Information Everywhere

An Introduction to Web-based Information Systems

by Jeremy Scott

TUTOR NOTES
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Introduction

Implementation of Curriculum for Excellence and the development of new National Qualifications presented a timely opportunity to revise the way computing science is taught in schools and to provide a more interesting, up-to-date and engaging experience for both tutors and learners.

This resource has been developed by the Royal Society of Edinburgh (RSE) and the BCS Academy of Computing to support a subset of the Information Systems Design & Development unit of Scottish National 4 Computing Science. It will seek to consolidate learners’ understanding of modern Information Systems concepts, through study of web technologies, including HTML.

Whilst this resource has been designed to be used as a standalone resource, learners would benefit from having covered some Computing Science prior to this – possibly via earlier packs in the RSE/BCS’s series on Computing Science such as:

- *Starting from Scratch: An Introduction to Computing Science*
- *Itching for More: An Intermediate Course in Computing Science*
- *I Love My Smartphone: A Computing Science Course in Mobile App Development*

All of the RSE/BCS’s resources build on state-of-the-art understanding of the pedagogy of Computing, drawn from around the world. This should enable learners to develop both coding skills and deep understanding of core Computing concepts, including computational thinking (see overleaf).

Whilst this resource is intended to support tutors’ thinking about how they might translate the intentions of the curriculum into classroom activity, it should not be seen as prescriptive. Rather, it is intended to stimulate innovation and offer tutors the flexibility and opportunity to deploy their creativity and skills in meeting the needs of learners.
Computational Thinking

Computational thinking is recognised as a key skill set for all 21st century learners – whether they intend to continue with Computing Science or not. It involves viewing the world through thinking practices that software developers use to write programs.

These can be grouped into five main areas, with abstraction at its core:

- seeing a problem and its solution at many levels of detail (abstraction).
- thinking about tasks as a series of steps (algorithms)
- understanding that solving a large problem will involve breaking it down into a set of smaller problems (decomposition)
- appreciating that a new problem is likely to be related to other problems the learner has already solved (pattern recognition), and
- realising that a solution to a problem may be made to solve a whole range of related problems (generalisation).

Furthermore, there are some key understandings about computers:

- Computers are deterministic: they do what you tell them to do. This is news to many, who think of them as pure magic.
- Computers are precise: they do exactly what you tell them to do.
- Computers can therefore be understood; they are just machines with logical working.

Whilst computational thinking can be a component of many subjects, Computing Science is particularly well-placed to deliver it.

Informational Thinking

Whilst Computational Thinking certainly applies to information systems, there are further overarching ideas that together could be referred to as “informational thinking”:

- Information systems rely on data structures.
  At its simplest, this concept can mean files, records and fields in a database; in a web site, structures may be linear, hierarchical or net.
- Data structures are linked.
  This can mean techniques such as hyperlinks or relations in a database.
- Information systems design and development is user-centred.
  In web development, this could involve drawing out common properties from seemingly different web pages to fit a common structure and layout.
Why WWW and HTML?

Since its inception in the 1990s, the World Wide Web (WWW) has become one of the principal means of information storage and delivery. In addition, the WWW is largely platform-agnostic, with the open standards of Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS) at its heart.

This resource seeks to provide learners with an understanding of modern on-line information systems – their origins, principles and practice. In doing so, it will also provide grounding in HTML and provides extension work that explores the use of CSS.

Like traditional coding in software development, HTML can provide an understanding of abstraction – a core computational thinking concept. Extension work in CSS can aid understanding of both abstraction and generalisation. Coding discrete elements on a web page such as a table or navigation bar can also cover decomposition.

Study of HTML can also provide an introduction to syntactically-demanding text-based coding for learners who may only have experience of more forgiving blocks-based coding environments such as MIT’s Scratch. As such, it can work as a transition into text-based coding in more traditional software development environments.

The use of HTML (and CSS) also means that this resource does not rely on any third-party software and adheres to open standards.
Using This Resource

There is already a wealth of excellent on-line materials that deliver the basics of the WWW and HTML; it therefore makes little sense to reinvent the wheel. Rather, this book signposts resources which the author has personally worked with and deems to be of high quality and practical for classroom use. Note that some of these work best when the learner signs up for an account with the service.

One such resource from Codecademy has been tailored and branded to fit with this resource and may be the first stop for teachers who do not have a prior preference.

As well as lessons, exercises and sample answers, this book contains suggested supplementary activities and inter-disciplinary learning opportunities.

It is not the author’s intention that all of these are attempted; rather, they are simply suggestions as to the kind of activities that tutors may find useful in order to enrich learners’ experiences.

Feel free to use this resource as you wish:

- as part of the Computing Science content within Curriculum for Excellence;
- to support the National 4 Information Systems Design & Development unit or the Added Value unit;
- as an introduction to Information Systems Design & Development in the National 5 course.

Above all, this resource should not be seen as prescriptive. It contains guidance and suggestions as to the kinds of approach which can make learning more engaging, whilst fostering computational thinking and greater understanding of Computing Science concepts in learners.
Curriculum for Excellence

This resource seeks to address the following Computing Science outcomes within Curriculum for Excellence:

Level 3

- By considering ways to protect technological devices, I can act safely and responsibly when selecting and using different technologies to communicate and collaborate. *TCH 3-08a*
- I can build a digital solution which includes some aspects of multimedia to communicate information to others. *TCH 3-08b*
- Using appropriate software, I can work individually or collaboratively to design and implement a game, animation or other application. *TCH 3-09a*

Level 4

- I can integrate different media to create a digital solution which allows interaction and collaboration with others. *TCH 4-08c*
- Through research, I can gain knowledge of computer systems or emerging technologies to understand their differing features and consider their suitability for the world of work. *TCH 4-08d*
- By learning the basic principles of a programming language or control technology, I can design a solution to a scenario, implement it and evaluate its success. *TCH 4-09a*
National Qualifications

This resource seeks to address and/or support the following outcomes within National 4 & 5 Computing Science:

National 4

From Information Systems Design and Development Outcome 1:

1. Develop simple information systems, using appropriate development tools, by:
   1.1 Creating a structure and links
   1.2 Integrating different media types
   1.3 Identifying and rectifying errors

From Added Value Unit Computing Science Assignment Outcome 1:

1. Develop, with guidance, a digital solution which will draw on and apply skills and knowledge of software and information system design and development by:
   1.1 Analysing a straightforward problem
   1.2 Designing a solution to the problem
   1.3 Creating a program or application as a solution to the problem
   1.4 Testing and reporting on the solution to the problem

National 5

From Information Systems Design and Development Outcome 1:

1. Develop information systems, using appropriate development tools by:
   1.1 Creating a structure and links
   1.2 Creating a user interface
   1.3 Writing or editing simple code
   1.4 Integrating different media types
   1.5 Identifying and rectifying errors
Known Issues

- A recent (2013 onwards) web browser such as Google Chrome, Mozilla Firefox, Apple Safari or Internet Explorer will be required to access content on Codecademy or Code Avengers websites. Older versions of Internet Explorer (such as v7 or 8), are incompatible.
- The URL for the chosen on-line tutorials will need to be whitelisted on any school proxy.
- Notepad++ is one of several free text editors that offers a better experience for learners coding HTML than Notepad which comes with Microsoft Windows. Tutors may wish to have this installed on learners’ computers prior to delivery of these materials.
Lessons and approaches

Lessons and approaches

Tutors using this resource may wish to consider the following approaches.

Deep Understanding

To accompany the lessons, there are sample written and discussion tasks to enable learners and tutors to assess “deep understanding” of the Computing Science concepts. This draws upon recent work in the CS Principles course at the Universities of San Diego and Glasgow. Aspects of this approach are also seen in UC Berkeley’s The Beauty and Joy of Computing course.

Traditionally, tutors have inferred the degree of learners’ understanding of what they have learned from the programs they have produced; however, research has shown that this is not always a strong indicator. Consequently, consolidation via quizzes, group discussion, questioning and class work/homework should be used to enable the tutor to formatively assess the learners’ understanding throughout the course, rather than simply infer this from their completed programs.

Group-Based Learning

Collaborative learning is a cornerstone of Curriculum for Excellence and these materials encourage this, through group-based learning. Pair programming can be defined as:

“… an agile software development technique in which two programmers work together at one workstation. One, the driver, types in code while the other, the observer (or navigator), reviews each line of code as it is typed in. The two programmers switch roles frequently.

While reviewing, the observer also considers the strategic direction of the work, coming up with ideas for improvements and likely future problems to address. This frees the driver to focus all of his or her attention on the "tactical" aspects of completing the current task, using the observer as a safety net and guide.” Source: Wikipedia

Pair programming can encourage collaboration between learners, as well as making good use of available resources within the classroom.

It is recommended that tutors explicitly advise learners to seek help from a neighbour before asking the tutor for help. Tutors will, however, understand the need to ensure that both learners are equally engaged in the work!
Suggested Activities

Additional activities are suggested throughout the notes. These should not be seen as prescriptive, but as possible ways to enrich a task or topic. Tutors are free to cherry-pick these as going through all of them is likely to significantly extend the unit.

These opportunities are indicated by Suggested Activity in the left margin.

NB Learner activities in the learner notes are signposted simply by the word “Activity”

Inter-Disciplinary Learning

The WWW is a “rich” multimedia environment that offers ample opportunity for inter-disciplinary learning. Within the materials, there are suggestions for possible inter-disciplinary activities, as well as many of the activities being inter-disciplinary in themselves.

Inter-Disciplinary Learning opportunities are signposted by IDL in the left margin.

Computational Thinking

Key Computational (or Informational) Thinking concepts are signposted by CT/IT in the left margin.

Video/Audio Resources

These are signposted using the symbol. In addition to the hyperlink within the text, this symbol is also clickable.
Introduction

What is Information?

CT/IT  This section outlines the concept of information i.e. an abstraction of the physical world. The main concepts involve learners appreciating that information is what is selected from a range of possible properties/attributes to describe objects or abstract entities.

Activity  

a) Look around and write down three objects you can see.

b) Now write down three important properties about each object – try to keep each property to just one or two words.

c) Once you have done this, write down a short description (again, just one or two words) about each property.
   If you find it easier, complete the “Description” column first and then decide what property the description relates to.

<table>
<thead>
<tr>
<th>a) Object</th>
<th>b) Property</th>
<th>c) Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desk</td>
<td>shape</td>
<td>rectangular</td>
</tr>
<tr>
<td></td>
<td>colour</td>
<td>brown</td>
</tr>
<tr>
<td></td>
<td>height</td>
<td>1 metre</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Real-world Information Systems

**Activity**
Imagine that a friend is coming to borrow something from your bedroom e.g. a game, a book, an item of clothing, etc. Describe how to find the item in your bedroom starting from your bedroom door.

Many learners will seek to describe how to find the object chosen in part a) algorithmically. This would be an excellent opportunity to link in with this aspect most familiar to learners from software development.

Another key feature of this activity, however, is recognising that things have structure. When describing how to find item a), learners will describe properties of objects in their room. In other words, they will be subconsciously assigning a structure to the things in their bedroom e.g. socks might be kept in the second drawer down in a chest of drawers - and stored as pairs.

**Activity**
In the same way as above, describe to someone how to find a teaspoon in your kitchen, starting from the kitchen door. You might even assume that the person you are instructing has never seen a teaspoon before!

This activity is very similar to that above, with the difference that the person performing the task may never have seen a teaspoon. This will elicit from learners the idea that a kitchen is itself a filing system where objects are filed largely according to their function, with something like a cutlery drawer categorised into further subsets according to the function of the item of cutlery.
Information Systems

1. Early information systems were paper- or card-based. Research some early examples and name or describe them below.
   - Ancient Library of Alexandria (300BC)
   - Domesday Book (1086)
   - King James Bible (1611)
   - Samuel Johnson’s Dictionary of the English Language (1755)
   - Encyclopaedia Britannica (1768)

2. Write down three problems you can think of when using paper- or card-based systems.
   1. Only one person can access information at a time
   2. Can take up a lot of physical space
   3. Sorting and searching can be difficult (with complex sort/search of very large systems becoming impracticable)

Show learners video “1 – What is an Information System”.
Computerised Information Systems

The “story” of a combination of computer hardware and software that is designed to:

- create
- store
- process and
- present information.

is intended to run throughout this resource as the definition of an information system.

3. Show how the examples above meet the definition of an information system by giving examples of how each one lets you create, store, process and present information.

<table>
<thead>
<tr>
<th>Information System</th>
<th>Operation</th>
<th>Example of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social networking site e.g. Twitter</td>
<td>Create</td>
<td>Post a new tweet</td>
</tr>
<tr>
<td></td>
<td>Store</td>
<td>New tweet is stored on Twitter's servers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>Tweets can be sorted by date, filtered by user, etc.</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>Tweets can be shown individually or in a list</td>
</tr>
<tr>
<td>Mobile phone contact list</td>
<td>Create</td>
<td>Add a new contact</td>
</tr>
<tr>
<td></td>
<td>Store</td>
<td>Save/commit the contact to phone</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>Edit a contact</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>Display contact in list or on its own</td>
</tr>
<tr>
<td>Media player playlist</td>
<td>Create</td>
<td>Create a new playlist</td>
</tr>
<tr>
<td></td>
<td>Store</td>
<td>Playlist will be stored upon creation</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>Add, delete, change order of songs; sort playlist; rename playlist</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>Display songs in playlist</td>
</tr>
<tr>
<td>School pupil records system</td>
<td>Create</td>
<td>Enrol a new pupil</td>
</tr>
<tr>
<td></td>
<td>Store</td>
<td>Save new pupil's details</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>Search for one or more pupils; edit pupil details</td>
</tr>
</tbody>
</table>
|                                        | Present   | Display a pupil's details; print out a class list;
Information vs. Data

Learners may find the concept of information and data abstract at first. This can be made more concrete by using lots of examples along the lines of those given already.

CT/IT Data vs information is an example of abstraction – a key computational thinking concept.

4. Look at the following data and write down three possible pieces of information they could represent:

a) SL62TBO
   A vehicle registration plus any other identifier e.g. a customer ID, a serial “number”, etc.

b) 170299
   A date of birth; a price; a quantity; an identity number

C) A URL; a number; a picture.
   The QR code shown is actually a representation of the Royal Society of Edinburgh’s URL – [http://www.royalsoced.org.uk/](http://www.royalsoced.org.uk/)

CT/IT Part c) above is another good example to illustrate abstraction levels:

1. The graphic is made up of pixels;
2. the pixels form a pattern;
3. the pattern represents text;
4. the text is represented as binary numbers;
5. the binary numbers are represented using transistors.
5. Now let’s do this the other way round. Write down three different ways of representing the following information:

a) Your name
   - Alan Mathison Turing
   - Turing, A
   - 41 108 97 110 32 77 84 117 114 105 110 103
     (Alan Turing in decimal ASCII codes)

b) Your date of birth
   - 23061912
   - 1912-06-23
   - 6/23/12
   - The twenty third of June, nineteen hundred and twelve

c) Your address
   - Hut 8, Bletchley Park, Milton Keynes. MK3 6EB
   - https://maps.google.co.uk/maps?q=51.997235,-0.741927&ll=51.996931,-0.741604&spn=0.003574,0.003659&num=1&t=h&z=18&layer=c&cbll=51.997277,-0.741674&panoid=wuHN-20HEojP1GYs754rMg&cbp=12,258.27,,0,0 (Google maps URL)
   - 51.997235,-0.741927 (latitude and longitude co-ordinates)
Structuring Information

Let learners see video “2 – What is a database?”. 

CT/IT File, record and field are abstraction levels for organisational units of information.

4. Which is each the following: a file, record or field?
   a) A Tweet ................................................................. Record
   b) Someone’s status on a Facebook profile ............... Field
   c) A Facebook posting.................................................. Record
   d) A Wikipedia page..................................................... Record
   e) All the entries in Wikipedia ................................. File

5. Using the example of a telephone directory, what would make up a
   a) field? A single item (or category) of data – surname, forename(s), street, etc.
   b) record? All the information about one person – one complete entry/line
   c) file? All entries - the complete A–Z.

   It is a sign of the times that this comparison may soon be unfamiliar to school students!

6. a) In the telephone directory example above, what is it that makes it easy to find a number in a telephone directory?

   It is structured – split into surname, forename, street, town, etc.
   It is also sorted – alphabetically by surname/forename/address.

   b) What would happen if this was not the case?

   Finding a number would be impractical – it would involve starting at page 1 and working your way through the entire phone book until you found the entry. The chance of overlooking it would be quite high due to boredom.
7. Some time ago, information systems began to move on-line. What benefit(s) come from accessing an information system over the Internet?

- Simultaneous access by multiple users
- Access from anywhere with an internet connection
- Low cost-to-user ratio
- Ability to link to other information systems
- etc.

Activity

Examine some on-line databases, and try to identify files/records/fields from each one. Examples you might look at include:

a) **Internet Movie Database (IMDb)**

File: All movies, All actors

Record: A single movie, a single actor

Field: Movie title, run time, plot summary; actor’s name, date of birth

b) **Chambers 21st Century Dictionary**

File: The complete A to Z

Record: a single word (and its variants)

Field: A word; its type/function; a definition, an exemplar of usage.

In reality, the structure of both of these database (and the IMDb in particular) is likely to be more complex than a simple flat file as suggested by this question; however, they will suffice as exemplars.

**Stress to learners that this resource will not explore databases, but it is important to know that the information in most large scale on-line information systems is stored using databases.**
A Brief History of the Internet

One Small Step for Technology

IDL Discuss with students the social revolution of the 1960s within the context of the technological revolution that was gathering pace.

It is interesting to note that the expectation of imminent space exploration raised by the moon landings was never fully realised and that Concorde is no longer flying. However, the personal computer revolution and the Internet have changed the world in ways that few would have predicted...

...except perhaps for Arthur C Clarke. This video clip, taken from an interview he gave to Australian Broadcasting Corporation in 1974, provides an uncannily accurate prediction of the future of Computing by Mr Clarke. It will also give learners an idea of the size of computers at the time!

This may also be an opportune time to pass on to learners two points:

- The idea that the Internet was built in order to withstand a nuclear attack is an urban myth;
- “Internet” should always be capitalised!

The World Wide Web

Let learners see video of Tim Berners Lee discussing the early WWW. Clip from the BBC’s 2010 programme The Virtual Revolution (Episode 1: “The Great Levelling”). This clip also stresses the difference between the WWW and the Internet.

For those with access to the original programme, a fuller exploration of this, along with a discussion of the democratisation of information can be found between 21:57 and 32:19. Warning – language advisory (use of the phrase “wet dream” at 31:07).

Activity Do you think that the WWW is the most important invention since the printing press? Explain your answer.

IDL Language/media studies/history

The above activity could also form the basis of a class debate “This house believes that the WWW is the most important invention since the printing press” (or an invention as important as the printing press).

1 This misconception most probably comes from the fact that one of ARPANET’S architects, Paul Baran, had worked on packet switching in an earlier project. In that case, the aim was indeed to create network redundancy in order to provide resilience in the event of a nuclear attack.
**Current WWW Developments**

**Suggested Activity**
Let learners view examples of early web pages and discuss the differences between then and now e.g.

- a [snapshot of the CERN site](#), the first website (as of November 1992)
- [The oldest surviving pages on the WWW](#)
- [How 20 popular websites looked when they launched](#)
- [The Internet Archive’s Wayback Machine](#) (provides access to archived snapshots of web pages)

**Suggested Activity**
Publish and be damned: Discuss how difficult it can be to remove information from the WWW once it has been published, referring to The Internet Archive and caching by search engines.

**Web 2.0**

**Suggested Activity**
Allow learners to go online and customise a website, such as [www.bbc.co.uk](#).

**Web on the Go**

1. Give **three** examples of an information system that you may access using a smart device such as a web-enabled TV, set-top box or games console.
   
   A. Online video-streaming service e.g. BBC iPlayer, Netflix
   
   B. Social networking e.g. Facebook, Twitter
   
   C. Most of the above are also available on games consoles. On the Xbox platform, Microsoft offers the Microsoft Marketplace, an online store which is a database of apps for sale.

Stress that apps on mobile and smart devices often just provide a feed of the same information on a web pages, but optimised for that device.

Discuss what these optimisations might be. [Elated.com’s “10 Ways the Mobile Web is Different”](#) provides a useful discussion of this.
Future WWW Developments

Discuss how quickly the WWW has “caught on” and compare this to other technologies. The next most rapidly adopted technology has probably been the mobile phone. Once again, this is an information and communication technology.

Discuss with learners what might be “the next big technology”.

Web 3.0 (The Semantic Web)

CT/IT  The Semantic Web can be a difficult concept for learners to grasp, but provides another good example of abstraction levels.

Suggested Activity  Look at a web page source and show the metadata. Discuss how it can be used by computers and how the current web is starting to make connections between data.

This clip of Tim Berners-Lee discussing the Semantic Web is taken from BBC Radio 4’s Today programme and is quite high level; it may, however, be useful nonetheless.

The Internet of Things

Let learners see TED talk by Dr John Barrett on The Internet of Things.

Investigate one of the following people or developments in Information Systems and write a short paragraph about it.

Ted Nelson, Doug Englebart, Bill Atkinson, Tim Berners-Lee, Sergey Brin & Larry Page, Robert Cailliau, Apple Macintosh, iPhone, iPad, Mozilla, W3C, Oracle, Google, Facebook, Twitter, Google Glass

Big Data

Activity  In small groups, research some examples of how big data is being used. Once you have done this, try to come up with your own ideas for how big data could be used.

Suggested Activity  Learners may need guidance in how large amounts of data can be mined for new, emergent information. In order to facilitate this, show big data slideshow (Source: BBC News)
Social, Legal and Ethical issues

Suggested Activity
Allow learners to explore the Google Glass site, including the promotional video for Google Glass.

Activity
In 1999, computer executive Scott McNealy was asked how developments in information systems might affect peoples’ privacy. McNealy was famously quoted as saying “You have zero privacy anyway. Get over it”.

Was Scott McNealy right and is it something that should concern us? Write a paragraph below reflecting your thoughts on this. You may want to consider arguments for and against such information systems.

IDL Language/Citizenship/Modern Studies
Host a class debate “This house would allow the storage of all personal information on information systems”.

Should governments and corporations be allowed to store unlimited personal information on information systems? Alternatively, would a national/worldwide DNA database be a good thing?
WWW pages

Web Sites

Activity
Use the web to find out what these suffixes are short for and give an example of each one. When you have finished, find out another one for yourself.

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Type of domain</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>.co.uk</td>
<td>Commercial (business)</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>.com</td>
<td>Commercial</td>
<td>None – and can be registered by anyone</td>
</tr>
<tr>
<td>.ac.uk</td>
<td>Academic</td>
<td>UK</td>
</tr>
<tr>
<td>.de</td>
<td>National</td>
<td>Germany (Deutschland) – not Denmark!</td>
</tr>
<tr>
<td>.ch</td>
<td>National</td>
<td>Switzerland</td>
</tr>
<tr>
<td>.gov.uk</td>
<td>Government</td>
<td>UK</td>
</tr>
<tr>
<td>.org</td>
<td>Organisation (non-profit)</td>
<td>None – and can be registered by anyone</td>
</tr>
</tbody>
</table>

Inside and Out

Suggested Activity
Show the source code of websites (or even just the status bar when hovering over a link) to identify internal and external links. This could also be done using Mozilla’s X-Ray Goggles.

What problems do you think might arise from using external hyperlinks in a website?

The problem of broken links if site changes URL of/deletes pages; lack of control over the information you are linking to.

Web Browsers

CT/IT Stress the idea that a web browser interprets and renders HTML code. This is another example of levels of abstraction (WWW page as viewed ↔ HTML ↔ machine code)

Activity Try visiting some web pages and compare how they look in different web browsers. Note any differences between them.

This task requires learners to have access to more than one browser. Obviously, do not compare pages when viewed between mobile and desktop browsers.
Creating a Website

Analysis

Problem analysis is broken down into four main considerations:

- **Purpose**
  Why are you making the information system/site?

- **Target Audience**
  Who is going to use your site?

- **Content**
  What information will be on your site?

- **Function**
  How will the site be used?

A simple memory-aid for learners is the four Ws – why, who, what and how.

**Activity**

Select two different websites and assess them in terms of four Ws. Try to choose websites that are clearly aimed at different target audiences.

Learners will then gather media for their websites.

Whilst this resource does not explicitly cover file types, compression, etc., it is worth stressing web-friendly formats here e.g. JPEG, PNG, MP3, MP4.

Design

User-centred design is an enormous area and detailed treatment of it is beyond the scope of this resource; however the following aspects are covered:

- usability considerations
- use scenarios
- story boarding
- WWW page layout
- user evaluation

---

2 Okay, that last one is more of an H...!
**Structure**

This resource covers three data structures which learners are likely to come across on the WWW. However, there are others that will be familiar to computing scientists and which may apply to other information systems, including:

<table>
<thead>
<tr>
<th>Data structure</th>
<th>Access method</th>
<th>Real-world example</th>
</tr>
</thead>
<tbody>
<tr>
<td>stack</td>
<td>push/pop</td>
<td>pile of books</td>
</tr>
<tr>
<td>queue</td>
<td>enter/exit</td>
<td>supermarket checkout</td>
</tr>
<tr>
<td>vector</td>
<td>by index</td>
<td>terrace of houses by house number</td>
</tr>
<tr>
<td>array</td>
<td>by indices</td>
<td>seating in theatre by row/seat number</td>
</tr>
<tr>
<td>record</td>
<td>by field identifier</td>
<td>patient record</td>
</tr>
<tr>
<td>table (of records)</td>
<td>by field criteria</td>
<td>search patient records</td>
</tr>
<tr>
<td>tree</td>
<td>parent/child</td>
<td>taxonomy tree for animal e.g. mammal + reptile + amphibian, etc</td>
</tr>
<tr>
<td>net</td>
<td>node to node</td>
<td>underground map</td>
</tr>
</tbody>
</table>

**Linear Structure**

Give an example from real life where information is organised in a linear structure.

A book (although can be accessed randomly by reader); an old-fashioned projector slide show; a music album. Learners may need some support to get started on this exercise.

Give an example of an information system where the information is organised in a linear structure.

**A slide show**

Write down one advantage and one disadvantage of using a linear structure in an information system.

**Advantage**  
Easy to navigate; gives developer control over what order information is accessed (so easy to impose a narrative or gradual unfolding of information).

**Disadvantage**  
Little control over what order information is accessed e.g. in a slide show, how do you view slide number 137 directly?
Hierarchical (Tree) Structure

Give an example from real life where information is organised in a tree structure.

Family tree

Give an example of an information system where information is organised in a tree structure.

Most web sites; filing system on most computers.

Write down one advantage and one disadvantage of using a tree structure in an information system.

Advantage  Lends itself to categorisation and organisation; imposed structure means users are less likely to get lost in hyperspace; users are now used to this structure!

Disadvantage  Can lead to fragmentation; some pages may belong in multiple categories and not always clear where they should go or be found; user can end up going many levels deep and still getting lost.

Net Structure

Give an example from real life of where you might find information organised in a net structure.

An underground rail map (show picture of London Underground map, for example).

Give an example of an information system where the information is organised in a net structure.

Wikipedia (whilst it has some hierarchical aspects, it is in essence a net structure).

Write down one advantage and one disadvantage of using a net structure in an information system.

Advantage  Freedom for use to navigate anywhere they want.

Disadvantage  Lack of pre-imposed structure leads to risk of user becoming lost in hyperspace. No control over order information is accessed (so difficult to impose a narrative or gradual unfolding of information).
Activity

Look at the following websites and draw a basic site map for each one. Just stick to the main navigation links:

http://www.nms.ac.uk/

Expanding “What’s on”. Note use of multiple navigation bars (horizontal, vertical and hierarchical)

http://www.apple.com/

Expanding iPad section. Note presence of Home (Apple) button on navigation bar.
http://www.tnmoc.org/

Expanding only the top-level “Visit” link.

Your own school’s website – http:// ________________________________
Consider the URL that we looked at previously:

http://www.royalsoced.org.uk/computingscience/infosys.html

What kind of structure do you think is being used here? **Hierarchical (tree)**

Explain your answer /computingscience/ is a folder or category with a document inside.

Lastly, take a look at the following sites and try to decide what structure they use:

**Wikipedia:** Net/Hierarchical hybrid

Explain your answer: Articles do appear in categories, but links in articles link to other articles across Wikipedia (and beyond)

**Google:** Net

Explain your answer: A simple interface of a search box and button. Resulting search creates a list of links which in turn creates a net. (This is very much a “curve ball” question!)

As you can see, sites do not always follow the accepted “rules” of web design!
Navigation

Show learners examples of different types of Navigation bars. Contrast vertical and horizontal, particularly in terms of the use of visible/available screen space.

What is the advantage to users of having a navigation bar on a website?

Reduces/eliminates the possibility of users getting “lost in hyperspace”.

Screen Design

As well as structuring the site, it is important to structure the data on individual screens. Pages on a web site will usually have a consistent layout.

Why do you think this is?

To make it easy for users to find the information they are looking for.

Go over the concept of a wireframe with learners. This video introduction to wireframing techniques may be suitable for colleagues and/or pupils.

Let learners watch video showing creation of a wireframe using Google Draw (although pencil and paper is often more immediate for learners).

Basic Rules for Screen Design

One approach to this section would be to get learners to devise their own screen design rules after they have evaluated some websites.
Implementation

Suggested Activity

Allow learners to create a document in Word, PowerPoint or similar package and save as a web page. Let them examine the HTML – they will see that it creates a great deal of code.

When discussing the reason for coding in HTML, suggest to learners that just as they wouldn’t use a calculator to do maths until they understood basic arithmetic, then the same applies for web authoring packages and learning HTML. Even the most skilled Dreamweaver-using web developer will know HTML inside-out!
Creating WWW Pages in HTML

HTML: the Language of the Web

**Suggested Activity**  Show learners the source of a web page.

**Activity**  Use Mozilla’s X-Ray Goggles to “peek” at the HTML elements of a web page. If demonstrating to learners, have a bookmark of X-Ray Goggles to activate them on any web page.

Learning HTML

There are several suitable on-line HTML tutorials, including:

**Codecademy**
http://www.codecademy.com/tracks/scotland

Codecademy is an excellent free resource that provides step-by-step lessons in HTML coding, with extension work in CSS.

The URL above links directly to a lesson sequence put together especially for these materials. Learners using this lesson sequence should create a Codecademy account that will keep track of their progress.

Codecademy also provides other coding courses in languages such as Java, Ruby, Python and others.

**Code Avengers**
http://www.codeavengers.com

Code Avengers is another excellent resource. It contains courses at three levels and its level 1 course in HTML and CSS (which is more than sufficient for the purposes of this pack) is free.

**w3schools.com**
http://www.w3schools.com

Another free resource which contains an excellent HTML tutorial.

**Mozilla’s Thimble**

Mozilla’s Thimble takes a project-based approach to learning HTML (although there is also a “Start from Scratch” option which requires some prior knowledge of HTML). Whilst an excellent resource – the projects will certainly engage learners – it arguably provides less “scaffolding” for learners than those shown above.
Did You Understand?

Look at the following piece of HTML code and answer the questions that follow.

```html
<!DOCTYPE html>
<!-- Written by pupils of RSE High School -->
<html lang="en">
<head>
  <title>Welcome to RSE High School</title>
</head>
<body bgcolor=white>
<!-- -->
<p style="color:green; font-family:verdana; font-size:20px; text-align:centre;">
<img src = "images/recycle.png">
<a href="reduce.html">Reduce</a> | 
<a href="reuse.html">Reuse</a> | 
<a href="recycle.html">Recycle</a>
<img src = "images/recycle.png">
</p>
<p align=centre><img src="images/school-and-flag.jpg"/></p>
<h3 style="color:white; font-family:verdana; text-align:left;">Welcome</h3>
<p>Last month, <a href=http://www.rsehighschool.com/>RSE High School</a> was awarded a prestigious Green School Award for its work in promoting a cleaner environment! This included:
<ul>
  <li>keeping the playground litter-free <em>at all times</em></li>
  <li>recycling all bottles, cans and paper</li>
  <li>promoting walking and cycling to school</li>
</ul>
<img src="images/pupils-recycling.jpg" width=300>
</body>
</html>
```
1. What is the purpose of the code on line 1?
   It tells the browser that the following code is written in HTML.

2. What is the purpose of the code on line 2?
   It is a comment for other developers. The user will never see this.

3. When the developer previews the site in a browser, the page does not seem to have a banner headline saying “Welcome to RSE High School”, despite this appearing in the <title> tag.
   The <title> tag contains the text which appears in a title bar or tab of a web browser. It is part of the metadata in the <head> of the web page. Only the tags within the <body> tag make up the web page as seen by the user.

4. Rewrite line 12 so that explains the lines of code which follow it.
   <!-- Navigation bar. Green, verdana, 20px, centred -->

5. Lines 13-21 do not appear in the centre of the page as the developer expected.
   Why?
   text-align:centre tag is in UK spelling; should be text-align:center

6. The word “Welcome” (line 25) does not appear when the web page is viewed.
   Explain why.
   It is white text on a white background.

7. Would lines 27-31 appear on the same line or different lines when viewed in a web browser? Explain your answer.
   The same line. In order to break a line, you need an appropriate HTML tag such as <p> or <br>
8. How could the developer change the bulleted list on lines 33-35 to a numbered list?
   Change `<ul>` and `</ul>` to `<ol>` and `/<ol>` respectively.

9. How will the text shown on lines 34 and 35 look when viewed in a web browser?
   a) 29 Bold
   b) 33 Italic

10. The “pupils-recycling.jpg” image (line 38) does not appear when the web page is viewed in a browser. The developer has checked all spelling and location of the image file. Why is this?
    Typo in the tag – should be `<img src="images/pupils-recycling.jpg" width=300>`
    i.e image source. Note also the use of plain quotes(“”) in HTML as opposed to the typographer’s quotes (””) that many applications such as Microsoft Word will auto-replace plain quotes with.

11. Why has the developer put only the width tag on line 38 and not both width and height tags?
    Using only one tag (in this case width) will ensure that the picture’s height is set by the web browser to keep it in proportion with the width, without having to specify the width explicitly.

12. When testing the website, the developer notices that the hyperlink on line 16 does not link to the reduce.html page. State two possible reasons for this.
    1. The filename is not “reduce.html”
    2. The file is not in the same folder as the current web page
Project

Analyse

- Encourage learners to think about how their project could link with work they’re doing elsewhere. In order to remain focussed, allow a maximum of 15 minutes to look at websites based around their idea.

**Now discuss your ideas with your teacher.**

*Once you have agreed on your project, describe what it will do below.*

- The main issue to look out for here is to ensure that the scope of the project is achievable for the learners concerned.

Design (Structure)

- Most learners are likely to opt for a hierarchical structure; however, the importance here is that they adopt a user-centred approach and consider the appropriateness of the structure for their chosen topic.
- The scope of the site map should be achievable within the time learners have available. It may be that they choose not to fully implement the site.

Design (Screen)

- It is important that learners’ designs are achievable. If they have not mastered tables and/or span/div, then they should avoid placing text and graphics side-by-side in a grid.
- If learners have tackled CSS, then they could think about using an external style sheet to enforce a “house style” on their website.

Implement

- Learners may use one of the environments they used during the tutorial; alternatively, they may use a free editor such as Notepad or Notepad++. If doing so, a split screen approach – browser on one half of the screen and editor on the other – can be helpful.

Test

- Learners should perform self-testing and get their classmates to test. They should describe the good and bad points that were found and how they were fixed (or not).
Document

- Learners should show they have considered how to write a short, snappy description of their project, including its main features.

Evaluate

- Encourage learners to discuss and reflect honestly on their work.
- Encourage learners to look at their code to see if they could make it more elegant e.g. if using a basic editor such as Notepad that doesn’t auto-format their code, could they have indented their code better to show structure more clearly? Is their use of upper/lower case consistent?
- Use of all of the projects as an opportunity to explain deep understanding, perhaps via a peer evaluation. For example:
  - a group displays its website to the class
  - learners ask how a piece was implemented
  - the group identifies the relevant code and explains it.

Maintain

Allow learners to look at mobile-formatted versions of popular websites. Elicit from learners the main differences:

- likely to be used “on the go”
- has to work on a small screen
- has to work with touch – no “hover” over links
- smaller/lower-resolution images
- fewer images
- larger text, less text
- fewer links
- simplified, less cluttered layout

Check Elated.com’s “10 Ways the Mobile Web is Different”

CT/IT

There are several sites which show the use of CSS to reformat the same content on a website for mobile. This can be a good way to show both the abstraction and generalisation strands of Computational Thinking.

Congratulations!

Encourage learners to continue their HTML (and CSS) development at home.
# Appendix A: Common HTML Tags

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;!DOCTYPE html&gt;</code></td>
<td>Tells the browser that this is an HTML document. The <strong>first</strong> tag on a page.</td>
<td></td>
</tr>
<tr>
<td><code>&lt;html&gt;&lt;/html&gt;</code></td>
<td>Tells the browser that what follows is written in HTML. The <strong>second</strong> tag on a page.</td>
<td></td>
</tr>
<tr>
<td><code>&lt;head&gt;&lt;/head&gt;</code></td>
<td>Stores information about the page, such as the title for the browser window.</td>
<td></td>
</tr>
<tr>
<td><code>&lt;title&gt;&lt;/title&gt;</code></td>
<td>Used inside the HEADING part to display text in the title bar or tab of the browser window</td>
<td><code>&lt;title&gt;My First Amazing Home Page&lt;/title&gt;</code></td>
</tr>
<tr>
<td><code>&lt;body&gt;&lt;/body&gt;</code></td>
<td>Where the content of your web page actually appears.</td>
<td><code>&lt;body&gt;Page content here...&lt;/body&gt;</code></td>
</tr>
<tr>
<td><code>&lt;!-- --&gt;</code></td>
<td>Comment. Messages for other coders displayed in the code only (they don’t appear when the web page is viewed)</td>
<td><code>&lt;!--Written by J Scott, 2013 --&gt;</code></td>
</tr>
</tbody>
</table>

## Working with Paragraphs

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;p&gt;&lt;/p&gt;</code></td>
<td>Defines a paragraph.</td>
<td><code>&lt;p&gt;This is some text in a very short paragraph&lt;/p&gt;</code></td>
</tr>
<tr>
<td><code>**h1 to h6**</code></td>
<td>Heading. Used to make titles stand out.</td>
<td><code>&lt;h1&gt;Big heading&lt;/h1&gt; &lt;h6&gt;Small heading&lt;/h6&gt;</code></td>
</tr>
<tr>
<td><code>&lt;br&gt;</code></td>
<td>Stands for (line) break. Text is forced onto a new line.</td>
<td><code>This text contains&lt;br&gt;a line break</code></td>
</tr>
</tbody>
</table>

## Working with Text

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;strong&gt;&lt;/strong&gt;</code></td>
<td>Strong. Text in between tags appears bold.</td>
<td><code>&lt;strong&gt;Bold text&lt;/strong&gt;</code></td>
</tr>
<tr>
<td><code>&lt;em&gt;&lt;/em&gt;</code></td>
<td><em>Emphasised</em>. Text in between tags is italicised.</td>
<td><code>&lt;em&gt;Italic text&lt;/em&gt;</code></td>
</tr>
<tr>
<td><code>&lt;ul&gt;</code></td>
<td>Unordered list – use with <code>&lt;li&gt;</code> tag to create a <strong>bullet point</strong> list</td>
<td><code>&lt;ul&gt; &lt;li&gt;Coffee&lt;/li&gt; &lt;li&gt;Milk&lt;/li&gt; &lt;/ul&gt;</code></td>
</tr>
<tr>
<td><code>&lt;ol&gt;</code></td>
<td>Ordered list – use with <code>&lt;li&gt;</code> tag to create a <strong>numbered</strong> list</td>
<td><code>&lt;ol&gt; &lt;li&gt;Coﬀee&lt;/li&gt; &lt;li&gt;Milk&lt;/li&gt; &lt;/ol&gt;</code></td>
</tr>
<tr>
<td><code>&lt;li&gt;</code></td>
<td>List item, used inside <code>&lt;ul&gt;</code> or <code>&lt;ol&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

## Working with Links & Images

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;a href&gt;&lt;/a&gt;</code></td>
<td>Used to define a hyperlink. <code>&lt;a&gt;</code> means anchor and <code>&lt;HREF&gt;</code> means Hypertext Reference</td>
<td><code>&lt;a href = &quot;movie.html&quot;&gt;Movie&lt;/a&gt;</code></td>
</tr>
<tr>
<td><code>&lt;img src&gt;</code></td>
<td>Tells browser that there is a picture. Stands for IMaGe SouRCe.</td>
<td><code>&lt;img src = “funny face.jpg”&gt;</code></td>
</tr>
</tbody>
</table>
Appendix B: Cascading Style Sheet (CSS) Tags

CSS tags can be used inside <p> and <h> tags to style elements on a page:

- anywhere in the HTML of a page;
- in the <head> of a document to set the properties of all <p> and <h> tags within that document;
- as a different file stored with all pages in a site, to set the properties of all <p> and <h> tags in the entire web site.

<table>
<thead>
<tr>
<th>TAG</th>
<th>Explanation</th>
<th>Example(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>style=</td>
<td>Getting ready to set the style inside a tag</td>
<td>&lt;p style=&quot;text-align: left&quot;&gt;</td>
</tr>
<tr>
<td>text-align</td>
<td>Sets the alignment of text</td>
<td>&lt;p style=&quot;text-align: right&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;p style=&quot;text-align: center&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Note US spelling of &quot;center&quot;</em></td>
</tr>
<tr>
<td>font-size</td>
<td>Sets the size of text (in pixels)</td>
<td>&lt;h1 style=&quot;font-size: 26px&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;p style=&quot;font-size: 12px&quot;&gt;</td>
</tr>
<tr>
<td>color</td>
<td>Sets the colour of text</td>
<td>&lt;p style=&quot;color: red&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;h6 style=&quot;color: ffff99&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Note US spelling of &quot;color&quot;</em></td>
</tr>
<tr>
<td>font-family</td>
<td>Sets the font of text</td>
<td>&lt;h3 style=&quot;font-family:Verdana&quot;&gt;</td>
</tr>
<tr>
<td>background-color</td>
<td>Sets the background colour of a paragraph</td>
<td>&lt;p style=&quot;background-color:yellow&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td>Sets the background colour of the entire page</td>
<td>&lt;body style=&quot;background-color:green&quot;&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;body style=&quot;background-color:#ff0000&quot;&gt;</td>
</tr>
<tr>
<td>float</td>
<td>Use in &lt;img&gt; tag to set the alignment of an image in a paragraph. Can wrap a graphic around text</td>
<td>&lt;img src=&quot;smiley.png&quot; style=&quot;float:right&quot;&gt;</td>
</tr>
</tbody>
</table>

Styles can be combined in a single tag simply by separating them with semi-colons (;) e.g.

```html
<p style = "font-size: 14px; color: orange; font-family: Bodoni"> ...
```
Appendix C: Colour (color!) Codes

These codes are created in a numbering system called hexadecimal (base 16, with digits from 0-15). Hexadecimal runs out of digits at 9, so starts using letters (A=10, B=11, etc). Each pair of hex digits defines the amount of red, green and blue in a colour e.g. 0000FF means no red (00), no green (00) and all blue(FF).

<table>
<thead>
<tr>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
<th>Hexadecimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>000000</td>
<td>000033</td>
<td>000066</td>
<td>000099</td>
<td>0000CC</td>
<td>0000FF</td>
</tr>
<tr>
<td>003300</td>
<td>003333</td>
<td>003366</td>
<td>003399</td>
<td>0033CC</td>
<td>0033FF</td>
</tr>
<tr>
<td>006600</td>
<td>006633</td>
<td>006666</td>
<td>006699</td>
<td>0066CC</td>
<td>0066FF</td>
</tr>
<tr>
<td>009900</td>
<td>009933</td>
<td>009966</td>
<td>009999</td>
<td>0099CC</td>
<td>0099FF</td>
</tr>
<tr>
<td>00CC00</td>
<td>00CC33</td>
<td>00CC66</td>
<td>00CC99</td>
<td>00CCCC</td>
<td>00CCFF</td>
</tr>
<tr>
<td>00FF00</td>
<td>00FF33</td>
<td>00FF66</td>
<td>00FF99</td>
<td>00FFCC</td>
<td>00FFFF</td>
</tr>
<tr>
<td>330000</td>
<td>330033</td>
<td>330066</td>
<td>330099</td>
<td>3300CC</td>
<td>3300FF</td>
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