

# The Four Fundamental Subspaces

Associated with each  $m \times n$  matrix  $A$  there are four important subspaces:

- 1 Column Space  $C(A) =$  set of all linear combos of the columns of  $A$  ( $\subset \mathbb{R}^m$ )
- 2 Null Space  $N(A) =$  set of solutions of  $Ax = 0$  ( $\subset \mathbb{R}^n$ )
- 3 Row Space  $C(A^T) =$  set of all linear combos of the rows of  $A$  ( $\subset \mathbb{R}^n$ )
- 4 Left Null Space  $N(A^T) =$  set of solutions of  $A^T y = 0$  ( $\subset \mathbb{R}^m$ )

Why are these important? How do we find bases? What are their dimensions?