EECS16A Sp 2022 Arias/Lustig Name: SID:

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

Please read the questions carefully and answer appropriately.

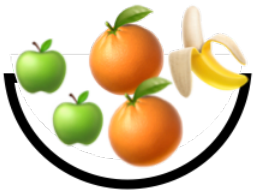
1. a. (2 points) The function $f(x, y) = 1 + 3x - 4y$
   i. Exhibits homogeneity
   ii. Is linear
   iii. Both i and ii are true
   iv. None of the above are true

Briefly explain:

b. (4 points) For each of the following functions, circle **all the possible operations** that when put in the box $\square$, 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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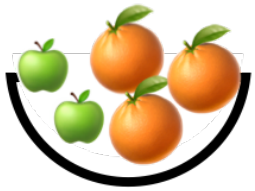
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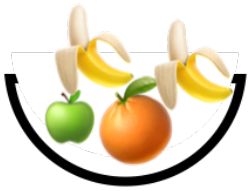
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(a) (5 points) Let $\vec{x} = \begin{bmatrix} x_a \\ x_o \\ x_b \end{bmatrix}$ be a vector, containing the prices of a single apple, single orange and single banana respectively. To find $\vec{x}$, we form the linear set of equations: $A\vec{x} = \vec{b}$. What are the entries of A and $\vec{b}$?

$$A = \begin{bmatrix} & & \end{bmatrix} \qquad \vec{b} = \begin{bmatrix} \\ \\ \end{bmatrix}$$

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

Answers for 2a:

$x_a =$ $x_o =$ $x_b =$

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):

(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):

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

(Unique, infinite solns., no solns.)

Solution(s):

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

(Unique, infinite solns., no solns.)

Solution(s):

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

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

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

(d) $\vec{a}\,\vec{b}^{\,T}\vec{b}\,\vec{a}^{\,T}\vec{a}\,\vec{b}^{\,T} \quad \in \mathbb{R}^{---\times----}$ or doesn't exist

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

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