This week's research materials cover three themes fundamental to Computer Science: Algorithm Analysis, Algorithm Correctness, and Distributed Algorithms. Understanding these themes is critical to research, design, and implementation, particularly in the fields of network communication; failing to pay close attention results in costly mistakes that often require substantial sums of money and working hours to correct, while taking time at the onset to test, model, and debug will have the long-term benefit of less work later in the project. Several methods of algorithm design and testing seek to minimize errors, but the complexity of design, as well as increasingly small form factors and the overall number of devices, particularly in wireless network communications, result in an increasing likelihood that some bugs will slip by. Methods such as Formal Verification, which is slow, and Machine-checked Proofing exist to assist in the detection and elimination of bugs before they become an issue, but the tools will only work as well as those designing and using them. Distributed algorithms pose a special challenge because they exist concurrently on multiple processors or devices, and require point to point communication or access to these other devices. A distributed algorithm, or system, is modeled by an undirected graph G, where nodes or vertices denote each processor, device, or task, V, and the lines of communication are denoted by edges, or E. Any node, v, will have direct communication by means of the edge, e, with any other node it is adjacent to, but may experience a delay in communication were one node lacks a direct edge or line of communication to other nodes. In this case, think of computers exchanging email, the sending computer and the receiving computer have several layers, or even devices, between them. Each edge represents not only the line of communication, but also a step in the process by which the message is sent and received. Distributed algorithms have the advantage of reliability, speed, and economy of scale, yet still suffer from some inefficiency due to various factors such as processor design, operating environment, the "pace of operations", network or messaging hierarchy, and many other factors that are not easily modeled. Frankly, the best solutions are those that meet some, or most criteria for which they are designed. Any distributed algorithm must consider the graph depicting the process, and many subgraphs which denote individual processes taking place within each node. Even with each edge (as in the case with email, the traveling message must also pass through multiple servers, each with their own distributed algorithms. The true measure of time to complete any task in a distributed algorithm will be the sum of all tasks in the algorithm, plus the sum of all associated tasks that are a prerequisite to completion.

Richard Givens

Week 1

Inquiry 2

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I've looked thoroughly at the list of Hottest Topics in Computer Science, and it is hard to select any topic that applies to the activities of my company or profession.

I am a Product Manager for an AMD Graphics partner, and though it seems that any of these topics apply, our business model is such that we produce nothing, but merely rebrand the goods of other companies. We contract outside manufacturers to design and manufacture all our goods, and rely on a distributor model for business. Unfortunately, we have no "original products" or designs. My job entails many aspects of other professions, ranging from analysis and reporting of sales performance figures, to determining the wording of marketing materials from raw technical specifications.

While the applications of Computer Science are extremely limited in my current profession and company, my goal is to grow into a position where Computer Science is a vital part. My final project for my Bachelor's Degree is titled "Disruptive Technologies in Medicine," and discusses the uses of Virtual Reality, Augmented Reality, and 3D- Printing as they relate to healing both the mind and body. This topic is extremely interesting to me; I am a person that is fascinated by Science Fiction, particularly the Cyberpunk genre. I recall novels, movies, games, and comic books which address these topics. In these modern times, we are seeing cybernetic limbs, regained mobility through virtual reality simulations, and so many other wonderful advancements. It's astounding, beautiful, and frightening at the same time. As a world, we are on the cusp of fundamental changes to the world of medicine, the science of life, and how we will live.

These advancements cover many of the hot topics mentioned, from biomedical engineering/medicine, to the emerging technologies involving communication and sensing, as well as human-computer interaction, computer security, artificial intelligence, and robotics. At some point, there will be a gestalt of humankind and machine that is everyday normal for society. Our societies must prepare for the inevitable change, and the problems that arise. I believe the main issues we will face are societal, more of a conflict between the "haves" and the "have-nots." Those that can afford these new technologies will take advantage of them, and those that are too poor will be left to fend for themselves. I do not believe research alone will address any of these, but the benefits to the survivability of humankind outweigh the potential risks of a dystopian and black market society.

One of the recent concerns of medical technology centers on potential vulnerabilities to technology or computer based attacks. It sounds far-fetched now, but it is possible at some future point a 0day attack may exist which will exploit a potential vulnerability and adversely affect the health of a patient, or in a more unrealistic version, create a patient that is "super-augmented" such as forcing adrenaline into their system at key times, determined by a control of some sort. If you can overclock a computer processor to run faster, you can overclock an implant to do more than intended. Researching these vulnerabilities or exploits, and patching them, will be an absolute necessity.

Hopefully, we will move forward with caution, compassion, and diligence. Unfortunately, my previous experience in Law Enforcement tells me otherwise. Research will solve the technical aspects of problems, but that is only part of the equation.