

# Scientific Computations CS 315 Assignment 1

*Total Marks: 8 Marks*

Due on Sunday, November 22, 2015

**Dr. Kareem Elgindy**

## Question 1 (2 marks)

Answer true or false:

- (a) (1/2 mark) Numerical analysis is the branch of mathematics concerned with the creation, analysis, and implementation of algorithms to obtain exact solutions to mathematical problems.
- (b) (1/2 mark) The terms “scientific computations” and “numerical analysis” are synonyms.
- (c) (1/2 mark) Through error analysis, we can generally alleviate errors occurring in scientific computing.
- (d) (1/2 mark) A real number can be exactly represented in a computer provided that the word-length suffices to store all the digits in its representation.

## Question 2 (2 marks)

- (a) (1 mark) Which of the following gives the four digit rounding value of the rational number  $19/7$ ?
  - (i) 2.7143.
  - (ii) 0.27143.
  - (iii) 2.714.
- (b) (1 mark) What number of iterations is necessary to approximate the root of the nonlinear equation,

$$4x - e^{-x} = 0,$$

to within  $10^{-10}$  using the bisection method and the initial interval  $[-2, 5]$ .

- (i) 36.
- (ii) 37.
- (iii) 10.

## Question 3 (2 marks)

Show that the upper bound for the absolute error when using  $k$ -digit chopping arithmetic for the machine representation of a real number,

$$x = 0.a_1a_2 \dots a_k a_{k+1} \dots \times 10^n, \quad n \in \mathbb{Z}, 1 \leq a_1 \leq 9, 0 \leq a_i \leq 9,$$

for each  $i = 2, 3, \dots$ , is  $10^{-k}$ , if  $x$  is within the range of the floating-point system.

### Question 4 (2 mark)

The surface area of the Earth might be computed using the formula

$$A = 4\pi r^2,$$

for the surface area of a sphere of radius  $r$ . Are there any errors in the computation of the Earth surface area using the above formula? Explain.