SMACK: when research in algorithms goes around in circles

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Abstract

We take a particle physicist's approach to the design and analysis of algorithms. We propose a theory of algorithmic interaction and present SMACK, a system for high-energy collision of algorithms using a national-scale accelerator.

1 Introduction

It is well known that researchers in algorithms often write papers by taking two absurdly complicated algorithms that no one will implement for two problems that no one cares about, and then combine them into an even more absurdly complicated algorithm for yet another problem that no one cares about.

In this paper we devise a Theory of Algorithmic Interaction in an attempt to understand and model this process, and using that, describe a system (SMACK) whose high-luminosity collision events will facilitate the search for new algorithms.

2 Theory of Algorithmic Interaction

We postulate the existence of a Standard Model of Fundamental Algorithms, whose composite states make up the rich zoo of algorithmic particles observable today. These fundamental building blocks, called Quirks, exist in many flavors. Many of these are familiar to those who have taken an undergraduate-level course in algorithms. Basic examples include Brute-Force and Divide-and-Conquer. Some composite particles familiar to most include Dynamic Programming and Linear Programming. We propose that almost all algorithms can be understood as the bound state of several quirks, and we have moreover found that the size of the composite algorithm appears to be unbounded, as they themselves are allowed to bind and form a larger algorithm. This proposition is shown to be true by choosing three algorithms at random[1] and verifying for these individual cases.

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[1] You will never be able to prove that the randomness was neither uniform nor independent.

- In 1996, Chan [2] combined the Convex Hull algorithms of Preparata and Hong [9] and Kirkpatrick and Seidel [8] into a new, faster algorithm for Convex Hull. We note that all of these algorithms are, in effect, Divide-and-Conquer algorithms. This shows that interaction between nontrivial instances of Divide-and-Conquer can produce even more complicated Divide-and-Conquer algorithms.

- More recently, Chekuri and Quanrud [3] combined an algorithm of Cunningham for Matroid Intersection [4] and an algorithm by Duan and Pettie for Maximum Weight Matching [5] into an algorithm for Maximum Weight Matroid Intersection. Cunningham's algorithm is a variant on Augmenting Paths; Duan and Pettie's work is an example of the technique of Scaling.

- The previously mentioned paper is an improvement on an earlier algorithm by Huang et al. [7] for the same problem, which instead combines Cunningham's algorithm with a technique of Frank [6], which also employs Scaling.

Under our theory, when two algorithms interact and form a bound state, a new and more efficient algorithm is created and energy is released in the form of computing resources. The interaction is mediated by the Big-Oh Obliteration gauge boson and appears to be coupled to sources of coffee, graduate students, and glaring advisors–though the precise coupling mechanism remains unknown. The Lagrangian for this theory, which determines the dynamics of algorithmic interaction is given by

$$\mathcal{L}_{\text{algo}} = \bar{\phi}_a(i(\gamma^\mu D_\mu)_{ab} - \delta_{ab}m)\phi_b - B^a_{\mu\nu}B^{\mu\nu}_a \tag{1}$$

Where ϕ is the field, a function of Space-Time [complexity], generated by the algorithm. γ^μ and D_μ are the spinor representation and covariant derivative, respectively, derived from the metric generated by Minkowski PSPACE-PTIME. m is a parameter denoting how confusing the interacting algorithms are, and $B^a_{\mu\nu}$ is the field strength tensor of the Big-Oh Obliteration field.

The computing energy produced from the creation of the daughter algorithm is typically radiated in quantized factors of $\log\log(n)$. In general, the daughter algorithm is unphysical and has a very short lifetime, typically decaying into a conference publication particle and (one hopes) a less efficient but actually implementable derivative, which then go their separate ways and never interact again. In most instances, composite algorithms have been observed to decay into only conference publications with no industry implementation particles to be found; this is known as the Missing Application Problem. Inspired by Wolfgang Pauli's proposal of the electron neutrino in 1930 [1], we speculate that industry implementations are produced but are too useless to be detected.

We further note that the Standard Model as it stands currently is incomplete, as there are many algorithms where no one appears to understand how they work.

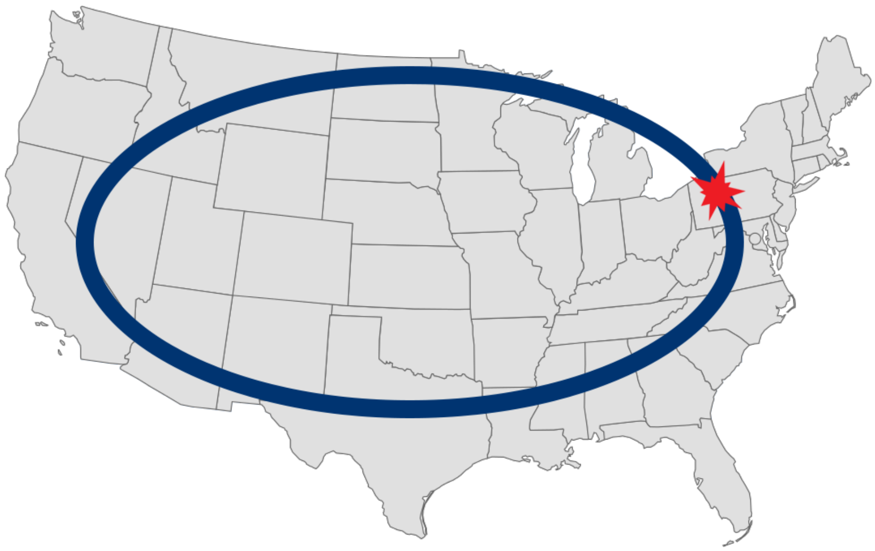

Figure 1: A detailed map of the SMACK apparatus[4], with a final collision site located in the vicinity of Carnegie Mellon University[5].

3 The SMACK system

To study and optimize the algorithmic interaction process, we have designed a high-luminosity algorithmic collider to maximize the production rate of new algorithms in the field and also to further the understanding of algorithmic interaction theory. The collider is split into two main components: the acceleration apparatus which prepares algorithm beams for interaction, and detectors at the interaction site.

The Super Magnificent Algorithm Collider Kontraption (SMACK) accelerates and refines two beams of algorithmic particles by injecting them into a circular track, where they complete three orbits before they are allowed to intersect. Figure 1 shows a map of the collider. Each beam passes through several acceleration cavities located at major research universities across the country, where on its first orbit it is allowed to interact with graduate students, on the second with postdocs, and on the third with research faculty. During each of these interactions, the algorithm beam is purified and excess factors of $\log\log(n)$ are radiated off along with caffeine and grant money.

We observed that this interaction sometimes generates Thesis or Grant Proposal particles, but they are kept separate from the main beam and not included in the analysis. We will refer to this circular track and its acceleration apparatus as the Tenure Track, due to its excessive length and tendency to push its

[4]Map of US from `https://commons.wikimedia.org/wiki/File:Blank_US_Map.svg`
[5]We reserve credit for the next algorithms paper that comes out of there.

contents to extreme standards of speed and efficiency.

The two algorithm beams interact at the collision site via the Big-Oh Obliteration Mechanism (BOOM) described above, mediated by the corresponding Big-Oh Obliterating Boson (BOOB). At the site of interaction, two detectors, FAME and FORTUNE, are placed to collect and analyze data on the algorithms produced by the collision.

The FAME detector, containing ultra-high precision citation calorimeters, is used to collect information on citation potential of the new algorithms once publication decay particles are incident upon it. Due to the high luminosity of this collider, unmanageably large amounts of data are generated by this experiment, and the detector employs a trigger system to filter out third-tier conference material. For collision events that pass the trigger threshold, the FAME detector computes its coupling strength to major research journals and automatically allocates grunt work to facilitate the paper-writing process.

The FORTUNE detector is optimized to detect potential for money of the collision events, and is split into industry funding and grant funding sectors. Since this experiment has reported significantly fewer events, a trigger system is not needed. As soon as FORTUNE the detector records a collision event with the remote hope of an industry application, the coupling strengths between the algorithm and major tech corporations are computed. The results are then sent to all companies with a non-zero coupling as well as government agencies along with a desperate plea for funding.

4 Experiments and Results

As a preliminary test, we injected Recursive Backtracking and Memoization into a miniature low-energy version of the collider, which simply made a few turns through the nearest undergraduate population. After a few trial runs, the miniature collider produced the composite Dynamic Programming along with a few auxiliary Extra-Credit particles, as expected.

For a full trial run, we took the algorithms from past proceedings of various Theoretical Computer Science conferences and injected them into SMACK. Measurements at the FAME detector showed high-energy interactions in various locations, including Carnegie Mellon University, the University of Texas at Austin, and the University of Waterloo. Unfortunately, we have not yet been able to access the produced algorithms. With any luck, the decayed publications will appear relatively soon on ArXiv[6] or in publication[7]. Furthermore, the FORTUNE detector has yet to record any events generated from this experiment.

[6] At which point we will be able to claim proper credit for them.

[7] In which case we will still try.

5 Conclusions and Future Work

We proposed a Theory of Algorithmic Interaction in the way of a Standard Model of Fundamental Algorithms, and gave experimental evidence to its existence. Of utmost importance is finding more experimental evidence, as well as deriving theoretical predictions based on this model.

As mentioned in the Theory section, the Missing Application Problem and the search for Useless Implementations (UI) of composite algorithms represents for Algorithmic Interaction Theory a large patch of uncharted waters, and more and more researchers have moved to the rich and exciting field of these Hopeless and Counterproductive Implementations (HCI).

As far as we can tell, SMACK works as designed. Unfortunately, retrieving the produced algorithms in time to take credit for their creation remains a problem. In general, finding new ways to optimize SMACK would also allow for a greater volume of algorithms to be produced. For the moment, we welcome and encourage research institutions around the nation to voluntarily credit us with all the algorithmic results they have produced within the past decade.

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