For each natural number $n$ and each number $x$ in $(-1,1)$, define

$$f\_{n}\left(x\right)=\sqrt{x^{2}+\frac{1}{n}}$$

and define $f\left(x\right)=|x|$. Prove that the sequence $\{f\_{n}\}$ converges uniformly on the open interval $(-1,1)$ to the function $f$. Check that each function $f\_{n}$ is continuously differentiable, whereas the limit function $f$ is not differentiable at $x=0$.