FAST

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Section: BS(CS)-S.A   Examination: Midterm - I
Semester: Fall 2021   Total marks: 20   Weight: 15
Time allowed: 60 mins   Date: October, 2021
Course: CS325 Numerical Computing   Instructor: Dr. Nauman

Q. No.:	1	2	3	4	5	6	Sum	Sign
Scored:							15	
Total:	3	5	4	2	4	2		

- Attempt all questions on the question sheet.

- Answer the questions as concisely as possible. Please keep your text within the provided space.

- Think about the question before answering. You have a lot of time to solve the paper but every question would require time to see what the examiner wants. Do not rush.

- In case of objective type questions, pick the most appropriate answer and put a *checkmark* in the box to its left.

1. What is the difference between a Rank 1 Tensor and a column vector?

Rank 1 Tensor:

$A = [1, 2, 1]$

$(3, \ )$

$A^T = [1, 2, 1]$

Column vector:

$A = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$

$A^T = [1 \quad 2 \quad 1]$

The difference between Rank 1 Tensor and a column vector is, the Rank 1 Tensor remains same if we take transpose. it is direction less. Column vector became row vector if transpose taken.

Score

2 / 3

2. What would be the 32-bit floating point IEEE-754 representation of the number 18.625? Show your working.

18.625

Step 1:

$18/2 = 9$ 0 ↑

$9/2 = 4$ 1

$4/2 = 2$ 0

$2/2 = 1$ 0

$1/2 = 0$ 1

$\begin{cases} 0.625 \times 2 = 1.25 & 1 \\ 0.25 \times 2 = 0.5 & 0 \\ 0.5 \times 2 = 1 & 1 \end{cases}$ ↓

10010 . 101
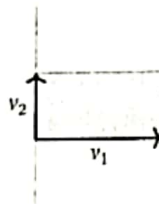
Step 2: Exponent = 4
= 127 + 4
= 131

⇒ 10000011

Step 3:

| 0 | 10000011 | 0010101000000000000000000 |

3. Consider a scenario in which there are two vectors on a 2-D plane v_1 and v_2. The polygon created by using these vectors as its two sides has the area of 4.1.

The vectors v_1 and v_2 are multiplied with the matrix m to get v_1' and v_2' respectively:

$$m = \begin{bmatrix} 3 & 0 \\ 2 & 2 \end{bmatrix}$$

What will be the area of the parallelogram which has v_1' and v_2' as its sides?

$\begin{bmatrix} v_1' \\ v_2' \end{bmatrix} m = \begin{bmatrix} 3 & 0 \\ 2 & 2 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$

Suppose, $\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 2.05 \\ 2 \end{bmatrix}$

$\begin{bmatrix} v_1' \\ v_2' \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 2 & 2 \end{bmatrix} \begin{bmatrix} 2.05 \\ 2 \end{bmatrix}$

$\begin{bmatrix} v_1' \\ v_2' \end{bmatrix} = \begin{bmatrix} 6.15 \\ 8.1 \end{bmatrix}$

Area = 49.815

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4. Continuing from the above question, write a matrix to replace m, which will cause the area to shrink down to absolute 0.

$$m = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Score

2 / 2

5. Take a look at the following code snippet:

```
import numpy as np
num_1 = 2e12
sp_1 = np.spacing(num_1)
num_2 = 15.22
sp_2 = np.spacing(num_2)
print(sp_1, "          ", sp_2)
```

Which of the following is a possible output of the code?

a) 1.7763568394002505e-15   0.000244140625
b) 0.000244140625   1.7763568394002505e-15

Provide a rationale for your answer.

The 2nd option is more possible output of the code because num sp-1 is very large number so the precision is very less and num-2 is very small number before floting point so the precision is high.

Score

4 / 4

6. Calculate the L-2 and L-1 norm of the vector: [6,8].

$L1 = X + Y$
$\quad = 6 + 8$
$\quad = 14$
$L2 = X^2 + Y^2$
$\quad = 36 + 64$
$\quad = 100$

Score

2 / 2