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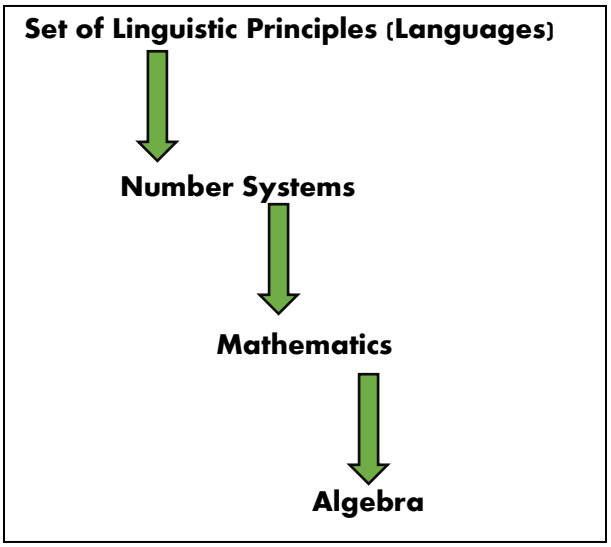
Problem Solving: The Computer Science Approach

When you think of numbers, you may be inclined to think of "mathematics", or "algebra". However, many may not realize that algebra is derived from mathematics – and mathematics is a sublanguage derived from numbers, and even further, a number system is derived from the overarching class of "languages".



In fact, mathematics is defined as "*the science of numbers* and their operations, interrelations, combinations, generalizations, and abstractions [as it relates to space and time and the physical world of measurement]" (Merriam-Webster Dictionary). But why mention all of these categories and subcategories? It is because of the nature of how we describe the world around us in so many different forms. All forms of description that are used for analysis of the world around us – whether it be numbers, words, pictures, or even other languages – arise from some set of linguistic principles: a language; and it is these very principles that we use to define the relationships found in nature, so that we can make use of them. Think about it: you are reading this essay by using the English language and its linguistic principles in order to capture the description of the message being conveyed here. Linguistic principles are key; they create a standard and allow the alphabet

(elements) of a language to form words or operations. These language standards are what allow us to build one layer of complexity atop another, including building new languages from other, lower-level languages. For example, before one can learn anything about the world of mathematics, they must first have some grasp of at least one numbering system. Without language, we would not be able to abstract simple or complicated ideas, and most importantly we would not be able to communicate about the real world; thus, we would not be able to solve problems.

The field of Computer Science captures the practicality of linguistic principles quite powerfully in a way very unique and distinguished from any other field of study. In fact, computer scientist study language systems called “finite automaton” and “Turing machines”, which are logical language machines used to solve a set of problems. These machines translate to the design of computers, which are in essence calculators. However, there is a caveat – some problems cannot be reasonably solved by computers because there is not a sufficient language (or algorithm) that a computer can execute in a more finite time frame. These classes of problems belong to the still-relevant million-dollar question of Computer Science: is P = NP? But this is beyond the scope of this discussion (Baugh, 2021).

Of course, many fields of study have some overlap in their “linguistic principles”, for instance, computer science and biology both use mathematics (another language!). Perhaps, computer science is so powerful because it seamlessly combines the enormity of power in the subjects of mathematics and electrical circuits (and thus all the advantages of the phenomena of electricity) – two of the most powerful languages for describing our world. In fact, nearly all other fields of study rely on and integrate the field of computer science for their enhanced application and continued development. It is actually very difficult to discuss any field at a

certain depth without unavoidably including the unignorable computer science aspect that handles all of the numbers involved; computer science relies exclusively on data – i.e. numbers and mathematics – and thus harnesses the power of the numerical relationships we discover that only a computer could feasibly calculate for us to make use of it.

Now that you have some grasp of the importance of language, let us transition to a current-day problem that can be solved by various approaches of different fields of study. This will demonstrate how computer science is very unique, powerful, and unavoidable in comparison to other fields. It is important to keep in mind that a field of study can be representative of a highly complex, abstracted language that the respective expert user implements in order to describe the world and approach solving a problem.

So, take for example the problem of the worldwide Covid-19 virus. The conversation around this virus continues to be the most dominating subject and it has been over one year now. The real problem from the beginning of its discovery stood in the fact that a new sickness that could potentially threaten the lives of the general public in a devastating parade was apparently on the rise. Many experts in their respective fields would have to make some decisions about how and why they would use their expertise to influence some outcome for some purpose: from pharmaceutical experts, practicing and non-practicing doctors of medicine, nurses, epidemiologists, immunologists, virologists, geneticists, data scientists (and the likes of their inseparable relationship to computer scientists), all the way down to unelected public health experts and officials, politicians, journalists, advertising agencies, and all forms of media experts who specialize in capturing millions of users attention every second such as Facebook and Twitter, and other forms of commercial advertising expertise. The point is not to make this a

journalistic discussion, it is simply to point out how so many fields of study came immediately into play and would influence various outcomes to a proposed problem.

It is important to note, however, that this problem is one to which there is no easy, definitive answer; many fields come up with contrasting solutions such as the effectivity of masks and lockdowns, and it is not necessarily a matter of misinformation or bad influence. But objecting ideas and differing conclusions from within the same field or from different fields are nothing new; in fact, it is was drives the development to the best possible solution. This excerpt captures this key idea perfectly:

> A plausible objection to the argument we are making that opposing ideas need to be heard is that, by giving false equivalence to incorrect ideas, lives may be lost. Scientists who are incorrect or misguided, or who misinterpret data, might wrongly persuade others, causing more to die when salutatory actions are rejected or delayed. While we are sympathetic to this view, there are many uncertainties as to the best course of action. More lives may be lost by suppressing or ignoring alternate perspectives, some of which may at least in part ultimately prove correct (Flier, Jeffrey, et al., 2020).

Also noteworthy is the principle that experts their respective fields (including the same field) could make erroneous applications as a solution to a problem. This is yet another reason why disagreement is necessary and healthy, and frankly, should be expected. There should always be some level of non-consensus. All areas of study are only useful insofar as to their ability to be accurately applied to the real world.

So, what was the proposed solution to Covid-19? Let us focus on three approaches made to the problem: The computer science (data science with modeling) approach, the political science approach, and the journalistic-media approach. Some of these approaches will no doubt have some overlap with other fields of approach. Beginning with the political science approach, these include all actions taken by government officials, including public health officials. Focusing the on the US government, most states largely mandated masks, and locked everyone down, ordering the rather arbitrary definition of "non-essential workers" to stay home. They claimed that we must "flatten the curve" in order to save lives based on the dramatic steep curve modeled by the Imperial College model headed by Neal Ferguson's team (Reynolds, 2021).

This is the perfect bridge to the computer science approach – the use of statistical data science models which rely exclusively on computers. Although Neal Ferguson and his team used statistical models that were relying on very new, rapidly changing data about the virus, nonetheless, Dr. Anthony Fauci, the head of the US Centers for Disease Control used this graph in a White House press briefing on national television as his rationale for why the government responses should be that of widespread uniform lockdown (Reynolds, 2021). Now that we have more data, the computer science field has proven to more accurately model US deaths. With the computer science field and political science field at play, this is the part where the journalistic-media gets eagerly involved to propose *their* solution.

For this field, they propose that the solution to the Covid-19 problem is to continuously, unabashedly, and unwaveringly report on everything possible about the virus. However, the primary mainstream outlets decided that the worst-case scenario was the best thing to report on, and so they constantly reached for and reported on virus data, symptoms, sad and rare stories that eventually appeared to be common because of the extensive reporting that people absorbed while

being locked at home. In doing this, it no doubt instilled fear and panic to the general public, causing many people to “panic buy” at the grocery store. Platforms like YouTube, Google, Facebook, and Twitter used their media platform to sensor people; their approach to silence whomever they deemed to be “misinformation” – even if it were a group of experts who raise genuine, scientific concerns about the overall approach to the problem that the government was enforcing (Niemiec, 2020).

Overall, there is a key principle that can be gathered from the Covid-19 problem, which serves as a perfect universal example as to how many fields approach the same proposed problem. It was demonstrated that even the computer science field can fall short, as any field can, when it is applied inaccurately or inertly. Going back to the first topic, the virus situation also demonstrates how powerful language can be with its communication; many solutions were proposed to the Covid-19 problem, and they were communicated through various forms of languages that essentially give an output for a solution to a problem.

In conclusion, this report may seem to have taken a dramatic turn, but it was on purpose. How did we get from discussing languages, to discussing computer science, to discussing a worldwide virus? It is because all of it relates to how we communicate with the world around us, and how we respond based on some linguistic framework. Think about it: information from various expert fields traveled around the world in the year 2020 about a tiny little virus. There is no way that a single article of information could travel and inform an outcome if it were not for the many languages that aid us, and that build on and complement each other to convey some overarching idea.

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