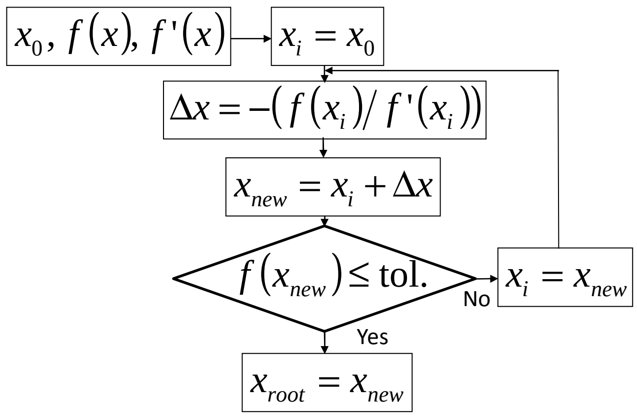
Numerical methods for PDE-Basics. **Written by:** Mauricio Barrera. November/2016

Problem 1. Given the function $f(x) := x^3 + 2x^2 + 10x - 20$, four iterations of the Newton method will be applied to find the root of $f(x)$, using $\sqrt[3]{20} \approx 2.714$ as starting guess.

At the root value x_{root}, $f(x_{root}) = 0$. The linear approximation to $f(x_{root})$ from any value x_i reads as $f(x_{root}) = 0 = f(x_i) + f'(x_i)\Delta x \rightarrow \Delta x = -\left(f(x_i)/f'(x_i)\right)$. Therefore, the generation of a value x_{new} closer to x_{root} than x_i is comes from $x_{new} = x_i + \Delta x$.

The corresponding flow diagram is set out below:



A chart showing the implementation results and a plot of the convergence - (that is, $f(x_i)$ versus iteration i) is set out below. The approximated value for x_{root} can be taken as 1.37.

i	x_i	$f(x_i)$	$f'(x_i)$	Δx
0	2,714418	41,8803	42,96186	-0,97483
1	1,739592	8,712611	26,03692	-0,33463
2	1,404967	0,770847	21,54167	-0,03578
3	1,369183	0,007912	21,10072	-0,00037
4	1,368808	8,59E-07