CURRICULUM ROADMAP - Nursery to Year 13

Computing

BIRKENHEAD HIGH SCHOOL ACADEMY

GDST GIRLS' DAY SCHOOL TRUST

Year 13 (SPR)

11: Programming techniques—selection, iteration (count and condition controlled), 2d lists, subroutines, text files and OOP.
12: Algorithms—Searching and sorting algorithms (bubble sort, insertion sort, merge sort, quick sort) are explained in an interactive and practical way, with reference to Big-O notation in terms of time and space complexity. Topic 5 tackles standard algorithms for depth-first and breadth-first graph traversals. Optimisation algorithms, such as Dijkstra's shortest path algorithm and the A* algorithm are covered along with a discussion of intractable problems
NEA—Development and evaluation—Development of code will continue using the iterative development process, the code will be tested and evaluated

Year 12 (SUM)

6: Data types - data representation of numbers and text, binary arithmetic using both fixed point and normalised floating point numbers, bitwise manipulation and masks
7: Data structures—The unit gives practical and worked examples of each of the different abstract data structures including linked lists, graphs, stacks, queues, trees, binary search trees and hash tables.
Programming and NEA analysis—Identify a real world problem to solve, discuss stakeholders, research the problem and come up with measurable success criteria for the project.

Year 12 (AUT)

1: Components of a computer - The structure and function of the processor, types of processor, different processor architectures, input, output and storage devices and how these can be applied to the solution of different problems.
2: Systems software - The functionality and purpose of the operating system, different types of operating system, applications software, software licences and how source code is translated into executable code.
3: Software development - systems analysis methods and algorithm design
Programming: Learning advanced coding in Python. Baselining prior knowledge and personalising learning

Year 11 (SPR)

12: Classification of programming languages - Characteristics and purpose of different levels of programming language, the purpose of translators, assemblers, compilers and interpreters
14: Relational databases and SQL - Relational databases concepts, the use of SQL to search for data from a relational database and the use of SQL to insert, update, delete data in a relational database

Year 10 (SUM)

8: Basic programming concepts - The use of data types and casting, the use of variables, constants and assignments, user input and display output, introduction to subroutines, the use of basic programming constructs, using meaningful identifier names, common arithmetic and comparison operators, common Boolean operators
9: Advanced programming concepts - Data structures and arrays, the use of records to store data, the use of basic string manipulation, random number generation, subroutines, the importance of local variables, structured

Year 10 (AUT)

1. **Systems Architecture:** Common CPU components, Von Neumann architecture, the performance of CPUs, the fetch, decode, execute cycle and embedded systems
2. Memory and Storage: Types of memory, RAM and ROM, the need for secondary storage, common types of storage and cloud storage
3. Computer networks: protocols and layers: Types of networks, modes of connection, star and bus network topologies, common network protocols, network security and the TCP/IP protocol model
4. Cybersecurity: Cybersecurity and cyber threats, malware, penetration testing, security measures
Programming: programming fundamentals

Year 9 (SPR)

Graphics Manipulation:
The unit explores how bitmap and vector images are represented and stored by the computer. There is also opportunity for pupils to practise skills in design, photo-editing and image manipulation using a suitable graphics package. The pupils' final posters are put into an assessment portfolio.
Cybersecurity: The students will start by considering the value of their data to organisations and what they might use it for. They will then look at social engineering techniques used by cybercriminals to try to trick users into giving away their personal data. The unit will look at the more common cybercrimes such as hacking, DDoS attacks, and malware, as well as looking at methods to protect ourselves and our networks against these attacks.

Year 8 (SUM)

Vector Graphics: This unit offers students the opportunity to design graphics using vector graphic editing software. Through this unit, students will be able to better understand the processes involved in creating such graphics and will be provided with the knowledge and tools to create their own.
Developing for Web: In this unit, students will explore the technologies that make up the internet and World Wide Web. Starting with an exploration of the building blocks of the World Wide Web, HTML and CSS, students will investigate how websites are catalogued and organised for effective retrieval using functioning website.

Year 8 (AUT)

Understanding Computers: Pupils will learn the theory of input, output and storage devices, look at the Input-Process-Output sequence and the Fetch-Decode-Execute cycle through practical activities. Pupils will then look at some simple binary to decimal conversion and vice versa, and learn how text characters are represented using the ASCII code. This will be followed by some simple binary addition.
Scratch coding part 2: Students will build on their understanding of the control structures' sequence, selection, and iteration (the big three), and develop their problem-solving skills. Students will learn how to create their own subroutines, develop their understanding of decomposition, learn how to create and use lists, and build upon their problem-solving skills by working through a larger project at the end of the unit :

Year 7 (SPR)

Coding using Kodu: Students will be introduced to the idea of computer programs requiring a precise series of statements and, through using Kodu, will understand how to build a world and program characters and objects using selection and iteration before moving on to enhance their games with more advanced features.
Coding with Scratch: The aim of this unit is to build students' confidence and knowledge of the key programming constructs. Importantly, this unit does not assume any previous Scratch programming experience, but it does offer students the opportunity to expand on their knowledge throughout the unit.

Year 6 (SUM)

Programming—Using variables in games.
This unit explores the concept of variables in programming through games in Scratch. First, pupils will learn what variables are, and relate them to real-world examples of values that can be set and changed. Pupils will then use variables to create a simulation of a scoreboard. Using the *Use-Modify-Create* model, pupils will experiment with variables in an existing project, then modify them, then they will create their own project. Finally, pupils will apply their knowledge of variables and design to create and improve their own computer game in Scratch.

Year 6 (AUT)

Computer Systems and Networks—Communication. Pupils learn about the World Wide Web as a communication tool. They learn how search engines work (including how they select and rank results). They will evaluate which methods of internet communication to use for particular purposes.
Media—3D modelling Pupils use a computer to produce 3D models in Tinkercad. They will initially familiarise themselves with working in a 3D space, including combining 3D objects to make a house and examining the differences between working digitally with 2D and 3D graphics. They make accurate 3D models and use 3D objects as placeholders. Finally, learners will examine the need to group 3D objects, then go on to plan, develop, and evaluate their own 3D model of a photo frame.

Year 5 (SPR)

Data and Information—Flat File databases. This unit looks at how a flat-file database can be used to organise data in records. Pupils use tools within a database to order and answer questions about data. They create graphs and charts from their data to help solve problems. They use a real-life database to answer a question, and present their work to others.
Creating media - video production: Pupils will learn how to create short videos. As they progress through this unit, they will be exposed to topic-based language and develop the skills of capturing, editing and manipulating video.

Year 4 (SUM)

Programming - Repetition in Games
This unit explores the concept of repetition in programming using the Scratch environment. It begins with a Scratch activity where pupils can discover similarities between two environments. Pupils look at the difference between count-controlled and infinite loops, and use their knowledge to modify existing animations and games using repetition. Their final project is to design and create a game which uses repetition, applying stages of programming design throughout.
Photo editing: Pupils will develop their understanding of how digital images can be changed and edited and how they can be reviewed and reused. They will consider the impact that editing images can have, and evaluate the effectiveness of their choices.

Year 4 (AUT)

Computer Systems and Networks—The Internet
Pupils explore the internet as a network of networks which need to be kept secure. They will learn that the World Wide Web is part of the internet, be given opportunities to explore the World Wide Web for themselves in order to learn about who owns content, what they can access, add and create. Finally, they will evaluate online content to decide how honest, accurate, or reliable it is, and understand the consequences of false information.
Data and Information - using Dataloggers Pupils consider how & why data is collected over time, how computers use special input devices called sensors to monitor the environment. They collect data as well as access data captured over long periods of time. They will look at data points, data sets, and logging intervals. Pupils will spend time using a computer to review and analyse data. They ask their own questions, then use data loggers to automatically collect the data needed to answer those questions.

Year 3 (SPR)

Computing Systems and Networks
Pupils develop their understanding of digital devices, with an initial focus on inputs, processes, and outputs. They start by comparing digital and non-digital devices, before introducing computer networks that include network infrastructure devices like routers and switches.
Creating media: stop frame animation
Pupils will use a range of techniques to create a stop-frame animation using chromebooks and apply those skills to create a story-based animation. This unit will conclude with pupils adding other types of media to their animation, such as music & text.

Year 2 (SUM)

Programming—an introduction to quizzes Pupils begin to understand that sequences of commands have an outcome and make predictions based on their learning. They use and modify designs to create their own quiz questions in Scratch Jr and realise these designs in ScratchJr using blocks of code. Finally, learners evaluate their work and make improvements to their programming projects.

Year 2 (AUT)

Computing systems and networks—IT around us With an initial focus on IT in the home, learners explore how IT benefits society in places such as shops, libraries, and hospitals. Whilst discussing the responsible use of technology, and how to make smart choices when using it.

Year 1 (SPR)

Media - Digital Painting
Explore the world of digital art and its exciting range of creative tools with your learners. Empower them to create their own paintings, while getting inspiration from a range of other artists. Conclude by asking them to consider their preferences when painting with digital devices.

Reception (SUM)

[repeated units throughout EYFS from F1-F2]
Computational thinking - creating and thinking critically
Barefoot Computing ***'Summer fun'*** *- lighthouses: creating algorithms*

Reception (AUT)

[repeated units throughout EYFS from F1-F2]
Computational thinking - playing and exploring in our environment
Barefoot Computing ***'Awesome Autumn'*** - making maps and following instructions

Nursery (SPR)

Computational thinking - Active learning, tinkering and persevering
Barefoot Computing ***'Winter Warmers'*** *- logical reasoning*

Year 13 (SUM)

Tidy up NEA.
Address misconceptions, revise and adapt teaching to suit learners leading up to the exams

Year 13 (AUT)

8: Boolean algebra—Boolean Algebra, logic gates, Karnaugh maps, D type flip flops, half and full adders.
9: Legal, moral, ethical issues—Computing related legislation, privacy, censorship, e-waste, technology and morality
10: Computational thinking—practical examples related to problem recognition and decomposition, abstraction and algorithm design. It covers the topics of backtracking, data mining, heuristics, performance modelling, pipelining and visualisation.
11: Programming techniques—selection, iteration (count and condition controlled), lists, 2d lists, subroutines, text files and OOP
NEA—Design and development— Decompose the problem, describe different features your solution will include, describe how testing will take place and begin to iteratively develop the coding solution

Year 12 (SPR)

3. Software development: programming paradigms, assembly language and an introduction to the main concepts of object-oriented programming.
4. Exchanging data: Databases, SQL, compression, encryption and transaction processing
5: Networks and web technologies - DNS and IP addressing, local area networks, packet switching, routers , the TCP/IP protocol stack, network threats, prevention of threats, HTML and CSS
Programming: Learning advanced coding in Python. Building on prior knowledge including selection, iteration, subroutines and lists.

Year 11 (SUM)

Programming: Exam style questions on all topics covered up to this point. There will also be an opportunity to revise topics from previous units
Theory : there will be an extensive amount of revision covered during this term based upon results of end of topic tests already completed and current understanding. We will aim to fill gaps

Year 11 (AUT)

10: Robust and secure programming– Data validation, simple authentication routines, suitable test data, different types of errors, identifying syntax and logic errors.
7: Algorithms - Decomposition, abstraction, problem solving, how to produce algorithms, input, processes and outputs, trace tables, algorithm efficiency, linear searching, binary searching, merge sorts and bubble sorts
11: Boolean logic - Logic gates and circuits, truth tables, Boolean operators and expressions, logical operators in truth tables to solve problems

Year 10 (SPR)

5: Hardware and software - The purpose and functionality of operating systems, utility software
6: Ethical, legal and environmental impacts: Privacy issues, legislation relevant to computer science, environmental impact of computer science and impacts and risks of digital technology on society
13: Data representation: Number bases, bit patterns, hexadecimal, converting between decimal and 8 bit binary, converting between decimal and hexadecimal, data storage, adding binary integers, binary shifts, representing characters and character sets, representing images, representing sound and compression.
Programming: Selection and Iteration (programming with IF statements, nested IF statements) and loops (using FOR and WHILE)

Year 9 (SUM)

Sound Editing: Students learn how sound is digitized and stored on computers. They will learn basic sound editing techniques and how to add sound effects and mix tracks. Ways of creating different sound effects (the job of a "foley artist") are described. Pupils will undertake a creative project to analyse, plan, record and edit a short sound file. This could take the form of a radio advertisement.
Data Science: In this unit, learners will be introduced to data science, and by the end of the unit they will be empowered by knowing how to use data to investigate problems and make changes to the world around them. Learners will be exposed to both global and local data sets and gain an understanding of how visualising data can help with the process of identifying patterns and trends. Towards the end of the unit, the learners will go through the steps of the investigative cycle to try to solve a problem in the school

Year 9 (AUT)

Computational thinking and logic: This unit introduces students to the world of computational thinking and logic. With the help of many unplugged activities, students get to understand the power of problem solving and the different methods that Computer Scientists use to tackle problems. Students will study logic gates and Boolean logic.
Python Programming continued: This unit introduces students to how data can be represented and processed in sequences, such as lists and strings. The lessons cover a spectrum of operations on sequences of data, that range from accessing an individual element to manipulating the entire sequence. Great care has been taken so that the selection of problems used in the programming tasks are realistic and engaging: students will process solar system planets, book texts, capital cities, leaked passwords, word dictionaries, ECG data, and more.

Year 8 (SPR)

Mobile App Development: This unit aims to take the students from designer to project manager to developer in order to create their own mobile app. Students will have an opportunity to build on the programming concepts they used in previous units before undertaking their project. Computer Crime & Cyber Security: Scams, hacking, copyright, protecting personal data
Python programming: This unit introduces students to text-based programming with Python. The lessons form a journey that starts with simple programs involving input and output, and gradually moves on through arithmetic operations, randomness, selection, and iteration. Emphasis is placed on tackling common misconceptions and elucidating the mechanics of program execution.

Year 7 (SUM)

Using Media: During this unit, students develop their understanding of information technology and digital literacy skills. They will use the skills learnt across the unit to create a blog post about a real-world cause that they would like to gain support for. Students will develop software formatting skills and explore concerns surrounding the use of other people's work, including licensing and legal issues.
Modelling data: The spreadsheet unit for Year 7 takes students from having very little knowledge of spreadsheets to being able to confidently model data with a spreadsheet. The unit uses engaging activities to progress students from using basic formulas to writing their own COUNTIF statements. This unit will give students a good set of skills that they can use in computing lessons and in other subject

Year 7 (AUT)

Impact of technology: This unit has been designed to ensure that students are given sufficient time to familiarise themselves with the school network. It also allows the teacher to discuss appropriate use of the school network, and to update and remind students of important online safety issues. Whilst completing this unit, students will also learn how to use presentation software effectively. In terms of online safety, this unit focuses on respecting others online, spotting strangers, and the effects of cyberbullying.
Networks: This unit begins by defining a network and addressing the benefits of networking, before covering how data is transmitted across networks using protocols. The types of hardware required are explained, as is wired and wireless data transmission. Students will develop an understanding of the terms 'internet' and 'World Wide Web', and of the key services and protocols used. Practical exercises are included throughout to help strengthen understanding.

Year 6 (SPR)

Data and Information—Spreadsheets This unit introduces pupils to spreadsheets. They will be supported in organising data into columns and rows to create their own data set. Learners will be taught the importance of formatting data to support calculations, while also being introduced to formulas and will begin to understand how they can be used to produce calculated data. Learners will be taught how to apply formulas that include a range of cells, and apply formulas to multiple cells by duplicating them. Learners will use spreadsheets to plan an event and answer questions. Finally, pupils will create graphs and charts, and evaluate their results in comparison to questions asked.
Creating media - web page creation: Pupils will be introduced to the creation of websites for a chosen purpose, identify what makes a good web page and use this information to design and evaluate their own website using Google Sites. Throughout the process, learners pay specific attention to copyright and fair use of media, the aesthetics of the site and navigation paths.

Year 5 (SUM)

Computer Networks and Systems—sharing information. Pupils will develop their understanding of computer systems and how information is transferred between systems and devices. They will consider small-scale systems as well as large-scale systems. They will explain the input, output, and process aspects of a variety of different real-world systems, and finally take part in a collaborative online project with other class members and develop their skills in working together online.
Media—Vector Drawing In this unit, pupils create vector drawings. They learn to use different drawing tools to help them create images and recognise that images in vector drawings are created using shapes and lines, and each individual element in the drawing is called an object. Learners layer objects and begin grouping and duplicating them to create more complex pieces of work. This unit is linked to Art learning on Kandinsky and the creation of a Liverpool skyline in a Kandinsky style.

Year 5 (AUT)

Programming—selection in quizzes. Pupils explore how conditions can be used in programs and use the *If… Then… Else* structure to select different outcomes, depending on whether a condition is true or false. They use selection outcomes to design a True of False quiz in Scratch. As an extension, they create a points variable for their quiz program.

Year 4 (SPR)

Programming - repetition in shapes.
Pupils will create programs by planning, modifying and testing commands to create shapes and patterns. They will use Logo, a text-based programming language.

Year 3 (SUM)

Programming -Sequence in music
In Scratch, pupils are introduced to a selection of motion, sound, and event blocks which they will use to create their own programs, featuring sequences. The final project is to apply stages of program design and to make a representation of a piano
Programming—Events and Actions
Pupils begin by moving a sprite in four directions (up, down, left and right). They will then explore movement within the context of a maze, using design to choose an appropriately sized sprite. This unit also introduces programming extensions, through the use of pen blocks. Pupils draw lines with sprites and change the size and colour of lines, and finally code their own maze trace program.

Year 3 (AUT)

Creating Media—Desktop Publishing Pupils learn how 'text' and 'images' can be used to communicate messages. They use desktop publishing software and consider choices of font size, colour and type to edit and improve documents. They learn how 'templates', 'orientation', and 'placeholders' can support them in making their own magazine front cover. They add text and images to their own pieces of work using desktop publishing software and evaluate how and why desktop publishing is used in the real world.
Branching Databases Pupils develop their understanding of what a branching database is and how to create one. They will gain an understanding of what attributes are and how to use them to sort groups of objects by using yes/no questions. The learners will create physical and on-screen branching databases. Finally, they will evaluate the effectiveness of branching databases and will decide what types of data should be presented as a branching database.

Year 2 (SPR)

Media—Making Music Learners will explore how music can make them think and feel. They will make patterns and use those patterns to make music with both percussion instruments and digital tools. They will also create different rhythms and tunes, using the movement of animals for inspiration. Finally, learners will share their creations and compare creating music digitally and non-digitally.
Data and information—Pictograms This unit introduces the learners to the term 'data'. Learners will begin to understand what data means and how this can be collected in the form of a tally chart. They will learn the term 'attribute' and use this to help them organise data. They will then progress onto presenting data in the form of pictograms and block diagrams and use the data to answer questions.

Year 1 (SUM)

Programming - introduction to animation.
Pupils use Scratch Jnr to investigate sprites and backgrounds. They will use programming blocks to use, modify, and create programs. Learners will also be introduced to the early stages of program design through the introduction of algorithms.

Year 1 (AUT)

Computing Systems and Networks - technology around us.
Pupils become more familiar with the different components of a computer by developing their keyboard and mouse skills, and also start to consider how to use technology responsibly.

Reception (SPR)

[repeated units throughout EYFS from F1-F2]
Computational thinking - Active learning, tinkering and persevering
Barefoot Computing ***'Winter Warmers'*** *- logical reasoning*

Nursery (SUM)

Computational thinking - creating and thinking critically
Barefoot Computing ***'Summer fun'*** *- lighthouses: creating algorithms*

Nursery (AUT)

Computational thinking - playing and exploring in our environment
Barefoot Computing ***'Awesome Autumn'*** - making maps and following instructions