# CSDS 440: Assignment 4

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## Problem 17

*Proof.* To prove by contradiction. Assume we have a local minimum $x$ in a convex function $f$ but there is another global minimum $x'$, where $f(x') < f(x)$.

Since $f$ is convex, by Jensen's inequality we must have:

$$\begin{aligned} f(\lambda x + (1-\lambda)x') &\leq \lambda f(x) + (1-\lambda) f(x') \\ &< \lambda f(x) + (1-\lambda) f(x) \\ &< f(x) \end{aligned}$$

Let $\lambda = 1$, we will have the below contradiction:

$$f(x) < f(x)$$

Thus, by contradiction, the local minimum of a convex function is always the global minimum.

□