Coding Foundations

Where to start learning how to code? Remarkably, this is the most difficult step. There are plenty of programming languages out there, and a seemingly unlimited number of tools to help you achieve what you want; but where do you begin?

In this section, we look at what you will need to take those first tentative steps into the world of coding. You won't become a programmer in twenty-four hours, learning how to code correctly takes time and patience, but with a little help, you can master the basics and start your coding journey.

A Brief History of Coding

It's easy to think that programming a machine to automate a process or calculate a value is a modern concept that's only really happened in the last fifty years or so. However, that assumption is quite wrong, coding has actually been around for quite some time.

01000011 01101111 01100100 01100101

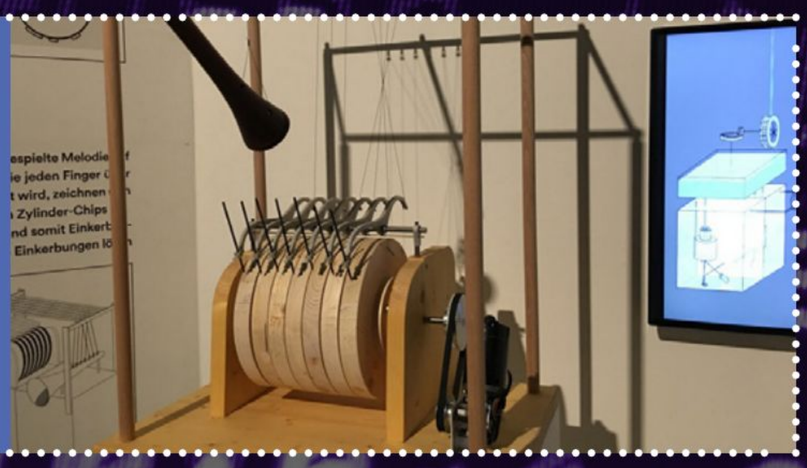
Essentially all forms of coding are made up of ones and zeros, on or off states. This works for a modern computer and even the oldest known computational device.

~87 BC

It's difficult to pinpoint an exact start of when humans began to 'program' a device. However, it's widely accepted that the Antikythera Mechanism is possibly the first 'coded' artefact. It's dated to about 87 BC and is an ancient Greek analogue computer and orrery used to predict astronomical positions.

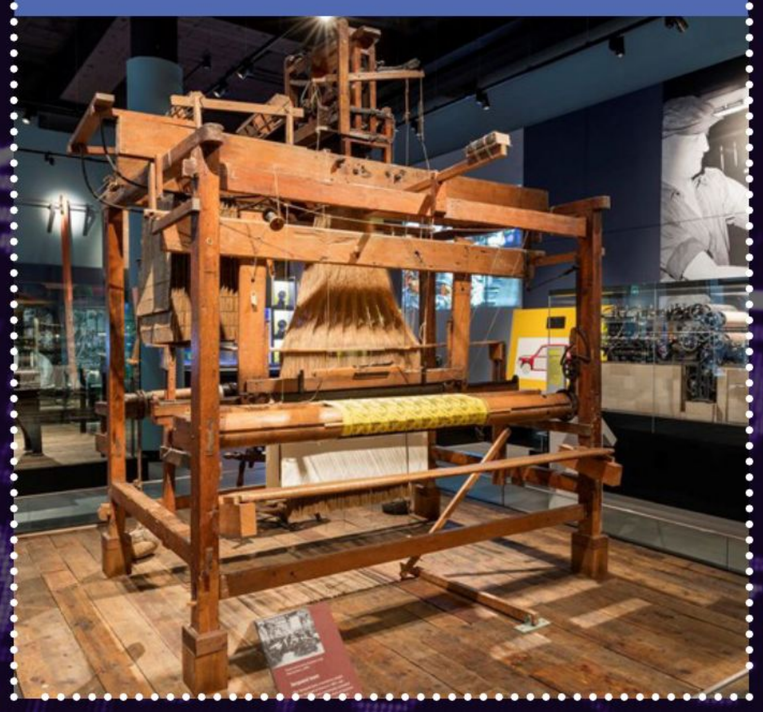
~850 AD

The Banū Mūsā brothers, three Persian scholars who worked in the House of Wisdom in Baghdad, published the Book of Ingenious Devices in around 850 AD. Among the inventions listed was a mechanical musical instrument, a hydro-powered organ that played interchangeable cylinders automatically.



1800

Joseph Marie Jacquard invents a programmable loom, which used cards with punched holes to create the textile design. However, it is thought that he based his design on a previous automated weaving process from 1725, by Basile Bouchon.



1842-1843

Ada Lovelace translated the memoirs of the Italian mathematician, Francis Maneclang, regarding Charles Babbage's Analytical Engine. She made copious notes within her writing, detailing a method of calculating Bernoulli Numbers using the engine. This is recognised as the first computer program. Not bad, considering there were no computers available at the time.

1930-1950

1951-1958

```
MONITOR FOR 6502 1.4          9-14-80  TSC ASSEMBLER  PAGE    2

C000                    ORG    ROM+$0000 BEGIN MONITOR
C000 8E 00 70  START    LDS    #STACK

                ****************************************
                * FUNCTION: INITA - Initialize ACIA
                * INPUT: none
                * OUTPUT: none
                * CALLS: none
                * DESTROYS: acc A

0013            RESETA  EQU    %00010011
0011            CTLREG  EQU    %00010001

C003 86 13      INITA   LDA A  #RESETA   RESET ACIA
C005 B7 80 04           STA A  ACIA
C008 86 11              LDA A  #CTLREG   SET 8 BITS AND 2 STOP
C00A B7 80 04           STA A  ACIA

C00D 7E C0 F1           JMP    SIGNON    GO TO START OF MONITOR

                ****************************************
                * FUNCTION: INCH - Input character
                * INPUT: none
                * OUTPUT: char in acc A
                * DESTROYS: acc A
                * CALLS: none
                * DESCRIPTION: Gets 1 character from terminal

C010 B6 80 04  INCH     LDA A  ACIA      GET STATUS
C013 47                 ASR A            SHIFT RDRF FLAG INTO CARRY
C014 24 FA              BCC    INCH      RECIEVE NOT READY
C016 B6 80 05           LDA A  ACIA+1    GET CHAR
C019 84 7F              AND A  #$7F      MASK PARITY
C01B 7E C0 79           JMP    OUTCH     ECHO & RTS

                ****************************************
                * FUNCTION: INHEX - INPUT HEX DIGIT
                * INPUT: none
                * OUTPUT: Digit in acc A
                * CALLS: INCH
                * DESTROYS: acc A
                * Returns to monitor if not HEX input

C01E 8D F0     INHEX    BSR    INCH      GET A CHAR
C020 81 30              CMP A  #'0       ZERO
C022 2B 11              BMI    HEXERR    NOT HEX
C024 81 39              CMP A  #'9       NINE
C026 2F 0A              BLE    HEXRTS    GOOD HEX
C028 81 41              CMP A  #'A
C02A 2B 09              BMI    HEXERR    NOT HEX
C02C 81 46              CMP A  #'F
C02E 2E 05              BGT    HEXERR
C030 80 07              SUB A  #7        FIX A-F
C032 84 0F     HEXRTS   AND A  #$0F      CONVERT ASCII TO DIGIT
C034 39                 RTS

C035 7E C0 AF  HEXERR   JMP    CTRL      RETURN TO CONTROL LOOP
```

The first true computer code was Assembly Language (ASM) or Regional Assembly Language. ASM was specific to the architecture of the machine it was being used on. In 1951 programming languages fell under the generic term Autocode. Soon languages such as IPL, FORTRAN and ALGOL 58 were developed.

1959

During the Second World War, there significant advances were made in programmable machines. Most notably, the cryptographic machines used to decipher military codes used by the Nazis. The Enigma was invented by the German engineer Arthur Scherbius but was made famous by Alan Turing at Bletchley Park's codebreaking centre.

Admiral Grace Hopper was part of the team that developed the UNIVAC I computer and she eventually developed a compiler for it. In time, the compiler she developed became COBOL (Common Business-oriented Language), a computer language that's still in use today.

1960-1970

Computer programming was mainly utilised by universities, the military and big corporations during the '60s and the '70s. A notable step toward a more user-friendly, or home user language, was the development of BASIC (Beginners All-purpose Symbolic Instruction Code) in the mid-sixties.

```
10 INPUT "What is your name: "; U$
20 PRINT "Hello "; U$
25 REM
30 INPUT "How many stars do you want: "; N
35 S$ = ""
40 FOR I = 1 TO N
50 S$ = S$ + "*"
55 NEXT I
60 PRINT S$
65 REM
70 INPUT "Do you want more stars? "; A$
80 IF LEN(A$) = 0 THEN GOTO 70
90 A$ = LEFT$(A$, 1)
100 IF (A$ = "Y") OR (A$ = "y") THEN GOTO 30
110 PRINT "Goodbye ";
120 FOR I = 1 TO 200
130 PRINT U$; " ";
140 NEXT I
150 PRINT
```

1970-1985

From the 1970s, the development of the likes of C, SQL, C with Classes (C++), MATLAB, Common Lisp and more came to the fore. The '80s was undoubtedly the golden age of the home computer, a time when silicon processors were cheap enough for ordinary folk to buy. This led to a boom in home/bedroom coders with the rise of 8-bit machines.

1990s-Present Day

The Internet age brought a wealth of new programming languages and allowed people access to the tools and knowledge needed to learn coding in a better way. Not only could a user learn how to code but they could freely share their code and source other code to improve their own.

Being a Programmer

Programmer, developer, coder, they're all titles for the same occupation, someone who creates code. What they're creating the code for can be anything from a video game to a critical element on-board the International Space Station. How do you become a programmer though?

Times have changed since programming in the ‘80s, but the core values still remain.

“It’s up to you how far to take your coding adventure!”

```
#include<stdio.h>
#include<dos.h>
#include<stdlib.h>
#include<conio.h>
void getup()
{
    textcolor(BLACK);
    textbackground(15);
    clrscr();
    window(10,2,70,3);
    cprintf("Press X to Exit, Press Space to Jump");
    window(62,2,80,3);
    cprintf("SCORE : ");
    window(1,25,80,25);
    for(int x=0;x<79;x++)
    cprintf("n");
    textcolor(0);
}

int t,speed=40;
void ds(int jump=0)
{
    static int a=1;

    if(jump==0)
        t=0;
    else if(jump==2)
        t--;
    else t++;
    window(2,15-t,18,25);
    cprintf("                    ");
    cprintf("          мллллллм");
    cprintf("          ллллллll");
    cprintf("          ллллллпп");
    cprintf(" л       мллллппп ");
    cprintf(" ллм   мллллллммм ");
    cprintf(" пллллллллллл  п ");
    cprintf("   пллллллпп      ");
    if(jump==1 || jump==2){
    cprintf("    ллп пл        ");
    cprintf("    лм   лм       ");
    }else if(a==1)
    {
    cprintf("    пллп  ппп     ");
    cprintf("      лм          ");
    a=2;
    }
    else if(a==2)
    {
    cprintf("     плм пл       ");
    cprintf("          лм      ");
    a=1;
    }
    cprintf("                  ");
    delay(speed);
}
void obj()
{
```

Being able to follow a logical pattern and see an end result is one of the most valued skills of a programmer.

MORE THAN CODE

For those of you old enough to remember the ‘80s, the golden era of home computing, the world of computing was a very different scene to how it is today. 8-bit computers that you could purchase as a whole, as opposed to being in kit form and you having to solder the parts together, were the stuff of dreams; and getting your hands on one was sheer bliss contained within a large plastic box. However, it wasn’t so much the new technology that computers then offered, moreover it was the fact that for the first time ever, you could control what was being viewed on the ‘television’.

Instead of simply playing one of the thousands of games available at the time, many users decided they wanted to create their own content, their own games; or simply something that could help them with their homework or home finances. The simplicity of the 8-bit home computer meant that creating something from a few lines of BASIC code was achievable and so the first generation of home-bred programmer was born.

From that point on, programming expanded exponentially. It wasn’t long before the bedroom coder was a thing of the past and huge teams of designers, coders, artists and musicians were involved in making a single game. This of course led to the programmer becoming more than simply someone who could fashion a sprite on the screen and make it move at the press of a key.

Naturally, time has moved on and with it the technology that we use. However, the fundamentals of programming remain the same; but what exactly does it take to be a programmer?

The single most common trait of any programmer, regardless of what they’re doing, is the ability to see a logical pattern. By this we mean someone who can logically follow something from start to finish and envisage the intended outcome. While you may not feel you’re such a person, it is possible to train your brain into this way of thinking. Yes, it takes time but once you start to think in this particular way you will be able to construct and follow code.

Second to logic is an understanding of mathematics. You don’t have to be at a genius level but you do need to understand the rudiments of maths. Maths is all about being able to solve a problem and code mostly falls under the umbrella of mathematics.

Being able to see the big picture is certainly beneficial for the modern programmer. Undoubtedly, as a programmer, you will be part of a team of other programmers, and more than likely part of an even bigger team of designers, all of whom are creating a final product. While you may only be expected to create a small element of that final product, being able to understand what everyone else is doing will help you create something that’s ultimately better than simply being locked in your own coding cubicle.

Finally, there’s also a level of creativity needed to be a good programmer. Again though, you don’t need to be a creative genius, just have the imagination to be able to see the end product and how the user will interact with it.

There is of course a lot more involved in being a programmer, including learning the actual code itself. However, with time, patience and the determination to learn, anyone can become a programmer. Whether you want to be part of a triple-A video game team or simply create an automated routine to make your computing life easier, it’s up to you how far to take your coding adventure!

Choosing a Programming Language

It would be impossible to properly explain every programming language in a single book of this size. New languages and ways in which to 'talk' to a computer or device and set it instructions are being invented almost daily; and with the onset of quantum computing, even more complex methods are being born. Here is a list of the more common languages along with their key features.

SQL

SQL stands for Structured Query Language. SQL is a standard language for accessing and manipulating databases. Although SQL is an ANSI (American National Standards Institute) standard, there are different versions of the SQL language. However, to be compliant, they all support at least the major commands such as Select, Update and Delete in a similar manner.

JAVASCRIPT

JavaScript (often shortened to JS) is a lightweight, interpreted, object-oriented language with first class functions. JavaScript runs on the client side of the web, that can be used to design or program how the web pages behave on the occurrence of an event. JavaScript is an easy to learn and also powerful scripting language, widely used for controlling web page behaviour.

JAVA

Java is the foundation for virtually every type of networked application and is the global standard for developing enterprise software, web-based content, games and mobile apps. The two main components of the Java platform are the Java Application Programming Interface (API) and the Java Virtual Machine (JVM) that translates Java code into machine language.

C#

C# is an elegant object-oriented language that enables developers to build a variety of secure and robust applications that run on the .NET Framework. You can use C# to create Windows client applications, XML Web services, client server applications, database applications and much more. The curly-brace syntax of C# will be instantly recognisable to anyone familiar with C, C++ or Java.

PYTHON

Python is a widely used high level programming language used for general purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasises code readability and a syntax that allows programmers to express concepts in fewer lines of code. This can make it easier for new programmers to learn.

C++

C++ (pronounced cee plus plus) is a general purpose programming language. It has imperative, object-oriented and generic programming features. It was designed with a bias toward system programming and embedded, resource-constrained and large systems, with performance, efficiency and flexibility of use as its design highlights.

RUBY

Ruby is a language of careful balance. Its creator, Yukihiro “Matz” Matsumoto, blended parts of his favourite languages (Perl, Smalltalk, Eiffel, Ada and Lisp) to form a new language. From its release in 1995, Ruby has drawn devoted coders worldwide. Ruby is seen as a flexible language; essential parts of Ruby can be removed or redefined, at will. Existing parts can be added to.

PERL

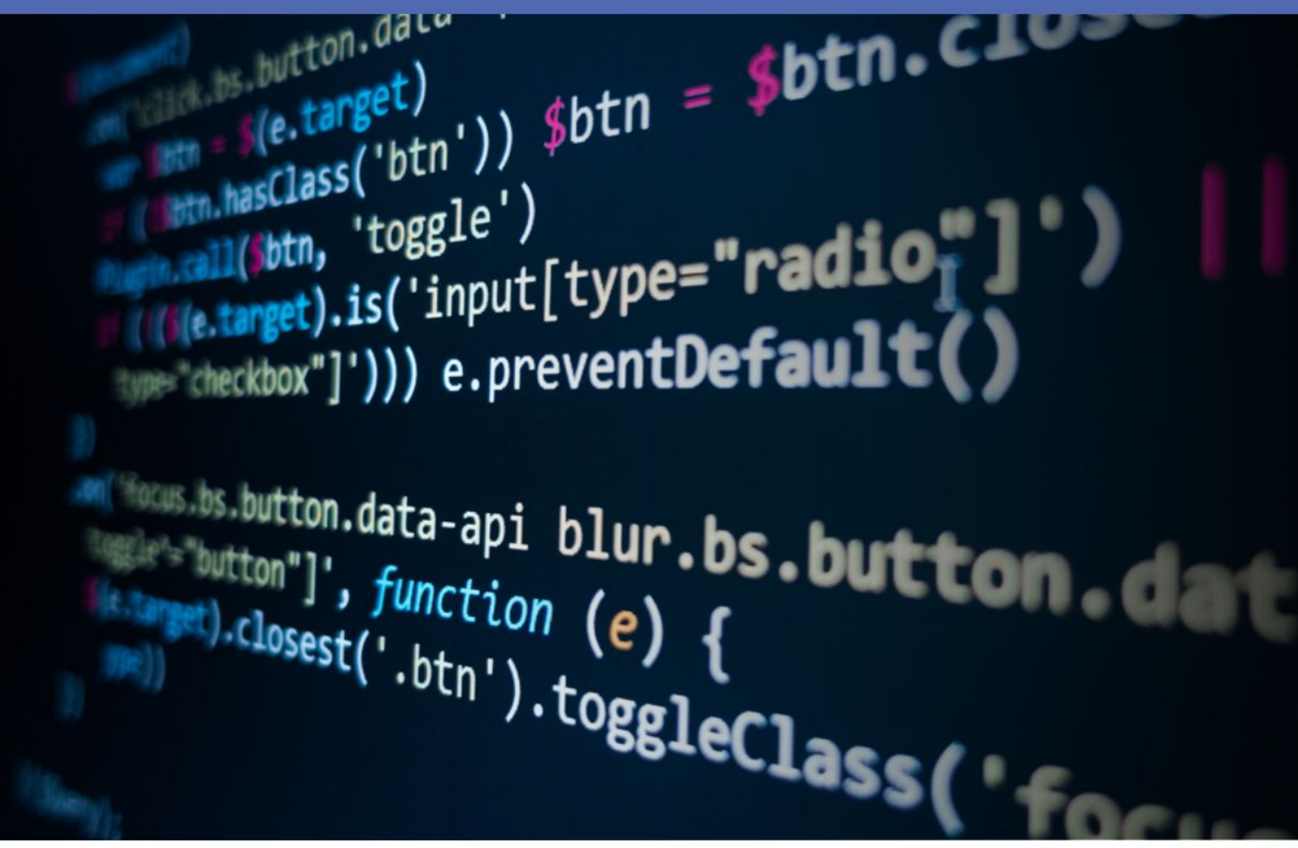
Perl is a general purpose programming language, used for a wide range of tasks including system administration, web development, network programming, GUI development and more. Its major features are that it’s easy to use, supports both procedural and object-oriented (OO) programming, has powerful built-in support for text processing and has one of the most impressive collections of third-party modules.

SWIFT

Swift is a powerful and intuitive programming language for macOS, iOS, watchOS and tvOS. Writing Swift code is interactive and fun; the syntax is concise yet expressive and Swift includes modern features that developers love. Swift code is safe by design, yet also produces software that runs lightning fast. A coding tutorial app, Swift Playgrounds, is available on the iPad.

Creating a Coding Platform

The term 'Coding Platform' can denote a type of hardware, on which you can code, or a particular operating system, or even a custom environment that's pre-built and designed to allow the easy creation of games. In truth it's quite a loose term, as a Coding Platform can be a mixture of all these ingredients, it's simply down to what programming language you intend to code in and what your end goals are.



Coding can be one of those experiences that sounds fantastic, but to get going with it, is often confusing. After all, there's a plethora of languages to choose from, numerous apps that will enable you to code in a specific, or range, of languages and an equally huge amount of third-party software to consider. Then you access the Internet and discover that there are countless coding tutorials available, for the language in which you've decided you want to program, alongside even more examples of code. It's all a little too much at times.

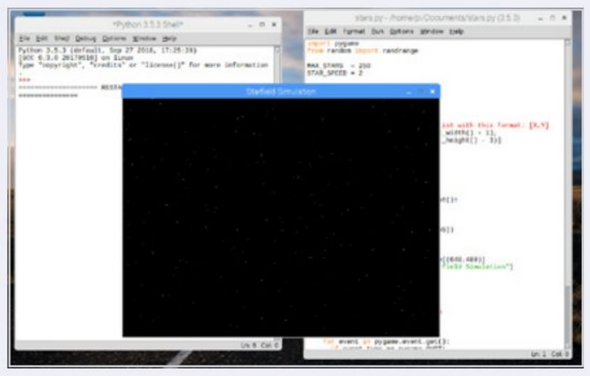
The trick is to slow down and, to begin with, not look too deeply into coding. Like all good projects, you need a solid foundation on which to build your skill and to have all the necessary tools available to hand to enable you to complete the basic steps. This is where creating a coding platform comes in, as it will be your learning foundation while you begin to take your first tentative steps into the wider world of coding.

HARDWARE

Thankfully, coding at the foundation level doesn't require specialist equipment, or a top of the range, liquid hydrogen-cooled PC. If you own a computer, no matter how basic, you can begin to learn how to code. Naturally, if your computer in question is a Commodore 64 then you may have some difficulty following a modern language tutorial, but some of the best programmers around today started on an 8-bit machine, so there's hope yet.

Access to the Internet is necessary to download, install and update the coding development environment, alongside a computer with either: Windows 10, macOS, or Linux installed. You can use other operating systems, but these are the 'big three' and you will find that most code resources are written with one, or all of these, in mind.

SOFTWARE



In terms of software, most of the development environments - the tools that allow you to code, compile the code and execute it - are freely available to download and install. There are some specialist tools available that will cost, but at this level they're not necessary; so don't be fooled into thinking you need to purchase any extra software in order to start learning how to code

Over time, you may find yourself changing from the mainstream development environment and using a collection of your own, discovered, tools to write your code in. It's all personal preference in the end and as you become more experienced, you will start to use different tools to get the job done.

OPERATING SYSTEMS

Windows 10 is the most used operating system in the world, so it's natural that the vast majority of coding tools are written for Microsoft's leading operating system. However, don't discount macOS and especially Linux.

macOS users enjoy an equal number of coding tools to their Windows counterparts. In fact, you will probably find that a lot of professional coders use a Mac over a PC, simply because of the fact that the Mac operating system is built on top of Unix (the command-line OS that powers much of the world's filesystems and servers). This Unix layer lets you test programs in almost any language without using a specialised IDE.

Linux, however, is by far one of the most popular and important, coding operating systems available. Not only does it have a Unix-like backbone, but also it's also free to download, install and use and comes with most of the tools necessary to start learning how to code. Linux powers most of the servers that make up the Internet. It's used on nearly all of the top supercomputers, as well as specifically in organisations such as NASA, CERN and the military and it forms the base of Android-powered devices, smart TVs and in-car systems. Linux, as a coding platform, is an excellent idea and it can be installed inside a virtual machine without ever affecting the installation of Windows or macOS.

THE RASPBERRY PI

If you haven't already heard of the Raspberry Pi, then we suggest you head over to **www.raspberrypi.org**, and check it out. In short, the Raspberry Pi is a small, fully functional computer that comes with its own customised Linux-based operating system, pre-installed with everything you need to start learning how to code in Python, C++, Scratch and more.

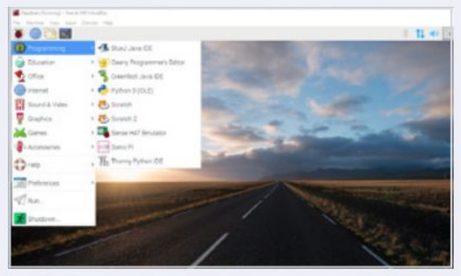
It's incredibly cheap, costing around £35 and allows you to utilise different hardware, in the form of robotics and electronics projects, as well as offering a complete desktop experience. Although not the most powerful computing device in the world, the Raspberry Pi has a lot going for it, especially in terms of being one of the best coding platforms available.

YOUR OWN CODING PLATFORM

Whichever method you choose, remember that your coding platform will probably change, as you gain experience and favour one language over another. Don't be afraid to experiment along the way, as you will eventually create your own unique platform that can handle all the code you enter into it.

VIRTUAL MACHINES

A virtual machine is a piece of software that allows you to install a fully working, operating system within the confines of the software itself. The installed OS will allocate user-defined resources from the host computer, providing memory, hard drive space etc, as well as sharing the host computer's Internet connection.



The advantage of a virtual machine is that you can work with Linux, for example, without it affecting your currently installed host OS. This means that you can have Windows 10 running, launch your virtual machine client, boot into Linux and use all the functionality of Linux while still being able to use Windows.

This, of course, makes it a fantastic coding platform, as you can have different installations of operating systems running from the host computer while using different coding languages. You can test your code without fear of breaking your host OS and it's easy to return to a previous configuration without the need to reinstall everything again.

Virtualisation is the key to most big companies now. You will probably find, for example, rather than having a single server with an installation of Windows Server, the IT team have instead opted for a virtualised environment whereby each Windows Server instance is a virtual machine running from several powerful machines. This cuts down on the number of physical machines, allows the team to better manage resources and enables them to deploy an entire server dedicated to a particular task in a fraction of the time.

MINIX NEO N42C-4

The NEO N42C-4 is an extraordinarily small computer from mini-PC developer, MINIX. Measuring just 139 x 139 x 30mm, this Intel N4200 CPU powered, Windows 10 Pro pre-installed computer is one of the best coding platforms we've come across.

The beauty, of course, lies in the fact that with increased storage and memory available, you're able to create a computer that can easily host multiple virtual machines. The virtual machines can cover Linux, Android and other operating systems, allowing you to write and test cross-platform code without fear of damaging, or causing problems, with other production or home computers.

The MINIX NEO N42C-4 starts at around £250, with the base 32GB eMMC and 4GB of memory. You'll need to add another hundred and fifty, or so, to increase the specifications, but consider that a license for Windows 10 Pro alone costs £219 from the Microsoft Store and you can begin to see the benefits of opting for a more impressive hardware foundation over the likes of the Raspberry Pi.