

#flo #hw

## 1 | Null Spaces and Ranges

### 1.0.1 |our terms!

nullspace, aka kernel :: subspaces of the domain range, aka column space :: subspace of the codomain

T:  $V \rightarrow W$  kernel goes to subspace of  $V$ , domain range goes to subspace of  $W$ , codomain of  $V$

nullspace and column spac :: vector space specific

### 1.0.2 |basis of null space

non-trivial nullspace means ur not bijective, because ur losing info. multiple things go to zero!

kernel is a subspace, so there exists a basis! multiple, potentially.

every transformation can be represented as a matrix convert this to reduced row echelon to find free variables  
don't need to worry about right hand elementary matrices because it's multiplied by all zeros!

LD rows mean u can't get to the identity matrix #extract into LD and identity matrix

$$\begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & -2 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} -5a \\ 2a \\ 1a \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

because everything needs to cancel each other – start from the free var, all zeros, then go backwards

$$\begin{bmatrix} -5 \\ 2 \\ 1 \end{bmatrix} \text{ is a basis vec}$$

number of free vars is the amount of info u are missing to fully restrain ur system

if our map is injective, then our null space is zero! because you can only send one thing to zero.

functions are by definition injective. are they? only of their domain? they can output undefined... right?  
#question

title: column space

In linear algebra, the column space of a matrix  $A$  is the span of its column vectors. The column space of

surjective: everything in  $A$  hits something in  $B$ . but, two things in  $A$  can hit one thing in  $B$ .

### 1.0.3 |fundamental theorem of linear maps!

KBxChapter3BReading#Fundamental theorem

amount of basis vecs in  $V$  can be divided into things that get sent to zero and things that don't get sent to zero  
things that don't get sent to zero induce a basis of the range?

to watch later.