Problem 1 (Tightness of Advanced Composition). Recall that the advanced composition theorem says that composing $k$ copies of an $(\epsilon, 0)$-differentially private algorithm satisfies $(1, \delta)$-differential privacy as long as $k \leq 1/(8\epsilon^2 \log(1/\delta))$. Show that for some choice of $k = \tilde{O}(1/\epsilon^2)$, composing $k$ copies of an $(\epsilon, 0)$-differentially private algorithm does not satisfy $(1, 1/10)$-differential privacy.

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$f(x) = \tilde{O}(g(x))$ means that $f(x) = g(x) \cdot \text{polylog}(g(x))$. The polylog factor is not actually necessary in this problem but may come up depending on how you solve the problem.