**(6 points) Question 1:**

**1) 5% - Solve 𝐴𝑥̂ = 𝑏 by least squares (i.e., calculate 𝑥̂).**

**𝐴 = [[1, 0],[0, 1],[1, 1]]; 𝑏 = [−1, 1, 0]**

**2) 1% - Verify your answer using Python**

**Ans1. (a)**

**x^ =** (inv((A.T)\*(A))\*(A.T)\*b) => Solving using least squares and modifying **Ax = b** to get to this form

A = => A.T =

A.T\*A = \* =

=> Therefore inv(A.T\*A) =

**x^ =**

**x^ =** \*

x^ =

Thus, the value of **x^ =**

**Ans1. (b)** Please check the attached jupyter pdf file

**(2 point) Question 2:**

**𝑇(𝑥, 𝑦, 𝑧) = (𝑧 ∗ 𝑥 + 1, 𝑧, 𝑦)**

**1) 2% - Is this a linear transformation? Explain your answer.**

**Ans2.**

No, this is not a linear transformation since the null vector is not mapped, as it doesn’t transform **v = 0** into T(**v)** = 0

T(0,0,0) = (0\*0 + 1, 0, 0)

= (1, 0, 0)

As T(**0**) != 0 => Thus, the transformation is non linear

**(7 points) Question 3:**

**Suppose 𝑇 is the linear transformation from 𝑅^2 to R^2 => 𝑇(𝑥, 𝑦) = (2𝑥, 3𝑦)**

**1) 2% - Find the matrix representation of the given linear transformation based on the**

**standard basis.**

**2) 1% - Is 𝑇 invertible? Explain your answer.**

**3) 2% - Find the Kernel of 𝑇**

**4) 2% - Find the Range of 𝑇**

**Ans.3(1)**

For getting the matrix representation we transform the standard vectors of the 2D space (e1 and e2) and get the matrix representation.

T(e1) = T() =>

T(e2) = T( =>

Thus, matrix representation of the linear transformation is

**Ans.3(2)**

Det(T) = 2\*3 – 0\*0 = 6 and since Det(T) != 0 => T is invertible

**Ans.3(3)**

Kernel represents the null space i.e., value for which T(**v**) = **0**

* T(2x, 3y) = (0,0)
* 2x = 0 => x = 0 & 3y = 0 => y = 0

Thus, kernel of the transformation T is t(0, 0)

**Ans.3(4)**

The range of transformation is the set of all outputs for transformation T and since in the transformation, we’re only scaling the vectors, we can conclude that the range of the transformation will be R^2