1) Director of studies, Eben Upton, from St. Johns, Cambridge, noticed that the number of applicants and the amount of computer literacy knowledge of an average applicant had decreased significantly from the past 10 years. So in response to this Eben Upton and his team (Raspberry Pi foundation) created the Raspberry Pi in 2011. This device is a small, portable, and affordable computer device that was created to aid in the development of computer literacy for young people, specifically helping young children to learn how to program. In 80's computer devices such as- commodore 64 and bbc microcomputer required users to learn basic computer coding in order use them. So users that used these devices, often children, had an inbuilt understand of how computers worked. However, in the late 1980's games console and personal computers were replacing these types of computers as the primary platform where children would play games on. These types of consoles are a closed platform system, designed to not be programmable for the general public. The personal computer was now more user friendly and removed the aspect in which users were required to code in order to open a simple program. Children these days are able to open a simple programming with a click of their mouse. Costing an affordable $35, the Raspberry pi foundation hoped that these devices would make computing more widespread in third world counties, homes and classrooms.

Originally designed for young people, older users also began adopting the raspberry pi, due to the endless amount of things that a raspberry pi can be used for. This device has all the essential components of a bare minimum computer. So it can be used as a personal computer, a retro-gaming system, and even a personal cloud server. There is indeed endless amount of things that you can use this device for. However, users need to keep in mind the specification of the Raspberry components as these ultimately determine whether or not something can be made using the pi or not.

The Raspberry Pi has many different models. The model which I will be discussing in detail is Raspberry Pi 3 Model B.

2) The Raspberry Pi, utilities its physical footprint to effectiveness in order to maximises the device's functional aim. A physical footprint of a device is essentially, the "size, shape, and material of a device and the amount of space that the unit uses." The Raspberry Pi is designed to be small. This size serves as an advantage as the smallness of the device means that the shipping cost of device would be kept at a minimum, in comparison with a full boxed computer device, and also be able to be integrated into other devices. Being small also means that the device will consume less power than a full size box because a small device generally uses power more effectively since with a large device electricity will need to travel greater distances to a component. The Raspberry Pi's usb port are all stacked to further minimise the size of the Raspberry Pi

The materials used in the Raspberry Pi is the typical materials that you would find in a normal electronic circuit board. This board contains a solder mask which is a thin polymer layer on cooper traces of the printed circuit. its aim is to make sure the soldiers blobs don't have an unintentional electrical connection, which could affect how the device will function.

The Raspberry Pi is also an open source hardware meaning that the design of it can be studied modified, and created by anyone. Being open source maximises customisability, which is one of the primary reasons why hobbyist love this device.

3) The Raspberry Pi, is a computer device that is essentially a single main system board. All the components are on one main system board. The main components of Raspberry Pi's main system board include- Gpu, Microsdhc card slot, Ethernet port, usd port. All of these components aid in the functionality of the device.

The type of GPU used in the Raspberry Pi is the Broadcom Videocore IV. This type of GPU is integrated in the main system board. The purpose of GPU is it implements Instruction sets that focuses on graphics. They're in charge of parallel mathematical operations that influence graphics. The Broadcom Videocore IV is a type of processor generally used for smart phones and tablets. A display device such as- monitor can be connected to the Raspberry Pi through the Pi's Hdmi port. Essentially, the GPU in the main system board of Rasberry Pi, aids with the monitor displaying information such as images.

Another component found in Raspberry Pi's main system board is the Ethernet port. This port allows for Ethernet connection. The role of the Ethernet connection is to allow for the transfer of data between two devices. The Ethernet port can also be used to connected the Raspberry Pi to a Modem. This therefore allows the Raspberry Pi to be able to use the internet; being able to use the internet is generally one of the functions that a computer device needs to have.

The USB port enables the connection between the Raspberry Pi and most peripheral devices. Being able to connect a mouse and keyboard with the USB port is vital in turning the Rasbery Pi into a personal computer. The mouse and keyboard are input devices that allows for the input of information in a computer device.

Another component found in the main system board is the Microsdhc slot. This slot reads and write information present in a Microsd card. In order to boot up the Raspberry Pi, the operating system needs to be installed in a Microsd card and then be inserted in the its Microsdhc slot.

4) The type of primary memory that is used in a Raspberry Pi is RAM, more specifically DRAM. This is a type is temporary volatile storage, meaning that if DRAM doesn't have any electricity then all then data stored in it will be lost. Whenever a user wants to use a Raspberry Pi application, the application must go from the secondary storage, a micosd card, to the primary memory, which is DRAM. The Cpu can only run application found in the DRAM of the Raspberry Pi. The amount of data

storage capacity of the DRAM determines how many applications the Raspberry Pi can run at the same time. When the DRAM is full and a user wants to run another application, some of the less frequently used application will go back into the secondary storage, thus freeing space for a new application to run in DRAM. This process is called paging.

Static RAM was one of the types of Ram that the company did not choose. The company wanted to keep the price of the Raspberry Pi low, thus DRAM was picked. The downside is that DRAM is slower then Static RAM. But the upside of DRAM is DRAM tends to be more compact than SRAM.

From the previous generation of the Raspberry Pi models, the amount of data storage capacity of DRAM has increased from 256mb to 1gb LPDDR2 RAM. The increased Ram allows Raspberry Pi to run multiple programs at the same time. This is an advantage to users that like to multitask. Simple games such as Minecraft is now able to be executed thanks to the increased RAM.

5) In the Raspberry Pi, the main method of storage used is with a secondary storage device. A secondary storage is considered non-volitale, meaning that data is still retained if there is no electricity. The type of secondary device the Raspberry Pi uses is a Microsdhc card.

In order to turn the raspberry pi into a personal computer, the operating system must be installed in the Microsdhc card. Once installed, the Microsdhc card is then inserted into Raspberry Pi's Microsdhc slot, thus allowing the personal computer to boot up. For users to execute applications on the Raspberry Pi all the applications must be stored in the Microsdhc card aswell.

A Microsdhc card is the predecessor of the original Microsd card. The Microsdhc card can have a maximum storage capacity of 32gb, while the Microsd card has a maximum storage capacity of 2 gb. A microsdhx, containing a maximum storage capacity of 2 tb, is the predecessor of the microsdhc card. The Raspberry Pi's memory card reader can only read the microsdhc card. This card was chosen because it 's significantly cheaper than the micrsdhx and contains just the right amount of storage. Having a 2tb memory card is wasteful since the applications that are on the Raspberry Pi does not take up a large amount of storage. A Microsdhc card was selected over a standard sd card to further minimise the size of the Pi. Having a smaller raspberry pi allows the device to be able to be used in a small hand held console.

Unfortunately, since the Raspberry Pi only has one Microsdhc card slot an expansion of storage is not possible. The only way is just to buy a Microsdhc card that contains more storage capacity.

6) The Cpu used by the Raspberry Pi is a 64bit quad core Arm Cortex a53. A Cpu is an integrated circuit chip found on the Raspberry Pi circuit board; the Cpu "process signals to control all devices within a machine." Within the Raspberry Pi's cpu, there is a control unit and arthimetic logic unit.

The arithmetic unit performs all the operations of Raspberry Pi and process data, while the control unit sends signals to other parts of systems such as the Usb ports. Arm cortex a53 is an alternative to high performance Arm cortex a57. Running the Arm v8 instruction set, the Arm cortex a53 is designed to be more energy efficient and cost efficient compared to the Arm cortex a57. However, the software is identical with both products and can run all same applications that exist today (2012). Because the Raspberry Pi's objective is to provide a low cost, small computer device, the Arm Cortex a53 is a good choice of a processor. This processor can be deployed at a low cost due to size of it. One way to make the Raspberry Pi device faster is by increasing the maximum instruction rate issued.

In order for the Raspberry Pi to maximise instruction rate issued, the Pi must utilise its quad cores. A Quad core is four independent units that can read and execute computer instructions. Just having a single core and increasing its clock speed can produce the same results as having four cores but the massive drawback is that it will cause the device to overheat. The process where the Cpu utilises all four cores is called parallelism. This means a task will be divided among the four cores. So all four cores will work together to complete a task.

7)

A machine language programmer will need to have a good understanding of the Cpu instruction set. This set is the list of commands in machine code that the cpu can understand and execute. It is rare to see a programmer code in machine code. The primary reason why is because each Cpu and assembler will have slightly different syntax and instructions. Machine code is also harder to read and write compared to a programming language. Nowadays, programmers will use a programming language and use a compiler which will turn the programming language into machine language. The Raspberry Pi utilises ARM v8 A64 cpu instruction set. The Arm v8 A64 instruction set can be categorised into three main groups: data processing group, load and stores group and branch instruction group.

The data processing instruction group performs move, arithmetic, logical, compare and multiply operations. Arithmetic logic instructions perform addition operation, division operation, subtraction and multiplication operations. When a programmer wants to execute operations they will need to be able to find the mnemonics, which are the abbreviation for the operations. So for the Addition operation the mnemonics is: ADD Rd,Rn,n; this add two 32-bit values together. For subtraction the mnemonics is SUB Rd,Rn,n and it deducts two 32 bit values. The data processing register can also transfer data from one register to another register or accumulator. This mnemonic is: Mov,Rd,n which moves the "n" value of register to the accumulator.

The Branch instruction "group transfers the flow of execution of program to a new address." So branch instructions can be classified in two groups. The unconditional branch instructions is where the executed control jumps to the a particular location. The conditional branch location is where the executed control jumps to a particular location if a condition is met; if the condition is not met then the next instruction will be executed. Finally, the load and stores group copies data to registers

8)

The Cpu instruction set has indeed evolved overtime. The Arm v8 a64 has some improvements. One of the main improvements is enabling applications to utilises the 64 bit devices. Which therefore means that the device (Raspberry Pi) can have more than 4gb of memory. With the armv7 being 32 bit, the registers were assumed to be 32 bit but since the armv8 is now 64 bit the registers are assumed to be 64bit. Another change in instruction is that 31 more registers for 64 bit has been added; this makes the microprocessors more efficient. The Arm v8 is a 64bit device it offers backward compatibility and allows old software migration. The Arm processor moving to 64 bit was a necessity as the competition had already migrated.

9)

In the past, programs had to be manually ran one at the time. As the demand for speed increased, technology had to evolve. The development of operating system allowed computers to manage themselves. An operating system is essentially just a big program that can run and manage other programs and perform basic computer task such as controlling peripherals. Nearly all computer devices have an operating system. The first ever operating systems was a system that required users to have an understanding of command lines, which are essentially the sentences or commands used to run applications. This Mdos system, Microsoft's first operating system, has its flaws; the primary flaw is that it could only run a single task. Running only a single task makes everything harder. When Apple introduced their GUI operating system it started the surge of replacing the command line interfaces such as- MDOS system with GUI operating systems. Microsoft had to adopt the GUI operating system to be able to compete with other companies, thus now producing what we now know today as the Windows operating system.

One of the disadvantages with a commercial operating system such as Windows or Os X operating system is its restrictions. A Windows and OS x operating system is closed source, meaning that it's source code cannot be edited or modified; this reduces the customisability of an operating system. On the other hand, Linux is open source, meaning that the user has full control of his computer and operating system.

The Raspberry Pi device can technically run any operating system but some operating system performs better on the Raspberry pi than others. Raspbian, released in 2012, is the default operating

system of the Raspberry Pi. This operating system is a based on one of the most popular Linux operating system: Debian. Raspbian is the recommended operating system for the Raspberry device as it is optimised for the low performance Arm Cpu. For new users of Raspberry Pi, this operating system provides a similar feel to Windows operating system. It does not require command line interfacing like a normal Linux operating system would require.

10)

To create a software on the Raspberry Pi a programming language needs to be used. The language needs to be able to be compiled with the Armv8 or Armv7 chip. The Raspberry Pi Foundation recommends Python as the first high level programming language that a new user should use. Developed by Guido Van Rossum in 1991, the Python programming language is designed for easy readability for a beginner. Compared to C++, the syntax of this language allows users to code in fewer lines. There are currently different versions of python available: python 1.0 (released in 1983), python 2.0 (released in 2000), and python 3.0 (released in 2008). Another high level programming language that is supported by Raspberry Pi is C++. This language is considered significantly harder than Python as it has stricter syntax. Released in 1983 by Bjarne Stroustrup, C++ is an object oriented programming language that is a superset of the C language.

In order to make programming easier, it is recommended that programmers should code in an IDE. An Integrated development environment contains a debugger, compiler, and text editor. The debugger assists in the detection and correction of programming errors in your application. A compiler converts the programming language into an assembler language that can be read by an assemble. An example of an IDE that Raspberry Pi supports is Code::blocks. This application is an open source cross platform IDE that supports C, C++ and Fortran. The advantage of this particular IDE is that it is easily navigable for a beginner and also accepts many different compilers such as GCC, Clang and more. The disadvantage of code::blocks is that because its designed to be easily navigable for beginners there will be some limitations.

For users that don't want to code their own applications, but still want application on their Raspberry Pi Computers The Pi Store is available to them. This store contains a variety of software that is written for and ported for the Raspberry Pi. The Pi store is only compatible with the Raspberry Pi operating system; so to download software, users will need to download it directly from their Raspberry Pi personal computer.

[1] http://www.zdnet.com/article/raspberry-pi-11-reasons-why-its-the-perfect-small-server/

[2] https://bbvaopen4u.com/en/actualidad/arduino-and-raspberry-pi-dominate-open-hardware-there-are-increasingly-better

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