The 1985 IEEE standard for floating-point arithmetic brought much needed order to computer arithmetic, and for the next 30 years virtually every computer adhered to it. In the last five years or so, new hardware designed for machine learning has been introduced that offers fast mixed precision “matrix multiply-accumulate” operations, thereby complicating the picture. We discuss the mathematical aspects of the current floating-point landscape. In particular, we explain how recent probabilistic error analysis is providing new understanding of accuracy, why stochastic rounding can be beneficial, and how low precision arithmetic can be exploited to deliver accurate results more quickly.