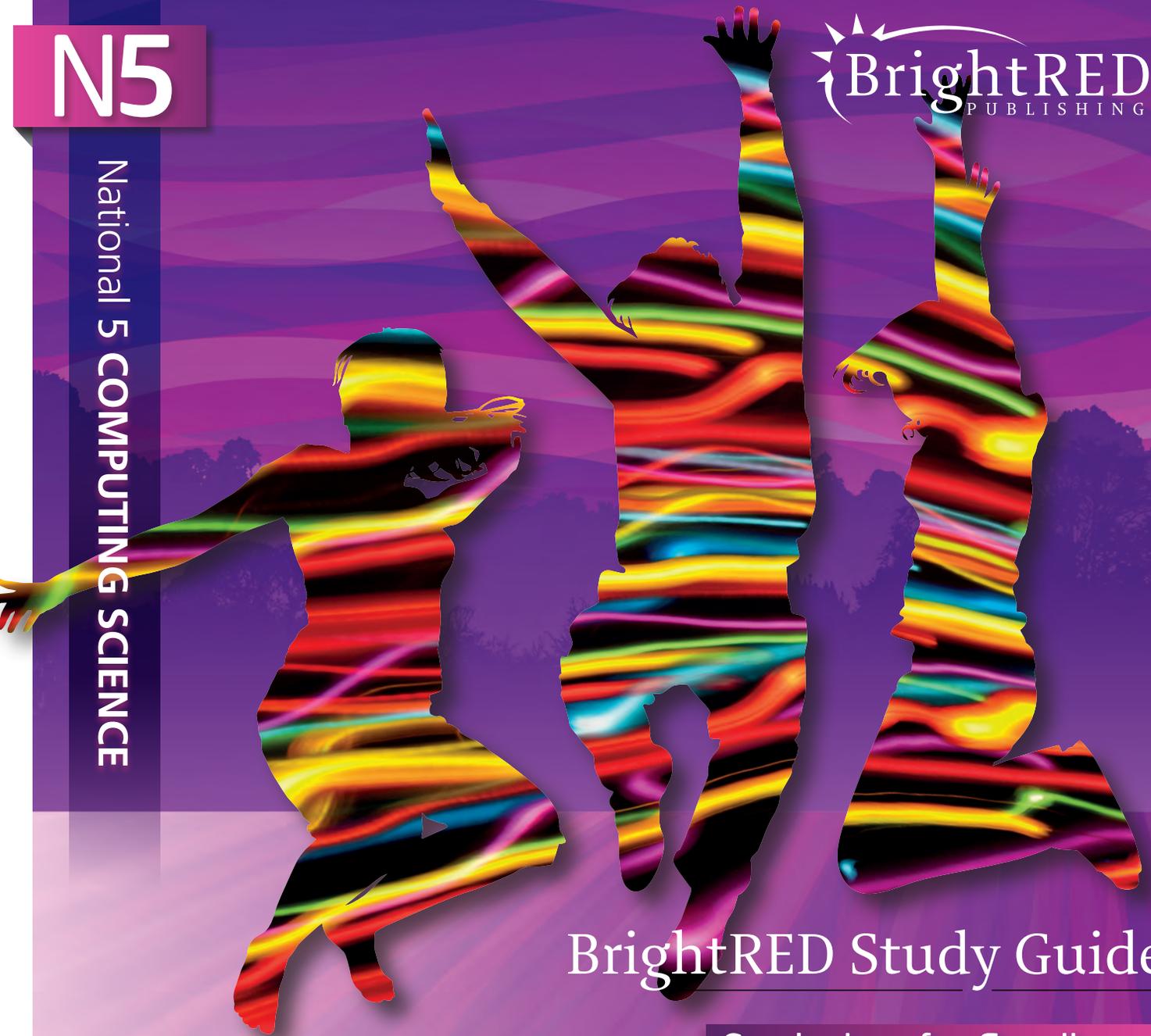


N5

National 5 COMPUTING SCIENCE

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BrightRED Study Guide

Curriculum for Excellence

N5

# COMPUTING SCIENCE



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## THE NATIONAL 5 COURSE

## SYLLABUS AND ASSESSMENT

## SYLLABUS

This course has four areas of study:

- 1 Software Design and Development
- 2 Computer Systems
- 3 Database Design and Development
- 4 Web Design and Development.

An outline of the contents of each area is given in the tables below.

Software Design and Development	
Analysis	The phases of the development process: analysis, design, implementation, testing, documentation and evaluation. Functional requirements of a problem: input, processing and output.
Design notations	Structure diagrams      Pseudocode      Flowcharts
User interface design	Wireframes
Data types and structures	Character, string, integer, real, Boolean 1-D arrays
Computational constructs	Assigning values Arithmetic operations (+, -, *, /, ^) Concatenate strings Expressions to concatenate strings Selection constructs using simple conditional statements with <, >, ≤, ≥, =, ≠ operators Selection constructs using complex condition statements Logical operators (AND, OR, NOT) Iteration using fixed and conditional loops Pre-defined functions (with parameters): random, round, length
Standard algorithms	Input validation Running total within loop Traversing a 1-D array
Testing	Normal, extreme and exceptional test data Syntax, execution and logic errors
Evaluation	Fitness for purpose Efficient use of coding constructs Robustness Readability: internal commentary, meaningful identifiers, indentation, white space

Computer Systems	
Data representation	Binary to represent positive integers Floating-point numbers Convert from binary to decimal and vice versa Extended ASCII code (8-bit) used to represent characters Graphics (bit-mapped and vector)
Computer structure	Processor (registers, ALU, control unit) Memory locations with unique addresses Buses (data and address)
Translators	Translation of high-level program code into machine code with interpreters and compilers
Environmental impact	The impact of the energy use of computer systems on the environment Measures to use less power
Security precautions	Firewalls      Encryption in electronic communications

contd

## Database Design and Development

Analysis	Identify the end user and functional requirements of a database problem
Data Protection Act 1998	Prior consent of data subject      Data used for limited, specifically stated purposes Accuracy of data      Data kept safe and secure
Design	Entity relationship diagram for 1-to-many relationships Data dictionary: tables, fields, primary key and foreign key, data types, validation Query design: multiple tables, fields, search criteria, sort order
Implementation	Relational databases with two linked tables Referential integrity SQL operations: — SELECT, FROM, WHERE      — UPDATE — AND, OR, <, >, =      — DELETE — ORDER on one or two fields      — equi-join between tables — INSERT
Testing	SQL operations work correctly
Evaluation	Fitness for purpose Accuracy of output

## Web Design and Development

Analysis	Identify the end user and functional requirements of a website
Website structure	Home page and up to four linked multimedia pages
User interface design	Visual layout and readability using a wireframe      Positioning of the media elements Navigational links      File formats of the media (text, graphics, video, audio) Consistency across multiple pages
Copyright, Designs and Patents Act 1988	Web content (text, graphics, video, audio)
Standard file formats	Audio (WAV and MP3): compression, quality, file size Bit-mapped graphics (JPEG, GIF, PNG): compression, animation, transparency, colour depth
Factors affecting file size	Resolution, colour depth, sampling rate      The need for compression
Prototyping	Low fidelity using wireframe
Cascading Style Sheets	Internal and external      Selectors, classes and IDs Properties text: font (family, size), colour, alignment, background colour
HTML	Tags: head, title, body, heading, paragraph, div, link, anchor, image, audio, video, lists – ol, ul and li Hyperlinks (internal and external)      Relative and absolute addressing
JavaScript	Mouse events: onmouseover, onmouseout
Testing	Matches user-interface design      Media (text, graphics, video) display correctly Links and navigation work correctly      Consistency
Evaluation	Fitness for purpose

## Grades

You will be given an overall grade (A–D) calculated from the total of the two marks.

Typically:

- Grade A is awarded for a total of 70 per cent or more.
- Grade B is awarded for a total between 60 and 69 per cent.
- Grade C is awarded for a total between 50 and 59 per cent.
- Grade D is awarded for a total between 45 and 49 per cent.

Boundaries can vary slightly depending on the difficulty of the course assessment.

## ONLINE



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## DON'T FORGET



You should use the syllabus as a kind of checklist to make sure that you understand exactly what knowledge is required for assessments in this course. Read it through and ask yourself if you know the topics covered in the table.



## THINGS TO DO AND THINK ABOUT

Don't spend too much time on a component that is not worth many marks at the expense of losing lots of marks in a more important component.

# DATA REPRESENTATION 2

## CHARACTERS

Text data is stored in many types of program on a computer. For example, word-processing, databases and websites all require to store textual information. Text is stored on a computer by representing each individual character as a unique binary code. The characters include letters (upper and lower case), numeric digits (0 to 9), punctuation marks (? , & , ! , £ etc.) and mathematical operations (+ , - , \* , / etc.).

### ASCII (American Standard Code for Information Interchange)

Standards for text representation have been developed so that different programs using the same codes can interpret data as the same characters.

ASCII is a common standard for representing text that uses an 8-bit (1-byte) code for each character. For example, the letter E is stored as 01000101 (or 69 in decimal), and the character £ is stored as 00100011 (or 35 in decimal).

There are 32 special character codes known as control characters. **Control characters** are special non-printing characters in a character set, used for special purposes. Examples of control characters are Return, Tab and End of file.

### Extended ASCII code

The standard ASCII code system can represent 128 different characters because it uses 7 bits for the character code while the 8th bit is used for error detection.

Extended ASCII code uses all 8 bits for the character code and can represent 256 characters that include symbols such as € (Euro), ½ (half), © (copyright), μ (micro unit) and so on.

### Character set

A character set is the complete list of characters that a computer system can represent.

This includes uppercase letters, lowercase letters, punctuation symbols, numeric symbols and control characters.

## BIT-MAPPED GRAPHICS

The tiny dots that make up a bit-mapped graphic image are called **pixels**. The word 'pixel' comes from the term 'picture element', since the pixels are the elementary parts of a picture.

### Bit depth

A **bit-mapped** graphics program stores the data in a two-dimensional grid of pixels. A binary code is used to represent the colour of each pixel. In a black-and-white image where each pixel can be only two states, black can be represented by a 1 and white by a 0. In an image with lots of colours, several bits are required for the colour code to represent all the different colours. The **bit depth** is the number of bits used for the colour code. Using 24 bits for the colour code of each pixel is quite common, as over 16 million different colours can be represented, which is at the limit of the number of colours that the human eye can distinguish.



Black and white



Colour

contd

### DON'T FORGET

The number of bits used to represent the colour of each pixel is called the bit depth. The higher the bit depth, the more colours that can be represented.

## Resolution

This is the number of pixels in a fixed area of a bit-mapped graphic.

High-**resolution** images have a large number of small pixels, and low-resolution images have a small number of large pixels.

High-resolution graphics have a better quality than low-resolution graphics but require more storage since there are more pixels in the image.

The resolution of graphics is normally measured in d.p.i. (dots per inch).

## VECTOR GRAPHICS

**Vector graphics** is a type of graphics that stores the image as a collection of objects such as rectangles, circles, lines, triangles and so on. The attributes of each object are stored, such as coordinates, length, breadth, fill colour and so on.

### EXAMPLE:

Object	Attributes
Rectangle	start x, start y, length, breadth, fill red, line green, and so on.
Ellipse	centre x, centre y, radius x, radius y, fill red, line black, and so on.
Line	start x, start y, end x, end y, line blue, and so on.
Polygon	point1 x, point1 y, point2 x, point2 y, point3 x, point3 y, fill green, line blue, and so on.



## COMPARISON OF BIT-MAPPED GRAPHICS AND VECTOR GRAPHICS

There are advantages and disadvantages that each type of graphics program has over others.

	Bit-Mapped Graphics	Vector Graphics
File size	The file size of bit-mapped graphics is large, since the colour code of thousands or even millions of pixels must be stored.	The file size of vector graphics is generally small, since only the objects and their attributes are stored, not pixels.
Editing	A bit-mapped image is edited at the pixel level.	Vector graphics are edited at an attribute level, for example changing the length of a rectangle or the line colour of a circle. Also, overlapping objects can be separated again, which cannot be done with bit-mapped graphics since the image is not stored as objects.
Fine detail	Bit-mapped graphics allow the editing of fine detail in photos taken by digital cameras. For example, the program Photoshop uses techniques such as airbrushing to produce the finished photographs shown in magazines, brochures and leaflets.	This kind of fine detail is not possible in vector graphics because the image is made up of shapes such as rectangles and lines.
Enlarging	If a bit-mapped image is enlarged, then it becomes jagged.	The resolution of a vector graphic image is NOT fixed by the resolution of the pixels, so that an enlarged image does NOT become jagged.

### ONLINE

Use a search engine to look up the features of the program Photoshop, using keywords such as 'Photoshop', 'editing', 'basics', 'tutorial' and so on.

### DON'T FORGET

You probably have both types of graphics program on your computer. The graphics program Paint is an example of bit-mapped graphics, whereas the drawing toolbar in Microsoft Word is an example of vector graphics.

### ONLINE TEST

Test yourself on graphics online at [www.brightredbooks.net/N5Computing](http://www.brightredbooks.net/N5Computing)

## THINGS TO DO AND THINK ABOUT

Bit-mapped graphics and vector graphics are two types of graphics software. Each stores and edits the image in different ways. Make sure that you learn the differences and the advantages and disadvantages of each type of software.

# DATABASE DESIGN AND DEVELOPMENT

## ANALYSIS AND DESIGN

### VIDEO

Watch the clip about databases at [www.brightredbooks.net/N5Computing](http://www.brightredbooks.net/N5Computing)



### WHAT IS A DATABASE?

A **database** is an organised collection of records holding data so that it can be stored and accessed quickly. Before computers, organisations such as banks, schools and supermarkets kept their data on a large number of paper records in filing cabinets. The advantages of keeping data on a computer include speed of retrieval of information, easier amendments to data, less waste of paper and space, and password protection to improve the security of files.

On the other hand, computer databases are liable to attacks from hackers where confidential information can be accessed and even changed. There is also the possibility of files being damaged or deleted by a virus attack.

### FILES, RECORDS AND FIELDS

#### File

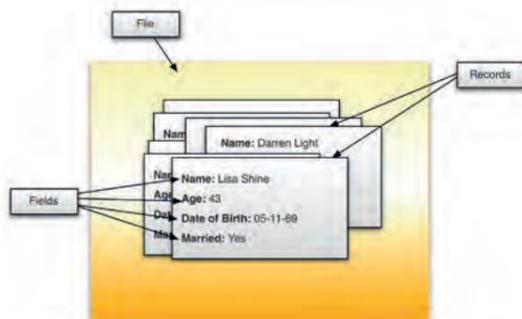
A database **file** is an organised collection of records on a particular topic. For example, a sports club may keep a file on its members' details, or a zoo may keep a file on the details of each of their animals.

#### Record

A **record** is the data held on one person or thing: for example, a student record in a school database, or an article record in a supermarket stock file.

#### Field

A **field** is the term given to one item of data in a record: for example, the age field in an employee's record, or the price field in a stock record.



### STAGES OF DEVELOPMENT

The development of a database follows a series of stages in the order shown below:

1. Analysis, 2. Design, 3. Implementation, 4. Testing, 5. Evaluation.

An outline of each stage is given below.

- 1. Analysis:** an investigation to determine the functional requirements of the database in terms of the inputs, processes and outputs that are carried out.
- 2. Design:** identifying the tables and fields (data types, validation and so on) required to solve the problem and the queries and reports.
- 3. Implementation:** a database package is used to convert the design into an actual database.
- 4. Testing:** the database is tested with carefully chosen test data to make sure that inputs and validation work correctly and that queries give correct results.
- 5. Evaluation:** assessing whether the software is fit for purpose and produces accurate output.

### ANALYSIS

The first stage in developing a database is to identify its functional requirements and the end users of the database.

#### End user

It is essential that the user interface is appropriate to the end users of the database. A database that is to be used by expert users will have a user interface which would not be appropriate for beginners or young children.

#### Functional requirements

The functional requirements describe the functions that the database will carry out in terms of inputs, processes and outputs.

The data that is to be input into tables, the processing of the data by queries and the output of data in reports must all be identified.

#### EXAMPLE:

A hockey club requires to store the details of its players (name, position, date of birth, address, email) and coaches (name, address, telephone number, email, salary) in a database.

The database has to be able to select players who were born in a given year and display the selected player records in an alphabetical list.

The database also has to be able to add a percentage increase to the coaches' salaries and display the names and salaries.

**Input** Enter the names, positions, date of births, addresses and emails into a player table.

Enter the names, addresses, telephone numbers, emails and salaries into a coach table.

**Processing** Select players who were born in a year and sort into alphabetical order.

Calculate the new salaries.

**Output** A report of a list of the players born in a given year.

A report of a list of the coaches and their salaries.

### DATA PROTECTION ACT

In the modern world, organisations such as companies, governments, sports clubs and medical centres hold personal data on people in databases and other information systems. The Data Protection Act was introduced to protect the rights of individuals in society against misuse of their data being held on computer systems and networks.

The data subjects are the people whose information is being stored. The data users are the people in the organisation who need to use the data to run the business. For example, in a dental practice, the data subjects would be the patients and the data users would be the dentists and secretaries.

#### Requirements of the Data Protection Act

The main requirements of this Act are:

- Information must not be given to other organisations without the consent of the individual.
- The data should be accurate and up to date.
- The data must only be used for limited purposes which are specifically stated.
- The data should be kept secure using passwords and physical security such as locks on doors.

### + DON'T FORGET

The analysis stage of a database project and the analysis stage of a programming project are basically the same. Both of these projects start with identifying the functional requirements (inputs, processes, outputs) of the software and the type of users who will be using the solution.

### + DON'T FORGET

The records of a database are often described as rows. This is because database records are often displayed in tables where each row is showing the data for one record.



### THINGS TO DO AND THINK ABOUT

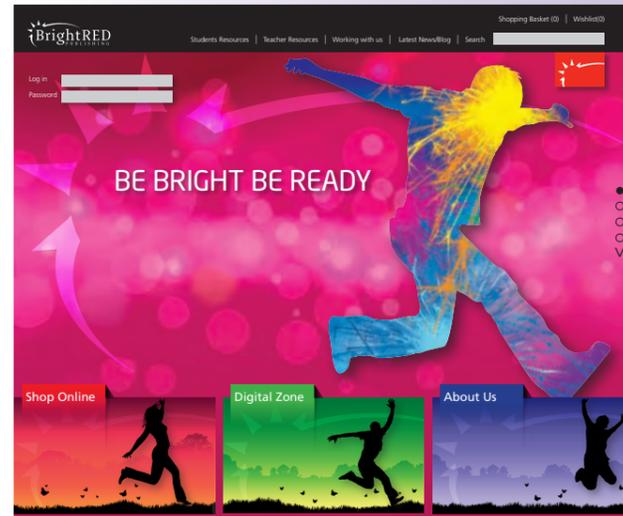
Consider a database that you have created in your practical work. Try to identify the inputs, processing and outputs performed by the database.

# HTML 1

## INTRODUCTION

The **World-Wide Web (WWW)** consists of multimedia information stored on the internet on websites.

At one time, websites were created using **Hypertext Mark-up Language (HTML)**, but this was very difficult and time-consuming, and these days most websites are created using a web-page editor. Web-page editors allow elements of the website to be dragged and dropped onto the page without the need for writing technically difficult HTML code to achieve the same thing.



## BROWSER

A **browser** is a program that displays web pages and allows the user to navigate around other websites on the internet. Internet Explorer is the most commonly used browser.

Browsers provide other functions such as:

- 1 Allowing the user to keep a list of shortcuts to favourite websites so that they can quickly be revisited.
- 2 Keeping a history of recently visited websites.
- 3 Accessing webmail to send and receive e-mails.
- 4 The settings can be customised to suit the preferences of the user, for example controlling which toolbars are displayed, which website is initially displayed, the zoom-in/zoom-out factor and so on.
- 5 Performing the transfer of files over the internet using the File Transfer Protocol (FTP).

## URL

Websites can be visited by entering a unique address called a **Uniform Resource Locator (URL)** into a browser program. The URL is made up of several component parts. These parts include the protocol, the domain name, the path to the file and the name of the file.

For example, the URL for a web page about laptops made by Dell on the PC World website is shown below.

http://www.pcworld.co.uk/hardware/laptops/dell.htm

Protocol      Domain name      Pathway      Filename

The **protocol** is an agreed set of rules between the sender and the receiver that is used to transfer the file. In this case, the Hypertext Transfer Protocol (HTTP) is used to transfer a web page.

contd

The **domain name** is the address of the server computer that is hosting the web page. Dots are used to separate the different parts (two or more) of the domain name. The parts are used to specify the type of organisation and the country in which it is based.

The tables alongside show some examples of the parts used in domain names for commonly used organisations and countries.

The pathway specifies the route to the page.

The filename is the name of the actual file that is being accessed.

If the URL is not known for a particular website, then the site and other relevant sites can be found by entering suitable keywords into a **search engine**.

Part	Meaning
.com	A company
.edu	An educational institution
.org	A non-profit-making institution
.gov	A governmental agency

Part	Country
.uk	United Kingdom
.fr	France
.nz	New Zealand
.it	Italy

## + DON'T FORGET

Universal Resource Locator is another expansion of the acronym URL as well as Uniform Resource Locator, but the phrase Uniform Resource Locator is used in this course.

## HYPertext MARK-UP LANGUAGE

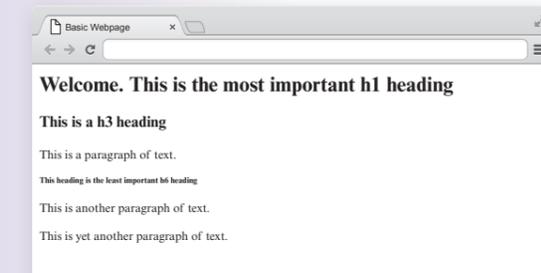
Hypertext Mark-up Language (HTML) is a language used to create web pages.

It consists of a series of tags which are used to describe the elements of the web page such as a head, title, body, image, audio, hyperlink and so on.

The elements of the page are surrounded by a start tag, <tag>, and a stop tag, </tag>.

### Basic web page

A web page has a head which contains a title and other information and a body which contains the contents of the page. An example of a basic HTML page is shown here.



A description of the tags in this code is given below:

- **html**: the <html> tags go around the whole file to specify that it is an HTML file.
- **head**: the <head> tags contain information such as the page title and CSS links (Later!).
- **title**: the <title> tags declare the page title which is displayed in the browser toolbar.
- **body**: the <body> tags go around the main content of the file, which includes elements such as text, images and tables.
- **headings**: headings are defined with the <h1> to <h6> tags.
- <h1> defines the most important heading. <h6> defines the least important heading.
- **paragraph**: paragraphs are defined with the <p> tag. They are used to represent blocks of text that are separated from adjacent blocks.

```
<html>
<head>
  <title>Basic Webpage</title>
</head>
<body>
  <h1>Welcome. This is the most important h1 heading</h1>
  <h3>This is a h3 heading</h3>
  <p>This is a paragraph of text.</p>
  <h6>This heading is the least important h6 heading</h6>
  <p>This is another paragraph of text.</p>
  <p>This is yet another paragraph of text.</p>
</body>
</html>
```



## THINGS TO DO AND THINK ABOUT

HTML tags can be nested, in the sense that one tag is placed inside another tag. For example, the title tag is nested inside the head tag. Think about other examples of nesting in HTML documents.

## ONLINE TEST

Test yourself on HTML at [www.brightredbooks.net/N5Computing](http://www.brightredbooks.net/N5Computing)

## ONLINE



Go online and download some of the websites that are stored in your favourites. Investigate the component parts of the URL displayed at the top of the screen in the browser.

# COMPUTING SCIENCE

Alan Williams

This BrightRED Study Guide is just the thing you need to tackle your course and gain the exam skills essential to succeed at National 5 Computing Science. Written by trusted author and experienced Computing teacher Alan Williams, this book is packed with brilliant examples, tasks and advice. It is the perfect companion to your studies.

- ▶ **Contains all of the essential course information**, arranged in easily digestible topics.
- ▶ **Designed in full colour, highly illustrated, accessible and engaging** to make sure all that study sticks!
- ▶ **Don't forget!** pointers offer advice on key facts and on how to avoid common mistakes.
- ▶ **Things to do and think about** sections at the end of each topic allow for further practice and research.
- ▶ **Worked examples** show you how to approach a range of concepts and questions.
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ISBN 978-1-84948-311-7



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