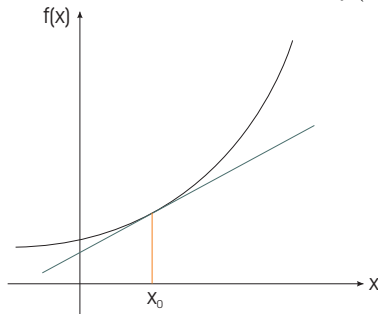


### 3.5 Taylor series and their application

We have a "normal" function  $f(x)$



$$f(x) \approx f(x_0) + (x - x_0)f'(x) \rightarrow \text{linear approximation!!}$$

Approximation of this function by a power series:

$$\begin{aligned} f(x) &= f(x_0) + \frac{1}{1!}(x - x_0)f'(x_0) + \frac{1}{2!}(x - x_0)^2 f''(x_0) + \dots + \frac{1}{n!}(x - x_0)^n f^n(x_0) + \dots \\ &= \sum_{n=0}^{\infty} \frac{1}{n!}(x - x_0)^n f^n(x_0) \quad \text{Taylor Series around the point } x_0 \\ \Rightarrow f(x) &\approx f(x_0) + (x - x_0)f'(x_0) + O((x - x_0)^2) \quad \text{linear approximation} \\ f(x) &\approx f(x_0) + (x - x_0)f'(x_0) + \frac{1}{2}(x - x_0)^2 f''(x_0) \quad \text{quadratic approximation} \\ \Rightarrow &\text{two most important approximations in physics because:} \end{aligned}$$

Potential:

