Cheatsheet Linear Algebra 2LD60

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3 Chapter three

Vector space	A set of vectors for which the set of axioms and closure condition on page 131 are satisfied.	C1: $\mathbf{x}+\mathbf{y} \in V$ C2: $\alpha\mathbf{x} \in V$
Subspace	A subset of a vector for which C1 and C2 also hold, but then for the subset of that vector.	C1: $\mathbf{x}+\mathbf{y} \in S$ C2: $\alpha\mathbf{x} \in S$ See example 4.1
Null space matrix	Solve the matrix for a solution equal to zero.	See example 4.2
Commuting matrices	Matrices A and B are said to be commuting if AB = BA.	
Spanning set for a vector space	The set $\{\mathbf{v}_1, ..., \mathbf{v}_n\}$ is a spanning set for V if and only if every vector in V can be written as a linear combination of $\mathbf{v}_1, ..., \mathbf{v}_n$.	

4 Examples

4.1 Subspace

Given is the following set of vectors: $S = \left\{ \begin{bmatrix} x \\ 1 \end{bmatrix} \mid x \text{ is a real number} \right\}$. To determine whether it is a subspace of $\mathbb{R}^2$ it has to fulfill closure conditions C1 and C2. Additionally it has to fulfill the property where x is a real number and the second row is equal to 1.

$$\begin{bmatrix} x \\ 1 \end{bmatrix} + \begin{bmatrix} y \\ 1 \end{bmatrix} \notin S \text{ when } \alpha \neq 1$$

Therefore it is not a subspace. But both conditions fail to hold.

$$\alpha \begin{bmatrix} x \\ 1 \end{bmatrix} = \begin{bmatrix} \alpha x \\ \alpha \end{bmatrix} \notin S$$

4.2 Null space

Determine N(A) if

$$A = \begin{bmatrix} 1 & 3 & -4 \\ 2 & -1 & -1 \\ -1 & -3 & 4 \end{bmatrix}$$

Use reduction techniques to solve for $A\mathbf{x} = \mathbf{0}$.

$$A \Rightarrow \left[\begin{array}{ccc|c} 1 & 3 & -4 & 0 \\ 0 & -7 & 7 & 0 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

So, $x_1 = x_2 = x_3$. Therefore the vector space N(A) consists of all vectors of the form

$$\alpha \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$