Perhaps the most significant astronomical discovery of our lifetimes, code-named GW170817, involved the collision of two incredibly dense dead stars called neutron stars. Notably the collision was detected both by gravitational wave observatories (including LIGO), and by traditional telescopes (that detect light). Crudely speaking, these stars are like gigantic atomic nuclei, and this "multimessenger" collision alone has shed new insights into how matter and gravity behave at their most extreme, far beyond what we can study in laboratories on Earth. Largely our new insights come from comparing observations against theoretical models that are severely limited in both quality and quantity. There is therefore a critical need to improve existing theoretical models of colliding neutron stars and black holes. Such improvements are very challenging, as our most detailed models are supercomputer simulations that generate full, non-perturbative solutions of the general relativistic field equations (numerical relativity).

After a gentle introduction to multimessenger astrophysics and the challenges associated with multimessenger source modeling, I will outline a new approach aimed at greatly reducing the cost of these simulations. With the reduced cost comes the potential to both perform colliding black hole simulations on the consumer-grade desktop computer, as well as add unprecedented levels of physical realism to colliding neutron star supercomputer simulations.