Algorithm 1

Require: A quantum algorithm A such that $Var(\nu(A)) \leq \sigma^2$ for some known σ, an accuracy ϵ such that $\epsilon < 4\sigma$.

Ensure: An estimate of $\mathbb{E}[\nu(A)]$.

1: Set $A' = A/\sigma$.
2: Run A' once and let $\widetilde{m}$ be the output.
3: Let B be the algorithm produced by executing A' and subtracting $\widetilde{m}$.
4: Apply algorithm 2 to algorithms $-B_{<0}/4$ and $B_{\geq 0}/4$ with accuracy $\epsilon/(32\sigma)$ and failure probability $1/9$, to produce estimates $\widetilde{\mu}^-$, $\widetilde{\mu}^+$ of $\mathbb{E}[\nu(-B_{<0}/4)]$ and $\mathbb{E}[\nu(B_{\geq 0}/4)]$, respectively.
5: Set $\widetilde{\mu} = \widetilde{m} - 4\widetilde{\mu}^- + 4\widetilde{\mu}^+$.
6: Output $\sigma\widetilde{\mu}$.