Computer Methods in Engineering
Exercise 5

Problem 1

Bracket search methods are described in lecture notes.

a) Implement the bracket search method to locate a minimum of the function $f(x) = x^2 - sin(x)$ on the interval $(a, b) = (0, 1)$. Split the interval (a, b) into four subintervals of length $\Delta x = (b - a)/4.0$ and initially select α and β by $\alpha = a + \Delta x, \beta = b - \Delta x$. Experiment with different values of Δx.

b) Implement the golden ration method to locate a minimum of the function $f(x) = x^2 - sin(x)$ on the interval $(a, b) = (0, 1)$. Compare the number of iterations used to find a solution with the number of iterations used in the previous point.

Problem 2

Consider the one dimensional function

$$f(x) = 2x^3 + 2x^2 - 4x \quad \text{for } x \in [-1, 1]. \tag{1}$$

a) Find the roots of $f(x)$ and check your result using the numpy `roots()` function. *Hint:* The `roots()` function take the polynomial coefficients as a vector input, e.g. for $h(x) = 2x^2 - 1$ you would write: `np.roots([2.0,0.0,-1])`.

b) Plot $f(x)$ in python using `plot()`. Use an appropriate sampling interval Δx on the x-axis. Give your plot a title and label the axes. Indicate the roots with a red dot and blue dot. Plot also the line $y = 0$

c) Use Netwon's method to find a root of the function f. Suggested starting-points are 0.5 and 0.75. As there are several roots, explain why you get the root you get when using the Netwon method.

d) Use Netwon's method to find a maximum or minimum value of the function f. Suggested starting-points are somewhere in the range $[-0.5, 0.0]$. Explain why you get the solution you get when using the Netwon method and your chosen starting-point.