

## HOMEWORK 5. NUMERICAL METHODS

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- (1) A lighthouse  $L$  is located on a small island 5 km north of a point  $A$  on a straight east-west shoreline. A cable is to be laid from  $L$  to point  $B$  on the shoreline 10 km east of  $A$ . The cable will be laid through the water in a straight line from  $L$  to a point  $C$  on the shoreline between  $A$  and  $B$ , and from there to  $B$  along the shoreline. (see Figure below). The part of the cable lying in the water costs \$5,000/km, and the part along the shoreline costs \$3,000/km. Where should  $C$  be chosen to minimize the total cost of the cable?
- (2) Implement the following algorithms: Bisection, Newton, and Secant methods for optimization in 1D.
- (3) Find the minimum value and minimum point of the following function

$$f(x) = -\sin(x) + x^2 + 1$$

on the interval  $[-1, 1]$  using the previous implemented algorithms.

- Compare the results in terms of number of iterations.
- Compare and comment the results obtained for each algorithm if

$$f(x) = \sin(x) - x^2 + 1$$

on the interval  $[-1, 1]$

**Note:**

- In Bisection method, use  $[a, b] = [-1, 1]$
- In Newton method, use  $x_0 = 0$ .
- In Secant method, use  $x_0 = -1.0$  and  $x_1 = 1.0$
- For *tolerances* or *uncertainty-interval* use:  $1e - 12$

