Cairo University
SBE 601 Numerical Methods in Biomedical Engineering - Spring 2017
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- You can work on the assignment in groups of **2-3 students**.
- Type your solutions in **LaTeX** using the provided template (Created by Eng. Yassin Amer).
- Please compress your **LaTeX** folder containing the solution after making sure that it works and email it to me: mrushdi@eng1.cu.edu.eg
- Please indicate clearly the contribution of each group member in the page of **LaTeX** template specified for that.
- Most of the problems are from the following textbooks:
  [Chapra 2011] Applied Numerical Methods with MATLAB for Engineers & Scientists
  by Steven Chapra (2011)
  [Dunn 2005] Numerical Methods in Biomedical Engineering
  by Stanley Dunn, Alkis Constantinides, and Prabhas V. Moghe (2005)
  [King 2010] Numerical and Statistical Methods for Bioengineering
  by Michael R. King, and Nipa A. Mody (2010)
  [Burden 2010] Numerical Analysis
  by Richard L. Burden, and J. Douglas Faires (2010)

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Assignment 1 Roots and Optimization

Book Chapter	**Problems**
Chapter 5, pp. 147-150, [Chapra 2011]	5.12, 5.15, 5.16
Chapter 6, pp. 178-181, [Chapra 2011]	6.3, 6.19
Chapter 7, p. 199-204, [Chapra 2011]	7.7, 7.25, 7.29
Chapter 12, p. 300-302, [Chapra 2011]	12.9, 12.14
Chapter 5, pp. 157-160, [Dunn 2005]	5.6, 5.7
Chapter 5, pp. 349-352, [King 2010]	5.2, 5.8, 5.10 (Read Box 2.1A, pp. 48-53 and Box 2.1B, p. 83)
Chapter 8, pp. 534-538, [King 2010]	8.5 (**Hint:** Apply Newton's method to the *derivative*. The iteration becomes: $x_{n+1} = x_n - \frac{f'(x_n)}{f''(x_n)}, \; n = 0, 1, \ldots$)
Chapter 10, pp. 629-647 [Burden 2010]	Exercise Set 10.1: 8(d) Exercise Set 10.2: 7(d)

Useful summary of root-finding methods, p. 349, [King 2010]:

Table 5.2. *Nonlinear root-finding methods*

Property	Bisection method	Regula-falsi method	Newton's method	Secant method	Fixed-point iteration
Type of method	bracketing	bracketing	open interval	open interval	open interval
Rate of convergence	$r = 1$ $C = 0.5$	$r = 1$	$r = 2$ for simple roots $r = 1$ for multiple roots; if Equation (4.25) is used then $r = 2$ $C = \left\lvert \frac{f''(x^*)}{2f'(x^*)} \right\rvert$	$r = 1.618$ $C = \left\lvert \frac{f''(x^*)}{2f'(x^*)} \right\rvert^{0.618}$	$r = 1$ $C = \lvert g'(x) \rvert$
Number of initial guesses required	2	2	1	2	1
Is convergence guaranteed as $i \to \infty$?	yes	yes	no	no	no
Other limitations	cannot be used to find a double root	cannot be used to find a double root	proximity of guess value to root to ensure convergence not known a priori	proximity of guess value to root to ensure convergence not known a priori	Convergence observed only if $\lvert g'(x) \rvert < 1$