Take AIM

Smith institute


# Accurate answers from imprecise calculations

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When asking questions, you usually want answers that are as accurate as possible. Nonetheless, less accurate answers can be desirable if they're produced faster. However, must we always compromise accuracy for speed?

Estimating the properties of systems influenced by randomness is commonplace, e.g. in weather forecasting, predicting stock markets, and recognising speech amongst background noise. A typical solution is to run computer simulations, and quote the behaviour seen on average. Unfortunately, to increase an estimate's accuracy we use higher precision and costlier simulations. Counterintuitively, low-precision simulations can remedy this.

Reducing the precision of individual computations, we recover high-accuracy estimates for the average behaviour by simply aggregating over more simulations, where the lower precision gives greater speed. Our research investigates optimal ways of increasing speed while limiting the impact on accuracy, ultimately recovering high-accuracy answers by utilising vast numbers of imprecise calculations. When constructing anything reliant on simulations, this approach opposes the traditional dogma, instead advocating the ethos: "high-accuracy by extensive use of low-precision computations".

This simple idea can impact both science and industry, influencing finance, weather prediction, and artificial intelligence. Huge cloud-computing centres can save time and money using these reduced-precision calculations, facilitating accurate real-time weather forecasting. Additionally, smaller and simpler devices, such as smartphones, can run applications faster with reduced power consumption, giving longer battery lives!

The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the TakeAIM competition in 2018 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to undergraduate and postgraduate students working in the mathematical sciences. First prize was £1,250 of Apple vouchers, with nine runners-up each receiving £100 of Amazon vouchers.