**Introduction to the Italicizing N Task Sequence** [**(Back to Top)**](#Navigation)

The first learning goal of the instructional sequence is interpreting matrices as mathematical objects that transform input vectors to output vectors. Thus, a goal of this introductory whole-class discussion is to help students conceive of input-output pairs of vectors that are related through a matrix transformation.

It is appropriate to introduce students to this through a mini-lecture with a few examples. This will provide the pre-requisite information students need to engage in the Italicizing N task sequence.

Time Required: Approximately 20 minutes.

**Assumed prior knowledge**

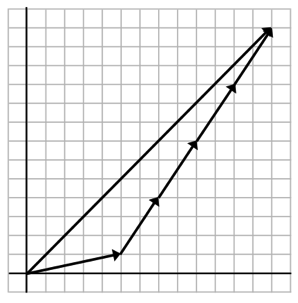
* Linear combinations, span, and linear (in)dependence
* Methods for determining solutions to a linear system such as Gaussian elimination; existence and uniqueness of solutions
* The interpretation of *A***x** = **b** as a vector equation both algebraically and geometrically
* The interpretation of *A***x** = **b** as a system of equations both algebraically and geometrically

**Mini-lecture on transformations**

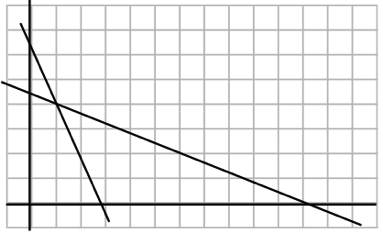
The instructor could begin by reminding the class that they have already worked with two interpretations of the equation Ax = b (vector equation & system of linear equations).

**Example Discussion Topic:**

Let’s review the interpretations of we’ve seen by considering the example

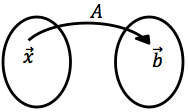
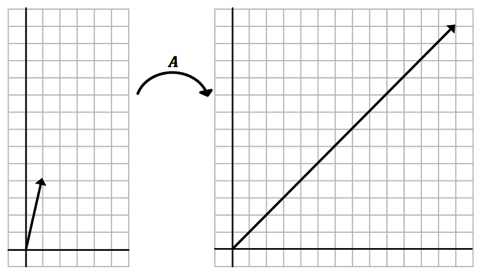
 As a vector equation:

* + The solution (1, 4) is the number of the first column vector and the number of the second column vector needs to become the linear combination

As a systems of equations:

* The solution (1, 4) is the location in the Cartesian plane in which the equations and intersect.

As a linear transformation:

* One can also consider  **is** as *A* transforming the vector **x** into the vector **b**. That is, we can think of *A* as “acting on **x**” to turn it into a vector **b**.
* Considering the same example , the transformation defined by
* Graphically:

**Definitions:**

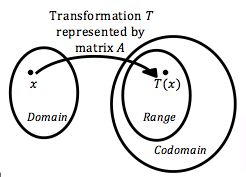
The instructor might give the following definitions and briefly relate them to how students are familiar with them from high school and calculus (functions from R to R).

**NOTE:**

Depending on the students’ backgrounds and/or the rigor of the linear algebra course, the instructor

could choose to wait until after students have worked on Task 1 to introduce these terms,

connecting them to the work students will have done in Task 1.

* A **transformation** (function) is a rule that assigns to each a vector .
* The **domain** is the set of all possible input vectors . Here, the domain is
* The output is the **image** of under the transformation *T*
* The **range** is the set of all images under the transformation *T*
* **Codomain**: The (vector) space that contains the range of the transformation *T*

**Examples (Use these if the above definitions have been given):**

**Familiar examples:**

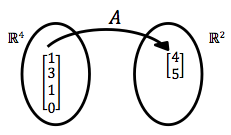
1. given by

* domain and codomain are both whereas the range is only

1. given by

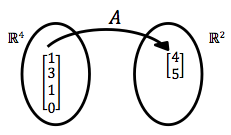
* domain and codomain are both and the range is also

**New Examples:**

1. Let be a transformation defined by . That is, , =Note that *A* is transforming vectors from into vectors in For examples, let . Then . A graphical interpretation is hard to do for this, but we can think of it set theoretically:
2. Let *T* be a transformation defined by *A*. Let , let . Find the image of under the transformation *T.*
3. If the domain for a transformation *T* is and the codomain for *T* is , and *T* is defined by a matrix *A*, what would the dimensions of *A* have to be? (i.e., how many rows and how many columns does *A* have and why?)

**Examples (use the versions below if the above definitions have NOT been given at this time)**

1. Let . Note that *A* transforms vectors from to vectors in For example, let . Then . A graphical interpretation is hard to do for this, but we can think of it set theoretically:



1. Let , let . Find the image of under multiplication by *A.*
2. What is the size of a matrix that sends vectors in to vectors in ?