EECS16A Sp 2022 Arias/Lustig Name: Miki Lustig SID: 123478956

(What is your) **Quest(?)**

Please read the questions carefully and answer appropriately.

1. a. (2 points) The function $f(x, y) = 1 + 3x - 4y$ $f(ax, ay) = 1 + 3ax - 4ay \neq a f(x, y)$
   i. Exhibits homogeneity
   ii. Is linear No, because of i.
   iii. Both i and ii are true No
   iv. None of the above are true

Briefly explain: Not homogenious, so not linear

b. (4 points) For each of the following functions, circle **all the possible operations** that when put in the box □, will result in a linear function. If none of the operations work, circle "none".

i.	$f(x) = x \square 3$	$+$	$-$	$\div$	$\times$	none
ii.	$f(x) = \sin(y_0) \square x$	$+$	$-$	$\div$	$\times$	none
iii.	$f(x, y) = 3x \square y$	$+$	$-$	$\div$	$\times$	none
iv.	$f(x, y) = e^{2x \square y}$	$+$	$-$	$\div$	$\times$	none

2. Ana and Miki go shopping. They see three gift baskets containing apples, oranges and bananas

$9 $8 $9

(a) (5 points) Let $\vec{x} = \begin{bmatrix} x_a \\ x_o \\ x_b \end{bmatrix}$ be a vector, containing the prices of a single apple, single orange and single banana respectively. To find $\vec{x}$, we form the linear set of equations: $A\vec{x} = \vec{b}$. What are the entries of A and $\vec{b}$?

$$A = \begin{bmatrix} 2 & 2 & 1 \\ 2 & 3 & 0 \\ 1 & 1 & 2 \end{bmatrix} \qquad \vec{b} = \begin{bmatrix} 9 \\ 8 \\ 9 \end{bmatrix}$$

(b) (3 points) Based on the system in part (b), find a solution for $\vec{x}$, via Gaussian Elimination (show your work):

$$\left[\begin{array}{ccc|c} 1 & 1 & 2 & 9 \\ 2 & 2 & 1 & 9 \\ 2 & 3 & 0 & 8 \end{array}\right] \quad \left[\begin{array}{ccc|c} 1 & 1 & 2 & 9 \\ 0 & 0 & 3 & 9 \\ 0 & -1 & 4 & 10 \end{array}\right] \quad \left[\begin{array}{ccc|c} 1 & 1 & 2 & 9 \\ 0 & 1 & -4 & -10 \\ 0 & 0 & 1 & 3 \end{array}\right] \quad \left[\begin{array}{ccc|c} 1 & 1 & 0 & 3 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 3 \end{array}\right] \quad \left[\begin{array}{ccc|c} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 3 \end{array}\right]$$

$x_a = 1$ $x_o = 2$ $x_b = 3$

3. (6 points) After performing Gaussian Elimination row reduction, you end up with a row-echelon form. For each of the following cases, circle whether the system has a unique solution, infinite solutions, or no solution. If any solutions exist, state the solution (if it is unique) or express the set of possible solutions.

(a) $\left[\begin{array}{cc|c} 1 & 3 & 0 \\ 0 & 1 & 0 \end{array}\right]$

(Unique, infinite solns., no solns.)

Solution(s): 0, 0

(b) $\left[\begin{array}{cc|c} 1 & 3 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{array}\right]$

(Unique, infinite solns., no solns.)

Solution(s): 0, 0

(c) $\left[\begin{array}{cc|c} 1 & 3 & 0 \\ 0 & 1 & 1 \end{array}\right]$

(Unique, infinite solns., no solns.)

Solution(s): 1, −3

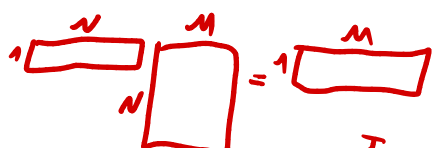
(d) $\left[\begin{array}{ccc|c} 1 & 2 & 3 & 0 \\ 0 & 0 & 1 & 1 \end{array}\right]$

(Unique, infinite solns., no solns.)

Solution(s): $x_3 = 1$
$x_2 =$ independent
$x_1 = -3 - 2x_2$

4. (5 points) Let $A \in \mathbb{R}^{N\times M}$, $B \in \mathbb{R}^{N\times L}$, $\vec{a} \in \mathbb{R}^{L}$, $\vec{b} \in \mathbb{R}^{M}$, $\vec{c} \in \mathbb{R}^{N}$. For each of the following expressions, state the size of the resulting product if it exists, or circle "doesn't exist" if the product is not valid.

(a) $\vec{c}^{\,T} A \quad \in \mathbb{R}^{1 \times M}$ or doesn't exist



(b) $\vec{b}^{\,T} A^T B \quad \in \mathbb{R}^{1 \times L}$ or doesn't exist

$A^T B \in \mathbb{R}^{M \times L}$

(c) $(B\vec{c}\,)^T A \quad \in \mathbb{R}^{\_\_\_ \times \_\_\_}$ or doesn't exist

(d) $\vec{a}\,\underbrace{\vec{b}^{\,T}\vec{b}}_{1}\,\underbrace{\vec{a}^{\,T}\vec{a}}_{1}\,\vec{b}^{\,T} \quad \in \mathbb{R}^{L \times M}$ or doesn't exist

(e) $\underbrace{\vec{b}^{\,T}\vec{b}}_{1}\,\underbrace{\vec{a}^{\,T}\vec{a}}_{1}\,\underbrace{\vec{b}^{\,T}\vec{b}}_{1} \quad \in \mathbb{R}^{1 \times 1}$ or doesn't exist

5. (0 points, but lots of credit) What is the airspeed velocity of an unladen swallow?

European or African?