

IFB102: Introduction to Computer Systems

Module 2 High Level Technologies: Further Investigation Questions (2019 semester 1) (v1)

These are the further investigation questions for the second IFB102 Introduction to Computer Systems Module. This document contains sets of further investigation questions corresponding to each week's lecture topic. They involve investigating topics beyond that covered in the lecture. To get a top mark you will need to provide critical understanding and insight.

You must undertake the further investigation questions *individually*.

It is important that all ideas, information and work taken from others is correctly cited and referenced; you must follow QUT guidelines for this: www.citewrite.qut.edu.au/cite/. You will be penalized for any work taken from others which is not correctly cited and referenced. More general study information is available here: <https://qutvirtual4.qut.edu.au/group/student/study/studying-effectively>

DUE DATE: The further investigation questions are due before 23:59 on **Friday of week 9, 3rd May**.

If for any reason you are unable to submit your assignment on time you can apply for an extension or

special consideration here:

<https://qutvirtual4.qut.edu.au/group/student/study/assignments/submitting/late-assignments-and-extensions> Tutors and units coordinators cannot give extensions.

These questions will be marked by your tutor and moderated by the IFB102 teaching team. Feedback on your answers will be provided through Turnitin comments and your tutor during practical classes.

Please note your answers to these questions must be your own and new original material; any other material must be correctly quoted, referenced and cited. You may not reuse other assignments of your own or other people for these questions.

SUBMISSION: Submit your assignment electronically to the Turnitin utility via the links on Blackboard. *Please ensure you received an acknowledgement that your assignment has been successfully submitted. Given the load on Turnitin and Blackboard leading up to the assignment deadline we strongly encourage you to submit a copy of your assignment early, you can submit multiple copies. Late submissions will be given zero marks.*

Please make sure you include the following details in your submission:

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Class 5: Languages and Libraries

The fifth lecture describes the two key methods by which we manage complexity in computer systems: high level programming languages and software libraries. These techniques are used extensively at all levels of a computer system from low level hardware and software to business processes and workflows. These questions explore programming languages, and software libraries and their APIs.

Please provide written answers to the following questions. Write a maximum of one page per question, plus references. If you write more than a page any excess material will be disregarded.

Please provide well thought answers; use critical thinking and try to be insightful: do not just repeat the marketing hype from companies. The goal is to produce a well thought out, insightful answer in just one page. Remember to correctly cite and reference all material you use.

(<http://www.citewrite.qut.edu.au/cite/>). Each question should have a list of references and in text citations

1. Programming Languages

Compare and contrast C with the JavaScript language. Explain their design and implementation and how it relates to their intended use.

The Programming Paradigm called (C) is an organized programming language (Soffar, 2019). It helps to solve a technical problem using functional modules and blocks (Soffar, 2019). A complete program can be created from an assortment of these modules (Soffar, 2019). Debugging, conservation and experimentation is then made easier with this modular program style (Soffar, 2019). The (C) Programming Paradigm is the basis for many other programming languages, and Python as one of them is an entirely Object-Oriented High-Level Programming Language and constructed from C and a little bit of C++ too (Soffar, 2019). Besides, the C Programming Paradigm is a small language requiring short approaches (Soffar, 2019). The strength of the (C) Programming Paradigm lies in the embedded onboard features as there are only 32 keywords in ANSI C only. (Soffar, 2019). Many features are also available with the C Programming Paradigm that can be used to evolve the programs (Soffar, 2019). The (C) Programming Paradigm is an assembler language, just defined (Soffar, 2019). This means that the code is compacted into an executable discipline as opposed to being adapted on the go at run time (Soffar, 2019). This article grants the processing speed of programs compiled in the (C) language; thus, many programming libraries are written in (C) (Soffar, 2019). However, despite the (C) programming having so many advantages, it also has its disadvantages. One of the most significant drawbacks is that the (C) programming paradigm is that it has little to no support for Object Oriented Programming (OOP) (Soffar, 2019). Certain lineaments such as Inheritance, Encapsulation, Polymorphism, etc (Soffar, 2019). The concrete basis for the development of the (C) programming language comes from the fact that it does not have rigid type checking (Soffar, 2019). An example for this would be that anyone can pass an integer value into a system demanding a floating point or decimal value. (Soffar, 2019). The (C) programming language is also commonly described as a procedure-oriented language in which the algorithms enforced are as a set of function calls (Soffar, 2019). Finally, the (C) programming language does not conduct Run Time Type Checking. It avoids this protocol by performing time type checking at the run time of the program (Soffar, 2019). The (C) programming language does not guarantee the correctness of the data type used and uses the alternative of performing automatic type conversion (Soffar, 2019). As with the added benefits of the (C) programming language not to mention its disadvantages, JavaScript also has some advantages and disadvantages (Soffar, 2019). JavaScript is first features interoperability by playing synchronously with other programming paradigms as it used in a multitude of applications (Guide.freecodecamp.org, 2019). Unlike PHP and SSI scripts, JavaScript can be placed into any web page with no regards to the file extension (Guide.freecodecamp.org, 2019). It can also be used within the writing of other programming paradigms, commonly Perl and PHP which are the main programming paradigms used in web development (Guide.freecodecamp.org, 2019). JavaScript has also been known to give special credit to Objects (Guide.freecodecamp.org, 2019). In JavaScript, Objects can exist in two different states (Guide.freecodecamp.org, 2019). Objects as General Containers, this is used in the case where a hash table is needed where the property to an object can be included at any one time (Guide.freecodecamp.org, 2019). This gives the authority for programmers to access different features in a variety of ways, like that dot(.) operator. (Guide.freecodecamp.org, 2019). Objects can also exist as unordered collections; this is typically when an object upholds the form of having both a Value pair and name (Guide.freecodecamp.org, 2019). Value Pairs can be of any type including objects (Guide.freecodecamp.org, 2019). This is an efficient and convenient approach to feature trees and records (Guide.freecodecamp.org, 2019). Every object in JavaScript can be compared to a small database somewhere (Guide.freecodecamp.org, 2019). Alongside, the variety of advantages that come with JavaScript, it also has a few disadvantages (Guide.freecodecamp.org, 2019). Firstly, with security tightening across all programming platforms, JavaScript and security is a bit of a hit and miss (Guide.freecodecamp.org, 2019). Due to the load and go delivery approach, JavaScript does not have a linker (Guide.freecodecamp.org, 2019). Therefore, computational units are all combined in a shared global space, which can cause a few security issues sometimes (Guide.freecodecamp.org, 2019). Lastly but most certainly not least, JavaScript has a rather slow bitwise operation, initiating the conversion between the operand 32-bit signed integer into a 64-bit decimal number (Guide.freecodecamp.org, 2019). This can sometimes cause accuracy problems in cases where JavaScript is used primarily is displaying a numerical output (Guide.freecodecamp.org, 2019).

2. OpenGL Software Library and APIs

Describe how the OpenGL library and its APIs hide the underlying complexity of graphics hardware and provide a high level and common interface across different systems for graphics programming.

Open Graphics Library or OpenGL for short is a blueprint describing both a cross language and podium API for creating programs that produce both 3D and 2D computer graphics too. The interactive platform has more than 250 contrasting function calls which are intended to illustrate advanced levels of 3D scenes from basic ogresses. In today's, most popular industry of creating video games, OpenGL and Direct3D have a head-to-head competition on Microsoft Windows platforms. OpenGL is commonly used in a multitude of applications such as CAD, Virtual and Augmented reality, Scientific Visualization, Information Visualization and most importantly Video Game Development (Computer Graphics, 2019). The new generation and upcoming graphics API's such as DirectX 12 and Vulkan will be of a decreased stage and come closer to a Graphics Processing Unit or GPU for short (Asawicki.info, 2019). As with most technological aspects including this one, it can be analyzed in greater depth using a simple illustration (Asawicki.info, 2019). The early times of simple computer graphics (like on Atari, Commodore 64), communications were primarily between the programs and their corresponding graphics hardware. (Asawicki.info, 2019). Secondly, as hardware and software are two components in any system that have a continuous evolution, operating systems have begun to suppress the direct communication of applications to hardware components (Asawicki.info, 2019). To the definition of standards had to be enabled to allows various devices and their applications to flood the market (Asawicki.info, 2019). Device drivers, however, appear as a separate layer (red rectangle) (Asawicki.info, 2019). This sentence can then be attributed to the second row of this illustration from the top (Asawicki.info, 2019). Furthermore, the Graphics API is like every other interface and is just a means of both standardized and documented communication definitive of its functions and all the other stuff that is used on the programs side and put enlace by the driver primarily. (Asawicki.info, 2019). The driver then translates these calls to specific commands to hardware devices (Asawicki.info, 2019). Besides, as the intensity and complexity of these games build up, it no longer becomes convenient to call the applications programming interface directly from the game logic code (Asawicki.info, 2019). Another layer is then added on the illustration as mentioned earlier represented by a yellow triangle called the game engine (Asawicki.info, 2019). It is a comprehensive and thorough library, providing and implementing in its graphical user interface higher lever objects such as (entity, asset, material, camera, light) using the previously mentioned Graphics API and some lower-level commands such as (mesh, texture and shader) (Asawicki.info, 2019). The above co-relates to the fourth row of the illustration as mentioned earlier (Asawicki.info, 2019). Finally, most triple-A game titles and game engines invariably over time become more complex, and there is a reduction in the manufacturing expenditure (Asawicki.info, 2019). Fewer game creation studios utilize their own engine technology and four on building upon pre-existence universal engines like (Unity and Unreal Engine) and focus on animating a seamless experience for avid gamers. (Asawicki.info, 2019). These game engines are now available for free with very attractive li-cense packages (Asawicki.info, 2019). This new trend affects most triple-A, indie and amateur game developers (Asawicki.info, 2019). Graphics and their corresponding drivers have become astonishingly complex over the years (Asawicki.info, 2019). Noticing it directly can be harder than expected but can be done by looking at the size of the installers (Asawicki.info, 2019). These drivers have large file sizes because they contain a multitude of graphics and music assets (Asawicki.info, 2019). They must implement all the different API's (DirectX 9, 10, 11, OpenGL) (Asawicki.info, 2019). Furthermore, these API's must have enabled, backward compatibility with previous generations and not necessarily reflect how modern GPUs work (Asawicki.info, 2019). This then means that additional logic is required to introduce some performance overhead (Asawicki.info, 2019).

Class 6: The Web

The sixth lecture concerns the world wide web: what it is, how it evolved and how it works. The web is ubiquitous and has become the fabric which connects almost everyone for business, education, healthcare, government and leisure. Thus it is important for everyone to understand the basics of how it works and how it is evolving. These questions concern current and new web technologies.

Please provide written answers to the following questions. Write a maximum of one page per question, plus references. Please provide well thought answers; use critical thinking and try to be insightful: do not just repeat the marketing hype from companies. Remember to correctly cite and reference all material you use (<http://www.citewrite.qut.edu.au/cite/>). Each question should have a list of references and in text citations

1. Site Technologies

Pick one of the following technologies and describe how it simplifies modern web site development: Angular, jQuery or Bootstrap.

When looking at web site development technologies, there are some that make web site development relatively easy and some that require a bit more effort to make the website presentable and publishable (Melville, 2019). The tech I have chosen to investigate further in the method of web-site development employing jQuery (Melville, 2019). jQuery in simple terms is a catalogue written in JavaScript, that is used primarily to clarify the front-end code that employs HTML (Melville, 2019). All the heavy work is carried out by jQuery making finding HTML elements simple and not to mention, rectify any cross-browser compatibility issues (Melville, 2019). Using ID tags with jQuery is possible, and one can just as easily use classes (or even selectors such as ": first" or ": hidden") to acquire elements (Melville, 2019). This is then followed by the "click" method to locate an event listener that responds to the user-clicking (or tapping the button), and the "toggle" method shows and hides the menu respectively when the button is selected (Melville, 2019). The simplicity of adding a button onto the webpage stems from the ability of merely including another element within the "button" class, and the jQuery selector \$('button') would locate and implement the click method to it instantaneously (Melville, 2019). The change of elements, from one to another, is also welcomed, with the presence of the code all in one location (Melville, 2019). jQuery provides for a more rapid pace development and creates code that functions on a broader range of web browsers (Melville, 2019). jQuery also has added benefits like allowing its library to be downloaded and thence parsed using raw JavaScript which can then lead to an outstanding boost in overall performance for some operations (Melville, 2019). In conclusion, the use of JQuery for website development has advantages that exceed its disadvantages. (Melville, 2019). In addition to the points mentioned above, jQuery has a multitude of other advantages such as being easy to integrate with the Visual Studio IDE (Melville, 2019). The jQuery library is integrated via the Manage NuGet file packages, a visual studio extension, dialogue box, is supported by Visual Studio 2010 (Melville, 2019). This then allows the "intellisense" feature of Visual Studio, providing developers unprecedented access to jQuery methods and syntax without leaving code view or do any further reading (Melville, 2019). Lastly, jQuery has been said to make web pages load faster (Melville, 2019). If your webpage originates from a strong base of HTML and CSS, uniform changes to your code can be made that would contribute to the reduction of system size (Melville, 2019). Unlike some other programming languages, jQuery and CSS files isolate their files from the actual web page (Melville, 2019). This then enables code developers to make modifications through one central code repository that would be reflected across the entire web page instead of searching through hundreds of folder structures (Melville, 2019). This feature has been an essential feature in CSS coding and most definitely is a proven success (Melville, 2019).

2. Web site scalability

Describe some techniques by which modern web sites can scale to handle thousands of concurrent users.

Most cases people don't even realize the amount of web traffic that is processed by web servers when people who visit specific webpages (HowStuffWorks, 2019). Web servers implement three different strategies to effectively and productively manage the load (HowStuffWorks, 2019). (1) The site could invest in a massive machine with amounts of processing power, random access memory, hard disk space, and most importantly redundancy if anything were to go wrong (HowStuffWorks, 2019). (2) The website can share the workload across several machines further reducing the load on every single device (HowStuffWorks, 2019). (3) The website can use a combination of the first two suggestions (HowStuffWorks, 2019). When a website is visited at any time of the day, typically a row of individual machines hosting a Web server software would be of the second approach at the front — the incoming requests for viewing web pages spread across all devices in mainly one of two ways (HowStuffWorks, 2019). The Domain Name Server (DNS) for a website ideally structure the load (HowStuffWorks, 2019). DNS is an internet service with the task of translating web domain names into IP addresses (HowStuffWorks, 2019). A Web server views a web page every time a request is made to it and immediately after the DNS rotates through IP addresses that are available hence, circularly to distribute the load (HowStuffWorks, 2019). Convenient access to all the web pages for that site would then be granted to these individual servers. Load balancing switches is also an option to distribute the load (HowStuffWorks, 2019). The Web site desired to be viewed at the Web servers for processing that then hands it over to one of the available servers (HowStuffWorks, 2019). The switch can then find out further which one of the servers has the least processing to complete so that they are all doing the same of work (HowStuffWorks, 2019). The load balancer distributes and divides the load amongst the three available web servers (HowStuffWorks, 2019). Anyone of the three can fail with no prior indication and no effect on site (HowStuffWorks, 2019). The benefits of this redundant approach are that the failure does not halt the workload and the other fully functional machines pick up where the first machine left off (HowStuffWorks, 2019). It also adds a certain amount of capacity incrementally (HowStuffWorks, 2019). The only downside of this process is that all these machines would have to communicate with a central database if any transaction or processing is going on (HowStuffWorks, 2019).

Class 7: Security

The seventh lecture concerns computer security at the operating system, network and hardware level. The more our world becomes connected and automated the more important computer security becomes. Computer security affects all aspects of computer systems. These questions investigate security technologies and how computer security is achieved in different contexts.

Please provide written answers to the following questions. Write a maximum of one page per question, plus references. Please provide well thought answers; use critical thinking and try to be insightful: do not just repeat the marketing hype from companies. Remember to correctly cite and reference all material you use (<http://www.citewrite.qut.edu.au/cite/>). Each question should have a list of references and in text citations

1. Mobile security

Describe two security issues affecting mobile devices and some proposed solutions.

As mobile devices continually advance with the times, there comes security issues and flaws. Written below are two commonly heard security flaws within the mobile device's ecosystem and some rectification suggestions (Selvarani, 2019). Firstly, Malware Attacks, Malware is a piece of software most widely masked by another useful third-party software application or program and passes into the mobile device undetected as a Trojan which appears to provide some significant functionality but instead contains a potentially harmful and malicious program (Selvarani, 2019). Within this category, there also exists another type of security flaw within the mobile device's platform called keystroke logging (Selvarani, 2019). Keystroke logging is another type of Malware that captures private and confidential information and sends to a cybercriminal's website or email address (Selvarani, 2019). Malware also includes viruses, spyware, and many others (Selvarani, 2019). Once these types of Malwares are installed, they can start a series of coordinated attacks from a remote or offsite location and multiply itself on other devices (Selvarani, 2019). The malicious applications can perform the following functions such as obtaining private and confidential information, starting random telephone calls, starting up the webcam present on most mobile devices these days, not to mention the microphone as well (Selvarani, 2019). Lastly, these malicious programs can also discretely record information and other malicious applications (Selvarani, 2019). Besides, Malware Attacks, with everything moving online, wireless attacks become a more common concern (Selvarani, 2019). Wireless attacks leverage the user's internet connectivity (Selvarani, 2019). When a mobile device's internet connectivity has been compromised, the method is most often subjected to eavesdropping and the extraction of private and personal information like account usernames and passwords (Selvarani, 2019). Wireless attacks can also render the unique hardware identification code (i.e., LAN MAC address) compromised by tracking and profiling the owner of that device (Selvarani, 2019). Malware most commonly makes full use of Bluetooth as a catalyst to speed up its movement (Selvarani, 2019). Prevention steps such as making sure that Wi-Fi, Bluetooth, and NFC Radios are switched off when not in use as this will reduce the mobile device's exposures to potential activities — besides that, ensuring that all mobile devices are configured with power on authentication to allow for minimal access if that device is lost or stolen (Selvarani, 2019). This could mean that a user purposely powers down his or her mobile device to avoid the complete drainage of the battery when the mobile device has limited power (Selvarani, 2019).

2. Firewalls

Describe ways in which different kinds of firewalls might help protect a university like QUT from various threats.

Firewalls are in existence to add a layer of security between the world wide web and its incoming and outgoing internet traffic (Cisco, 2019). There are many diverse firewall architectures in existence today (Cisco, 2019). Firewalls commonly described as the primary line of defense in network security has been put into practical use in almost every organization these days, like government organizations and educational organizations (Cisco, 2019). A Firewall can take the form of a physical piece of hardware, be in the form of an operating system or even both. (Cisco, 2019). Furthermore, there are many different and fundamentally distinct types of firewalls available such as Packet-filtering, Stateful inspection, Circuit-level gateways, Proxy and, Next-gen firewalls (Dosal, 2019). These firewalls each operate in their own way (Dosal, 2019). The Packet-filtering firewall creates a checkpoint at a traffic router or switch and is the longest standing and most essential form of firewall architecture (Dosal, 2019). The firewall scans the packets of data entering the router - inspecting and scrutinizing surface level information like destination and origin IP address, packet type, and port number without examining the data packet and its contents whilst the packet of data is open, instead this happens, when the packet of data is closed. (Dosal, 2019). If the data packet does not pass the inspection, it is prevented from reaching the end-user (Dosal, 2019). Secondly, there are Circuit Level gateways, this type of firewall endorses or rejects internet traffic without consuming a significant amount of computing resources and it does so with incredible speed (Dosal, 2019). Circuit level gateways operate by verification of the transmission control protocol (TCP) handshake which is designed to ensure the legitimacy of the data packet (Dosal, 2019). This is the primary reason for large organizations not only having Circuit level gateways as their only type of firewall (Dosal, 2019). Thirdly, there is the existence of Stateful Inspection Firewalls combine both packet inspection technology and TCP handshake protocol creating a more rigid security protection rather than just having one technology operating individually (Dosal, 2019). The downside, however, is that these two protocols combined take a toll on the computing resources which could hence slow down the rate at which data packets are transmitted and received (Dosal, 2019). The final type of firewalls is the proxy firewall or application-level gateways (Dosal, 2019). This operates as a filter layer between one's network and the traffic source (Dosal, 2019). A secure connection to the incoming traffic source and begins the rigorous process of inspecting the incoming data packet through the proxy firewall (Dosal, 2019). Deep-layer packet inspections may be performed during this period (Dosal, 2019). Only once the data packet has passed the security scan will it finally reach the client or user (Dosal, 2019). This only downside is that this type of firewall can create a significant drag in the processing time of webpages and files sent over the world wide web due to increased steps during the data packet transferal process (Dosal, 2019).

Class 8: Mobile, Cloud and the Internet of Things

The eight-lecture discussed how Moore's Law is giving rise to new classes of technology, including the cloud, mobile devices and the Internet of Things (IoT). These questions investigate different technologies associated with these computing systems.

Please provide written answers to the following questions. Write a maximum of one page per question, plus references. Please provide well thought answers; use critical thinking and try to be insightful: do not just repeat the marketing hype from companies. Remember to correctly cite and reference all material you use (<http://www.citewrite.qut.edu.au/cite/>). Each question should have a list of references and in text citations.

1. Cloud Operating Systems

Explain why new operating systems are required for cloud computing systems and the specific cloud support they provide.

An operating system programmed to functionally run on the cloud as well as various virtualization environments is called a Cloud Operating System (Techopedia.com, 2019). Various processes such as operation, execution and methods of Virtual Machines, Servers and other Infrastructure can be crucially managed alongside back-end hardware and software assets (Techopedia.com, 2019). Cloud computing is most defined as an operating system that offers a vast selection of applications was enabling users to complete simple tasks such as document writing, graph drawing or sketching and not to mention, class and program compilation (Techopedia.com, 2019). The cloud-based software is run on a software and requires a select type of operating system which supports a multitude of cloud features (Techopedia.com, 2019). The cloud can be perceived as a single computer with multiple instances (other networks) running at selected intervals of time (Techopedia.com, 2019). The first step would be going through the documentation for a single machine (instance) installation completing successfully (Techopedia.com, 2019). Most virtual machines instances implemented on cloud-based virtual machines run fully specked out operating systems that would those days be running on physical devices, e.g., Linux, Windows (Techopedia.com, 2019). The cloud operating system is a relatively modern type of software, created to respectively and holistically manage a massive amount of data from large infrastructures (Bhardhan and Singh, 2019). CPU's, storage, networking - as a logical, malleable and aggressive performing environment (Bhardhan and Singh, 2019). Unlike other universal physical machines, the cloud operating system accumulates all the data centre infrastructure to create a single compute instance whose resources can be quickly allocated, dynamically to any application that may require those resources (Bhardhan and Singh, 2019). Having a compute instance in the cloud is further supported by services such as infrastructure services that thoroughly virtualize the server, storage, and network resources and cumulatively channel them into a shared mainframe-like computing platform that is buoyant and perfectly capable of accomplishing the most demanding tasks with near-native performance (Bhardhan and Singh, 2019). Besides that, cloud operating systems are also given application services; these services provide built-in-service level controls to all applications (Bhardhan and Singh, 2019). Applications services can even further be broken down into availability services, security services, and scalability services (Bhardhan and Singh, 2019).

2. Internet of Things

Investigate and describe some of the changes necessary to conventional computer hardware, operating systems, networking or security to support the Internet of Things.

A topic that had made the center of discussion these days both in workplaces during working hours and outside workplaces, off working hours is the Internet of Things (IoT) (Morgan, 2019). Internet of Things are devices that have constant links to the Internet (and/or to each other) and includes every form of common household appliances such as cellphones, coffee machines, washing machines, headphones, lamps, wearable devices and almost everything else you can think of (Morgan, 2019). The communications between these devices and the internet are typically just one click of a button away (Morgan, 2019). The Internet of Things (IoT) concept applies to small components embedded within giant machines, for example, the jet engine attached to an airplane or the drill onboard an oil rig (Morgan, 2019).

In the IoT ecosystem, four main components must be considered ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). Firstly, Hardware and Software ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). As the diversity in devices and the multitude of protocols for receiving and transferring data increases (i.e., expands), the architecture must be modular so that specific hardware components and software programs can be replaced when at fault preventing the problem of having to re-design an entirely new solution ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019).

In addition, Network Connectivity, is key when having to deal with IoT products ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). Whilst IoT devices are diverse, they must still transmit and receive data packets through a medium with absolutely no flaws in security protocols ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). Some abstract principles assist here, parameters like location and the naming scheme of individual components are considered irrelevant ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). The entire system must be engineered for transparency ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019).

Moreover, there is also edge computing ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). Edge computing functions by allowing computed decisions made close to the point of data origin and / or collection as possible ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). Advantages, of having edge computing make calculated decisions include a vast increase in speed and reduction in network bandwidth ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). But edge computing has been known to stem from the basic principles of cloud computing too ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). An agile IoT architecture must be able to account for upcoming developments in hardware, software as well as networking ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019).

Lastly, comes Data management ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). Data requires a higher level and much more complex level of processing, and it also does not need immediate decision making that is often sent to data centers for analysis, insight and storage ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). The architecture for these systems stem from the flexibility it must support multiple environments ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). An example, an IoT device might need to communicate with ancient equipment and share connectivity information with an enterprise resource planning system based on the cloud ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019). To perform this action, the IoT architecture must be agile and be able to adapt to process and manage data from many contrasting sources ("Forbes Insights: 4 Reasons Why Architecting for Change Is Critical for IoT", 2019).

References for IFB102 Assignment

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