COSC4364 Spring 2018

Assignment 1

Given: 2018-01-25 Due: 2018-02-01

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. The discussion carries significant weight for credit.

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 Blackboard.

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)** (Book exercise 1.3.1) Determine the 32-bit IEEE machine representation of the following decimal numbers

a. 2^{-19}, b. 48.03125, c. $-4x2^{-13}$

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

a. 0.2, b. 0.05, c. 0.03125

Problem 3. **(a through e and g 2p each, f 3p, h 6p, Total 21p)** (Book exercise 1.3.5) What are the floating-point numbers corresponding to the following IEEE binary representations

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

Relative Error.

Problem 4. (1p) (Book exercise 1.1.3) 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) (Book exercises 1.1.7, 1.4.9 and 1.4.19)

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 $1-\cos x$ for x close to 0? Explain your approach.
c. Find a good way to compute $\sin x+\cos x-1$ for x near 0.

Horner's Rule

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

a. $P(x) = 3x^4+8x^2-7x+12$ at $x=-4$
b. $P(X) = 2x^4-4x^3-5x^2+3x+6$ at $x=2$
c. $P(x) = 7x^5-21x^3+5x-1$ at $x=4$

Taylor series

Problem 7 (3p). (Book exercise 1.2.8) Determine how many terms in the Taylor series for e^x are needed to compute e with 15 correct decimal digits, rounded.

Problem 8 (2p). (Book exercise 1.2.37 Determine in terms of h the first two terms and the error term in the Taylor series for $\ln(3-2h)$.

Matlab

Problem 9. **(20p)** (Book exercise 1.2.14C) Write a Matlab program for computation of π according to the following procedure in single and double precision. Discuss the outcome. Note that by default Matlab uses double precision.

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 cos(x) and the Taylor series approximations in the same plot

$S_1 = 1$
$S_3 = 1- x^2/2!$
$S_5 = 1-x^2/2!+x^4/4!$
$S_7= 1—x^2/2!+x^4/4!-x^6/6!$
$S_9 = 1-x^2/2!+x^4/4!-x^6/6!+x^8/8!$