Accredited

AS and A LEVEL

Delivery Guide

H046/H446

COMPUTER SCIENCE

Theme: Data Types

December 2014

OCR
Oxford Cambridge and RSA

We will inform centres about any changes to the specification. We will also publish changes on our website. The latest version of our specification will always be the one on our website (www.ocr.org.uk) and this may differ from printed versions.

Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee.
Registered in England. Registered company number 3484466.

Registered office: 1 Hills Road
Cambridge
CB1 2EU

OCR is an exempt charity.

CONTENTS

Introduction

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: A clear outline of the content covered by the delivery guide;
- Thinking Conceptually: Expert guidance on the key concepts involved, common difficulties students may have, approaches to teaching that can help students understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: A range of suggested teaching activities using a variety of themes so that different activities can be selected which best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resourcesfeedback@ocr.org.uk.

KEY

Click to view associated resources within this document.

Click here — Click to view external resources

AS Level only — AS Level content only

Curriculum Content

a) Primitive data types, integer, real/floating point, character, string and Boolean

b) Represent positive integers in binary.

c) Use of Sign and Magnitude and Two's Complement to represent negative numbers in binary.

d) Addition and subtraction of binary integers.

e) Represent positive integers in hexadecimal

f) Convert positive integers between Binary Hexadecimal and denary

g) Representation and normalisation of floating point numbers in binary.

h) Floating point arithmetic, positive and negative numbers, addition and subtraction.

i) Bitwise manipulation and masks: shifts, combining with AND, OR, and XOR.

j) How character sets (ASCII and UNICODE) are used to represent text.

Activities	Resources
Numbers and Binary addition (BBC Bitesize) http://www.bbc.co.uk/education/guides/zjfgjxs/revision/1 The BBC bitesize website for computer science contains much of the content needed for this topic. Learners could use this resource independently and can also self-test since there are multiple-choice tests for each section.	Click here

Thinking Conceptually

Data types are the fundamental building block of understanding about how data is stored in a computer program.

It is important that students have an appreciation of how the computer stores data and carries out calculations even though these may not be used in many day-to-day programming activities and can therefore even be considered esoteric. Some might say it is important that you draw this line as to not put off students from entering the field after study as it is one of the more 'dry' parts of the course content. A good proportion of those in industry who 'code' might never touch binary, let alone bitwise operators.

Common misconceptions or difficulties students may have

Students usually have issues with treating numbers in a different way than they are normally used to, but this is something that students must overcome. There are mathematical components such as addition, multiplication and using exponents that students should have a solid grasp of before starting this part of the course. Students' learning and understanding will benefit through having worked-through examples to reference and lots of practice. Parallels could be drawn between these and puzzles such as Sudoku in that they require you to have lots of practice to become versed in doing the calculations and complete them with speed.

It also must be noted that the subject matter isn't particularly relatable to real life and so can seem quite abstract and dull at times. It would be a good idea to weave in and out of this topic with something that is a bit less taxing on the mind. It might, for example, be a good idea to cover a topic like 1.5.2 Moral and Ethical Issues at the same time, so that this topic has chance to sink in and helps to maintain student interest.

This may also give some time to get exemplar questions completed for homework or as lesson starters/plenaries to help students remember, and if students have any large problems with it from a mathematical perspective and need any additional help.

Thinking Conceptually

Conceptual links to other areas of the specification – useful ways to approach this topic to set students up for topics later in the course.

Other areas of the specification that would link to Data Types are 1.4.2 Data Structures and 1.4.3 Boolean Algebra. It would be advised that this topic is taught first as it covers primitive data types.

This topic also has a direct link to the programming element and so if possible, it would be good to teach points a) and j) using an actual programming language such as:

- Python
- C family of languages (for example C# C+ etc.)
- Java
- Visual Basic
- Delphi

ACTIVITIES

Unless the learner has studied Computer Science before, it is unlikely that they have come across many of the data types present since we are unlikely to encounter them outside the realm of the subject area.

It is suggested that:

- Lots of examples are given
- Perhaps get students to make up their own examples as this can make the process seem more real and meaningful
- Where possible using an actual programming language to demonstrate examples such as points a) and j) would make it more practical and therefore meaningful for students.

Thinking Contextually

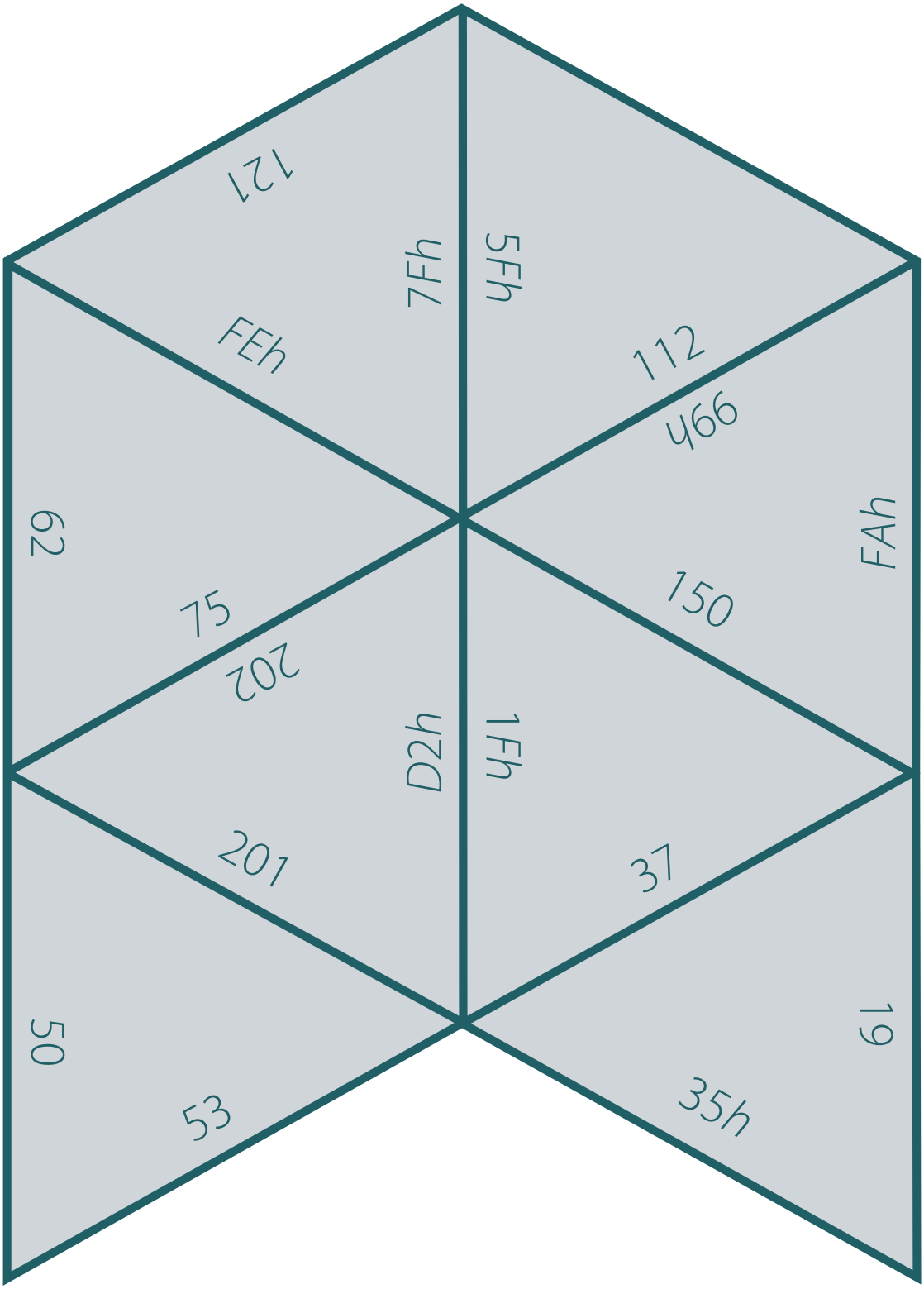
Activities	Resources
Denary to Hex conversion Jigsaw This activity works best in pairs or groups of 3. It addresses misconceptions and provides practice of converting Denary to Hex. Cut out the 24 triangular jigsaw pieces for each group. The group task is to match sides to create a hexagon from the triangular pieces. Use matching pairs to further consolidate concepts, for example: 38 = 26h and 61 = 3Dh Ask students how many possible sets of numbers they can find. Furthermore students could find ASCII equivalents at: http://www.asciitable.com/ Further jigsaws can be created yourself using freely available Tarsia software: http://www.mmlsoft.com/index.php/products/tarsia	Learner Resource 1 Teacher Resource 1 Click here Click here
Bitwise manipulation activity Each member of the class should be given one of the unfilled worksheets. The students should fill in these worksheets using what they have learnt about bitwise manipulation and shifting in order to consolidate their learning.	Learner Resource 2 Teacher Resource 2

Thinking Contextually

Activities	Resources
Binary numbers (CSUnplugged) http://csunplugged.org/binary-numbers Activity in many different languages along with other interpretations and links to similar activities in order to get students out of their seats.	Click here
Binary numbers game (CISCO) http://forums.cisco.com/CertCom/game/binary_game_page.htm Online flash game that students can use to test out their skills. Could be used as a competition with prizes.	Click here

Learner resource 1 – Denary to Hex Conversion Jigsaw

See page 9



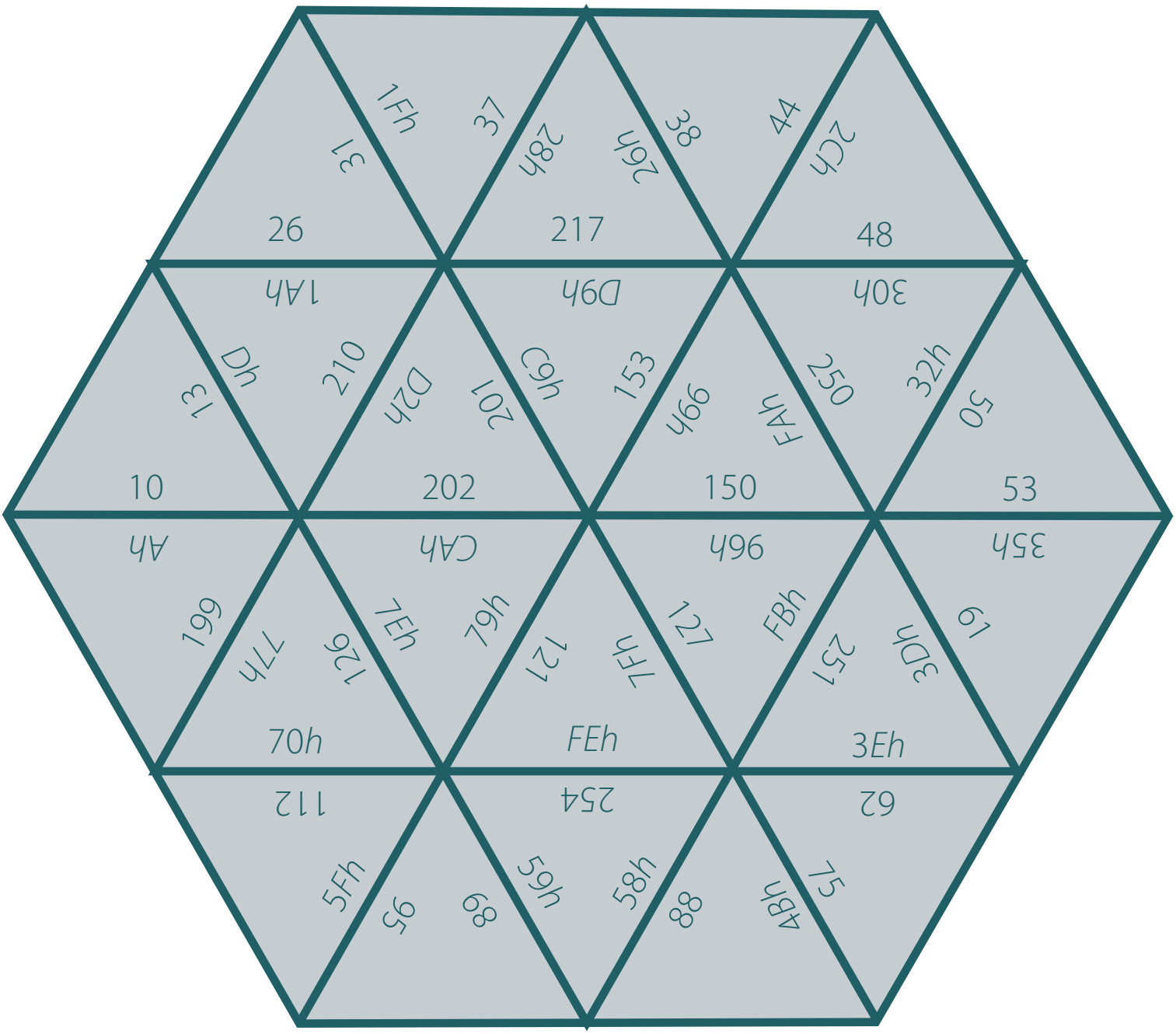
Learner resource 2 Bitwise Manipulation

See page 9

Operand A	Operand B	Bitwise op 1	Result 1	Bitwise op 2	Result 2	Bitwise op 3	Result 3	Left shift operand A 2 places	Right Shift operand A 2 places
1001 0011	1110 0101	AND		OR		XOR			
0100 0010	0111 0011	AND		OR		XOR			
0100 1101	1111 0000	AND		OR		XOR			
0101 0010	1101 1111	AND		OR		XOR			
0101 1101	0011 0011	AND		OR		XOR			

Teacher resource 1 – Denary to Hex Conversion Jigsaw

See page 9



Teacher resource 2 Bitwise Manipulation

See page 9

Operand A	Operand B	Bitwise op 1	Result 1	Bitwise op 2	Result 2	Bitwise op 3	Result 3	Left shift operand A 2 places	Right Shift operand A 2 places
1001 0011	1110 0101	AND	1000 0001	OR	1111 0111	XOR	0111 0110	10 0100 1100	0010 0100
0100 0010	0111 0011	AND	0100 0010	OR	0111 0011	XOR	0011 0001	01 0000 1000	0001 0000
0100 1101	1111 0000	AND	0100 0000	OR	1111 1101	XOR	1011 1101	01 0011 0100	0001 0011
0101 0010	1101 1111	AND	0101 0010	OR	1101 1111	XOR	1000 1101	01 0100 1000	0001 0100
0101 1101	0011 0011	AND	0001 0001	OR	0111 1111	XOR	0110 1110	01 0111 0100	0001 0111


We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

OCR customer contact centre
General qualifications
Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk