Computational Methods in Physics (PHY 365)

FA23

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Lab 15

MATLAB's integral function

- q = integral (fun , xmin , xmax) numerically integrates function fun from xmin to xmax using global adaptive quadrature and default error tolerances.
  - fun must be a function handle.
  - xmin and xmax can be $-\infty$ or ∞.
  - If both are finite, they can be complex.
  - If at least one is complex, integral approximates the path integral from xmin to xmax over a straight line path.

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    - If both are finite, they can be complex.
    - If at least one is complex, integral approximates the path integral from xmin to xmax over a straight line path.
- q = integral (fun , xmin , xmax , Name , Value) specifies additional options.
    - For example, specify 'WayPoints' followed by a vector of real or complex numbers to indicate specific points for the integrator to use.

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  f = @ (x) exp(-x .^2) .* log(x) .^2;

- Calling the integral function

  integral_int = integral (f , x_lower , x_upper);

MATLAB's integral function

- Displaying the result

  disp (['The result is ', num2str (integral_int)])

MATLAB's integral2 and integral3 functions

- q = integral2 (fun , xmin , xmax , ymin , ymax) approximates the integral of the function over the planar region xmin ≤ x ≤ xmax and ymin(x) ≤ y ≤ ymax(x).

- q = integral2 (fun , xmin , xmax , ymin , ymax , Name , Value) specifies additional options with one or more Name,Value pair arguments.

- q = integral3(fun , xmin , xmax , ymin , ymax , zmin , zmax) approximates the integral of the function over the region xmin ≤ x ≤ xmax, ymin(x) ≤ y ≤ ymax(x) and zmin(x,y) ≤ z ≤ zmax(x,y).

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  x_lower = −3;

  x_upper = 3;

  y_lower = −5;

  y_upper = 5;

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  x_upper = 3;

  y_lower = −5;

  y_upper = 5;

- The integrand

  f = @ (x,y)   x .^2 + y .^2;

MATLAB's integral2 and integral3 functions

- Calling the integral2 function

  integral2_int = integral (f , x_lower , x_upper , y_lower , y_upper);

MATLAB's integral2 and integral3 functions

- Calling the integral2 function

  integral2_int = integral (f , x_lower , x_upper , y_lower , y_upper);

- Displaying the result

  disp (['The result is ', num2str (integral2_int)])

MATLAB's int function

- int(expr , var) computes the indefinite integral of "expr" with respect to the symbolic scalar variable "var".
    - Specifying the variable is optional.
    - If the variable is not specified, the function int uses the default variable determined by symvar.
    - If expr is a constant, then the default variable is x.

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- int(expr , var , a , b) computes the definite integral of the expression with respect to the variable from "a" to "b".

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syms x

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  f = $\sin(x)$

- The integral

  int_int = int (f);

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- Problem: Determine the integral

$$I = \int \sin(x)\, dx$$

- Defining the function

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syms x
f = sin(x)
```

- The integral

```
int_int = int (f);
```

- Displaying the result

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disp ( ['The result is ', char (int_int) ] )
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syms x
f = 1 / (x - 1)
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- The integral

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int_int = int (f , x , 0 , 2);
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$$I = \int_0^2 \frac{1}{x-1} dx$$

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  syms x

  f = 1 / (x − 1)

- The integral

  int_int = int (f , x , 0 , 2);

- Displaying the result

  disp(['The result is ', char(int_int)])

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- The integrand has a pole in the interior of the interval of integration.
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- The integrand has a pole in the interior of the interval of integration.
    - Mathematically, this integral is not defined.
- The Cauchy principal value of the integral exists.
    - → int_int = int (f, x, 0, 2, 'PrincipalValue', true);

References

- https://www.mathworks.com/help/matlab/ref/integral.html
- https://www.mathworks.com/help/matlab/ref/integral2.html
- https://www.mathworks.com/help/matlab/ref/integral3.html
- https://www.mathworks.com/help/symbolic/int.html