**Computing Science – National 5**

**Course Summary**

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| **Software Design and Development** |
| Computational constructs | Expressions to assign values to variables |
| Expressions to return values using **arithmetic** operations + - \* / ^ |
| Execution of lines of code in sequence demonstrating input – process- outputThe Algorithm below* 2 inputs
* 1 process
* 1 output

1. **Send** “Enter First Number” **to display**2. **Receive first\_number** **form keyboard**3. **Send** “Enter Second Number” **to display***Input*4. **Receive** **second\_number** **from keyboard***Process*5. **Set** **total to** first\_number + second\_number*Output*6. **send** **total** **to display** |
| Expressions to **concatenate strings** and arrays using the & operatorBob Smith is an example of **concatenation** |

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|  | Use of selection constructs including **simple** and **complex conditional statements** and logical operators.This is a simple statement as there is one conditions**1. If pupil\_mark >=50 then** **2. send pass message to display****3. Else****4. send fail message to display****5. End if**This is a complex statement as there are two conditions**1. If pupil\_mark >=50** **2. And assessments\_mark = 100 then** **3. send pass message to display****4. Else****5. send fail message to display****6. End if** |
| **Iteration** and **repetition** using fixed and conditional loops **Fixed loop** below as it will loop a fixed number of times depending on the users answerBelow is a **Conditional Loop** as it depends whether the user has any money left. |
| **Pre-defined functions** (with parameters) - **RND** will round numbers 22.34 becomes 22 or **Root** 4 will become 2, or 9 will become 3. |
| Data types and structures | **String** - text variable like name |
| **integer** - a round number used for number of people or items **real** - contains decimals used for distances or measurements |
| **Graphical objects** - pictures |
| **Boolean variables** - Yes or No |
| **1D arrays** - used for a variable with many pieces of data all of the same data type. Pupilname (20)  |
| Testing and documenting solutions | For an exam out of 100**Normal** – 78, 45,67, 85, 44 **Extreme** – 0, 100**Exceptional** - -89, bob |
| **Errors****Syntax** – The rules of the programming language have been broken. E.g. a typing mistake **Displya** rather than **Display****Execution** – using **Average = total / 0** would give an execution error.**Logic** –will only show up when you run the program. Please see belowCounter = 0RepeatCounter = counter + 1**Until counter = 0** |
| **Readability of code** **internal commentary** - information about what the program does written by the programmer alongside the actual code. **Green in Livecode.****meaningful identifiers** - Calling variable names that mean something length or height rather than L or H**indentation** starting parts of the code slightly into the middle of the page making it easier to read. |
| Algorithm Specification | **Input validation** - checking that what is entered by the user is acceptable e.g. that an age isn’t a negative number. 1. **Repeat** 2. **Send “Please enter data” to display**3. **Receive** data from keyboard4. **If** data is outwith range then5. **Send** **“re-enter data” to display**6. **Until** data is within range |
| Design notations also applies in ISDD | **Pseudocode** example 1 SET total TO 0SET count TO 0WHILE count ˂ 10 DO RECEIVE nextInput FROM KEYBOARD SET total TO total + nextInput SET count TO count + 1END WHILESEND total / 10 TO DISPLAY**Pseudocode** example 2RECEIVE age FROM KEYBOARDWHILE age ˂ 0 OR age ˃ 130 DO SEND “Enter an age between 0 and 130” TO DISPLAY RECEIVE age FROM KEYBOARDEND WHILE |
| **Structure Diagram****Flow Chart** |
| Low-level operations and computer architecture | **Units of storage:** **8** bits = **1** byte**1024** bytes = **1** Kilobyte **1024** Kilobytes = **1** Megabyte **1024** Megabytes = **1** Gigabyte **1024** Gigabytes - **1** Terabyte **1024** Terabytes = **1** Petabyte |
| **Translation** of high-level program code to **binary** (**machine code**): **interpreters** - translates it line by line, spots errors more easily but takes longer.**compilers** - creates the machine code in one step, less likely to spot errors but more efficient. Creates a **run time version** that can't be edited. |
| Use of binary to represent and store:Real numbers uses **mantissa** & **exponent** - **2.56** X 10**5** **Mantissa = 2.56** **Exponent = 5****Characters** - **ASCII** allocates a different **binary code** to each letter, **A = 00100001**I instructions, **machine code** - the only characters the processor can understand 10101011101Graphics **bit-mapped** and **vector****Bit-mapped,** graphics are made up of **pixels** |
| **Basic computer architecture:**   **Processor*** Registers - temporary storage locations holding data being processed
* ALU – deals with comparisons and arithmetic calculations
* control unit - controls all other parts of the processor, ensures instructions are carried out in the correct order

**Memory** * Random Access Memory - temporary data storage only held as long as the computer is switched on.
* Read only memory - Permanent memory not lost when the computer is switched off. Data stored on a hard disk or a memory stick.

 **Buses** * data - carries data to and from the processor, memory and other devices. Bi-directional
* address - carries address info from processor to the memory.
* control - made up of a number of separate wires.

**In interfaces** allows a processor to send and receive data to and from peripherals like printers, scanners, keyboards and projectors.  |
| Binary Decimal Conversion | **128 64 32 16 8 4 2 1** 1 1 1 1 1 1 1 1 = **255** 0 1 1 0 1 0 0 1 = **105**   |
| Computational Constructs | **Hexagon(n)****Repeat 6 Times****Move (n)****Rotate (60)****End Repeat** |
| **Calculations** | **Formula**Number of pixels = image width x resolution x image height x resolution**Example 1**This is enlarged but is 1 inch by 1 inch.In that case there are 72 x 1 x 72 x 1 = 5184 pixels**Example 2**Bitmap with a resolution of 600x600 pixels in 8 bit colour.Storage requirements600 x 600 x 1 bytes = 360000It is 1 byte as it is 8 bits per pixel 360000/1024 = 351.6 kilobytes**Example 3**Calculate the number of pixels in 4 inch by 5 inch photograph scanned which has a resolution of 600 dots per inch. Pixels = 4 x 600 x 5 x 600 = 7,200,000 bits7,200,000 / 8 = 90000 bytes90000 bytes / 1024 = 878.9 Kb**Vector Graphics**It is possible to edit **each object** separately, for example, change the shape, colour, size and position.Even if an object in a vector graphic is quite large, it doesn't need a lot of computer memory. Therefore the file size of a vector graphic is often very **small**.Vector graphics are **scalable** when you resize them, they **do not lose quality**. |

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| **Information Systems Design and Development** |
| The following concepts and vocabulary may apply to a range of information systems types and contexts including:Databases, websites, games, mobile applications, kiosk systems. |
| Structures and links database | **Database structure:** **field** - the fields below; Exhibitor, Company Name, Area, Stand Number, Product Reference, Item Name, Price (£) **record**  - A single row in a table, there are 8 records below **file** - the entire database |
| **Database structure:** flat file all the data is stored in one table **Drawbacks** Data duplication Data inconsistency or update/ deletion/insertion anomalies Data integrity errors (due to data inconsistency) Inconsistent search results in multi-value fields**linked tables** Table would be split into EXHIBITOR(Exhibitor Code, Company Name, Area)PRODUCT(Product Ref, Item name, Price (£), Exhibitor Code\*) **primary keys -** these are unique identifiers for each row in a table**foreign keys** – a primary key from a different table |
| **Database operations** **Simple search** – a search on ABC Music would return the followingComplex search – Searching on two (or more) fields at once for example Company name = FutureTech and Price > 1500 would return the followingSimple sort – Sorting a table by one field, class registers are sorted by surnameAllan, TomBennet, GordonClark, PetulaDonaldson, LukeElliot, PaulaComplex sort – same as above but if two people have the same second name they are sorted by first name as wellAllan, TomBennet, GordonClark, PetulaDonaldson, LukeElliot, PaulaFerguson, AlexFerguson, Sarah**This is in Alphabetical or Ascending order** |
| **Field types** **text** – A Roberts, ML1 3XF**numbers** - 124**date** – 29 April 2012**time** – 08:30**object** – Picture, video or sound file.**calculated** – pay \* 20%**link** – www.bbc.co.uk**Boolean** – either yes or no |
| **Validation** **presence check** – data must be entered before the user can continue, usually has a star.**restricted choice** *-* please see below, the user can only select one option. **Benefits** Reduces the chance of human error Does not require the user to type a text response Speeds up the ordering process as inputs are reduced to mouse clicks Allows the use of a touchscreen  |
| Good design to avoid data duplication and modification errors (insert, delete, update)Flat file databases can lead to errors as shown belowIs it a man John Silver or a woman Joan Silver? |

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| Structures and linksweb based | **Website** – a series of web pages linked together, bbc.co.uk has thousands of linked pages**Page** – A single page written in html on the internet, normally forms a website when linked with other pages**URL** - Uniform Resource Locator - http://www1.skysports.com/football/ |
| **Hyperlinks** **Internal** – links to pages on the same site**External** – links to a completely different website. **relative addressing** – code to link to weather would be **<a href=”/weather” >/a****Benefit** – less coding, link will still work if the domain name changes**absolute addressing** - code to link to weather would be **<a href=”http://www.bbc.co.uk/weather” >/a****Benefit** – easier to follow the code as it shows the whole address. |
| **Navigation -** back, forward, home. |
| **Web browsers -** software allowing web pages to be viewed. Firefox, Chrome, IE **search engines** - provide a list of links when a user types a search. Google, Yahoo, Bing |
| **Good design to aid navigation** - links clearly marked, consistent style**usability -** Video clips, forums **accessibility -** large text available, alt tags on pictures |
| **Testing websites**  | Check navigation Checks all hyperlinks/hotspots Ensure graphics are not pixelated Ensure audio clips run Check JavaScript issues Check compatibility with browsers |
| **User interface****also applies to SDD** | **User requirements** **visual layout** - eye-catching, simple to use and clear of cluttered buttons and text.**navigation** - **hierarchical**, with links organised into sub categories, or **linear**, where pages are visited in one step-by-step order.**selection –** options include clicking on a menu or radio buttons or filling in a form.**consistency –** using the same font, colours styles & menus **interactivity –** using video/audio, allowing users to post comments etc**readability –** use white space andshort pages to ensure it is easy to read.**Accessibility –** Reading text aloud or having large fonts for users with eyesight issues. |
| **Media types** | **Standard file formats**:* Text: txt, rtf
* Audio: wav, mp3
* Graphics: jpeg, bmp, gif, png
* Video: mp4, avi
* Pdf: Portable Document Format
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| **Factors affecting file size** and **quality****resolution** - the number of pixels used to make up the picture. **colour depth** - the number of possible colours used to make up a pixel. The more possible colours the greater the file size.**sampling rate -** in sound files the number of recordings taken per second., the greater the sample rate the higher the quality and file size. |
| **Need for compression** - reduces the file size so that the web page loads more quickly. Reducing bit depth has the same impact. Quality of the image is affected. |
| Coding | **Scripting languages** - JavaScript is used to make the webpages interactive, eg display date/time |
| **Mark-up languages** - HTML used to code the webpages, styles can be used. |
| Purpos, features, functionality, users | Description of **purpose**, **main features** and **functionality** |
| **Users:** expert **-** use keyboard short cuts**novice -** require extra help, clear menus age-range |
|  hardware  | **Input devices -** put data into the processor e.g scanner, keyboard, mouse **output devices** - display data from the processor e.g. monitor, printer, projector,  |
| **Processor type -** dual, triple and quad code **speed (Hz) -** 1.8GHz to 3.4Ghz (faster) |
| **Random Access Memory -** used for current files, temporary storage of data which is lost if the device is switched off. **Read Only Memory -**  ROM retains its memory even after the computer is turned off.  |
| **Device types** **Supercomputer** - large processing power and memory, used by large organisations.**Desktop -** processing power but not portable.**laptop -** portable but generally less powerful than a desk top **tablet -** portable but no physical keyboard.**smartphone -** use 3G or connect to wifi. same functions as a tablet. |
| software | **Operating systems -** controls and organises the general operation of the computer. Windows, iOS, Android  |
| **Web browsers -** allows web pages to be viewed e.g Chrome, Firefox, IE |
| **Utilities -** software installed on the Operating System e.g defragment, anti virus, compression  |
| storage | **Local -** storing data on your own device**web/cloud -** storing data to a remote server on the internet. **Benefits of the web/cloud**Can access data from any computer device remotely. No requirement for own servers, less need for own technical support on site. Automatic backup/recovery of data |
| **Capacity -** Measured in GB & TB eg laptops have either 500GB or 1TB of storage. Servers in companies have far more. |
| **Rewriteable -** Data can be removed and added any time e.g. USB stick**read-only -** as soon as data is saved onto the device it can't be edited. e.g FIFA15  |
| **Interface -** Allows data to be converted between the processor and devices like printers and keyboards .  |
| **Data transfer speed -** Thunderbolt is faster than usb 3.1 which in turn is faster than firewire  |
| **Storage devices*** Built-in - each device like a laptop or phone has storage space within it.
* external - external hard drives allow users to do backups
* portable - usb drives are very portable
* Magnetic - like a an old style video tape.
* optical - DVD and CD, can become scratched

Solid state - robust as there are no moving parts |
|  networking / connectivity | **Stand-alone -** using a device but not connected to the internet, not common now. **networked -** a number of devices linked together to share data, internet, printers, communication. |
| **LAN** - Local Area Network - A number of devices linked together in 1 location e.g. a school**WAN** - Wide Area Network - A network linking different locations used by banks & supermarkets**internet -** largest WAN, about 10 billion devices linked together |
| **Client Server** Data can be stored/accessed centrally. Only accessible by registered users. Different access rights for users . Shared peripherals . Expensive as they have to purchase servers and additional hardware. |
| **Peer to Peer** Resources stored on device available to other peers . No centralised stored .Not as secure as Client Server Risk from viruses |
| Security risks | **Viruses -** software written specifically to cause hard to a computer system**Worms -** malware that can copy itself from device to device **Trojans -** harmful software designed to look like something useful to the user e.g. a downloaded mp3 file. **Hacking -** unauthorised access to a computer system. |
| **Spyware -** records actions carried out on a computer without the user knowing. Can find out websites visited and passwords.**Phishing -** Sending fake emails which link to a fraud site asking people to enter secure information like account numbers and passwords.**Keylogging -** Software which records every key stroke entered onto a computer. The fraudsters can then work out usersnames/passwords.  |
| **Online fraud -** paying for goods that don't arrive or being conned into sending bank details.**Identity theft -** criminals find out enough personal details about someone to obtain loans/credit cars/products in their name.  |
| **DOS Denial of Service attacks -** so many requests are sent to a computer in a short space of time that it crashes. |
| Security precautions | **Anti-virus software** - Software like Avast and Norton which scan for viruses and delete them.  |
| **Passwords** – guidelines to make a strong password, number of characters, mix of lower/uppercase, special characters. |
| **Encryption** – Converting a message into code so that it can’t be read by a hacker |
| **Biometrics** – recognises parts of the body to allow or restrict access – fingerprints, iris, (eye) facial recognition. |
| **Security protocols** - makes the website more secure when users are accessing online banking etc**Firewalls -** block unwanted data from arriving in a network |
| **Security suites -** a package containing a number of different security tools to ensure the user is fully protected from all types of threats  |
| Legal implications | **Computer Misuse Act -** illegal to hack into computer systems and create/send malware like viruses/trojans etc. |
| **Data Protection Act -** data subjects have the right to see data held about them, any errors corrected, personal data should not be transferred outwith the EU.  |
| **Copyright, Designs and Patents Act -** illegal to copy software, music and movies.  |
| **Health and Safety regulations -** eyesite can become damaged and Repetitive Strain Injury can happen. The solutions are eye tests and regular breaks. |
| **Communications Act -** makes it illegal to use a neighbours wifi without permission and trolling on social media deliberately upsetting other users. |
| Environmental impact | **Energy use** - Every electrical device, including computers, use energy, powersaving and standby mode limit the amount of energy used. |
| **Disposal of IT equipment** - Computers contain "heavy metals" which cause pollution. Options for disposal include; give it to charity, sell it, part exchange for a new PC, have it recycled. Make sure all data is wiped first.  |
| **Carbon footprint -** amount of greenhouse gases produced, ways to reduce it are; videoconferencing rather than meetings, make electronic copies of documents rather than printing. |