

Abstract: Lecture Themes of Algorithm Analysis, Algorithm Correctness, and Distributed Algorithms

Computers were created for the purpose of innovation and making tasks simpler with automation. However, as technology advances, the complexities behind the scenes grow and challenge the possibilities of computers. Extensive research into algorithm analysis is conducted to test the extents of its potentials. In trying to find out the necessary amount of time, storage, etcetera to execute a certain program, there really is no method absolutely correct; there are limitations, assumptions made, and so many different perspectives the issue can be observed in. Many times, combinations of several methods together are applied to achieve the best results.

Bugs are expensive. Thankfully, testing phases have expanded and improved to a point just short of 100 percent of bugs are detected in the pre-silicon phase. The major player in allowing for this rate is formal verification. John Harrison describes how his company Intel combines the various traditional approaches along with even symbolic trajectory evaluation (STE) in order to break down the levels of verification and establish greater reliability in the mathematics. The more difficult sections are aided with the computers taking care of the tedious reasoning and applying the basic foundations of mathematical solutions as possible, and otherwise using the higher order logic (HOL) theorem prover to shape the system from an ideal model to actual, real-world programming.

The introduction of the distributed system to replace the centralized system greatly expanded the scope of communication and programming. However, distributed algorithms that run on these systems have a very complex setting. Nodes may be individual parts, yet they exist in an environment that requires high levels of coordination with other nodes. A look into sensor networks shows a more applicative model by looking at the various studies and measures of running time along with acknowledgements of the limitations of a specific principle. There are too many variances from an ideal that may occur, so to understand the complete picture of how distributed systems function, research will continue to be in the works.

Research-Based Approach in the Workplace

I have been in hospitality the majority of my career, and being in a customer support position means a lot of technology is involved to collaborate with humans or other devices. At ResortShare, which is a timeshare management company, our purpose is to help clients owning timeshares rent out their unused units by marketing to non-owners. In order to make these connections, the main tools were the computers which was used for its basic hardware setup and application software. Although our team works very well together with the current systems, there are still some setbacks within technology that can be looked into to improve the workflow. The databases we use can be simplified, security can be enhanced to further assure users of confidentiality, and communication can be better applied to our specific purposes.

With all of the different platforms and software applications that we use, when looking for a specific record, where do we begin to look? We have historical logs for reservation rates and onboarded clients in our databases. However, these are all in separate spaces in relation to the different reports created from the data for future yields, and no one really maintains or keeps them organized in the midst of all other duties. When pulling from separate locations to create various reports, the search time is long and effective use of the data is spoiled. Also, even if we were to combine the databases into an organized environment, how should we go about it so that the data is secure and never at risk of being lost? We may look into using a different type of database models, and utilizing atomicity to make sure all updates are done at the same time to receive the appropriately matching results to each subject.

We used to track our clients and reservations manually. This included counting how many were processed that day, how many clients responded to our program change flyers (sent out by snail mail), to even website page clicks. Now, to adapt to the times, our processes were updated to have Google Analytics count our website popularity ratings, and having platforms such as Salesforce keep our records organized. However, using these different tools means that we are exposing data about our company out to other parties. Along with conversion to more technological procedures, we had to make sure certain protocols were set in place for the security of our data. The basic firewalls we currently have in place can be strengthened. We may even want to consider extending our control over network-level security by creating strict limits on inbound transmissions for just a few open communication ports, and employing temporal reasoning algorithms and user activity monitoring to detect and prevent abnormal access to data. Extra support for personal privacy with highly effective encryption and tokenization for single data elements would ensure the protection of privacy and the integrity of personal and business-related information.

The way we process reservations and clients can always be improved so the more menial tasks are automated. However, there are some limitations towards the work around and programming of algorithms to create such a process. For example, being a third-party company, we have to work with and abide with the rules of another company's system. For example, we can only access their website during their set business hours. Picking up rooms was initially able to be done with a program we had created, but due to extra security measures taken by the main company (pop-ups verifying that the user is not a robot), we were unable to bypass it and had to go back to real humans collecting the inventory pieces. Our development team still tried to find a loophole in order to make our reservation team's process easier, but to no avail. Not only would this most likely involve a very complex computation to override, but may also be unlawful, so we abandoned this idea. Another example might be the way that room rates are calculated. The current algorithms behind the scenes need to be constantly updated along with new trends that we are finding, which is inefficient. Aspects of machine learning might be helpful in this case to have algorithms be able to develop and make decisions on data inputs rather than strictly follow mathematical formulas already set.

With technology, there is obviously a lot more that can be done, and with greater speeds than manual. However, there are risks associated that must also be taken into account for to make sure data is properly stored and protected. Research into improvements of the current systems used would definitely improve the quality of the information in the databases and how it is used.