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Feynman Integral Reductions Via Priority Function

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Feynman integrals are central to scattering amplitudes and precision collider physics, yet their evaluation is often bottlenecked by the combinatorial complexity of integration-by-parts (IBP) reductions. There has been quite rapid progress in recent years, with developments such as finite field techniques, symbolic reduction rules, syzygies, intersection theory, improved seeding, and various combinations of them.
In this talk, we present a new reduction method based on a priority function. The goal of this method is to reduce the number of required seeding integrals and thus accelerate the computations. An effective priority function can be determined for specific integral topologies using AI techniques—specifically, we used Genetic Algorithms and Large Language Models—or by human heuristics, or a combination of AI and human input. We found that some priority functions work well for specific topologies but not for others, while some work relatively well for many topologies, including those with a large number of loops. In some examples, the number of seeding integrals is reduced by a factor of 3000, showing the potential of the priority function method.

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