DIAGNOSTIC IN-CLASS QUIZ: DUE FRIDAY OCTOBER 18: LINEAR TRANSFORMATIONS

MATH 196, SECTION 57 (VIPUL NAIK)

Your name (print clearly in capital letters): ______________________________

PLEASE DO *NOT* DISCUSS ANY QUESTIONS.

The quiz covers basics related to linear transformations (notes titled `Linear transformations`, corresponding section in the book Section 2.1). Explicitly, the quiz covers:

- Representation of a linear transformation using a matrix, and identifying the domain and co-domain in terms of the row and column counts of the matrix.
- Relationship between injectivity, surjectivity, rank, row count, and column count.
- Relationship between the entries of the matrix and the images of the standard basis vectors under the corresponding linear transformation.

The question are fairly easy if you understand the material. But it's important that you be able to answer them, otherwise what we study later will not make much sense.

(1) *Do not discuss this!*: Which of the following correctly describes a $m \times n$ matrix?
   (A) There are m rows, and each row gives a vector with m coordinates. There are n columns, and each column gives a vector with n coordinates.
   (B) There are m rows, and each row gives a vector with n coordinates. There are n columns, and each column gives a vector with m coordinates.
   (C) There are n rows, and each row gives a vector with m coordinates. There are m columns, and each column gives a vector with n coordinates.
   (D) There are n rows, and each row gives a vector with n coordinates. There are m columns, and each column gives a vector with m coordinates.

   Your answer: ______________________

(2) *Do not discuss this!*: For a $p \times q$ matrix A, we can define a linear transformation T_A by $T_A(\vec{x}) := A\vec{x}$. What type of linear transformation is T_A?
   (A) T_A is a linear transformation from $\mathbb{R}^p$ to $\mathbb{R}^q$
   (B) T_A is a linear trnasformation from $\mathbb{R}^q$ to $\mathbb{R}^p$
   (C) T_A is a linear transformation from $\mathbb{R}^{\max\{p,q\}}$ to $\mathbb{R}^{\min\{p,q\}}$
   (D) T_A is a linear transformation from $\mathbb{R}^{\min\{p,q\}}$ to $\mathbb{R}^{\max\{p,q\}}$

   Your answer: ______________________

(3) *Do not discuss this!*: With the same notation as for the preceding question, which of the following is true?
   (A) If $p < q$, T_A must be injective
   (B) If $p > q$, T_A must be injective
   (C) If $p = q$, T_A must be injective
   (D) If $p < q$, T_A cannot be injective
   (E) If $p > q$, T_A cannot be injective

   Your answer: ______________________

(4) *Do not discuss this!*: With the same notation as for the previous two questions, which of the following is true?
   (A) If $p < q$, T_A must be surjective

(B) If $p > q$, T_A must be surjective
(C) If $p = q$, T_A must be surjective
(D) If $p < q$, T_A cannot be surjective
(E) If $p > q$, T_A cannot be surjective

Your answer: ____________________________

(5) *Do not discuss this!*: With the same notation as for the last three questions, which of the following is true?
(A) The rows of A are the images under T_A of the standard basis vectors of $\mathbb{R}^p$.
(B) The columns of A are the images under T_A of the standard basis vectors of $\mathbb{R}^p$.
(C) The rows of A are the images under T_A of the standard basis vectors of $\mathbb{R}^q$.
(D) The columns of A are the images under T_A of the standard basis vectors of $\mathbb{R}^q$.

Your answer: ____________________________