Computational Methods in Physics (PHY 365)

FA23

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Lab 13

MATLAB's quad function

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- q = quad(fun , a , b) tries to approximate the integral of function fun from a to b to within an error of 10^{-6} using recursive adaptive Simpson quadrature.
  - fun is a function handle.
  - Limits a and b must be finite.
  - The function y = fun(x) should accept a vector argument x and return a vector result y, the integrand evaluated at each element of x.

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- q = quad(fun , a , b , tol) uses an absolute error tolerance "tol" instead of the default.

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- The interval

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x_lower = 0;
x_upper = 2;
```

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```
x_lower = 0;
x_upper = 2;
```

- The integrand

```
f = @ (x) 1 ./ (x .^ 3 - 2 * x - 5);
```

MATLAB's quad function

- Calling the quad function

  ```
  quad_int = quad(f , x_lower , x_upper);
  ```

MATLAB’s quad function

- Calling the quad function

```
quad_int = quad(f , x_lower , x_upper);
```

- Displaying the result

```
fprintf(‘The approximate value of the integral is %3.4f \n’,
quad_int)
```

MATLAB's dblquad function

- q = dblquad(fun , xmin , xmax , ymin , ymax) calls the quad function to evaluate the double integral fun(x,y) over the rectangle (xmin ≤ x ≤ xmax, ymin ≤ y ≤ ymax).

- q = dblquad(fun , xmin , xmax , ymin , ymax , tol , method) uses the quadrature function specified as method, instead of the default quad.
  - Valid values for method are @quadl or the function handle of a user-defined quadrature method that has the same calling sequence as quad and quadl.

MATLAB's dblquad function

- Problem: Compute the following integral using dblquad function.

$$I = \int_{0}^{\pi}\int_{\pi}^{2\pi}\left[y\ \mathsf{sin}\left(x\right) + x\ \mathsf{cos}\left(y\right)\right]dx\,dy.$$

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- Problem: Compute the following integral using dblquad function.

$$I = \int_{0}^{\pi} \int_{\pi}^{2\pi} \left[y \ \mathsf{sin}\left(x\right) + x \ \mathsf{cos}\left(y\right) \right] dx\, dy.$$

- The intervals

  x_lower = pi;

  x_upper = 2 * pi;

  y_lower = 0;

  y_upper = pi;

MATLAB's dblquad function

- The integrand

```
f = @ (x , y)   y .* sin (x) + x .* cos (y);
```

- Calling the dblquad function

```
dblquad_int = dblquad (f, x_lower, x_upper, y_lower,
y_upper);
```

MATLAB’s dblquad function

- The integrand

```
f = @ (x , y)   y .* sin (x) + x .* cos (y);
```

- Calling the dblquad function

```
dblquad_int = dblquad (f, x_lower, x_upper, y_lower,
y_upper);
```

- Displaying the result

```
fprintf(‘The approximate value of the integral is %3.4f \n’,
dblquad_int)
```

References

- https://www.mathworks.com/help/matlab/ref/quad.html
- https://www.mathworks.com/help/matlab/ref/dblquad.html
- https://www.mathworks.com/help/matlab/ref/quadl.html