

If $|f_N(x) - f(x)| < \frac{\epsilon_1}{2}$, then we have the following

$$-\frac{\epsilon_1}{2} < f(x) - f_N(x) < \frac{\epsilon_1}{2}$$

$$-\frac{\epsilon_1}{2} + f_N(x) < f(x) < \frac{\epsilon_1}{2} + f_N(x)$$

$$-\frac{\epsilon_1}{2} - |f_N(x)| \leq -\frac{\epsilon_1}{2} + f_N(x) < f(x) < \frac{\epsilon_1}{2} + f_N(x) \leq \frac{\epsilon_1}{2} + |f_N(x)|$$

$$\text{So, } |f(x)| < \left| |f_N(x)| + \frac{\epsilon_1}{2} \right| = |f_N(x)| + \frac{\epsilon_1}{2}$$