

Progress Report

Syed Ahmad Raza

2016.11.15

First order numerical differentiation

An algorithm was coded in C++ for numerical differentiation using three different commonly used schemes. The functions $\sin(3x)$ and $\cos(3x)$ were differentiated using forward difference method, backward difference method and central difference method.

Forward difference method

$$f'(x) = \frac{f(x_{i+1}) - f(x_i)}{x_{i+1} - x_i} \quad (1)$$

Backward difference method

$$f'(x) = \frac{f(x_i) - f(x_{i-1})}{x_i - x_{i-1}} \quad (2)$$

Central difference method

$$f'(x) = \frac{f(x_{i+1}) - f(x_{i-1})}{x_{i+1} - x_{i-1}} \quad (3)$$

The results are shown in the figures below.

2nd order numerical differentiation

Another algorithm was coded in C++ for double derivatives using similar three commonly used schemes. The functions $\sin(3x)$ and $\cos(3x)$ were differentiated twice using forward difference method, backward difference method and central difference method.

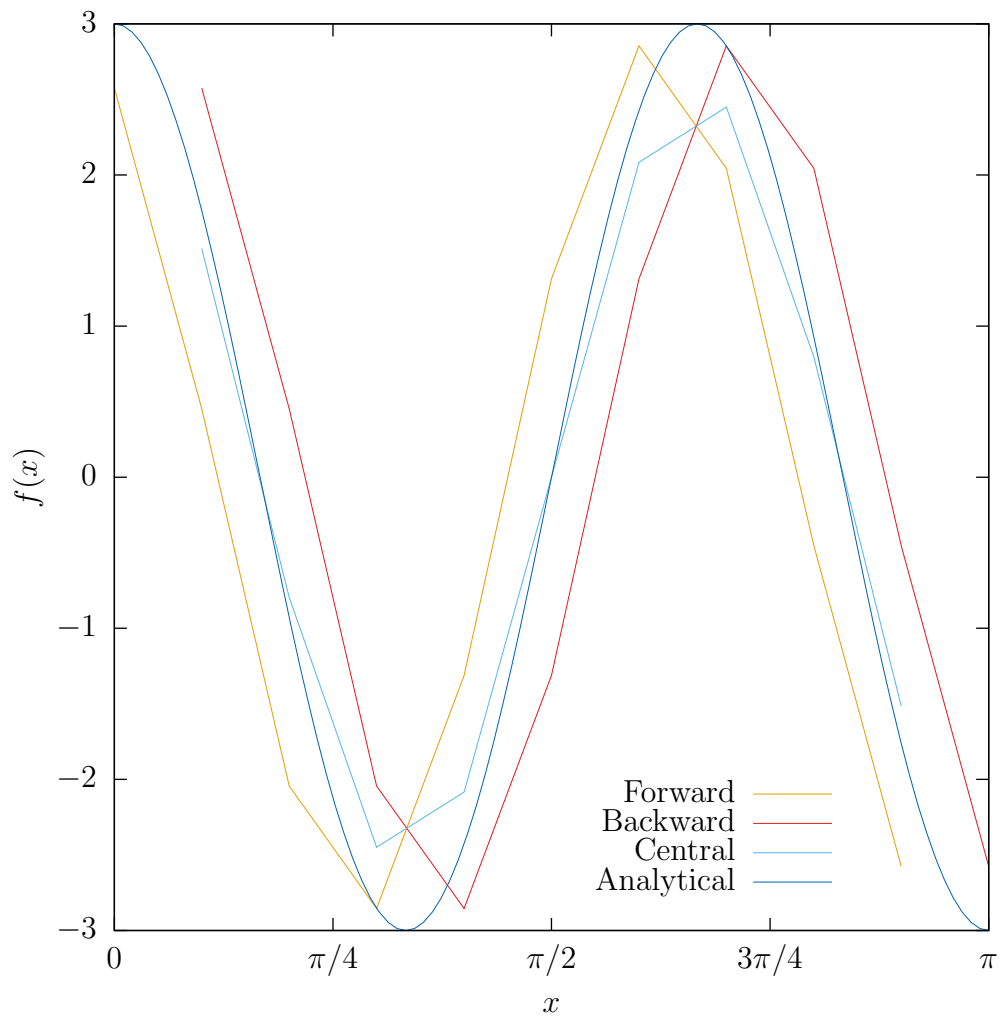


Figure 1: Comparison of numerical differentiation of $\sin(3x)$ using 10 intervals

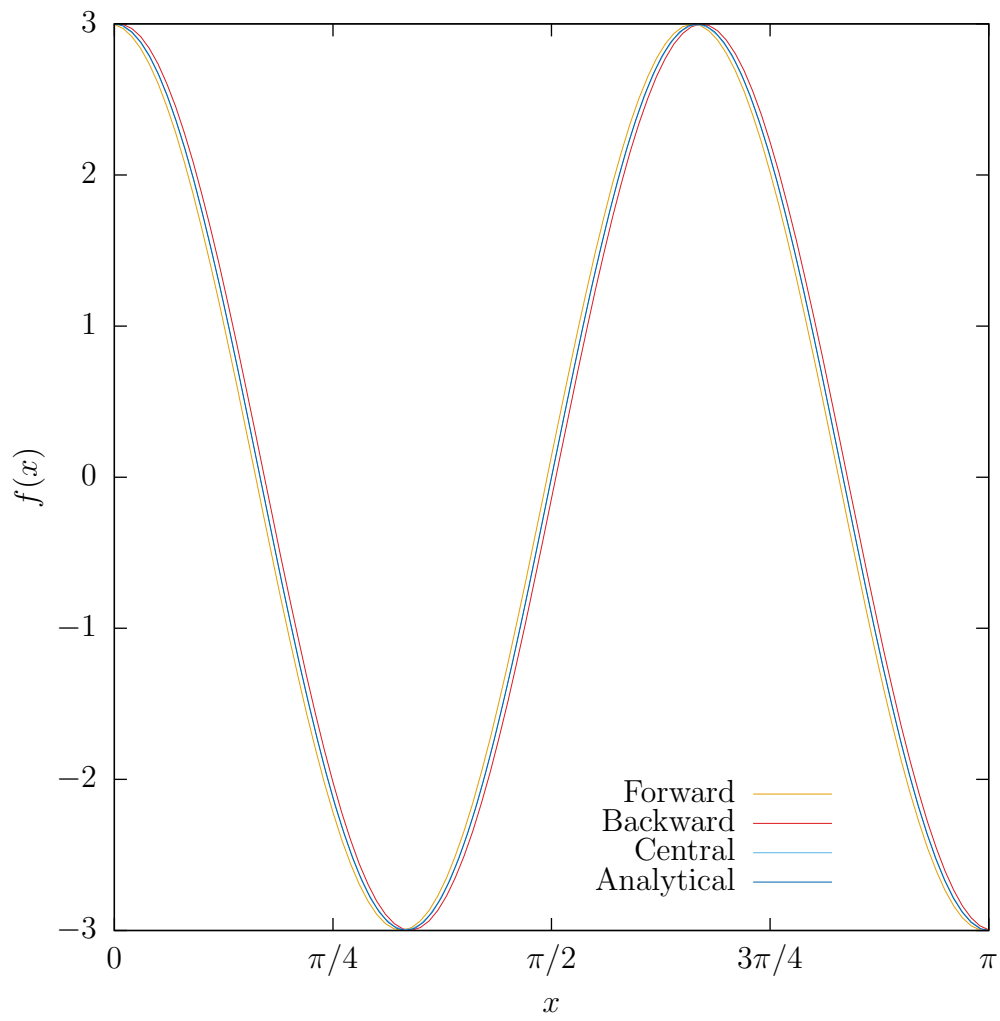


Figure 2: Comparison of numerical differentiation of $\sin(3x)$ using 100 intervals

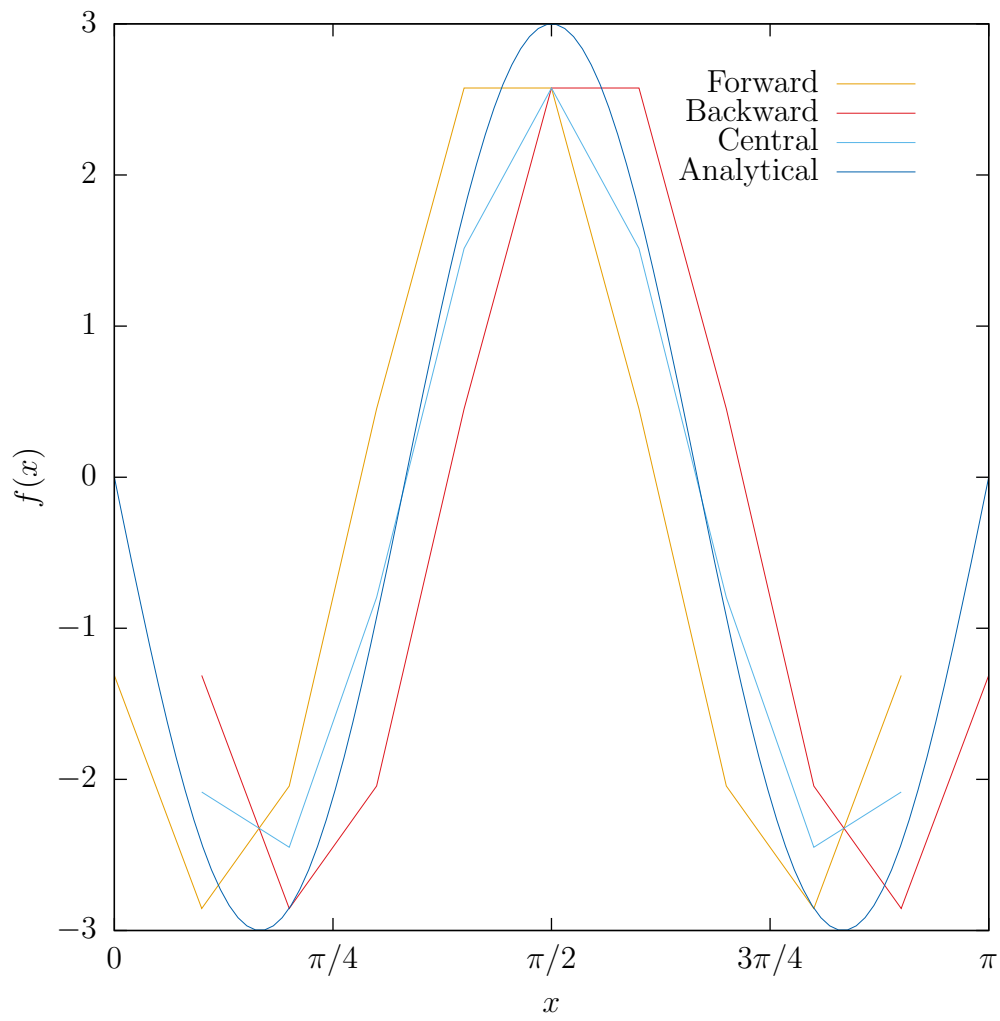


Figure 3: Comparison of numerical differentiation of $\cos(3x)$ using 10 intervals

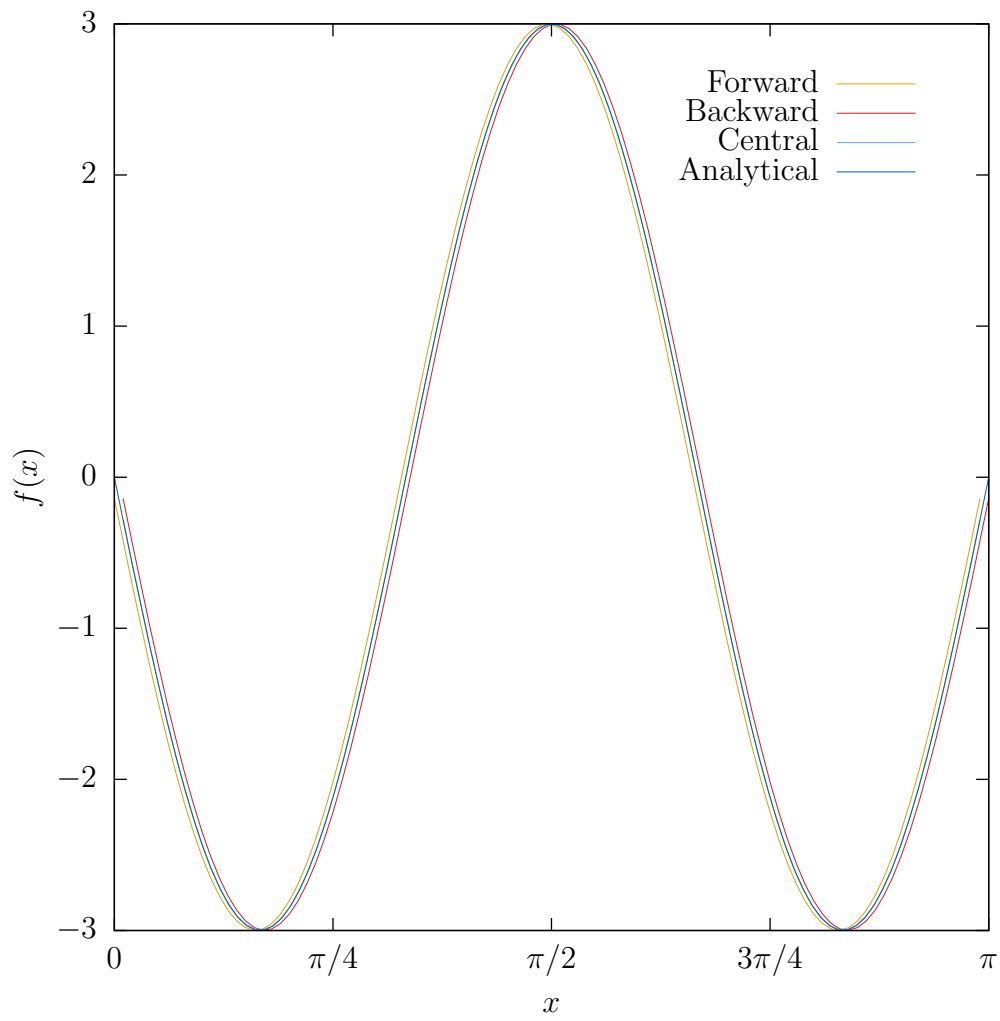


Figure 4: Comparison of numerical differentiation of $\cos(3x)$ using 100 intervals

Forward difference method for 2nd derivative

$$f'(x) = \frac{f(x_{i+2}) - 2f(x_{i+1}) + f(x_i)}{h^2} \quad (4)$$

Backward difference method for 2nd derivative

$$f'(x) = \frac{f(x_i) - 2f(x_{i-1}) + f(x_{i-2}))}{h^2} \quad (5)$$

Central difference method for 2nd derivative

$$f'(x) = \frac{f(x_{i+1}) - 2f(x) + f(x_{i-1}))}{h^2} \quad (6)$$

The results are shown in the figures below.

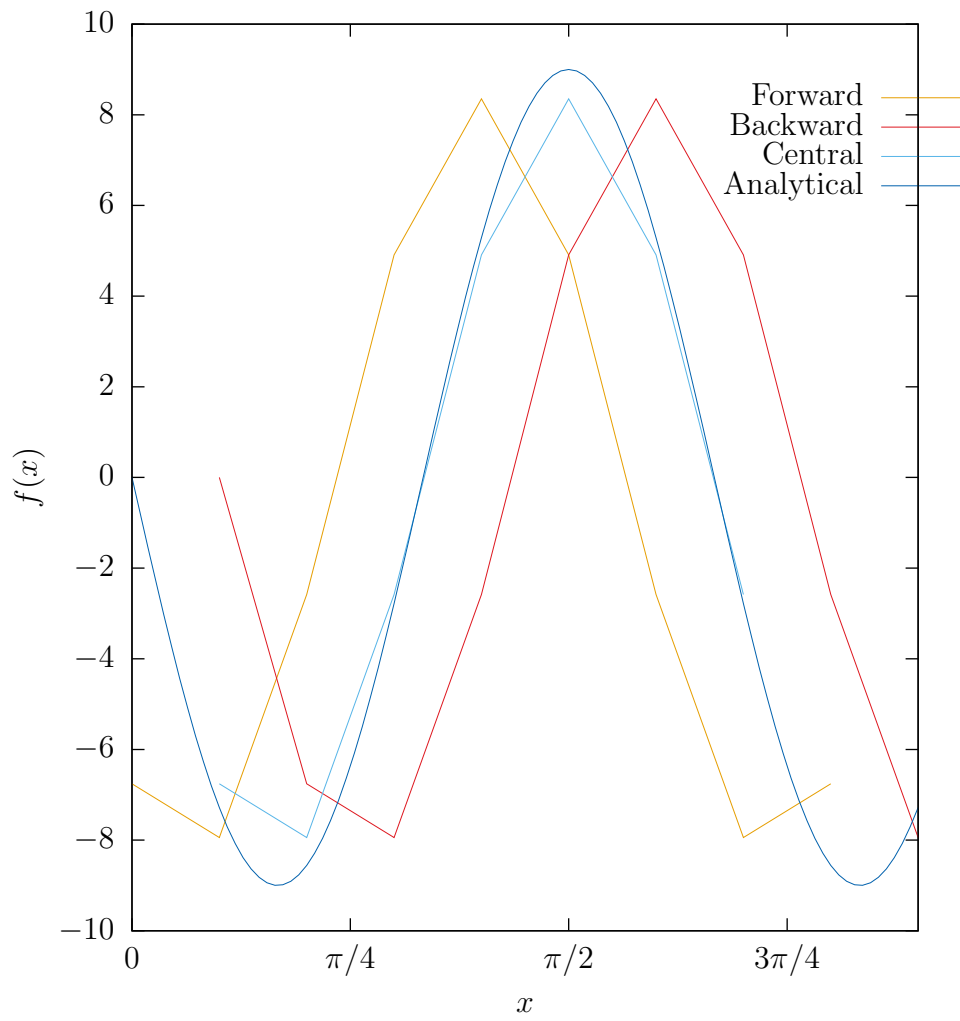


Figure 5: Comparison of double derivative of $\sin(3x)$ using 10 intervals

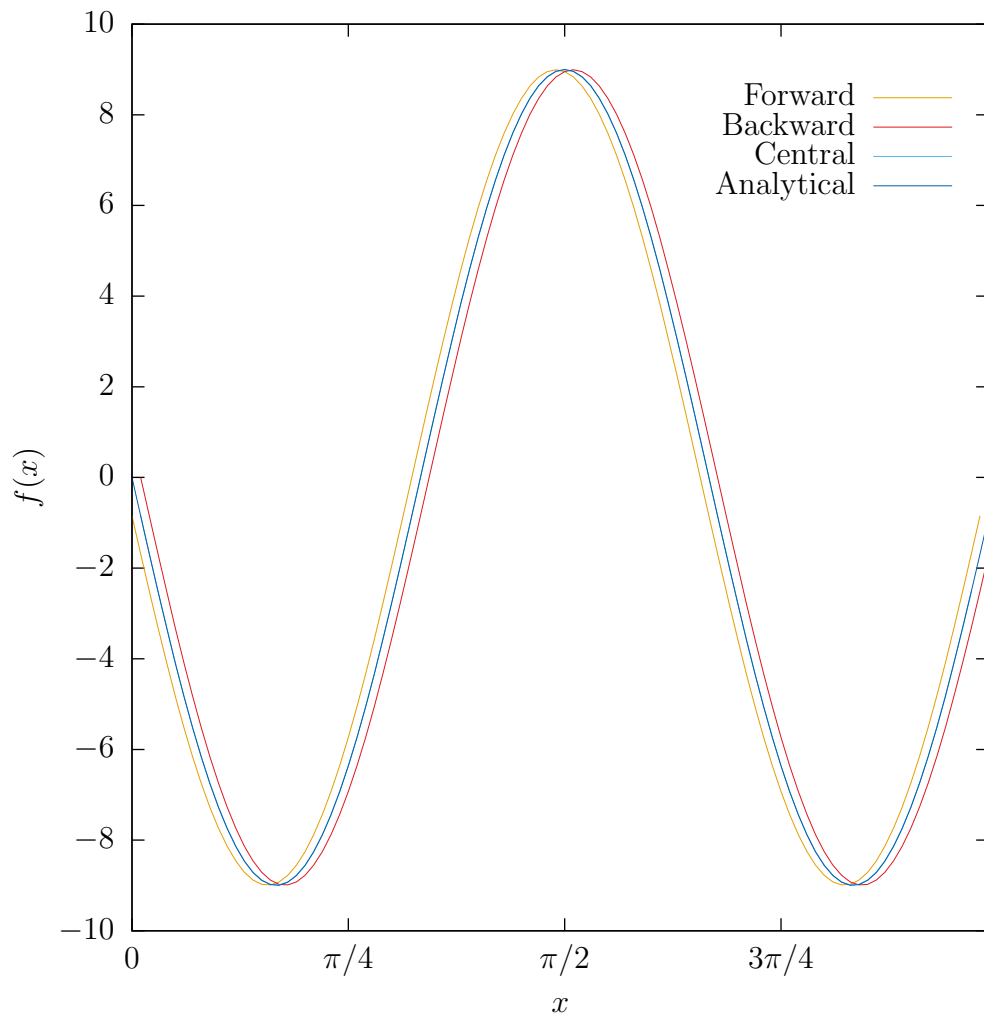


Figure 6: Comparison of double derivative of $\sin(3x)$ using 100 intervals

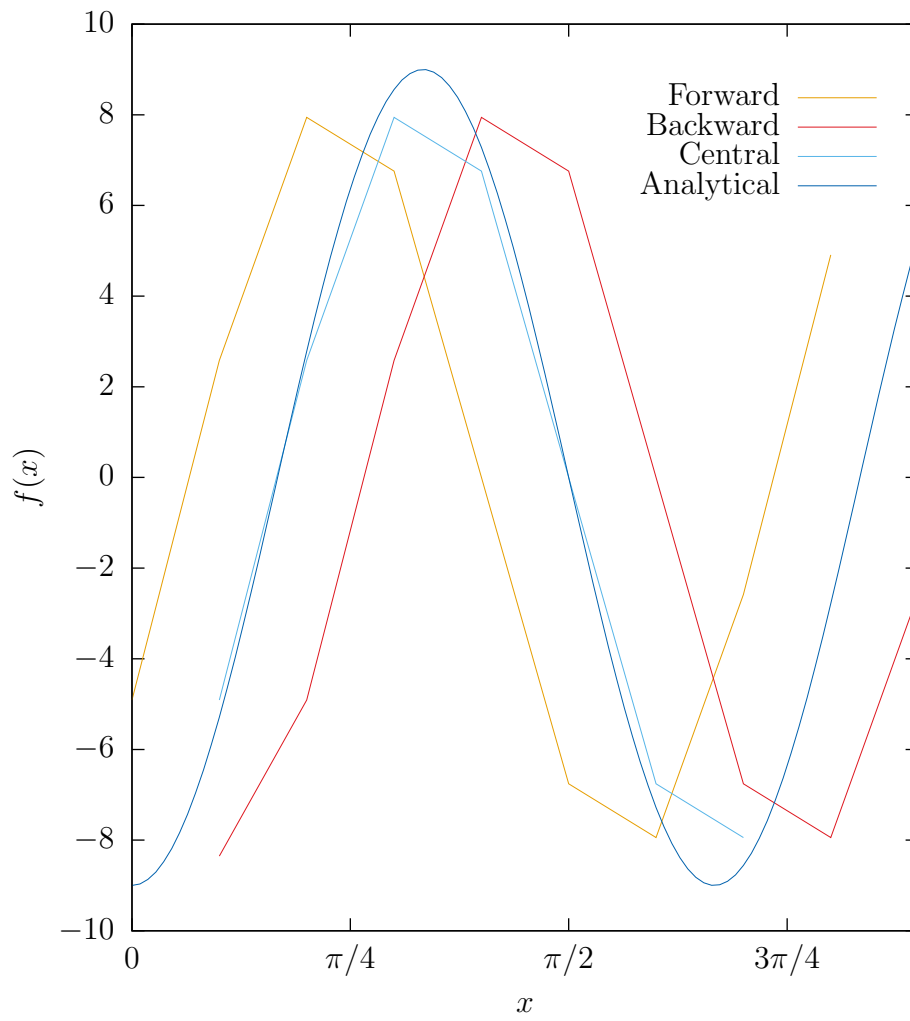


Figure 7: Comparison of double derivative of $\cos(3x)$ using 10 intervals

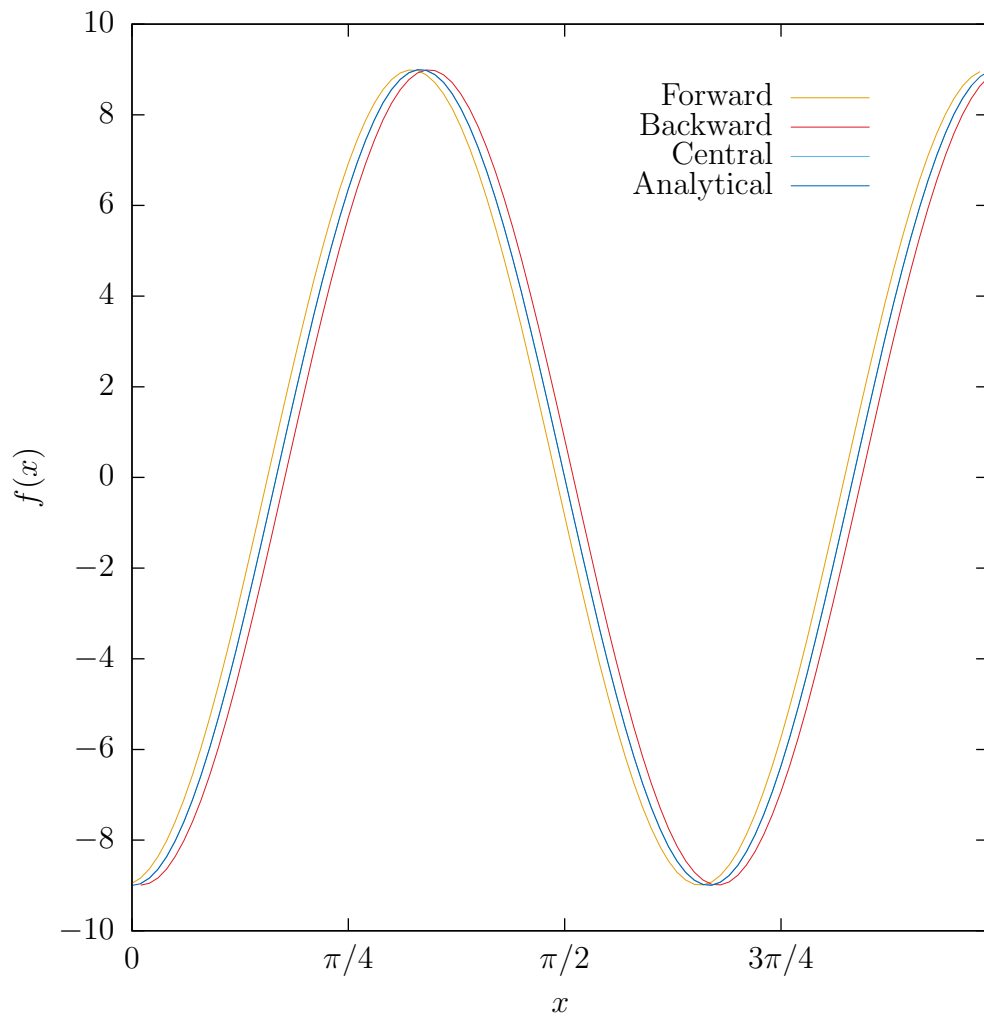


Figure 8: Comparison of double derivative of $\cos(3x)$ using 100 intervals