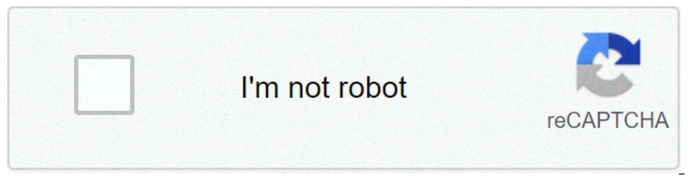

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Printed in Dubai A catalogue record for this title is available from the British Library ISBN 978 1471809309 eISBN 978 1471809323 4 SIR SHAHBAZ 0300 9204594 Contents Introduction Section 1 Theory of computer science Chapter 1 Binary systems and hexadecimal 1.1 Introduction 1.2 The binary system 1.3 Measurement of the size of computer memories 1.4 Example use of binary 1.5 The hexadecimal system 1.6 Use of the hexadecimal system Chapter 2 Communication and internet technologies 2.1 Introduction 2.2 Data transmission 2.3 Error-checking methods 2.4 Internet technologies Chapter 3 Logic gates and logic circuits 3.1 Introduction 3.2 Logic gates 3.3 Truth tables 3.4 The function of the six logic gates 3.5 Logic circuits 3.6 Logic circuits in the real world Chapter 4 Operating systems and computer architecture 4.1 Introduction 4.2 Operating systems 4.3 Interrupts 4.4 Computer architecture 4.5 The fetch–execute cycle Chapter 5 Input and output devices 5.1 Introduction 5 SIR SHAHBAZ 0300 9204594 5.2 Input devices 5.3 Output devices Chapter 6 Memory and data storage 6.1 Introduction 6.2 File formats 6.3 Lossless and lossy file compression 6.4 Memory and storage 6.5 How to estimate the size of a file Chapter 7 High- and low-level languages 7.1 Programming languages 7.2 Translators 7.3 What happens when things go wrong? Chapter 8 Security and ethics 8.1 Introduction 8.2 Security and data integrity 8.3 Cookies 8.4 Loss of data and data corruption 8.5 Firewalls and proxy servers 8.6 Security protocols 8.7 Encryption 8.8 Applications 8.9 Computer ethics 8.10 Free software, freeware and shareware Section 2 Practical problem-solving and programming Chapter 9 Problem-solving and design 9.1 Introduction 9.2 Algorithms 9.3 Test data 9.4 Validation and verification 9.5 Using trace tables 9.6 Identifying and correcting errors 9.7 Producing algorithms 6 SIR SHAHBAZ 0300 9204594 Chapter 10 Pseudocode and flowcharts 10.1 Introduction 10.2 Assignment 10.3 Conditional statements 10.4 Loop structures 10.5 Input and output statements 10.6 Standard actions 10.7 Examples of algorithms in pseudocode 10.8 Standard flowchart symbols Chapter 11 Programming concepts 11.1 Introduction 11.2 Programming 11.3 Declaration and use of variables and constants 11.4 Basic data types 11.5 How to make your program work Chapter 12 Data structures: arrays and using pre-release material 12.1 Introduction 12.2 Arrays 12.3 Using pre-release material Chapter 13 Databases 13.1 Introduction 13.2 What are databases used for? 13.3 The structure of a database 13.4 Practical use of a database Index 7 SIR SHAHBAZ 0300 9204594 Introduction Aims This textbook has been written to provide the knowledge, understanding and practical skills that a student would need for the Cambridge International Examinations Computer Science IGCSE and GCE O Level courses. The textbook is part of a package which includes a student CD-ROM. A teacher's CD-ROM is also available separately which includes additional guidance and other useful information (see later in this introduction). This book and accompanying student CD-ROM provide: • practice end-of-chapter questions which include questions from past Cambridge International Examinations papers • activities which give students additional guidance and practice • sample program solutions for programming activities • hints and tips where these provide additional help and knowledge. Although this book has been written with the Cambridge International Examinations syllabus in mind, it can still be used as a useful reference textbook for other GCSE computing courses. It is also a useful source of information for those students starting an A level computer science course – especially at AS level. Using the book The textbook contains 13 chapters. Although it is possible for some elements of the practical problem-solving chapters to be examined in Paper 1 (Theory of Computer Science), and vice versa, the sections for the theory work are in Chapters 1 to 8 and the practical work in Chapters 9 to 13. The book has been split into Section 1 (Theory of computer science) and Section 2 (Practical problem-solving and programming) to follow the Cambridge International Examinations syllabus as closely as possible. Activities are shown throughout the books as follows: Activity 1.1 Student CD-ROM The accompanying student CD-ROM contains additional guidance to enhance the learning process in a number of key areas in the textbook. The CD-ROM uses animation and verbal commentary wherever this is found helpful in the learning process. The CD-ROM includes sample program solutions for the programming activities. 8 SIR SHAHBAZ 0300 9204594 Where book topics are included in the CD-ROM the following symbol is used: Teacher's CD-ROM An additional teacher's CD-ROM is available to accompany this textbook. This CD- ROM includes the following material: • possible responses to sample examination and other questions • each question part suggests a level of difficulty • expected responses to the questions at that level are included • additional notes on why the responses meet the required level only • answers to the end-of-chapter questions in this textbook and to some of the activities where relevant • program files in Python and Java for activities and end-of-chapter questions. • a scheme of work to help teacher's plan their two-year computer science course; this scheme includes: • chapter numbers from the book • topic to be covered from the chapter • approximate time allocation advised to cover the topic • Cambridge International Examinations syllabus reference • relevant page numbers from the textbook • activities found in the textbook to help in the teaching process • any additional notes to help plan the lessons. The teacher's CD-ROM has not been through the Cambridge endorsement process. David Watson and Helen Williams September 2014 9 SIR SHAHBAZ 0300 9204594 Section 1 Theory of computer science Chapters 1 Binary systems and hexadecimal 2 Communication and internet technologies 3 Logic gates and logic circuits 4 Operating systems and computer architecture 5 Input and output devices 6 Memory and data storage 7 High- and low-level languages 8 Security and ethics 10 SIR SHAHBAZ 0300 9204594 11 SIR SHAHBAZ 0300 9204594 1 Binary systems and hexadecimal In this chapter you will learn about: • the binary system • measurement of computer memories • the hexadecimal system • how to convert numbers between different number base systems 1.1 Introduction As you progress through this book you will begin to realise how complex computer systems really are. By the time you reach Chapter 12 you should have a better understanding of the fundamentals behind computers themselves and the software that controls them. However, no matter how complex the system, the basic building block in all computers is the binary number system. This system is chosen since it consists of 1s and 0s only. Since computers contain millions and millions of tiny 'switches', which must be in the ON or OFF position, this lends itself logically to the binary system. A switch in the ON position can be represented by 1; a switch in the OFF position can be represented by 0. 1.2 The binary system We are all familiar with the denary (base 10) number system which counts in multiples of 10. This gives us the well-known headings of units, 10s, 100s, 1000s and so on: The BINARY SYSTEM is based on the number 2. Thus, only the two 'values' 0 and 1 can be used in this system to represent each digit. Using the same method as denary, this gives the headings of 20, 21, 22, 23 and so on. The typical headings for a binary number with eight digits would be: A typical binary number would be: 1 1 1 0 1 1 1 0 12 SIR SHAHBAZ 0300 9204594 1.2.1 Converting from binary to denary It is fairly straightforward to change a binary number into a denary number. Each time a 1 appears in a column, the column value is added to the total. For example, the binary number above is: 128 + 64 + 32 + 8 + 4 + 2 = 238 (denary) The 0 values are simply ignored. Activity 1.1 Convert the following binary numbers into denary: a 0 0 1 1 0 0 1 1 b 0 1 1 1 1 1 1 1 c 1 0 0 1 1 0 0 1 d 0 1 1 1 0 1 0 0 e 1 1 1 1 1 1 1 1 f 0 0 0 0 1 1 1 1 g 1 0 0 0 1 1 1 1 h 1 1 1 1 0 0 0 0 i 0 1 1 1 0 0 0 0 j 1 1 1 0 1 1 1 0 1.2.2 Converting from denary to binary The reverse operation, converting from denary to binary, is slightly more complex. There are two basic ways of doing this. The first method is 'trial and error' and the second method is more methodical and involves repetitive division. Method 1 Consider the conversion of the denary number, 107, into binary. This method involves placing 1s in the appropriate position so that the total equates to 107: Method 2 This method involves successive division by 2. The remainders are then read from BOTTOM to TOP to give the binary value. Again using 107, we get: 13 SIR SHAHBAZ 0300 9204594 Figure 1.1 Activity 1.2 Convert the following denary numbers into binary (using both methods): a 4 1 b 6 7 c 8 6 d 1 0 0 e 1 1 1 f 1 2 7 g 1 4 4 h 1 8 9 i 2 0 0 j 2 5 5 1.3 Measurement of the size of computer memories A binary digit is commonly referred to as a BIT; 8 bits are usually referred to as a BYTE. The byte is the smallest unit of memory in a computer. Some computers use larger bytes but they are always multiples of 8 (e.g. 16-bit systems and 32-bit systems). One byte of memory wouldn't allow you to store very much information; therefore memory size is measured in the following multiples: Table 1.1 Name of memory size Number of bits Equivalent denary value 1 kilobyte (1 KB) 210 1 024 bytes 14 SIR SHAHBAZ 0300 9204594 1 megabyte (1 MB) 220 1 048 576 bytes 1 gigabyte (1 GB) 230 1 073 741 824 bytes 1 terabyte (1 TB) 240 1 099 511 627 776 bytes 1 petabyte (1 PB) 250 1 125 899 906 842 624 bytes (Note: 1024 × 1024 = 1048576 and so on.) To give some idea of the scale of these numbers, a typical data transfer rate using the internet is 32 megabits (i.e. 4 MB) per second (so a 40 MB file would take 10 seconds to transfer). Most hard disk systems in computers are 1 or 2 TB in size (so a 2 TB memory could store over half a million 4 MB photos, for example). It should be pointed out here that there is some confusion in the naming of memory sizes. The IEC convention is now adopted by some organisations. Manufacturers of storage devices often use the denary system to measure storage size. For example, 1 kilobyte = 1000 byte 1 megabyte = 1000000 bytes 1 gigabyte = 1000000000 bytes 1 terabyte = 1000000000000 bytes and so on. The IEC convention for computer internal memories (including RAM) becomes: 1 kibibyte (1 KiB) = 1024 bytes 1 mebibyte (1 MiB) = 1048576 bytes 1 gibibyte (1 GiB) = 1073741824 bytes 1 tebibyte (1 TiB) = 1099511627776 bytes and so on. However, the IEC terms are not universally used and this textbook will use the more conventional terms shown in Table 1.1. This also ties up with the Cambridge International Examinations computer science syllabus which uses the same terminology as in Table 1.1. 1.4 Example use of binary This section gives an example of a use of the binary system. We will introduce the idea of computer REGISTERS; this subject is covered in more depth in Chapter 4. A register is a group of bits; it is often depicted as follows: Figure 1.2 15 cambridge igcse computer science workbook pdf free download

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