isaac computer science

Free Online Transition Courses – Limited Places so be quick if interested:

- 7 July: Data Representation
- 12 July: Programming Concepts
- 14 July: Boolean Logic
- 19 July: Computer Systems

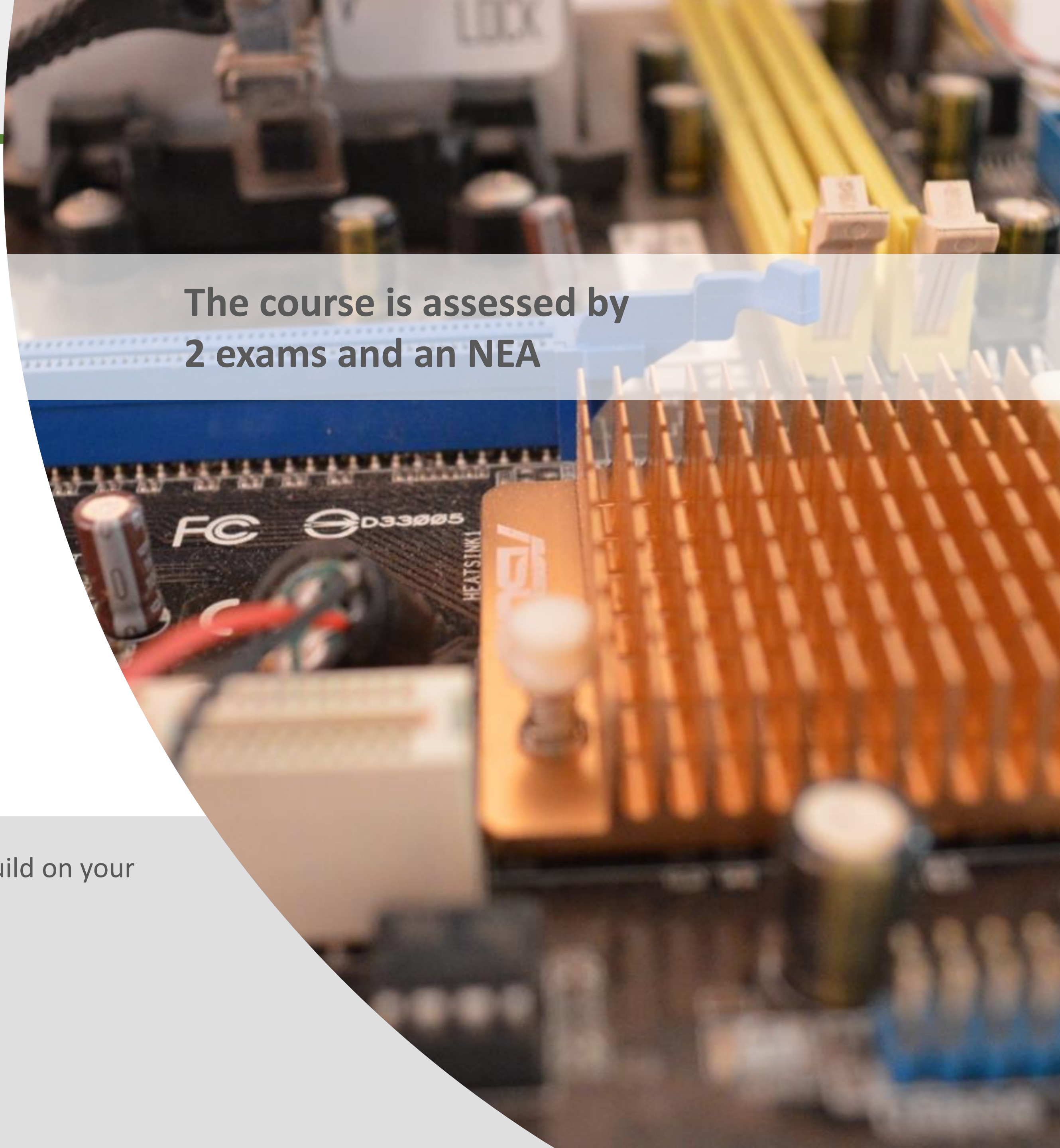
All of the sessions are free to attend.

https://tinyurl.com/3uv3ehxm

GCSE to A level

Computer Science Transition workbook

- The topic of **Computer Science** is at the heart of the modern world
- Studying it can make you extremely sought after in todays job market
- The transition from GCSE to A level is significant, this includes:
  - An increased emphasis on **technical content**
  - An increased emphasis **independent research**



The course is assessed by 2 exams and an NEA

This workbook is designed to allow you to practice some of these skills and build on your existing knowledge.

Please complete by your first lesson back in September.

2 Independent research task

Craig'n'Dave

Emerging computer technology

Expected time to complete: 2 hours

In this task you get to investigate any area of emerging computer technology which interests you.

You can pick any area which interests you, but examples could be:

- Artificial intelligence
- Robotics
- Automated self driving cards
- Quantum computing

In no more than ONE side of A4 summarise the area you have chosen under the following four headings:

1. What is it?
2. What are the possible Social, Moral, Cultural and Ethical **benefits** of this technology on society
3. What are the possible Social, Moral, Cultural and Ethical **risks** of this technology on society
4. My conclusion on this technology and what it will mean for our world 10 years from now

Additional help:

For additional help and support in structuring your answer you might like to watch some of the videos from the following Craig 'n' Dave playlists:

OCR:
SLR 17 – Ethical, morale and cultural issues
https://student.craigndave.org/videos/slr-17-ethical-moral-and-cultural-issues

AQA:
SLR 19: Moral, social, legal, cultural issues
https://student.craigndave.org/videos/slr19-moral-social-legal-cultural-issues

5 Key terms task

Craig'n'Dave

Getting to grips with terminology

Expected time to complete: 2 hours

An important aspect of being successful with your study of Computer Science is getting to grips with subject related terminology. There are over 240 specific terms you will need to learn!

Below are a handful of the key terms you will need to become familiar with.

Control Unit | **Register** | **Busses**

Von Neuman Architecture | **Optical Storage** | **Operating System**

Intermediate Code | **Device Driver** | **Compiler**

Assembly Language | **Machine Code** | **Lossy Compression**

Hashing | **Normalisation** | **TCP/IP Stack**

Packet Switching | **ASCII** | **Problem Decomposition**

1. Research each of the key terms and write a definition.
2. Resist the urge to simply cut and paste a definition from the first website you find. Many definitions found on The Internet are overly complicated and wordy.
3. Ask yourself:
   - Does my definition make sense?
   - Is it succinct, to the point?
   - Does the definition have appropriate depth and detail for A'Level?
   - Could I give this definition to another student so they could revise from it?

Structure and function of the processor
Address Bus
"The part of the bus which carries identification about where the data is being sent."
H446/01: COMPUTER SYSTEMS
1

Structure and function of the processor
Control Bus
"This bus carries command and control signals to and from every other component of a computer."
H446/01: COMPUTER SYSTEMS
12

Structure and function of the processor
Fetch-Decode-Execute
"The complete process of retrieving an instruction from store, decoding it and carrying it out. Also known as the instruction cycle."
H446/01: COMPUTER SYSTEMS
13

Structure and function of the processor
CPU
"Central Processing Unit"
"The main part of the computer, consisting of the registers, ALU and control unit."
H446/01: COMPUTER SYSTEMS
14

Structure and function of the processor
Clock Speed
[illegible]
H446/01: COMPUTER SYSTEMS
15

Structure and function of the processor
Cores
A part of a multi-core processor. A multi-core processor is a single component with two or ore independent actual CPUs, which are the units responsibly for the fetch-decode-execute cycle."
H446/01: COMPUTER SYSTEMS
6

Structure and function of the processor
Cache
"A part of the main store between the central processor and the rest of the memory. It has extremely fast access, so sections of a program and its associated data are copied there to take advantage of its short fetch cycle."
H446/01: COMPUTER SYSTEMS
17

Structure and function of the processor
Pipelining
[illegible]
H446/01: COMPUTER SYSTEMS
18

Structure and function of the processor
Von Neumann Architecture
[illegible]
H446/01: COMPUTER SYSTEMS
19

Structure and function of the processor
Harvard Architecture
[illegible]
H446/01: COMPUTER SYSTEMS
20

Structure and function of the processor
Contemporary Architecture
[illegible]
H446/01: COMPUTER SYSTEMS
1

Types of processor
CISC
"Complex Instruction Set Computer"
[illegible]
H446/01: COMPUTER SYSTEMS
22

Types of processor
RISC
"Reduced Instruction Set Computer"
[illegible]
H446/01: COMPUTER SYSTEMS
23

Types of processor
GPU
"Graphical Processing Unit"
[illegible]
H446/01: COMPUTER SYSTEMS
24

Types of processor
Multicore System
[illegible]
H446/01: COMPUTER SYSTEMS
25

Types of processor
Parallel Processor System
[illegible]
H446/01: COMPUTER SYSTEMS
6

Input, output and storage
Input Device
[illegible]
H446/01: COMPUTER SYSTEMS
27

Input, output and storage
Output Device
[illegible]
H446/01: COMPUTER SYSTEMS
28

Input, output and storage
Storage Device
[illegible]
H446/01: COMPUTER SYSTEMS
29

Input, output and storage
Magnetic Storage
[illegible]
H446/01: COMPUTER SYSTEMS
30

Input, output and storage
Flash Storage
[illegible]
H446/01: COMPUTER SYSTEMS
1

Input, output and storage
Optical Storage
[illegible]
H446/01: COMPUTER SYSTEMS
32

Input, output and storage
RAM
"Random Access Memory"
[illegible]
H446/01: COMPUTER SYSTEMS
33

Input, output and storage
ROM
"Read Only Memory"
[illegible]
H446/01: COMPUTER SYSTEMS
34

Input, output and storage
Virtual Storage
[illegible]
H446/01: COMPUTER SYSTEMS
35

6 An introduction to the basics of programming tasks

Programming basics

Expected time to complete: 6 hours

Learning to “code” is a fun and essential part of A Level Computer Science. This task is ideal if you haven't done the GCSE in Computer Science or you simply want a nice refresher ahead of starting your A Level course.

1. Head over to the web site: https://www.learnpython.org/
2. Complete the following python tutorials under the heading:
   - Hello, World!
   - Variables and Types
   - Lists
   - Basic Operators
   - String Formatting
   - Basic String Operations
   - Conditions
   - Loops
   - Functions
3. Each section presents you with theory, code to run and exercises to try out.
4. If you want to practice writing your own python programs you can download and install a simple python development tool here: https://www.python.org/downloads/

Additional note:

This task is most suited to students who intend to do the A Level and have not previously gained much / or any programming experience from the GCSE Computer Science course.

Although the language chosen here is Python, and that may not be what you will be using at A Level, it is the underlying programming concepts which are important.

The list of topics above cover the standard set of programming concepts you would be expected to know having completed a GCSE and Computer Science and so will prepare you well for the A level.

9 Systems architecture task

Looking under the hood of the processor

Expected time to complete: 2 hours

The CPU "Central Processing Unit" is the central core of any computer system. You will study what it contains and how it works it in depth at A Level.

1. Start by watching the following 3 videos from Craig 'n' Dave
    1. **AQA:** https://student.craigndave.org/videos/aqa-alevel-slr17-the-processor-and-its-major-components
    2. **AQA:** https://student.craigndave.org/videos/aqa-alevel-slr17-alu-cu-registers-and-buses
    3. **AQA:** https://student.craigndave.org/videos/aqa-alevel-slr17-performance-of-the-cpu
2. Produce a fully annotated diagram on a single sheet of A4 / A3 paper which shows how the CPU works.
3. Make sure the diagram includes and covers:
    - Major CPU components and what they are for:
        - Arithmetic Logic Unit (ALU)
        - Control Unit (CU)
        - Cache
    - The main registers
        - Program Counter (PC)
        - Memory Address Register (MAR)
        - Current Instruction Register (CIR)
        - Memory Data/Buffer Register (MDR / MBR)
    - Fetch-decode-execute cycle
    - Include annotations which explain how the performance of a CPU can be improved by:
        - Increasing the clock speed
        - Increasing the cache size
        - Increasing the number of cores

10 Memory task

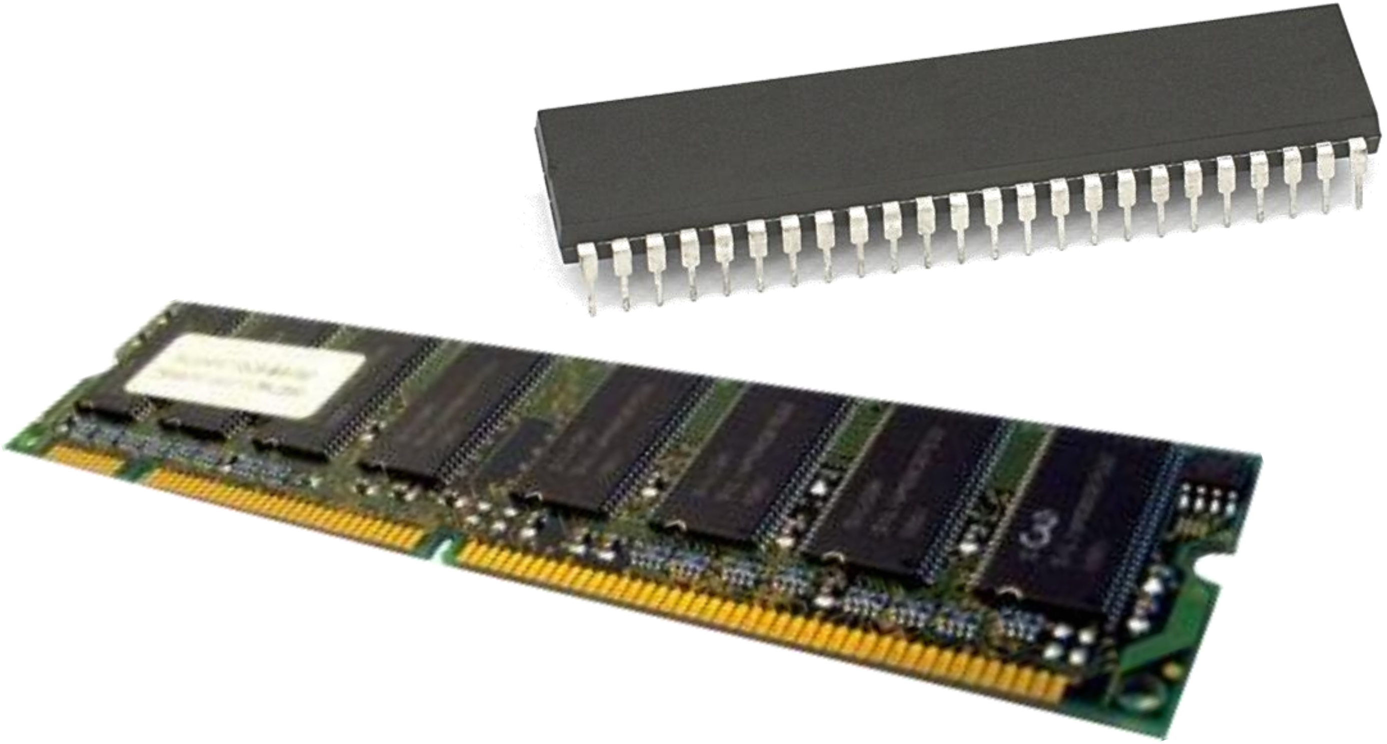
Different types of memory

Expected time to complete: 1 hour

Computer memory comes in many different forms, some of the main ones are:

- Random Access Memory (RAM)
- Read Only Memory (ROM)
- Virtual Memory

Carry out some research into these forms of memory and then complete the tasks on the following slide.



Additional help:

For additional help and support in completing this task you might like to watch some of the following videos from Craig 'n' Dave:

RAM and ROM:
https://student.craigndave.org/videos/ocr-gcse-slr1-2-ram-and-rom

The need for Virtual Memory:
https://student.craigndave.org/videos/ocr-gcse-slr1-2-the-need-for-virtual-memory

10 Memory task

Craig'n'Dave

Different types of memory

Expected time to complete: 1 hour

Random Access Memory (RAM)

14 Computational logic task

Craig'n'Dave

Truth tables to circuit diagrams

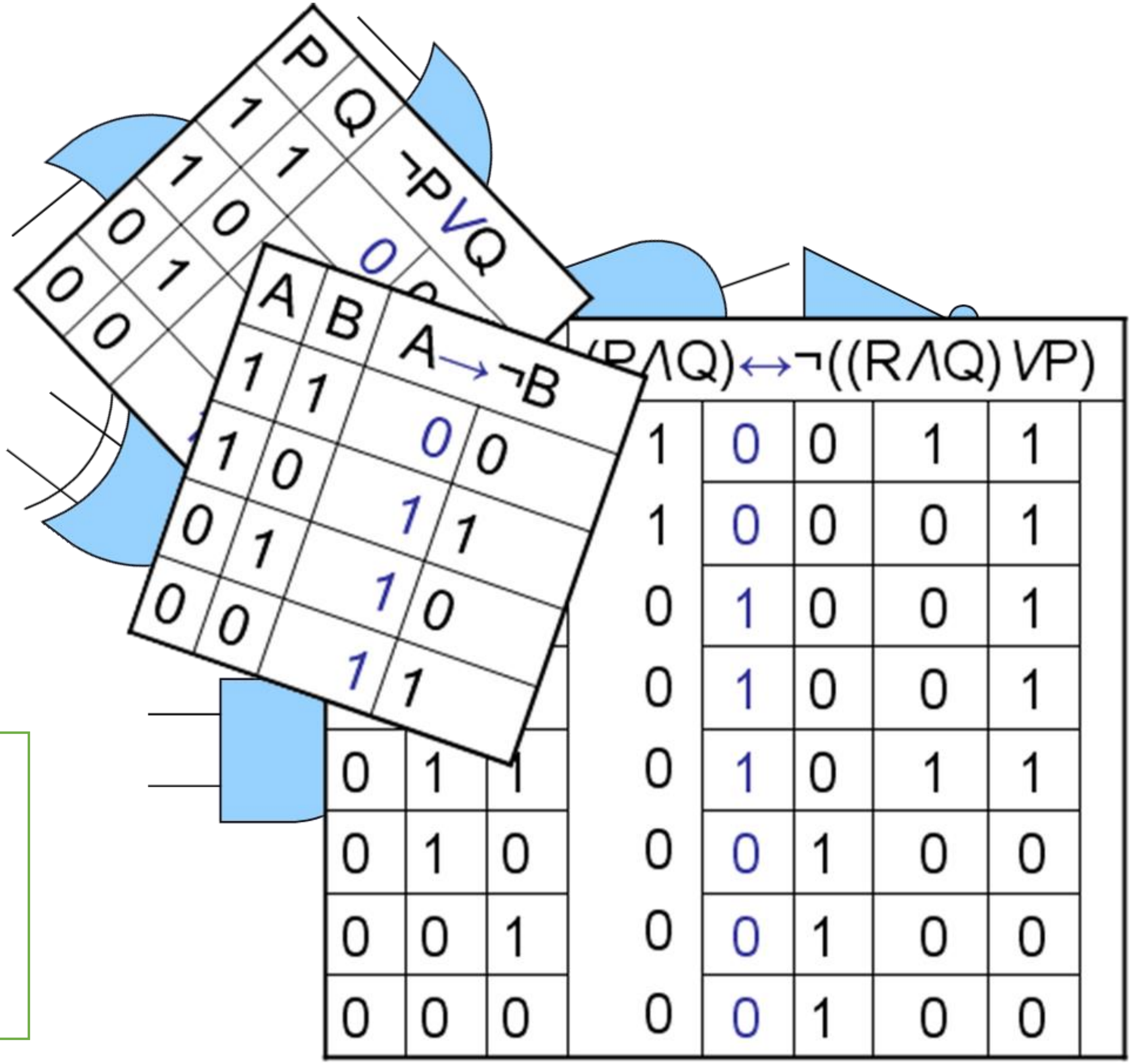
Expected time to complete: 2 hours

An important area of computer science is understanding the logic gates and diagrams which are used to represent the physical circuitry of computer systems.

Carry out some research into the following areas:

- Logic gates:
    - AND
    - NAND
    - NOR
    - NOT
    - OR
    - XOR
- Truth tables
- Boolean expressions
- Circuit diagrams

Complete the tasks on the following slides.



Additional help:

For additional help and support in structuring your answer you might like to watch some of the videos from the following Craig 'n' Dave playlists:

OCR: SLR 15 – Boolean algebra
https://student.craigndave.org/videos/slr-15-boolean-algebra

AQA: SLR16 – Logic gates & Boolean algebra
https://student.craigndave.org/videos/slr16-logic-gates-boolean-algebra

14

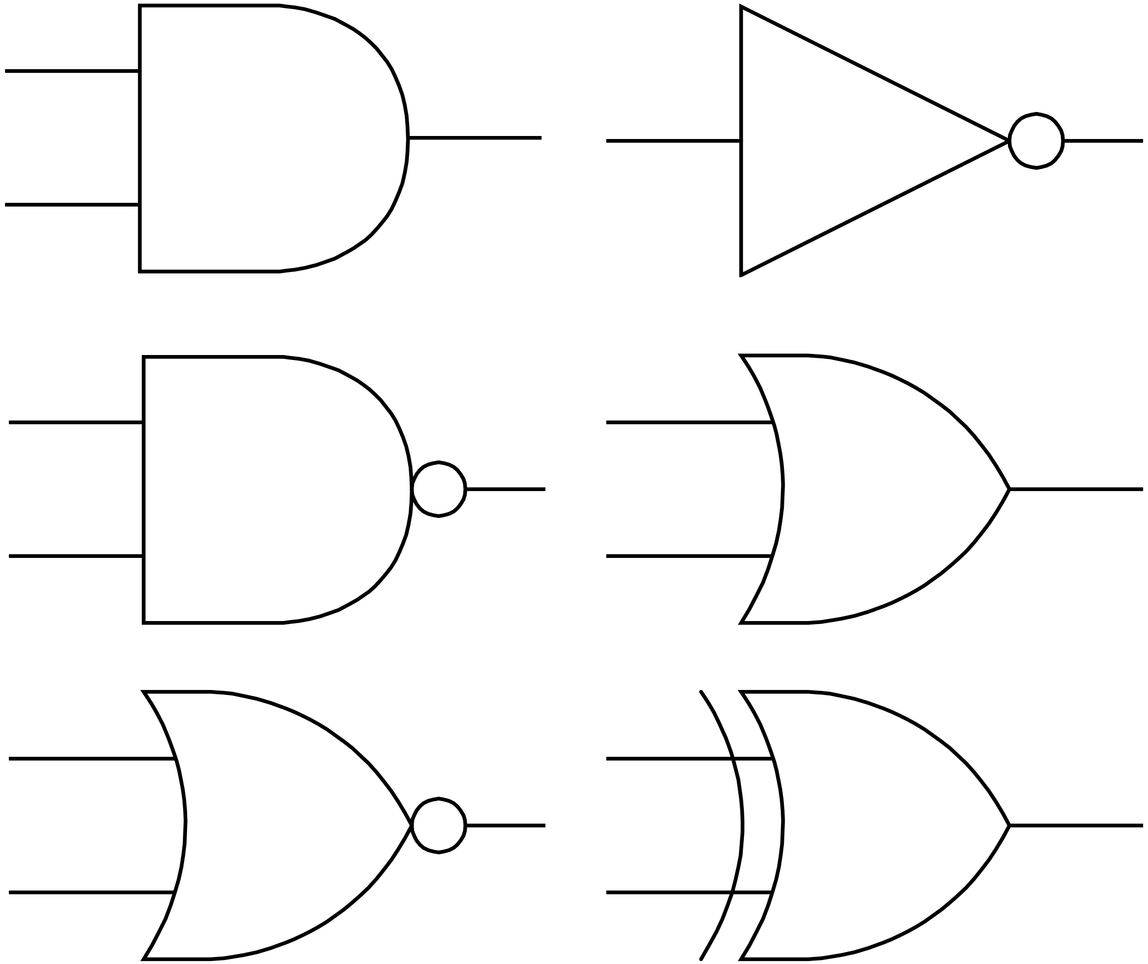
Computational logic task

Craig'n'Dave

Truth tables to circuit diagrams

Expected time to complete: 2 hours

1. Drag the labels into their correct place on the following diagram:



OR

AND

XOR

NOT

NAND

NOR

Truth tables to circuit diagrams

Expected time to complete: 2 hours

2. Draw the circuit diagram which would represent the following Boolean expression:

AQA Boolean Expression: $\mathbf{F = \overline{(A \oplus B) \bullet \overline{C}}}$

OCR Boolean Expression: $\mathbf{F = \neg(\neg C \wedge (A \veebar B)}$

A

B

C

F

3. Complete the truth table for the circuit diagram you have drawn

A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

15 Binary task

Craig'n'Dave

Representing negative numbers in binary

Expected time to complete: 1½ hours

In GCSE computer science you will have learnt how to represent positive whole numbers in binary e.g. 47

At A Level you will need to know how to represent negative as well e.g. -47

Start to recapping (or learning if you didn't do the GCSE) how to represent positive whole numbers between 0-255 in binary

Now research how to represent negative numbers in binary using the method known as:

- Two's complement

Complete the tasks on the following slides.

Additional help:

For additional help and support in structuring your answer you might like to watch some of the following videos from Craig 'n' Dave:

GCSE recap: How to represent positive binary values 0-255
https://student.craigndave.org/videos/aqa-gcse-slr13-number-bases

A Level: Representing negative binary values using Two's Complement
https://student.craigndave.org/videos/aqa-alevel-slr11-twos-complement

15 Binary task

Representing negative numbers in binary

Expected time to complete: 1½ hours

1. Write out the positive binary number 107, the answer should be displayed in 8 bits.

128	64	32	16	8	4	2	1	Binary weighting
								Binary value

2. Write out the negative binary number -107 using Two's Complement, the answer should be displayed in 8 bits.

								Binary weighting
								Binary value

3. How would you represent the lowest negative number possible using Two's Complement, given 8 bits.

								Binary weighting
								Binary value

4. How would you represent the largest positive number possible using Two's Complement, given 8 bits.

								Binary weighting
								Binary value

16 Binary task

Craig'n'Dave

Converting between base-2, base-10 and base-16

Expected time to complete: 1½ hours

As humans we have use the decimal or denary number system (base-10), made up of the unique digits 0-9.

Computer systems at the most basic level use only binary 1's and 0's (base-2).

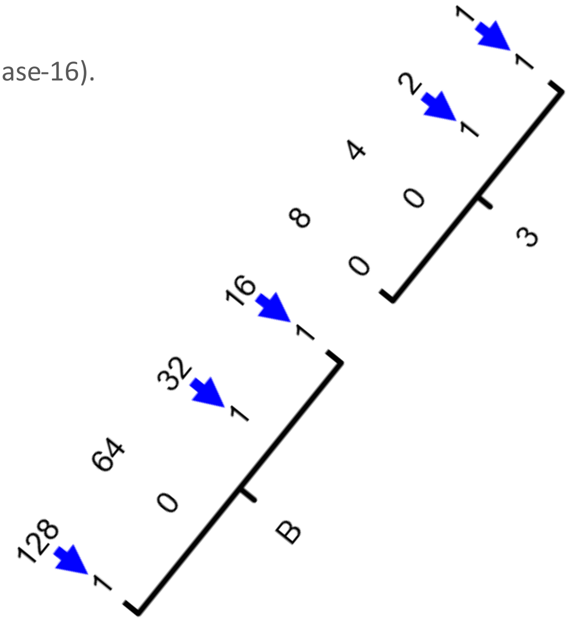
As a computer scientist you will also need to become familiar with the hexadecimal number system (base-16).

You will also need to be comfortable with converting numbers between these three base systems.

Research the following areas:

- Base-2 binary number system
- Base-10 decimal/denary number system
- Base-16 hexadecimal number system
- How to convert between base-2, base-10 and base-16

Complete the tasks on the following slides.



Denary	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Additional help:

For additional help and support in structuring your answer you might like to watch some of the following videos from Craig 'n' Dave:

Base 2, 10 and 16 number systems:
https://student.craigndave.org/videos/aqa-alevel-slr10-base-2-10-and-16-number-systems

Converting between binary, hex and decimal:
https://student.craigndave.org/videos/aqa-alevel-slr11-aqa-converting-between-binary-hex-and-decimal

Converting between base-2, base-10 and base-16

Expected time to complete: 1½ hours

1. Convert the base-2 binary number 11000101 into base-10 and base-16.
(Show all your working)

2. Convert the base-16 hexadecimal number 9F into base-2 and base-10.
(Show all your working)

You may wish to cut and paste this standard binary weighting line to help lay out parts of your answer

128	64	32	16	8	4	2	1	Binary weighting
								Binary value