Knowledge Organiser: Yr 11 Computer Science;
Boolean Logic

1 Why Computers use Binary

- Computers use 1s and 0s to represent the flow of electricity in their circuits:

  0 = off

  1 = on

- Transistors are used inside the CPU and operate similarly to switches, where they can be open or closed, to allow electricity to flow or not flow

2 Logic Gates

- The physical switches inside an electronic device which are able to perform the calculations a computer needs to carry out on electronic Signals

- For this course you only need to know three logic gates: AND, OR and NOT

3 AND Gates

AND Gate

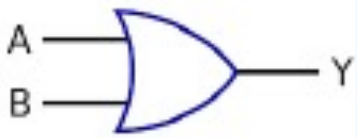
Only has an output of 1 if both A AND B are 1

A AND B = Y

$A \wedge B$

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

4 OR Gates



OR Gate

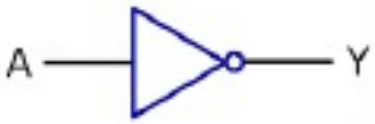
Has an output of 1 if either A or B are 1

A OR B = Y

$A \vee B$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

5 NOT Gates



Not Gate

Inverts / swaps the input (0 becomes 1 and 1 becomes 0

Only 1 input

NOT A = Y

$\neg A$

A	Y
0	1
1	0

Leave blank to allow students to glue.

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6 Truth Tables

- A truth table can be used for a logic circuit to list every possible combination of input and show the different output each would give.

- It is possible to work out how many rows a truth table will have for its possible inputs using the formula:

2^{inputs}

- For example, for the logic expression C AND (A OR B) = Y, there are 3 inputs (A, B and C – as Y is the output). Therefore the truth table would have 2^3 rows… i.e. 8 rows (2 x 2 x 2 = 8) as shown below:

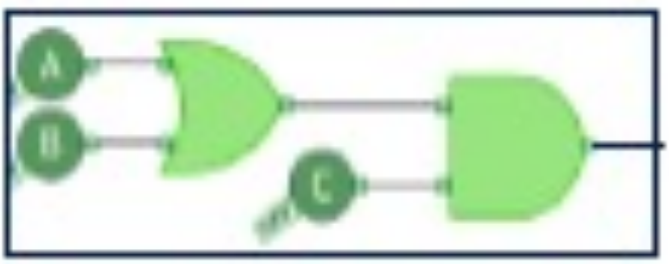
3 inputs therefore $2^3 = 8$ rows in the truth table

A	B	A OR B	C	Out
0	0	0	0	0
0	1	1	0	0
1	0	1	0	0
1	1	1	0	0
0	0	0	1	0
0	1	1	1	1
1	0	1	1	1
1	1	1	1	1

7 Drawing Circuit Diagrams

- When we combine logic gates it can be confusing at first on how to draw a diagram to show them. For example, in the diagram shown in section 6 above we had Y = C AND (A OR B). If we were given this and asked to create the diagram ourselves, it might seem sensible to start with the "C AND" part. However, just like in Maths, we always complete the part in brackets first.

- So for Y = C AND (A OR B), we start with the Brackets and draw A OR B. Once we have done this, the output from that can be put into whatever is outside the brackets. In this case we would draw the output from A OR B going into an AND gate with C.



- This would still be true even if the logic circuit had been written as: Y = (A OR B) AND C; We would still draw the part in the brackets first and then the output of that would go into whatever was outside the brackets.

Leave blank to allow students to glue.

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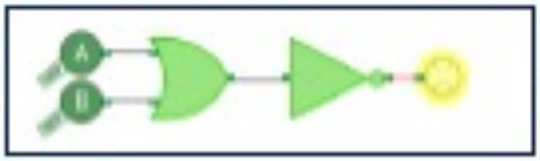
8 **Example of Combined Gates with a NOT**

NOT(A OR B)

$\neg(A \vee B)$

2 inputs
therefore
$2^2 = 4$ rows in
the truth table



A	B	A OR B	NOT A OR B
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

The result of A OR B gets inverted

There is no rule to say how many columns you must have in a truth table. In the example above we could have simply had A, B and then the Output. However, by adding an A OR B column and then doing a NOT of this column separately, it allowed us to break the logic down and complete the part in brackets first.

Leave blank to allow students to glue.

How do we use Knowledge Organisers in Computer Science?

How can we use knowledge organisers at home to help us?

- **Retrieval Practice**: Read over a section of the knowledge organiser, cover it up and then write down everything you can remember. Repeat until you remember everything.
- **Flash Cards**: Using the Knowledge Organisers to help on one side of a piece of paper write a question, on the other side write an answer. Ask someone to test you by asking a question and seeing if you know the answer.
- **Mind Maps**: Turn the information from the knowledge organiser into a mind map. Then reread the mind map and on a piece of paper half the size try and recreate the key phrases of the mind map from memory.
- **Sketch it**: Draw an image to represent each fact; this can be done in isolation or as part of the mind map/flash card.
- **Teach it**: Teach someone the information on your knowledge organiser, let them ask you questions and see if you know the answers.

How will we use knowledge organisers in Computer Science?

- **Revision:** We will access this knowledge organiser electronically as part of revision homework tasks, using the techniques above to help us revise prior learning.
- **Test:** We will do regular low stakes tests to check our ability to retrieve information from memory.
- **Mark our answers:** Once we have done a low stakes test we can mark our work using the knowledge organiser.
- **Improve our work:** Once we have finished a piece of work we might use this knowledge organiser to see if there is any information on it that we could add into an answer.
- **Pre-reading:** We may sometimes read sections of the knowledge organiser before we cover them in lesson as homework and note down specific questions we may have or specific concepts we are finding more challenging to understand ready to share in lesson.

Date	Section of knowledge organiser	Score