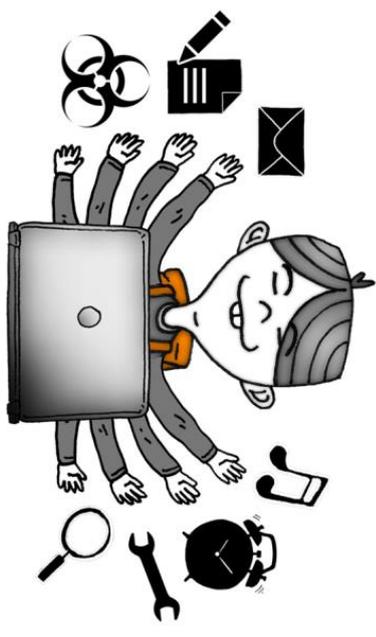
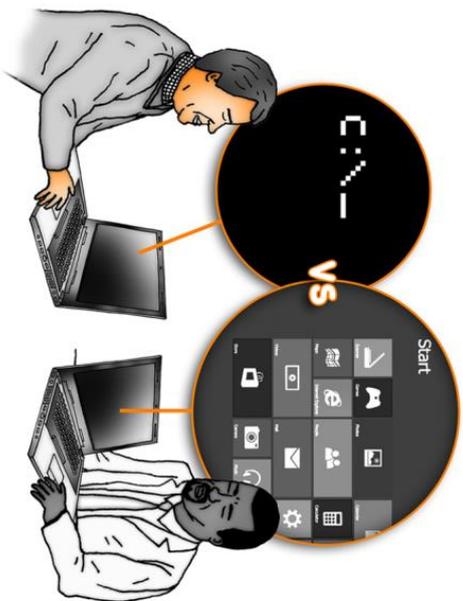
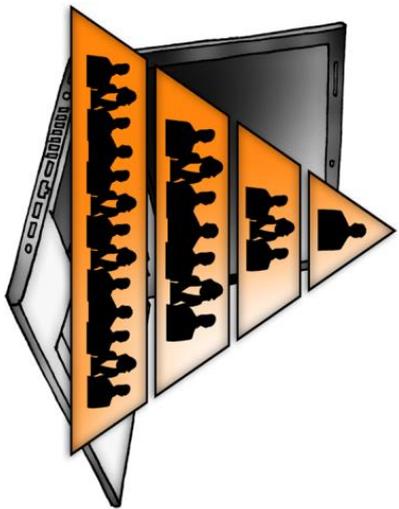
- “It is important for Encryption software to be used especially for online banking and payments” To what extent do you agree with this statement?
- Research examples of Encryption Software, how do they work?
- Justify why Encryption is essential for sending data over a network securely
- Examine the use of Symmetric and Asymmetric Encryption

Utility software- Defragmentation

- Defragmentation speeds up file access on a hard disk, explain why this is the case
- “You should not use defragmentation software on a SSD”, justify this statement
- “The more fragmented the hard drive becomes the slower it will perform,” justify this statement
- Research examples of Defragmentation Software, how do they work?

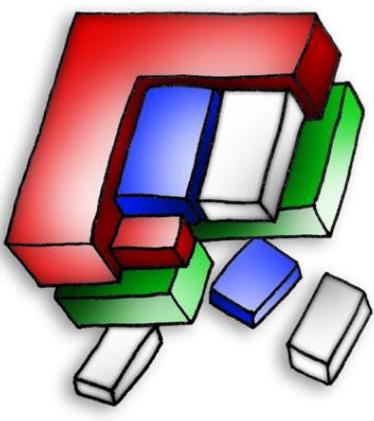
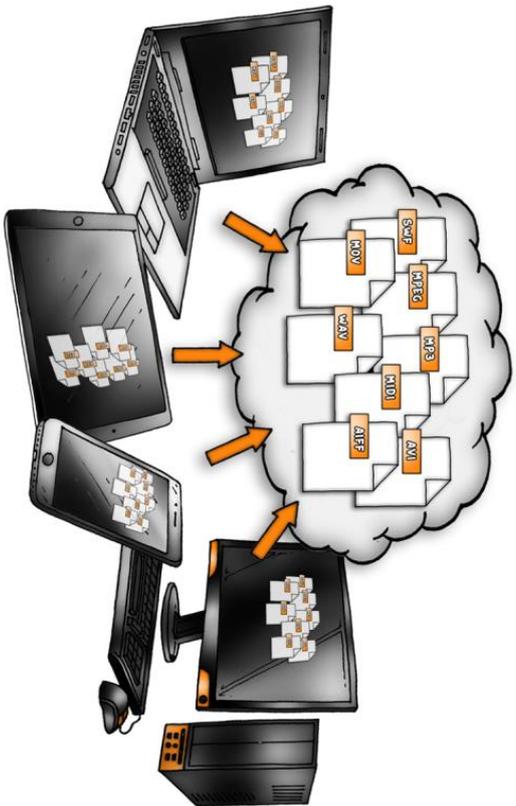
Operating System- Memory Management

- “Memory management must ensure memory is used efficiently and is stored safely” discuss this statement
- There are two ways programs and data can be split by the operating system Paging and Segmentation, explain how each works
- Justify why memory management is needed
- Explain how the Operating System manages RAM



Grosp IT

SYSTEM AND APPLICATION SOFTWARE



Operating System - User management

- Describe the difference between a single-user and a multi-user Operating System
- What anti-theft measures can be put in place to protect user accounts?
- Parents can edit the user access controls of their devices to ensure their children are protected, what settings may they wish to change?
- Give an other example when you may need different user access controls for users on the same computer.

Operating System- User Interfaces

- Compare the interface of two Operating Systems
- Identify the features of a GUI
- Identify the features of a CLI
- Explain the relationship between an application and the operating system
- Examine why a CLI would be used by a technician
- Why would a CLI not suitable for ever day users?

Operating System - Multi-tasking

- Discuss the statement "It seems like programs are being processed by the OS at the same time but they are not"
- Explain how the Operating System works with the CPU
- The process of scheduling is very important during Multi-tasking, how does scheduling work?
- How is Virtual Memory used during Multi-tasking?

Operating System- File Management

- How does the Operating System manage the hard disk?
- The Operating System works with Utility Software to manage the files, list examples of Utility Software used for File Management
- Files have extensions such as .pptx, why do files need file extensions?
- Storage is using organised into a hierarchical structure, is this for the Operating System or the user?

Operating System- Peripheral management and drivers

- How does the Operating System communicate with peripherals?
- Why are device drivers essential for a Computer System?
- When a technician replaces a peripheral such as a keyboard what must happen before the device will work?
- It is important device drivers are updated, why may device driver need to be updated?

Utility Software- Backups

- Why are backups necessary?
- Explain the difference between a Full backup and a Incremental backup
- Businesses such as a bank may wish to carry out both Full and Incremental backups, when are they likely do carry out a Full backup and an Incremental backup?
- Compare the advantages and disadvantages of Full backups and Incremental backups.

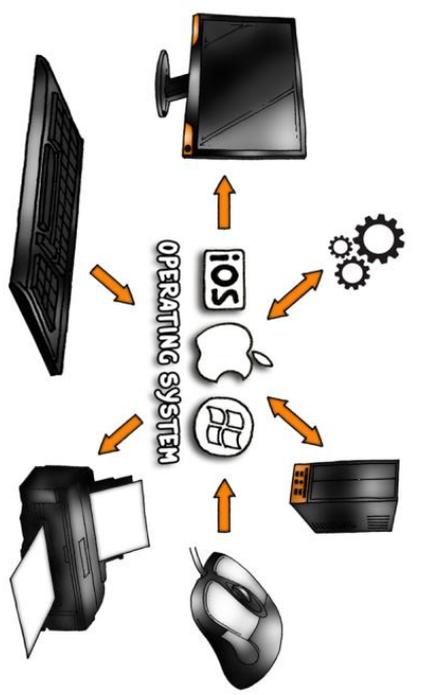
Utility Software- Compression

- Streaming media online has become increasingly popular, why is compression important when streaming?
- Explain the difference between Lossy and Lossless compression.
- What must you do with a compressed file before it can be used?

Utility Software- Defragmentation

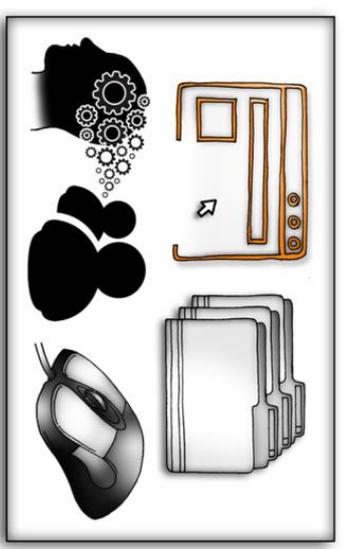
- Explain how defragmentation software organises data
- Files are stored on the hard disk in available spaces, how can files become fragmented?
- What is the ideal way the files could be stored on the hard disk?
- Create an image which represents the hard drive before and after defragmentation





ThinkIT

SYSTEM AND APPLICATION SOFTWARE



Software

- Define the term Software
- State the two Software categories
- Explain the difference between the two Software categories
- List all of the Software which you have used in the past seven days
- Describe what makes successful piece of Software

System software

- Define the term System Software
- State the purpose of System Software
- State the function of System Software
- System Software is separated into two categories, state the two categories of System Software
- In the form of a diagram shows the relationship between computer hardware, parts of the operating system, applications and the user

Operating system

- Define the term Operating System
- List the top 5 Operating Systems
- Give two reasons why an Operating System is needed in a computer
- Operating Systems with a GUI have been WIMP based, state what WIMP stands for
- Explain how the Operating System provides security in a Smart Phone?

Application software

- Define the term Application Software
- List five examples of Application Software
- Discuss the statement "We need do not need Application Software on our Computers"
- Describe what is meant by Open Source Software
- Describe what is meant by Proprietary Software
- State the type of Application Software which is most suitable to keep customer records



Operating System Functions

- List the five Operating System Functions
- Give examples of peripherals the Operating System will manage
- State the four types of User Interface the Operating system can provide
- Describe what is meant by a Multi-tasking Operating System
- Discuss the need for user access levels

Utility software

- Define the term Utility Software
- Give three examples of Utility Software
- List common jobs which are carried out by Utility software
- Give two examples of Utility Software which are used for file management
- Explain the job of defragmentation software
- Explain what is meant by a Backup Utility
- Explain what is meant by a compressed file
- State why it is necessary for files to be compressed

Utility software- Security

- Describe the purpose of Anti-Virus Software
- Give three examples of Anti-Virus software packages
- Explain why Anti-Virus Software must be updated regularly
- Describe the purpose of Anti-Spyware Software
- Explain the job of encryption software
- State what is required to encrypt/decrypt data

Software used to models/simulations in the real world

- Describe what is meant by a computer model/simulation
- Computer simulations can be created for a range of applications e.g. flight simulation, state three other examples
- Discuss advantages and disadvantages of using computer models/simulations
- Discuss the use of a flight simulator to train pilots