**How to describe subspaces**

* **span**: a set of vectors that span the space
* **condition**: the conditions the vectors in the space must satisfy

**four subspaces of U and four subspaces of A**

* **row spaces of *A* and *U*** have **same dimension** **r** and same **basis**: the **same space**
  + because according to the definition: **combinations stay in space**
  + ***A*** <--> ***U*** can transpose **in both directions**
* **nullspace(kernel of *A*)**
  + **nullspace** of ***A*** or ***U*** or ***R*** are **the same**
  + **dimension(nullity)**: **n - r**
  + **basis**: **special solutions**
* **column space(range of A)**
  + **column space** of ***A*** or ***U*** or ***R*** are **different**
  + **dimension:** but they have **the same dimension r**
  + **basis:** **columns with pivots** (in ***A*** or ***U*** or ***R***)
  + the **number** of independent columns equals the **number** of independent rows
  + if the **rows** of a square matrix are **linearly independent**, so are the **columns**
* **left nullspace of *A***(the nullspace of ***AT***)
  + **yT*A* = [y1 … ym] [ *A* ]= [0 … 0]** **to mulipty the rows of A** produce **zero row**
  + **dimension: m - r**
  + **basis: m - r rows *L-1PA* (*L-1PA* = *U*)**
* **fundamental theoreem of linear algebra I**
  + **C(A) = column space of A; dimension r**
  + **N(A) = nullspace of A; dimension n - r**
  + **C(AT) = row space of A; dimension r**
  + **N(AT) = left nullspace of A; dimension m - r**