Floating-point computations produce approximate results, possibly leading to inaccuracy and reproducibility problems. For longer runs with a high number of computations, the inaccuracy of floating-point could change the outcome. We performed a comprehensive study of trade-offs between accuracy and performance on modern graphics processing units (GPUs) which is missing. From our analysis we conclude that higher precision is slower on NVidia GPUs and performance is dependent on arithmetic intensity and degree of multithreading. As a result of this analysis, for applications like machine learning which tolerate slight accuracy variations, we built a tool which automatically selects the floating-point precision of the operations in a GPU program leading to better performance and accuracy tradeoffs.