The online advertising industry is a rich environment for novel mathematical problems at the intersection of technology and theory. After introducing myself, AppNexus, and how I came to have my role there after having studied differential geometry and general relativity at UW (PhD '08), I'll give an overview of the online advertising ecosystem, including both Class 1 and RTB (real-time bidding) mechanisms, and sketch a few of the interesting "data science" problems we encounter at AppNexus, including buy-side and sell-side optimizations, fraud detection, and marketplace design. The theoretically optimal bidding strategy for the direct-response advertising in a second-price auction setting is particularly elegant; I'll discuss some details of how AppNexus implements it in practice as well as a recent mathematical innovation to help solve the "boiling the ocean" problem.