# MTH 352/652
# Quiz #6

1. Construct a finite difference approximation to the second derivative of a function $f(x)$ using its values at the points $x$, $x + \Delta x$ and $x - 2\Delta x$.

$$f(x+\Delta x) = f(x) + f'(x)\Delta x + \frac{f''(x)}{2}\Delta x^2 + \frac{f'''(x)}{3!}\Delta x^3 + \cdots$$

$$f(x-2\Delta x) = f(x) - 2f'(x)\Delta x + 2f''(x)\Delta x^2 + \frac{8f'''(x)}{3!}\Delta x^3 + \cdots$$

$$\Rightarrow 2f(x+\Delta x) + f(x-2\Delta x) = 3f(x) + 3f''(x)\Delta x^2 + cf'''(x)\Delta x^3 + \cdots$$

$$\Rightarrow f''(x) = \frac{2f(x+\Delta x) - 3f(x) + f(x-2\Delta x)}{3\Delta x^2} + cf'''(x)\Delta x + \cdots$$

2. What is the order of this approximation?

$O(\Delta x)$