Numerical Integrals

ME EN 275
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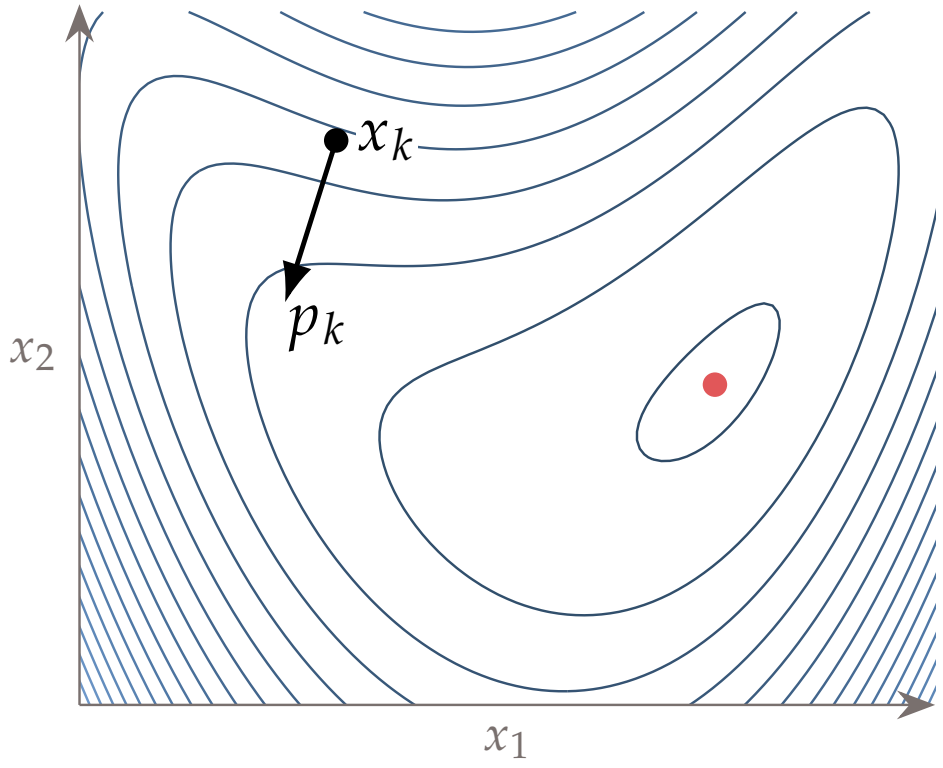
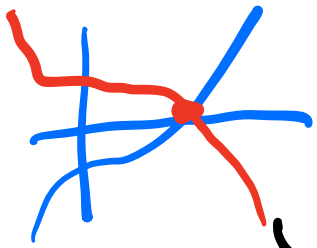


Root Finding Review



$y = x^2 \sin x$ (explicit)

$\rightarrow y - x^2 \sin x = 0$

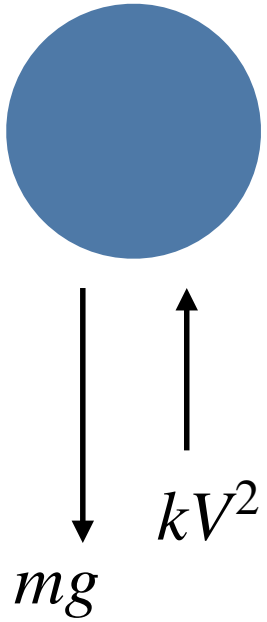
$y = x^2 \sin(x+y)$ (implicit)

$\rightarrow y - x^2 \sin(x+y) = 0$

$f(y,x) = g(y,x)$

$\hookrightarrow \underbrace{f(y,x) - g(y,x)}_{r(y)} = 0$

Scipy Demo



$$V = \sqrt{\frac{mg}{k}} \tanh\left(\sqrt{\frac{kg}{m}} t\right)$$

$$V - \sqrt{\frac{mg}{k}} \tanh\left(\sqrt{\frac{kg}{m}} t\right) = 0$$

$$r(m)$$

Where We Are

Algebra

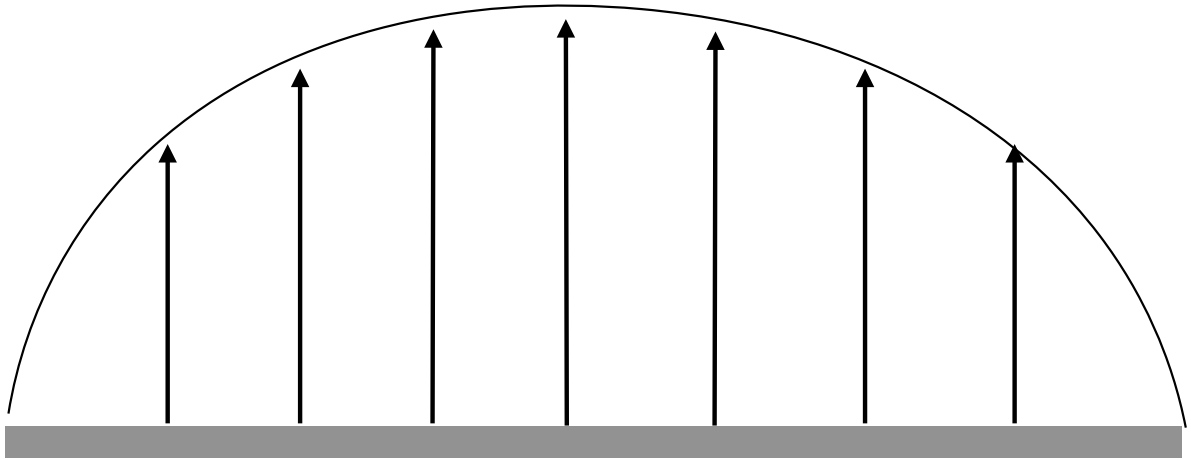
root finding

Calculus

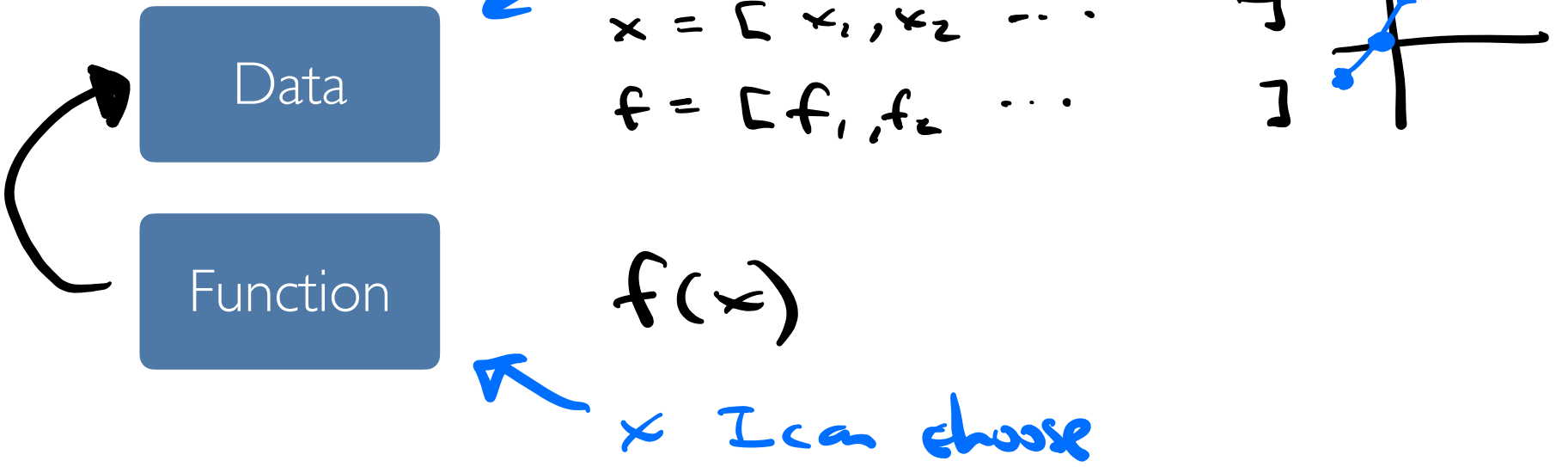
integration

differentiation

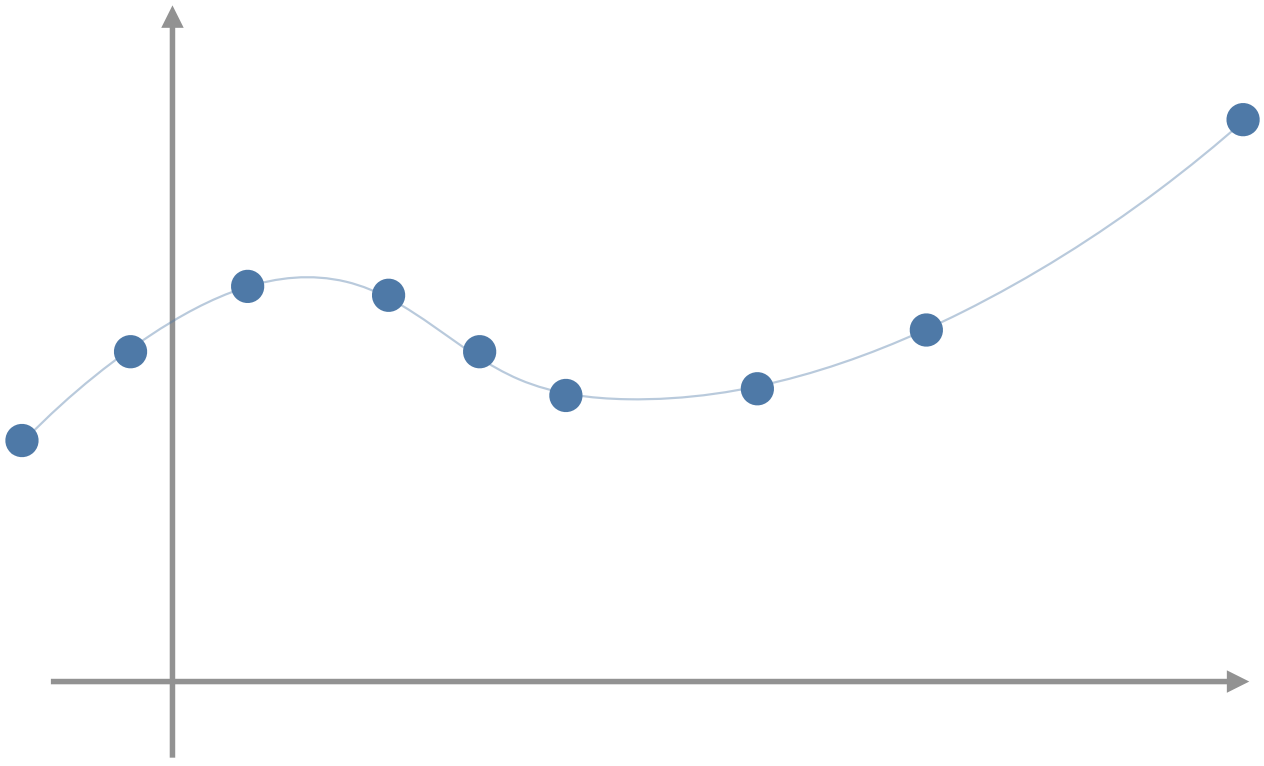
Motivation



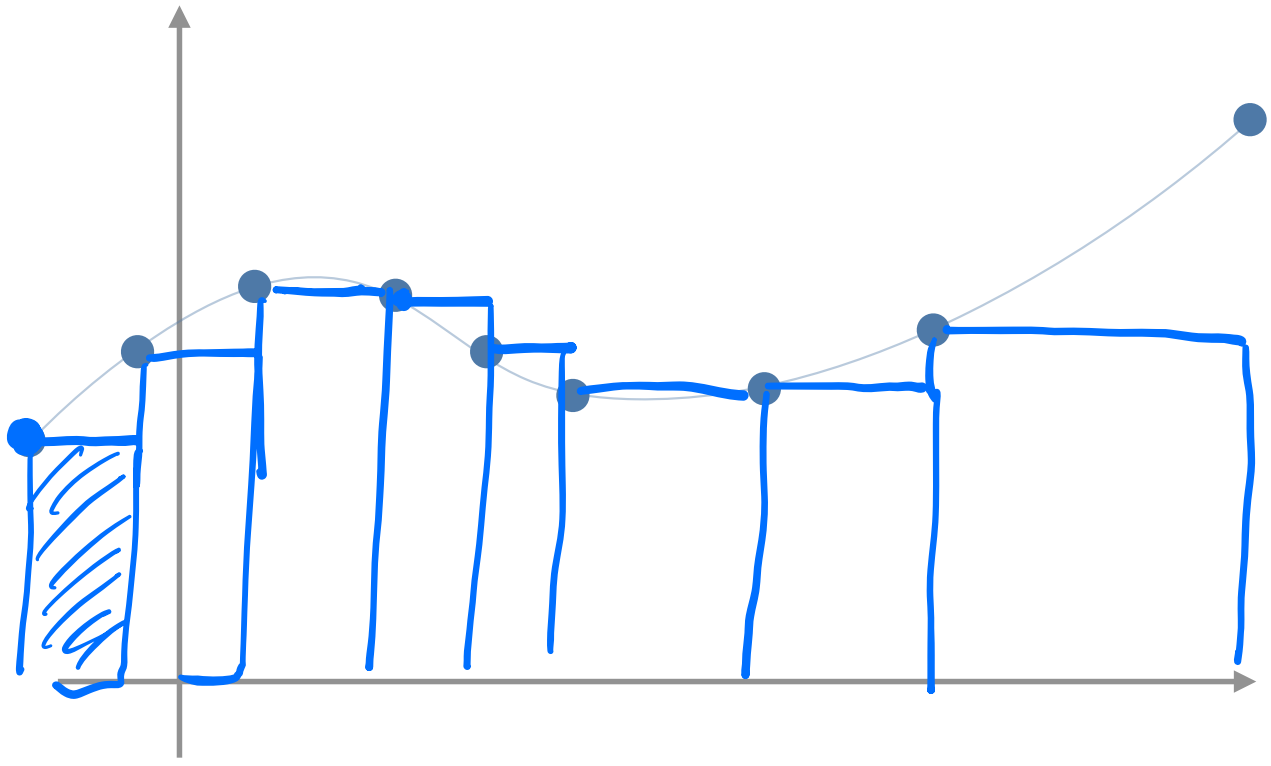
Two Types



How would you do it?

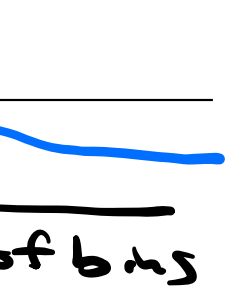


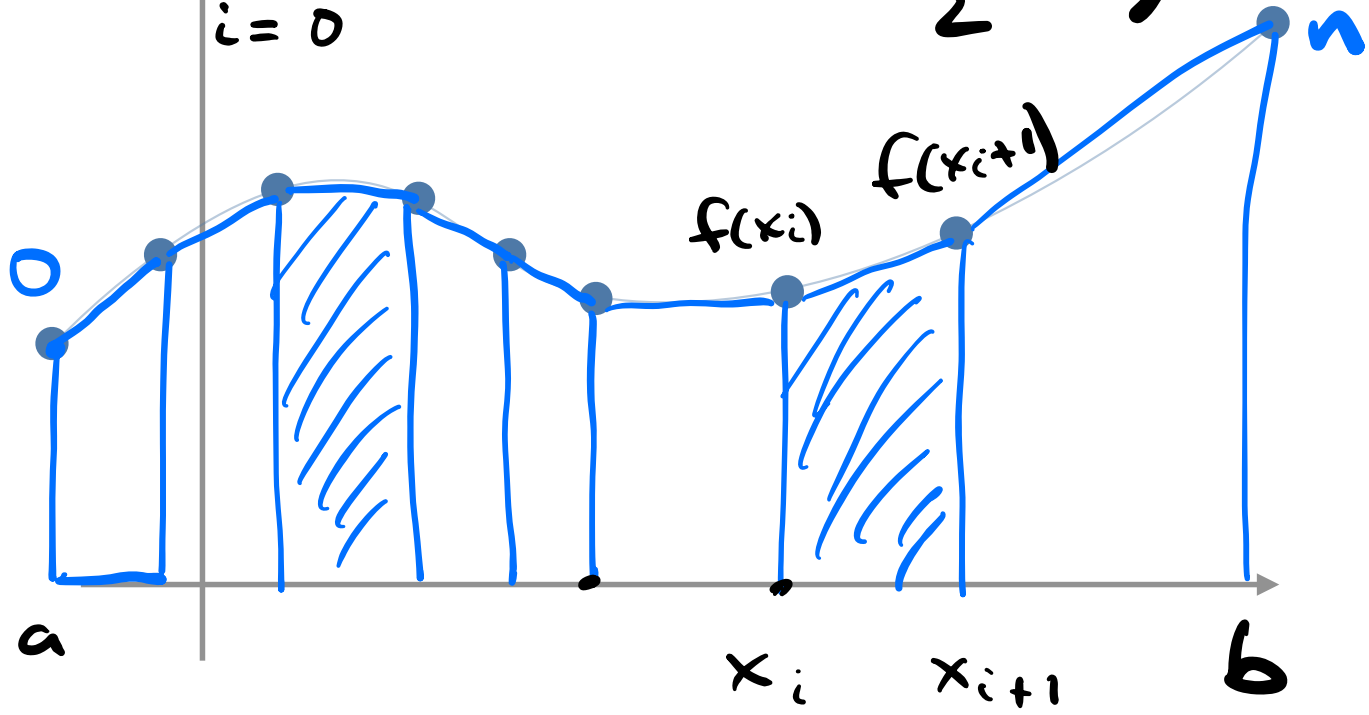
Rectangle rule



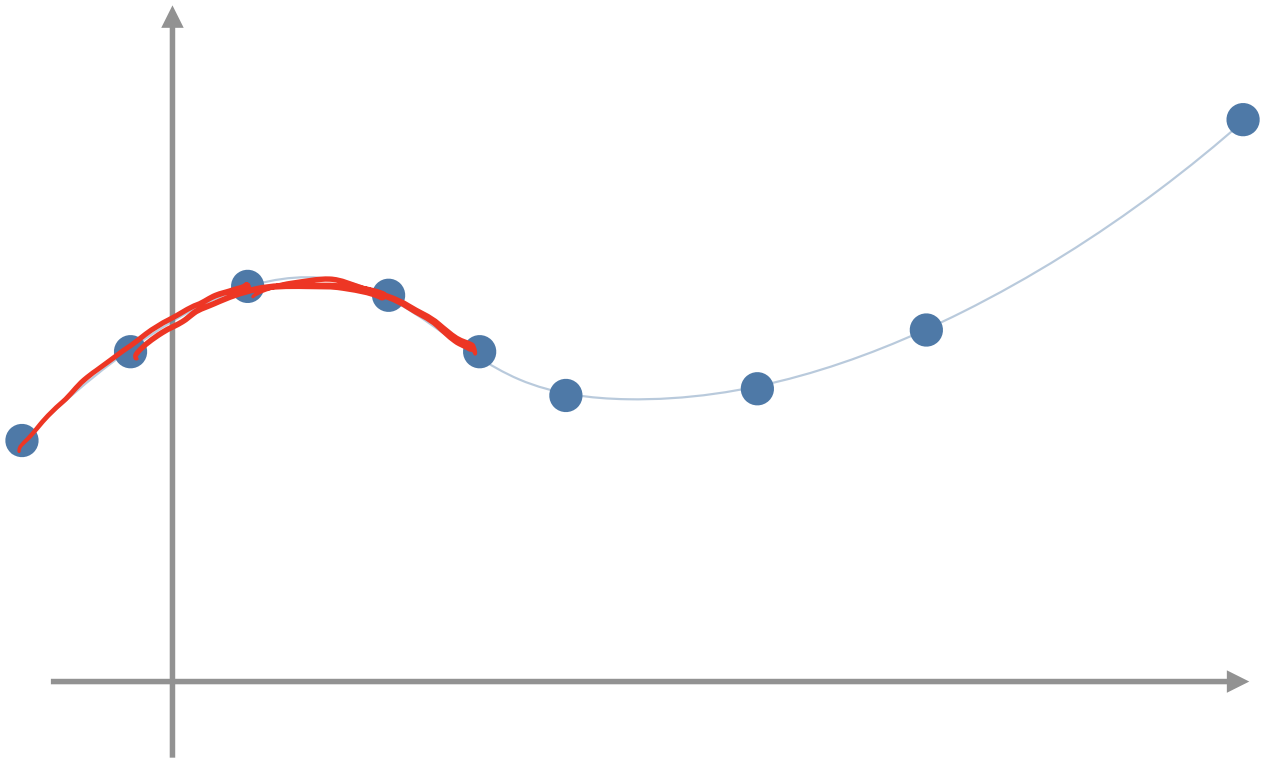
Trapezoidal rule

$$\int_a^b f(x) \cong \sum_{i=0}^{n-1} (x_{i+1} - x_i)\left(\frac{f(x_{i+1}) + f(x_i)}{2}\right)$$

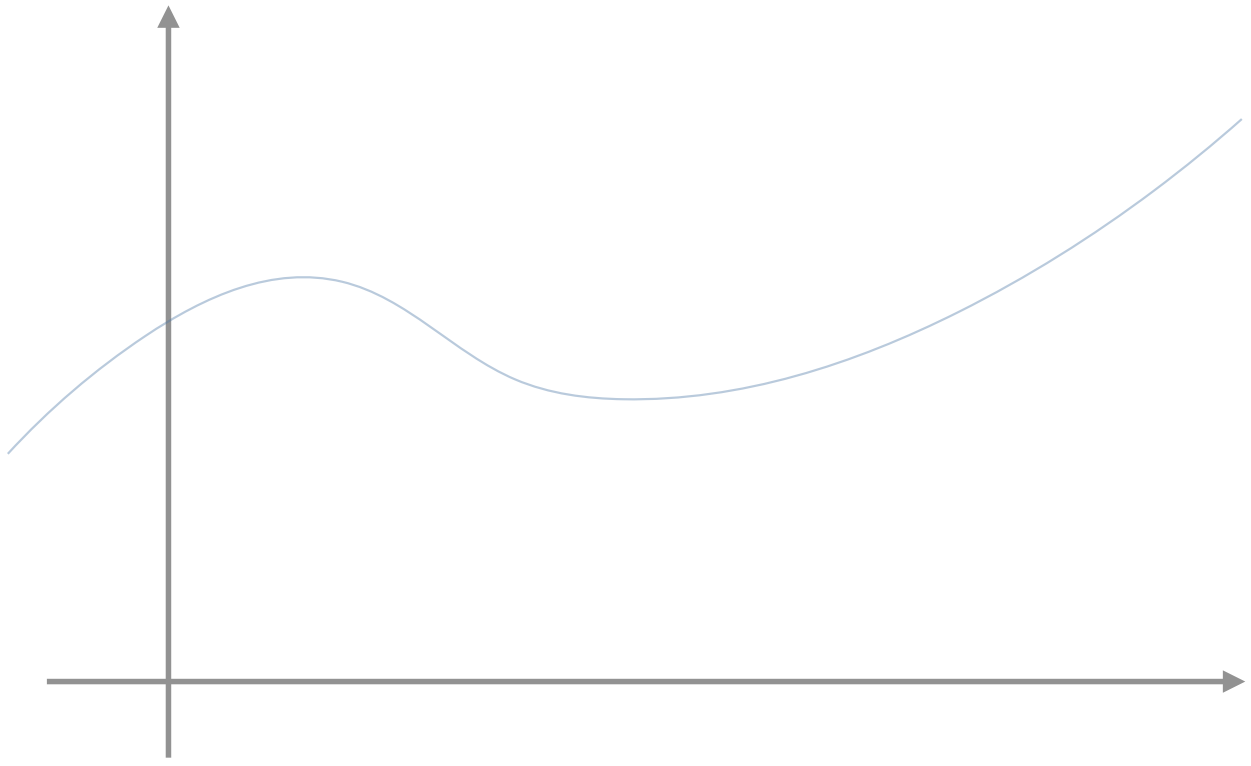




Simpson's rule



Gaussian quadrature



Let's try it

$$\int_0^{\pi} \sin(x^2)$$

np.trapz ← trapezoidal

or np.trapezoid

scipy.optimize.quad ← Gaussian quadrature.

integrate