COSC4364 Spring 2016

Assignment 1

The assignment should be carried out individually. Copying or team solutions not allowed. The UH academic honesty policy applies. For the Matlab problems (Problem 9 and 10) working code needs to be submitted together with instructions on how to run the code (if necessary) in order to receive credit. The output of the code together with a discussion of the results need to be submitted as well.

For Problems 1 – 8 documentation of how the results were obtained is necessary in order to receive credit. Without any insight provided of how the results were obtained no credit will be given.

Submit your results via e-mail to johnsson@cs.uh.edu.

This assignment is due February 4, 2016.

Problem	a	b	c	d	e	f	g	h	Total
1	2	4	2						8
2	2	2	2						6
3	2	2	2	2	2	3	2	6	21
4	1								1
5	2	2	4						8
6	2	2	2						6
7	3								3
8	2								2
9	20								20
10	15								15
Total									90

Floating-Point representation

Problem 1. **(a and c 2p each, b 4p. Total 8p)** Determine the 32-bit IEEE machine representation of the following decimal numbers

a. 2^{-30}, b. 64.015625, c. $-8x2^{-24}$

Problem 2. **(3x2p. Total 6p)** Which of the following values have a machine representation.

a. 1/5, b. 1/10, c. 1/256

Problem 3. **(a through e and g 2p each, f 3p, h 6p, Total 21p)** What are the floating-point numbers corresponding to the following IEEE binary representations

a. $(0\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 000)_2$

b. $(1\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 000)_2$
c. $(0\ 1111\ 1111\ 0000\ 0000\ 0000\ 0000\ 0000\ 000)_2$
d. $(1\ 1111\ 1111\ 0000\ 0000\ 0000\ 0000\ 0000\ 000)_2$
e. $(0\ 0000\ 0001\ 0000\ 0000\ 0000\ 0000\ 0000\ 000)_2$
f. $(0\ 1000\ 0001\ 0110\ 0000\ 0000\ 0000\ 0000\ 000)_2$
g. $(0\ 0111\ 1111\ 0000\ 0000\ 0000\ 0000\ 0000\ 000)_2$
h. $(0\ 0111\ 1011\ 1001\ 1001\ 1001\ 1001\ 1001\ 100)_2$

Relative Error.

Problem 4. (1p) What is the relative error in rounding 4.9997 to 5.000?

Managing Loss of Significance

Problem 5. (a 2p, b 2p, c 4p, total 8p)

a. For small x which is the better way of evaluating $(1+x)^2$: Directly as $(1+x)^2$ or as $(x+2)x+1$? Explain your choice.
b. How would you evaluate sqrt(x+4)-2 for small x? Explain your approach.
c. Calculate e^x-x-1 for x=0.01 with 5 significant digits.

Horner's Rule

Problem 6 (3x2p = 6p). Use Horner's rule to evaluate

a. $P(x) = 2x^4+9x^2-16x+12$ at x=-6
b. $P(X) = 2x^4-3x^3-5x^2+3x+8$ at x=2
c. $P(x) = 3x^5-38x^3+5x^2-1$ at x=4

Taylor series

Problem 7 (3p). Use the Alternating Series Theorem to determine the number of terms in the Taylor series for ln(1+x) needed for computing ln(1.1) with an error less than $1/2x10^{-8}$.

Problem 8 (2p). In the Taylor series expansion for $3x^2-7+\cos x$ what is the coefficient for x^2?

Matlab

Problem 9. **(20p)** Write a Matlab program for computation of π according to the following procedure in single, double and quad precision. Discuss the outcome.

Integer k; real a,b,c,d,e,f,g
a <- 0

b <- 1
c <- 1/sqrt(2)
d <- 0.25
e <- 1
for k=1 to 5
    a <- b
    b <- (b+c)/2
    c <- sqrt(ca)
    d <- d-e(b-a)^2
    e <- 2e
    f <- b^2/d
    g <- (b+c)^2/(4d)
    output k,f, |f-π|, g, |g-π|
end for

Problem 10. (15p) Write a Matlab program that plots sin(x) and the Taylor series approximations

$S_1 = x$
$S_3 = x- x^3/6$
$S_5 = x-x^3/6+x^5/120$
$S_7= x-x^3/6+x^5/120-x^7/5040$
$S_9 = x-x^3/6+x^5/120-x^7/5040+x^9/362880$