The Inverse Beta Decay reactions in a water-Cherenkov neutrino detector produce a variety of complex signatures in the detector. To model these processes, Monte-Carlo simulations are employed to understand the probabilities of observing certain detector signals given neutrino parameters such as event vertex, direction and energy. Once the detector is operational, we aim to understand the opposite: the relative probabilities of competing neutrino event hypotheses given an observed detector signal. To accomplish this task, we propose generating likelihoods using HITMAN, which utilizes neural ratio estimators and an analytic decomposition of the likelihood using the extended maximum likelihood method. In this talk, we explore this deep learning technique and its applicability for reconstruction of low-energy antineutrino inverse beta decay events in these detectors. Of particular interest is studying the resolutions of Eos, a small prototype antineutrino detector with a target medium comprised of a mixture of water and scintillating material. Beyond neutrino physics, this technique can find utility where Bayesian analysis of a model is required for a system where a forward simulation exists.