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Homework number: 5
Homework Title: Exercise 5.1

Problem description:

Consider the nonlinear equation

$$f(x) = x^2 - 2 = 0$$

- (a) With $x_0 = 1$ as starting point, what is the value of x_1 if you use Newton's method for solving this problem?
- (b) With $x_0 = 1$ and $x_1 = 2$ as starting points, what is the value of x_2 if you use the secant method for the same problem?

Problem solution:

Ad (a): As we know from Newton's method, we can calculate the next point the following way:

$$x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)}$$

Thus in our example we get:

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 1 - \frac{f(1)}{f'(1)} = 1 - \frac{1^2-2}{2*1} = 1 - \frac{-1}{2} = 1.5$$

Ad (b): For the secant method, we can calculate the next point the following way:

$$x_{k+1} = x_k - \frac{f(x_k)(x_k - x_{k-1})}{f(x_k) - f(x_{k-1})}$$

Thus in our example we get:

$$x_2 = x_1 - \frac{f(x_1)(x_1 - x_0)}{f(x_1) - f(x_0)} = 2 - \frac{f(2)(2-1)}{f(2) - f(1)} = 2 - \frac{2^2-2}{2^2-2-(1^2-2)} = 2 - \frac{2}{3} = \frac{4}{3} = 1.\overline{33}$$