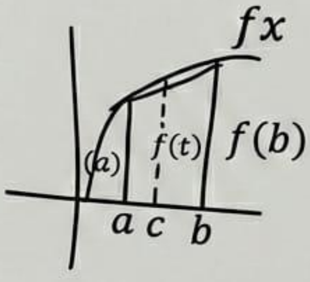
Trapezoid Rule

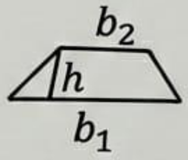
Numerical Integration and Diff

$$I = \int_a^b f(x)dx$$

التكامل



Trapezoid
شهه منحرف



$$A = \frac{(b_1 + b_2)}{2} \cdot h$$

$$T_1 = [f(a) + f(b)]\,\frac{(b-a)}{2}$$

a x_0 — x_1 — x_2 — x_3 — x_{n-1} — b x_n

$$\int_a^b f(x)dx \approx \frac{h}{2}[f(x_0) + 2f(x_1) + 2f(x_2) + \cdots f(x_n)]$$

$+F(x_n)$

$$\int_0^{\pi/2} \sin x \, dx$$

$$T_1(1) = \begin{bmatrix} \sin 0 + \sin \frac{\pi}{2} \\ 0 \quad + \quad 1 \end{bmatrix} \frac{\frac{\pi}{2} - 0}{4}$$

$$0.785398 \underset{jo\sqrt{5}}{=} 1 * \frac{\pi}{4}$$

Integration for Error

$$\int_0^{\pi/2} \sin x \, dx = [-\cos x]_0^{\pi/2} = -[\cos \frac{\pi}{2} - \cos 0]$$

$$= -[0 - I] \quad I$$

Matrix Normalization & AI Applications

Matrix normalization is the process of scaling the numbers inside a matrix so they fall within a specific, consistent range (usually between 0 and 1, or scaled to have a mean of 0 and a standard deviation of 1).

- **How it works (Min-Max Normalization):** You take every number in the matrix, subtract the smallest number in the entire matrix, and divide by the range (maximum - minimum).

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

- **Applications in AI:**
  - **Equal Footing:** If an AI model looks at house prices (**$500,000**) and number of bedrooms (**3**), the giant price numbers will overpower the bedroom numbers. Normalization makes sure all features are treated equally by the algorithm.
  - **Faster Training:** Neural networks learn using a process called Gradient Descent. When data is normalized, the network converges on the right answer much faster and more stably.
  - **Image Processing:** In Computer Vision, pixel values (0 to 255) are often normalized to a range of 0 to 1 so the neural network processes the image data efficiently.
- **Example:**

Imagine a simple matrix: [2, 4, 8]

1. Min is 2, Max is 8. Range is 6.
2. Normalize 2: (2 - 2) / 6 = 0
3. Normalize 4: (4 - 2) / 6 = 0.333
4. Normalize 8: (8 - 2) / 6 = 1
5. Resulting normalized matrix: [0, 0.333, 1]