**Exploring Uses for Algorithms**

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As more and more demanding algorithms are implemented into day to day life, research and analysis on faster algorithms becomes more important. Even the likes of sorting algorithms are receiving new, potentially more efficient solutions, and are part of the innumerable amount of algorithms made to benefit more from the use of technology in society. Not all of these algorithms are used for complete good though, such as algorithms that are unfairly biased towards certain social groups.

While new algorithms are being made and analyzed for new problems, old problems are also receiving new, more efficient solutions. Even proposals for new sorting algorithms are getting made. One such proposal presented at the International Conference on Future Networks and Communications (FNC) in August 2020 was the OneByOne (OBO) sort. In short, the algorithm compares the first element of an array with the rest, seeking out the smallest element, then swaps the position of the first element with that of the smallest element. The process then continues for the next element. According to the article, the OBO sort runs as it’s best-case complexity of O(n) when used on a sorted array and it’s average/worst-case complexity of O(n2) when the array is in reverse order, or when every element in the array is ordered except for the smallest as the final element. In comparison to other sorts, the OBO sort’s best case complexity is comparable to the bubble and insertion sort when used on a sorted array, and is faster than the selection sort. In regard to OBO’s average and worst case scenarios, it is less complex than the bubble and selection sorts, and about on par with the insertion sort. The OBO will still continue to see revisions, including testing on other data types and an attempt at reducing the amount of comparisons required.

Another fairly recent sorting algorithm that has been proposed is called Difference sorting (DFC), which has a complexity of O(n log n). The DFC sorts by seeking the largest value in an array, then takes the difference between the largest value and every element in the array, and then proceeds to seek out the biggest difference (stored in a separate array). The operand that provided the biggest difference is now the starting element of the array and the cycle repeats.

Researchers in Yale, Cornell and other universities are developing tools designed to help adults with autism get jobs. One of these tools is supposed to discern the specific “visual reasoning” abilities the user possesses (Olivia). The tool would include a test for the user with autism along with eye sensors and cameras. Based on the test and the data provided from the cameras and sensors, the ways in which the test problems were solved could be revealed; therefore, allowing one to figure out jobs that would be a good fit for the user. These researchers also aim to alleviate the social anxieties for people with autism by creating an “interview simulation” (Olivia). This simulation tracks the stress levels of the user as they perform the fake interview, and outputs data on the sources of the user’s anxiety. Part of the Yale team specifically is developing an AI made to ask the autistic user questions at times in which they are already preoccupied, and then it determines whether or not an appropriate response was formed; this is to help the user get better at addressing interruptions. The last major thing that these researchers are developing is a cooperative environment designed to force people with autism to work together on solving a common problem. This program is designed to give social advice and hints as the collaborative process goes on to help the user develop their team skills.

Algorithms are currently being used to varying extents in Canada to predict where crimes will occur. Some of the policing technologies in Canada are still in development, but one that is currently in use is Palantir’s Gotham. Gotham is used to create links between victims, witnesses, suspects, and places. The Saskatchewan Police Predictive Analytics Lab is developing algorithms that would use data given by police about previous offenders along with victims to make predictions of possible kidnappings. This algorithm is mainly targeted at catching “repeat and violent offenders” (Munn).

Especially recently, algorithmic bias has been put under the spotlight. As AI becomes increasingly popular and the use of algorithms to push the automation of jobs has been massively encouraged, it is important to realize that algorithms are only as good as the people who make them and that they have the same inherent biases that everyday people do. For example, Amazon was using machine learning to hire managers and used resumes from the past ten years where 74 percent of the positions were held by men. Because of this, the algorithm essentially favored those who had “man” on their resume and penalized those who had “woman” on their resume (Dastin). Similarly, the algorithms used for facial recognition software made by Microsoft and IBM only had upwards of a 0.8 percent margin of error for all light-skinned men. This margin of error for darker skinned women was 20 percent in one case and 34 percent or more in other cases. “The data set used to assess its performance was more than 77 percent male and more than 83 percent white” (Hardesty). Fixing this issue has been sensitive and difficult. In some cases, algorithms are not able to view sensitive attributes so as to protect a candidate’s privacy. “Similarly, a job-matching algorithm may not receive the gender field as an input, but it may produce different match scores for two resumes that differ only in the substitution of the name “Mary” for “Mark” because the algorithm is trained to make these distinctions over time” (Barton *et al*.).

There are many causes for these inherent biases being implemented in algorithms, such as historical and systemic biases or a lack of consideration from those who make them. It is important to recognize these mistakes and fix them to allow and maintain equal access to newer technologies and to generally improve the algorithms that are behind them. Even when the results of inherent biases are involuntary, they can have lasting effects on certain communities when not addressed. Because of this—and the recent emergence of AI—the Organization for Economic Cooperation and Development (OECD) and the European Union (EU) have each come up with their own set of guidelines to mitigate algorithmic bias in AI. Both include transparency—which focuses on how decisions are made, diversity policies, fairness, and accountability (“Artificial Intelligence in Society” and “Ethics guidelines”). Despite these measures, it still remains a difficult question of how to gauge fairness. Due to the fact that there is no simple way to do so, companies that produce these technologies, and therefore the algorithms, must put extra research in to assist in avoiding biases. Naturally, companies also must avoid violating anti-discrimination laws, which provides some basis (although nowhere near perfect) of fairness.

Furthermore, there are general ideas that exist that could further serve to avoid algorithmic biases. The AINow Institute has guidelines that require an “algorithmic impact assessment process” that “draw directly from impact assessment frameworks in environmental protection, data protection, privacy, and human rights policy domains” (Crawford *et al.*). These assessments are scrutinized internally, externally, and by public audiences. Unfortunately, even this is not infallible, as the multiple audiences assessing an algorithm may still not account for all biases. Rather, Lee, Resnick, and Barton all suggest that laws and the practices of AINow should solely be used as a starting point, and that stakeholders should be engaged, the teams creating the algorithms should have diversity, and that there should be a bias impact statement template in which a group must determine whether or not the algorithm is biased (Barton *et al.*). As the depth and usage of algorithms expands, it is beyond important to recognize inherent biases and constantly check for those that would negatively affect others. Analyzing these key issues within algorithms and continuing to create frameworks and policies to prevent these biases will help these algorithms become more accurate and fairer over time, allowing for equal opportunities in technology usage and lessening overall algorithmic discrimination.

Algorithms are pertinent in our day-to-day lives, and are usually made to make people’s lives better. Life can be busy, but it should not be busy because of waiting on algorithms to do their jobs; as such, newer more efficient algorithms should always be sought after. They work behind the scenes in almost every single field, including in extremely important and life-saving technologies. They have been used to assist those with autism in finding jobs that are a good fit for them, in predicting and preventing crimes in multiple countries, and new ones are constantly being discovered to assist the growth of machine learning and usage. They are, however, not without fault—algorithmic bias plays a large role in how algorithms are analyzed now and in the future to help lessen and eventually eliminate prejudices. Studying and analyzing algorithms not only ensures the efficiency of our programs, but allows the future of technology to be fair and allows for groundbreaking technology to evolve and get better.

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